

TRAFFIC IMPACT STUDY

EARLY CHILDHOOD EDUCATION FACILITY STORM LAKE, IOWA

December 17, 2018
Project No. 18-22291

The logo for ISG, consisting of the letters 'ISG' in a bold, sans-serif font, centered within a dark gray square.

Signature Sheet

I HEREBY CERTIFY THAT THESE CALCULATIONS WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

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**Early Childhood Education Facility
Storm Lake, Buena Vista County, Iowa**

Engineer's Project Number: 18-22291

Dated this 17th day of December, 2018.

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Executive Summary

Studied Intersection Description and Location

This Traffic Impact Study (TIS) studied current and future traffic conditions at the existing intersection of Iowa Highway 7 (IA-7), Iowa Highway 110 (IA-110), and 90th Avenue in the City of Storm Lake, Buena Vista County, Iowa. A proposed development is located north of this study intersection. Additional studied areas include the intersections formed by the proposed driveways. A project location map is provided in **Appendix A: Study Area Overview + Intersection Map**.

This study critically analyzes the subject intersections, assesses the current traffic control, and makes recommendation for improvement. The study area is located on the far west end of the City of Storm Lake in a rural/urban transitional area. There is a church immediately south of the proposed site development. Further to the south there are the Canadian National Railway and the Storm Lake Elementary and Middle schools. To the west, north, and east, the land is used as farmland and rural residences. Land use maps are provided in **Appendix B: Land Use Maps**.

The City of Storm Lake has been progressively growing, and much of most recently annexed lands on the west side of the City have been used to support the construction of Storm Lake's elementary and middle schools. According to the City of Storm Lake's Comprehensive Plan, the City is expected to grow geographically to the north, east, and west. To the north at the intersection of 90th Avenue and Highway C49, a feed mill on 18 acres of land is planned to be fully operational by 2020. Other areas to the north and west will largely be low density residential. As the City grows, local leaders believe additional pressure will be exerted on the already crowded elementary and middle schools. To address this need, the Storm Lake Early Childhood Education facility is proposed. Citizens will have the opportunity to vote on a bond issue December 2018. If approved, the first phase of the Early Childhood Education facility will be constructed in 2020.

Proposed Development

The first phase of the proposed development will accommodate 200 Kindergarteners and about 30 staff. Site facilities will be constructed at this time, including driveways, parking, and a fire lane. Preliminary plans for Phase 1 work are shown in **Appendix C: Phase I Preliminary Plan**. The second phase of the proposed development will accommodate an additional 200 preschoolers, 200 1st graders, and 70 staff. During this phase, a bus turnaround will be converted into additional parking, and a larger bus turnaround will be constructed. A conceptual site plan at full build out is shown in **Appendix D: Full Build Conceptual Site Plan**.

As shown in the Appendices, the proposed development will be located along 90th Avenue. Three driveways will access 90th Avenue, the southernmost driveway located approximately 300' north of the intersection of IA-7, IA-110, and 90th Avenue. The distance between site driveways will also be approximately 300'.

Multi-Modal Considerations

90th Avenue, IA-7, and IA-110, all two-lane asphalt roads, currently do not have bicycle facilities or sidewalks. IA-7 has 6-foot paved shoulders, and 90th Avenue has 6-foot gravel shoulders. IA-110 has 3-foot paved and 3-foot gravel shoulders. No pedestrians and one bicyclist was observed during the study periods. There are no established transit routes or bus stops in the area.

Traffic Control

Currently, the intersection of IA-7, IA-110, and 90th Avenue is two-way stop-controlled on the side streets, IA-110 and 90th Avenue.

Growth

The City of Storm Lake's overall population has been steadily increasing by about 1.2% annually since 1990, and according to Storm Lake's Comprehensive plan, local leaders expect the population to grow by 10% every decade (about 1% annually). Alternatively, traffic volume has fluctuated on IA-7, IA-110, and 90th Avenue the past 25 years – overall decreasing by 1.8% annually on IA-7, decreasing by 0.2% annually on IA-110, and increasing by about 8% annually on 90th Avenue. For the purposes of this study, traffic growth on 90th Avenue and IA-110 are expected to be driven by area development, including both the feed mill and residential development. Residential development growth rates were calculated to be 7.0% for 90th Avenue and 4.2% for IA-110. On IA-7, area growth is expected to balance the recent decrease in traffic, causing a net growth of 0.9%. This study assumes the planned feed mill will be operational by 2020, and some office expansion will occur between 2020 and 2024.

Findings

Existing Level of Service

Traffic counts were conducted in the study area during the expected morning and afternoon peaks. Level of service is acceptable for all movements (LOS C for northbound and southbound left-thru movements, LOS B for northbound right movement, and LOS A for all others) during both peak periods at the intersection of IA-7, IA-110, and 90th Avenue.

Proposed Level of Service

Baseline (2020), Baseline (2024), and Baseline (2040) conditions were created by projecting the existing traffic into the future using the stated growth rates and then adding in the expected traffic as a result of the planned feed mill. Proposed traffic was added to these baseline conditions to create Phase I (2020), Phase II (2024), and Build (2040) conditions. Using Synchro and SimTraffic modeling software, it was determined that the existing two-way stop-control is insufficient to manage the area traffic for the Phase I, Phase II, Build, and Baseline (2040) conditions.

Recommendations

Based on the modeled Phase I, Phase II, and Build conditions, traffic control modifications are recommended to accommodate proposed traffic. The following modifications are recommended:

- Implement all way stop-control at Intersection 1 prior to Phase I development.
 - Eastbound and westbound approaches should be modified to accommodate two lanes each direction: eastbound left/thru, eastbound thru/right, westbound left, westbound thru/right.
 - A lane shift taper and additional pavement is recommended east of Intersection 1 to accommodate the proposed layout.
- Install gate arms to the existing railroad crossing on IA-110.
- Immediately explore funding opportunities for a future traffic signal or roundabout.
- Implement traffic signals or roundabout control prior to Phase II development.

As the area develops and as traffic growth projections change, the study area should be re-evaluated.

Conclusions

Currently, the studied area is operating acceptably. Traffic as a result of the proposed development is expected create unacceptable delays and level of service on the side street approaches. All-way-stop control is recommended as a temporary measure to accommodate the increase in traffic expected during Phase I development in 2020. A long-term solution will need to be agreed upon. Traffic signals or a roundabout are options that would provide equal benefit to the area road network.

Once the recommended improvements are implemented, the area should be monitored as drivers adjust to the new traffic patterns. Nearby residential development is expected into the future. The study area corridor should be reevaluated on a regular basis, as the adjacent area develops, or as growth projections change.

Introduction

Purpose of Report

The purpose of this report is to document the methodologies, findings, recommendations, and conclusions of the subject study, including the basis for all assumptions, traffic parameters utilized, and conclusions. This report presents data in a logical format including tables and figures in order to accurately and clearly convey the data and its meaning.

Study Objectives

The objectives of this study include the following:

1. Identify the existing deficiencies in the transportation system and immediate area.
2. Analyze operational impacts of the development for both proposed and future conditions.
3. Recommend necessary improvements to the transportation system and immediate area to maintain a safe, efficient system.

Analysis of Existing Conditions

Study Area Description

The proposed development is located north of the intersection of Iowa Highway 7 (IA-7), Iowa Highway 110 (IA-110), and 90th Avenue in the City of Storm Lake, Buena Vista County, Iowa. The study area includes this intersection and three additional intersections created by the proposed development's access driveways. The following intersections are studied:

1. Intersection 1: the intersection of Iowa Highway 7 (IA-7), Iowa Highway 110 (IA-110), and 90th Avenue
2. Intersection 2: the intersection of 90th Avenue and the development's drop off entrance driveway
3. Intersection 3: the intersection of 90th Avenue and the development's parking entrance driveway
4. Intersection 4: the intersection of 90th Avenue and the development's bus and service yard entrance driveway

Project location and study area intersection maps are provided in **Appendix A: Study Area Overview + Intersection Map**.

Area Growth

The study area is located on the far west end of the City of Storm Lake in a rural/urban transitional area. There is a church immediately south of the proposed site development. Further to the south, the Canadian National Railway runs east-west. Located south of the railway are the Storm Lake Elementary and Middle schools. To the west, north, and east of the proposed development, the land is used as farmland and rural residences.

The City of Storm Lake currently has an estimated population of 10,773 people. The City has been progressively growing geographically, and much of most recently annexed lands on the west side of the City have been used to support the construction of Storm Lake's elementary and middle schools. According to the City of Storm Lake's Comprehensive Plan, the City is

expected to grow to the north, east, and west. The northern and western areas will largely be low density residential.

A feed mill is planned for construction on 18 acres at the northwest corner of 90th Avenue and Highway C49, north of the proposed development. Between 2020 and 2024, development is expected to attract 80 tractor/trailer rigs per day during the non-harvest season and up to 400 rigs per day during the harvest season. Trucks are expected to arrive during 12 hours per day during the non-harvest season and at all hours per day during the harvest season. Approximately 20 employees will work at the feed mill when the plant opens, and typical work hours are assumed to be 8:00 AM to 5:00 PM. Office expansion is planned after 2020, and this report assumes expansion will occur by 2024. After expansion, the feed mill is expected to employ approximately 42 employees, and there will be no increase in truck traffic.

Existing and future land use maps are provided in **Appendix B: Land Use Maps**. As the City grows, local leaders believe additional pressure will be exerted on the already crowded elementary and middle schools. To address this need, the Storm Lake Early Childhood Education facility is proposed. Citizens will have the opportunity to vote on a bond issue December 2018. If approved, the first phase of the Early Childhood Education facility will be constructed in 2020.

Proposed Land Use

The first phase of the proposed development, planned for 2020, will accommodate 200 Kindergarteners and about 30 staff in the first of three building pods. Site facilities will be constructed at this time, including driveways, parking, and a fire lane. Preliminary plans for Phase I work are shown in **Appendix C: Phase I Preliminary Plan**. The second phase of the proposed development, planned for 2026, will accommodate an additional 200 preschoolers, 200 1st graders, and 70 staff. During this phase, the second and third building pods will be constructed, a bus turnaround will be converted into additional parking, and a larger bus turnaround will be constructed. A conceptual site plan at full build out is shown in **Appendix D: Full Build Conceptual Site Plan**.

As shown in the Appendices, the proposed development will be located along a section of 90th Avenue, which, according to DOT map documentation, belongs to the City of Storm Lake. Three driveways will access 90th Avenue – the southernmost driveway located approximately 300' north of the intersection of IA-7, IA-110, and 90th Avenue. The distance between site driveways will also be approximately 300'.

It is assumed that once the proposed development is built the Kindergarten program will be moved from the existing elementary school located south of the proposed development along IA-110 to the new early childhood education facility. The staff at the new facility will be relocated teachers and support staff and some will be new hires. Once Phase II is complete and the proposed Early Childhood Education facility takes on preschoolers and 1st graders, the 1st grade program will be removed from the existing elementary school and the pre-K program will be removed from the current East Early Childhood Center. Again, the additional staff will be composed of both relocated staff and new hires.

Diverted trips differ from new trips in that diverted trips add traffic to streets adjacent to a site (i.e. 90th Avenue), but may not add traffic to the area's major travel routes (i.e. IA-7 and IA-110). Pass-by trips are similar to diverted trips; however pass-by trips are pulled from the adjacent roadway only, are not diverted from another roadway, and add no traffic to the area road network. The trips generated because of the proposed development are either new or diverted.

Area Roadway System

Through and adjacent to the study area:

- IA-7 is an east-west Principal Arterial
- IA-110 is a north-south Principal Arterial
- 90th Avenue is a north-south Collector

IA-7 is a two-lane undivided highway and is also known as Milwaukee Avenue. IA-7 has a posted speed limit of 50 MPH. IA-110 is a two-lane undivided highway, also known as Abner Bell Road, and has a posted speed limit of 45 MPH. 90th Avenue is a two-lane undivided road and is also known as County Road 18, though it appears that the county maintained section of the road starts north of the proposed development. 90th Avenue has a statutory speed limit of 55 MPH. A right-turn lane is provided on eastbound IA-7, and a stop-controlled channelized right-turn is provided on northbound IA-110. IA-110 and 90th Avenue are stop-controlled.

Immediately south of the intersection between IA-7, IA-110, and 90th Avenue is an active railroad crossing owned by the Canadian National Railway. IA-110 crosses a single line of track on grade. Post mounted crossing signals with flashing lights have been installed approximately 12' from center of rail, and gate arms are not currently present.

The study area lies in a transitional urban/rural area on the west edge of town. Sidewalks and pedestrian crossings are not provided in the study area. Currently, there are no bicycle accommodations provided along IA-7; however, cyclists are permitted on this roadway. 6-foot shoulders are provided along IA-7, IA-110, and 90th Avenue. The shoulders are paved on IA-7 and gravel on 90th Avenue. On IA-110, the shoulders are 3-foot paved and 3-foot gravel. There are no established transit routes or bus stops in the area.

Storm Lake Middle School and Storm Lake Elementary School are located about 1/4 miles south of the study area. As a result, the area sees many school buses and student drop-offs or pick-ups. Because of this high proportion of buses, about 6% of traffic during the peak hours are heavy vehicles (up to 10-20% for northbound right and westbound left movements).

Previous Studies

Synder & Associates, Inc prepared a traffic impact study for the City of Storm Lake in 2013. The study area included the 0.8 mile stretch of IA-7 starting at 90th Avenue and ending at Barton Street. At the intersection of 90th Avenue and IA-7 (Intersection 1), the 2013 study recommends constructing left-turn lanes along IA-7 in both directions, and installing a traffic signal when traffic volumes warrant installation. The 2013 study also recommends that if a traffic signal is constructed, the railroad crossings could be improved to include gate arms, and a northbound right-turn lane should be constructed. The study does not recommend widening the entire length of highway to three lanes, and it states, "Maintaining two lanes of traffic along the western portion of the study area will aid in keeping traffic speeds down, at least approaching Storm Lake."

The report is unclear about when these improvements should occur. The 2013 study anticipates a potential 80% increase in traffic at Intersection 1 as a result of future development; however the report does not state when full development is expected to occur. As a result, it is difficult to directly compare the 2013 study to this Early Childhood Education Facility study.

Existing Traffic Volumes and Conditions

IA-7 has shown to have an AADT of 4130 (east of Intersection 1) and 4790 (west of Intersection 1) vehicles per day (vpd) through the study area (2015 AADT) according to IADOT traffic data as presented in **Exhibit 1**. Additionally, IA-110 and 90th Avenue currently see approximately 2460 and 940 vehicles per day, respectively.

To allow for a detailed analysis, existing traffic counts were collected for Intersection 1 on September 27, 2018 from 6:30 AM to 9:30 AM and from 2:30 PM to 5:30 PM. Synchro (v10)

and SimTraffic were utilized to analyze the traffic conditions within the study area and model the subject intersections along 90th Avenue. Summary diagrams of the traffic counts and the analysis worksheets for the existing conditions are provided in **Appendix E: Existing Traffic Counts + Analysis Reports**.

Due to the proximity of the Storm Lake Middle and Elementary schools, the calculated peak hour factor at the intersection of IA-7, IA-110, and 90th Avenue is considered low for several movements and the intersection as a whole. The peak hour factor for the intersection was 0.75 during the morning peak and 0.83 during the afternoon peak. For this study, the peak hour factor was calculated by movement for both peak periods and applied to the existing, baseline, and proposed analyses.

Table 1 shows the existing LOS and delay for Intersection 1 for both of the peak hour periods.

Exhibit 1: Area Traffic

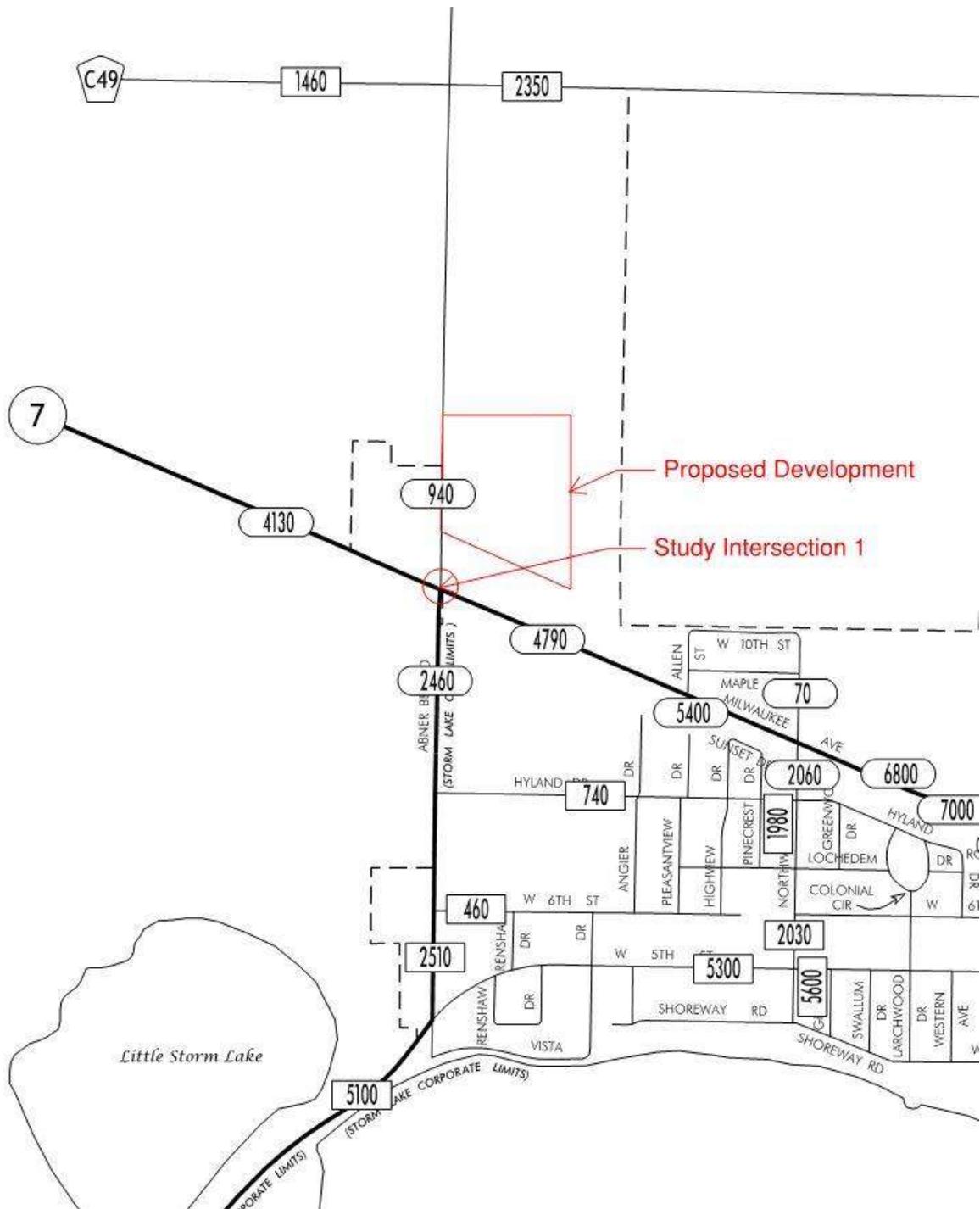


Table 1: Existing LOS – Intersection 1

INTERSECTION 1	AM PEAK											
	2018 EXISTING											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)	1	269	82	64	82	2	24	54	158	3	33	0
Queue (ft)	7		7	45			97		80	42		0
Mvmt Delay (sec)	7.4	0.0	0	8.6	0.0	0.0	22		12.5	21.2		0.0
Mvmt LOS	A	A	A	A	A	A	C		B	C		A
Delay (sec)	7.0	0.1		4.0			16.2			21.2		
LOS	A	A		A			C			C		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK											
	2018 EXISTING											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)	1	168	45	71	213	7	41	44	102	2	37	3
Queue (ft)	5		0	38			79		63	49		24
Mvmt Delay (sec)	7.8	0.0	0	8.0	0.0	0.0	23.5		10.8	20.9		9.6
Mvmt LOS	A	A	A	A	A	A	C		B	C		A
Delay (sec)	6.9	0.1		2.4			15.4			20.2		
LOS	A	A		A			C			C		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

See the Conclusions section for discussion on level of service and delay.

Anticipated Future Development

As discussed previously, local officials with the City of Storm Lake expect population growth into the future. The City of Storm Lake is poised to grow geographically, and areas of the City limits have been annexed in, ready for residential development. Additionally, other areas have been identified for residential development; however, these have not been annexed in yet.

Population Growth

The City of Storm Lake’s 2013 Comprehensive Plan assumes 10% population growth per decade into the future (0.96% annualized growth). However after examining census data, these projections are no longer being met. **Exhibit 2** and **Table 2** below show slowing population growth.

Exhibit 2: Historical Population Growth

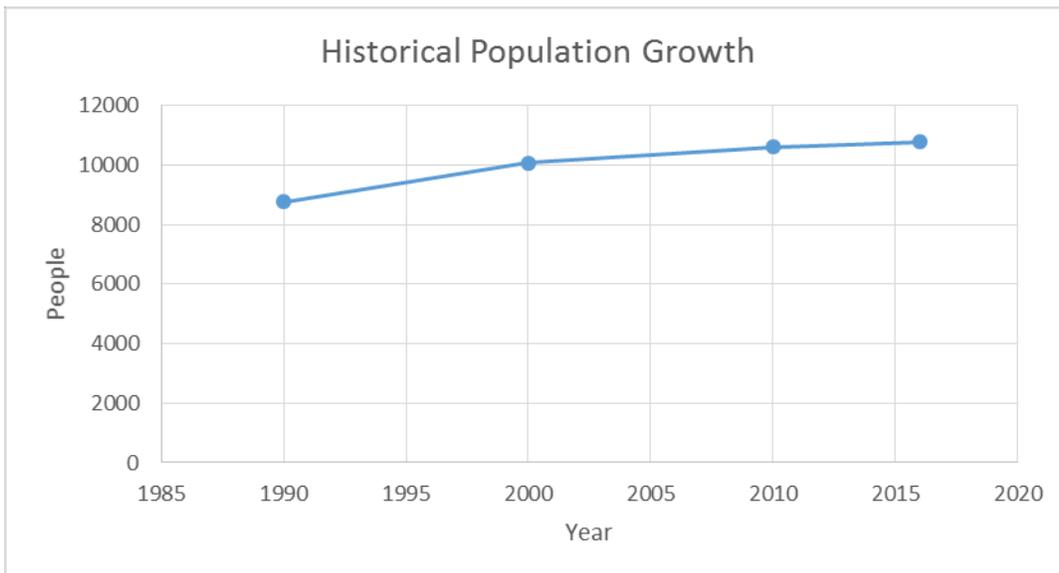


Table 2: Historical Population Growth

Historical Population Growth		
Year	AADT	Annualized Growth
2016	10773	0.3%
2010	10600	0.5%
2000	10076	1.4%
1990	8769	

Traffic Growth

Examining past traffic volume maps, average traffic has overall been decreasing on this segment of IA-7, decreasing slightly on IA-110, and increasing on 90th Avenue. **Exhibit 3** and the tables below show the traffic volume trends of the subject roadways.

Exhibit 3: Historical Traffic Volume Trends

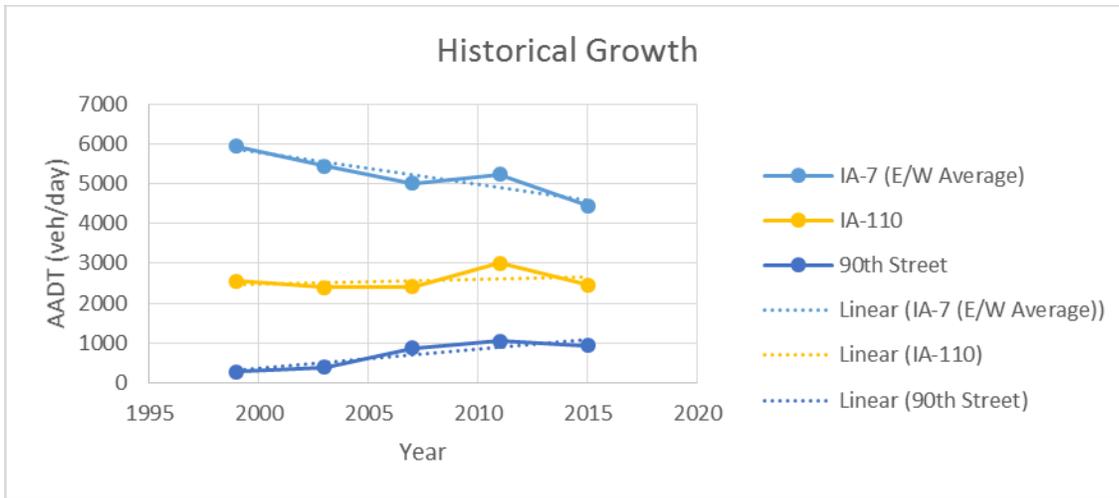


Table 3: Historical Traffic Volume Trends

Historical IA-7 (West) Growth			Historical IA-7 (East) Growth		
Year	AADT	Annualized Growth	Year	AADT	Annualized Growth
2015	4130	-4.1%	2015	4790	-3.8%
2011	4890	0.8%	2011	5600	1.4%
2007	4740	-1.8%	2007	5300	-2.2%
2003	5100	-1.9%	2003	5800	-2.4%
1999	5500		1999	6400	
Average Growth		-1.8%	Average Growth		-1.8%
Annualized Growth		-1.8%	Annualized Growth		-1.8%

Historical 90th Street Growth			Historical IA-110 Growth		
Year	AADT	Annualized Growth	Year	AADT	Annualized Growth
2015	940	-2.7%	2015	2460	-4.8%
2011	1050	5.1%	2011	3000	5.6%
2007	860	22.7%	2007	2410	0.2%
2003	380	7.9%	2003	2390	-1.6%
1999	280		1999	2550	
Average Growth		8.2%	Average Growth		-0.2%
Annualized Growth		7.9%	Annualized Growth		-0.2%

Planned Development

Referring to the Existing and Future Land Use maps in **Appendix B: Land Use Maps**, some residential development growth is expected north and south of the study area. Some areas are planned as “Low Density Residential” and other areas are planned as “Reserve Residential”. These reserve residential areas, according to the City’s comprehensive plan, are “not likely to be specifically required to accommodate development over the next 20 years but are meant to express the long-term desire of the City. Development in either or both of these areas is not specifically precluded prior to 2030 depending on residential market demand and economic conditions.” Therefore, it is assumed that the following will be developed by the design year (2040):

- all low density residential and reserve residential lands within the City limits, and
- 1/2 of low density residential and reserve residential lands outside of the current City limits

Some traffic from the planned feed mill is expected to travel through the study area. The below table summarizes the feed mill’s expected trip generation during peak hours and in a day during the harvest season. Trucks are expected to arrive at the feed mill throughout the day, at all hours during the harvest season, and the typical employee will have an 8am to 5pm working day.

Table 4: Planned Feed Mill Trip Generation

	Year 2020 (During Harvest Season)			Year 2024 (During Harvest Season)		
	Morning Peak Hour	Afternoon Peak Hour	Total Daily Trips	Morning Peak Hour	Afternoon Peak Hour	Total Daily Trips
Trucks	64 (50% Entering 50% Exiting)	64 (50% Entering 50% Exiting)	800	64 (50% Entering 50% Exiting)	64 (50% Entering 50% Exiting)	800
Employees / Passenger Vehicles	20 (100% Entering)	0*	40	42 (100% Entering)	0*	84

*Employees’ shifts end during the evening peak hour

Trip distribution diagrams for the feed mill’s truck and employee traffic are provided in **Appendix S: Feed Mill Trip Distribution Diagrams**.

Growth Rate Assumptions

Considering population growth, traffic growth, and planned development, some assumptions were made regarding background growth.

For 90th Avenue, it is assumed that area residential development will be the driving factor in traffic growth. From the Future Land Use map, 227 acres of residential area will be developed by 2040 at a density of about 2.1 single family homes per acre. Applying an average daily trip generation rate of 9.4 trips per dwelling unit (from the ITE Trip Generation Manual, 10th Edition for Land Use Code 210) and adding that to the current traffic (1000 AADT), it is estimated that annualized traffic growth on 90th Avenue will be approximately 7.0%. This growth rate is consistent with 90th Avenue’s historical 7.9% annualized growth. For this study, it is assumed that background traffic on 90th Avenue will grow 7.0% annually between the time of traffic count data collection (2018) and the design year (2040).

Currently, traffic has been decreasing slightly on IA-110. It is assumed that this trend will continue into the future; however this conflicts with the likelihood of future residential growth

south of the study area. Using the same thought processes as in the above 90th Avenue traffic growth discussion, it is assumed that 230 acres will be developed by 2040. At:

- a density of 2.1 single family homes per acre,
- a trip generation rate of 9.4 trips per dwelling unit, and
- an existing traffic volume value of 2500 AADT,

an estimate for the annualized traffic growth on IA-110 is approximately 4.2%. Therefore, this report assumes that traffic will grow 4.2% annually IA-110 between the time of traffic count data collection (2018) and the design year (2040).

It is assumed that the decreasing traffic present on IA-7 will be balanced by planned residential development and consequent population growth. Using an estimate of 1.8% annual decrease in traffic volume, IA-7’s estimated year 2040 AADT at Intersection 1 is 2825 vpd. The 2018-2040 net increase of 2341 vpd per leg of IA-7 as a result of the expected development is then added to the projected 2825 vpd. A growth rate between today’s 4223 vpd on IA-7 to the estimated 5166 vpd in year 2040 is calculated to be 0.9%. Therefore, this report assumes there will be 0.9% average annual growth in traffic volume between the time of traffic count data collection (2018) and the design year (2040).

Table 5: Summary of Assumed Annualized Growth Rates

Road Segment	Assumed Annualized Growth
IA-7 (East and West legs)	0.9%
90th Avenue	7.0%
IA-110	4.2%

Future Baseline Analyses

Phase I of the proposed development is expected to occur in 2020, and Phase II is expected to occur around 2024. To analyze the impact of proposed traffic on the area roadway network, baselines for 2020, 2024, and the design year, 2040, were developed. Geometric or control deficiencies that arise in these baseline analyses will need to be addressed regardless of the construction of the proposed facility. The traffic movement diagrams and analysis reports are provided **Appendices F – H**, and a volume, queuing, level of service, and delay summary for Intersection 1 is provided in **Tables 6-8**.

Table 6: Baseline 2020 LOS – Intersection 1

INTERSECTION 1	AM PEAK																				
	2020 BASELINE																				
	Overall	Eastbound			Westbound			Northbound			Southbound										
L		T	R	L	T	R	L	T	R	L	T	R									
Volume (veh)	1	269	82	64	82	2	24	55	163	3	38	0									
Queue (ft)	5			0			42			95			72			45			0		
Mvmt Delay (sec)	7.4	0.0	0	8.6	0.0	0.0	22.6			12.6			21.7			0.0					
Mvmt LOS	A	A	A	A	A	A	C			B			C			A					
Delay (sec)	7.4	0.1			4.0			16.4			21.7										
LOS	A	A			A			C			C										

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK																				
	2020 BASELINE																				
	Overall	Eastbound			Westbound			Northbound			Southbound										
L		T	R	L	T	R	L	T	R	L	T	R									
Volume (veh)	1	168	45	71	213	7	41	45	106	2	43	3									
Queue (ft)	5			0			37			77			59			49			25		
Mvmt Delay (sec)	7.8	0.0	0	8.0	0.0	0.0	24			10.8			21.4			9.6					
Mvmt LOS	A	A	A	A	A	A	C			B			C			A					
Delay (sec)	7.2	0.1			2.4			15.5			20.7										
LOS	A	A			A			C			C										

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 7: Baseline 2024 LOS - Intersection 1

INTERSECTION 1	AM PEAK											
	2024 BASELINE											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)	1	269	82	64	82	2	26	59	173	5	51	0
Queue (ft)	5		0	36			76		68	48		0
Mvmt Delay (sec)	7.4	0.0	0	8.6	0.0	0.0	24.5		12.8	24.2		0.0
Mvmt LOS	A	A	A	A	A	A	C		B	C		A
Delay (sec)	8.3	0.1		4.0			17.3			24.2		
LOS	A	A		A			C			C		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK											
	2024 BASELINE											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)	1	168	45	71	213	7	45	49	112	3	57	6
Queue (ft)	5		0	38			71		60	51		29
Mvmt Delay (sec)	7.8	0.0	0	8.0	0.0	0.0	26.2		10.9	23.8		9.6
Mvmt LOS	A	A	A	A	A	A	D		B	C		A
Delay (sec)	8.2	0.1		2.4			16.4			22.7		
LOS	A	A		A			C			C		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 8: Baseline 2040 LOS - Intersection 1

INTERSECTION 1	AM PEAK												
	2040 BASELINE												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		1	269	82	64	82	2	33	75	220	15	167	0
Queue (ft)		0		0	41			121		73	129		0
Mvmt Delay (sec)		7.4	0.0	0.0	8.6	0.0	0.0	185.6		14.1	145.9		0.0
Mvmt LOS		A	A	A	A	A	A	F		B	F		A
Delay (sec)	57.2	0.1			4.0			79.6			145.9		
LOS	F	A			A			F			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2040 BASELINE												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		1	168	45	71	213	7	56	62	141	10	189	15
Queue (ft)		0		7	52			130		58	121		49
Mvmt Delay (sec)		7.8	0.0	0	8.0	0.0	0.0	159.9		11.5	128.7		9.7
Mvmt LOS		A	A	A	A	A	A	F		B	F		A
Delay (sec)	49.0	0.1			2.4			64.9			121.3		
LOS	E	A			A			F			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Proposed Development

Trip Generation

The proposed development, once fully constructed will serve preschool, Kindergarten, and first grade students. It is assumed that once this facility is built, the facility will help alleviate classroom congestion at the existing Early Childhood Center and Storm Lake Elementary School. Once the facility is built, the facility will take on the preschool program at the Early Childhood Center and the Kindergarten and first grade programs at the Storm Lake Elementary School. This move will make space for additional classrooms within the other programs such as 3-year-old preschool, 2nd grade, 3rd grade, and 4th grade. Some staff will also make the move from the old facilities to the new Early Childhood Education Facility, but some staff will be newly hired as well. As a result, the proposed development will attract new trips made up of staff, buses, and student drop-offs and pick-ups. Diverted trips will be made up of parents who would alternative have dropped off or picked up their student at the existing elementary school.

Office Hours at the Early Childhood Center are 7:30 am to 4:00 pm. School Hours are from 8:15 am to 3:00 pm. The existing Early Childhood Center is located on the east side of the City of Storm Lake and provides education to preschool students among other programs.

Office Hours at the existing elementary school are 7:30 am to 4:00 pm. School Hours are from 8:25 am to 3:25 pm. The elementary school serves Kindergarten through 4th Grade.

Office Hours at the existing middle school are 7:30 am to 4:00 pm. School Hours are from 8:10 am to 3:25 pm. The existing middle school is located south of the proposed development and serves students in grades 5 through 8. Although the proposed development will not replace any programs at the middle school, some parents looking to drop off their children at proposed school may need to also drop off their children at the middle school.

The observed traffic peaks were from 7:30 am to 8:30 am and 3:30 pm to 4:30 pm. Observed peaks are consistent with the expected arrival and departure times of buses, parents, and staff. While it is expected that many parents will choose to drop off their children at the new facility, it is expected that fewer parents will pick up their children during the afternoon peak hour and choose to take advantage of after school programs. The below tables provide a summarized profile of the expected trips generated by the proposed development during Phase I and Phase II. In **Appendix I: Detailed Trip Generation Notes**, a breakdown of staff, parent, and bus entering and exiting trips is detailed.

Table 9: Generated Trips - Phase I

Early Childhood Education Center (Phase I)

	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	% Diverted Trips	% New Trips	# of Diverted Trips Entering	# of Diverted Trips Exiting	# of New Trips Entering	# of New Trips Exiting
Weekday AM (AM Peak Hour of Generator)	142	61%	39%	86	56	35%	65%	25	25	61	31
Weekday PM (PM Peak Hour of Generator)	94	34%	66%	32	62	28%	72%	13	13	19	49

Table 10: Generated Trips - Phase II

Early Childhood Education Center (Phase II)

	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	% Diverted Trips	% New Trips	# of Diverted Trips Entering	# of Diverted Trips Exiting	# of New Trips Entering	# of New Trips Exiting
Weekday AM (AM Peak Hour of Generator)	412	62%	38%	256	156	49%	51%	100	100	156	56
Weekday PM (PM Peak Hour of Generator)	262	31%	69%	81	181	38%	62%	50	50	31	131

Modal Split

Pedestrian and bicycle movements were counted at the time of data collection. No pedestrians and one cyclist were observed during the study times. Due to the proximity of the railroad to Intersection 1, the high posted speeds present in the study area, and the distance between the proposed development, the existing schools, and area accommodations, an increase in pedestrian and cyclist traffic is not expected.

Trip Distribution

The proposed traffic makeup includes new staff, students being dropped off or picked up, and buses, all of which have different route patterns. Using the existing traffic data as a guide to where buses are coming and going, where parents live and work, and where the background commuter traffic is flowing, the proposed trips were distributed between Intersections 1-4 for Phase I, Phase II, and the Build scenarios (design year 2040). In **Appendix J: Detailed Trip Distribution Diagrams**, a breakdown of staff, parent, and bus trips is provided. It is assumed that the proposed trip volume in the Build scenario (design year 2040) will resemble that of Phase II; however the trips will be distributed differently to better reflect the changing background traffic flow patterns.

Analysis of Future Conditions

Future Design Analyses

The proposed trips were applied to the Baseline (2020), Baseline (2024), and Baseline (2040) volumes to create the Phase I (2020), Phase II (2024), and Build (2040) design scenarios. The traffic movement diagrams and analysis reports for these scenarios are provided **Appendices K – M**, and volume, queuing, level of service, and delay summaries for Intersection 1-4 are provided in **Tables 11-22**. A * denotes that vehicles in a movement are experiencing 5 minutes or more average delay, often as a result of overcapacity left turn movements.

Table 11: Phase I (2020) - Intersection 1

INTERSECTION 1	AM PEAK												
	2020 PHASE 1												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
IA-110/90th Ave & IA-7													
Volume (veh)		45	269	61	56	82	18	20	83	144	19	49	25
Queue (ft)		42		3	42			74		77	54		53
Mvmt Delay (sec)		7.9	0.0	0	8.5	0.0	0.0	161.7		12.3	356		9.0
Mvmt LOS		A	A	A	A	A	A	F		B	F		A
Delay (sec)	56.1	2.2			2.7			82.2			299.2		
LOS	F	A			A			F			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2020 PHASE 1												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
IA-110/90th Ave & IA-7													
Volume (veh)		14	168	38	62	213	18	27	51	99	13	63	35
Queue (ft)		14		5	38			64		58	49		54
Mvmt Delay (sec)		7.9	0.0	0	8.0	0.0	0.0	30.8		10.7	50.7		9.9
Mvmt LOS		A	A	A	A	A	A	D		B	E		A
Delay (sec)	12.1	1.4			2.0			18.0			40.5		
LOS	B	A			A			C			E		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 12: Phase I (2020) - Intersection 2

INTERSECTION 2	AM PEAK											
	2020 PHASE 1											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				48		3		98	48	3	45	
Queue (ft)				50		19		0	0		0	
Mvmt Delay (sec)				10.2		9.7				7.6	0.0	
Mvmt LOS				B		A				A	A	
Delay (sec)	1.7			10.1			0.0			0.3		
LOS	A			B			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 2	PM PEAK											
	2020 PHASE 1											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				25		1		58	25	1	86	
Queue (ft)				47		10		0	0		0	
Mvmt Delay (sec)				9.8		8.8				7.4	0.0	
Mvmt LOS				A		A				A	A	
Delay (sec)	1.0			9.8			0.0			0.1		
LOS	A			A			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 13: Phase I (2020) - Intersection 3

INTERSECTION 3	AM PEAK												
	2020 PHASE 1												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				0		0		65	33		2	48	
Queue (ft)				0		0		0	0		0		
Mvmt Delay (sec)											7.5	0.0	
Mvmt LOS											A	A	
Delay (sec)	0.1			0.0			0.0			0.2			
LOS	A			A			A			A			

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 3	PM PEAK												
	2020 PHASE 1												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				33		2		58	0		0	54	
Queue (ft)				48		18		0	0		0		
Mvmt Delay (sec)											9.5	8.7	
Mvmt LOS											A	A	
Delay (sec)	1.7			9.8			0.0			0.0			
LOS	A			A			A			A			

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 14: Phase I (2020) - Intersection 4

INTERSECTION 4	AM PEAK												
	2020 PHASE 1												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				6		0		59	6	0	44		
Queue (ft)				28				0	0	0			
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	0.3			9.4				0.0			0.0		
LOS	A			A				A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 4	PM PEAK												
	2020 PHASE 1												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				6		0		52	6	0	48		
Queue (ft)				25				0	0	0			
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	0.4			9.3				0.0			0.0		
LOS	A			A				A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 15: Phase II (2024) - Intersection 1

INTERSECTION 1	AM PEAK												
	2024 PHASE II												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
IA-110/90th Ave & IA-7													
Volume (veh)		122	269	19	39	82	52	7	128	119	41	83	75
Queue (ft)		54		0	28			95		53	93		56
Mvmt Delay (sec)		9.6	0.0	0	8.2	0.0	0.0	*		11.8	*		9.6
Mvmt LOS		A	A	A	A	A	A	F		B	F		A
Delay (sec)	*	5.4			1.2			*			*		
LOS	F	A			A			F			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2024 PHASE II												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
IA-110/90th Ave & IA-7													
Volume (veh)		39	168	21	55	213	28	6	65	96	38	106	89
Queue (ft)		32		0	37			59		56	89		60
Mvmt Delay (sec)		8.2	0.0	0	7.9	0.0	0.0	55.2		10.6	*		10.5
Mvmt LOS		A	A	A	A	A	A	F		B	F		B
Delay (sec)	*	3.2			1.7			26.9			*		
LOS	F	A			A			D			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 16: Phase II (2024) - Intersection 2

INTERSECTION 2	AM PEAK												
	2024 PHASE II												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				143		8		159	143	8	56		
Queue (ft)				66		29		0	0	13			
Mvmt Delay (sec)				12.9		9.9				8.0	0.0		
Mvmt LOS				B		A				A	A		
Delay (sec)	3.2				12.7			0.0			0.6		
LOS	A				B			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 2	PM PEAK												
	2024 PHASE II												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				72		4		60	72	4	161		
Queue (ft)				49		16		0	0	9			
Mvmt Delay (sec)				11.3		8.9				7.5	0.0		
Mvmt LOS				B		A				A	A		
Delay (sec)	1.9				11.2			0.0			0.1		
LOS	A				B			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 17: Phase II (2024) - Intersection 3

INTERSECTION 3	AM PEAK											
	2024 PHASE II											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				0		0		68	91	5	64	
Queue (ft)				0		0		0	0	0		
Mvmt Delay (sec)										7.6	0.0	
Mvmt LOS										A	A	
Delay (sec)	0.1			0.0			0.0			0.3		
LOS	A			A			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 3	PM PEAK											
	2024 PHASE II											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				91		5		60	0	0	74	
Queue (ft)				50		26		0	0	0		
Mvmt Delay (sec)										8.7	0.0	
Mvmt LOS										A	A	
Delay (sec)	3.4			10.1			0.0			0.0		
LOS	A			B			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 18: Phase II (2024) - Intersection 4

INTERSECTION 4	AM PEAK												
	2024 PHASE II												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				6		0		62	6	0	63		
Queue (ft)				25				0	0	0			
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	0.3			9.6				0.0			0.0		
LOS	A			A				A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 4	PM PEAK												
	2024 PHASE II												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				6		0		54	6	0	68		
Queue (ft)				24				0	0	0			
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	0.3			9.4				0.0			0.0		
LOS	A			A				A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 19: Build (2040) - Intersection 1

INTERSECTION 1	AM PEAK												
	2040 BUILD												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		122	269	19	39	82	52	14	144	165	51	200	75
Queue (ft)		55		0	38			195		75	218		65
Mvmt Delay (sec)		9.6	0.0	0.0	8.2	0.0	0.0	*		12.7	*		9.6
Mvmt LOS		A	A	A	A	A	A	F		B	F		A
Delay (sec)	*	5.4			1.2			*			*		
LOS	F	A			A			F			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2040 BUILD												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		39	168	21	55	213	28	18	78	126	45	237	99
Queue (ft)		39		0	53			64		71	148		63
Mvmt Delay (sec)		8.2	0.0	0	7.9	0.0	0.0	*		11.2	*		10.6
Mvmt LOS		A	A	A	A	A	A	F		B	F		B
Delay (sec)	*	3.2			1.7			*			*		
LOS	F	A			A			F			F		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 20: Build (2040) - Intersection 2

INTERSECTION 2	AM PEAK											
	2040 BUILD											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				143		8		175	143	8	183	
Queue (ft)				88		26		0	0	19		
Mvmt Delay (sec)				17.3		10.1				8.1	0.0	
Mvmt LOS				C		B				A	A	
Delay (sec)	3.1			16.9			0.0			0.2		
LOS	A			C			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 2	PM PEAK											
	2040 BUILD											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				72		4		73	72	4	309	
Queue (ft)				60		19		0	0	10		
Mvmt Delay (sec)				14.1		9				7.6	0.0	
Mvmt LOS				B		A				A	A	
Delay (sec)	1.6			13.8			0.0			0.1		
LOS	A			B			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 21: Build (2040) - Intersection 3

INTERSECTION 3	AM PEAK											
	2040 BUILD											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				0		0		84	91	5	191	
Queue (ft)				0		0		0	0	9		
Mvmt Delay (sec)										7.7	0.0	
Mvmt LOS										A	A	
Delay (sec)	0.1			0.0			0.0			0.1		
LOS	A			A			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 3	PM PEAK											
	2040 BUILD											
	Overall	Eastbound			Westbound			Northbound			Southbound	
L		T	R	L	T	R	L	T	R	L	T	R
Volume (veh)				91		5		73	0	0	222	
Queue (ft)				59		25		0	0	0		
Mvmt Delay (sec)											0.0	
Mvmt LOS										A	A	
Delay (sec)	2.2			12.0			0.0			0.0		
LOS	A			B			A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 22: Build (2040) - Intersection 4

INTERSECTION 4	AM PEAK												
	2040 BUILD												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				6		0		78	6	0	190		
Queue (ft)				24				0	0	0			
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	0.2			11.3				0.0			0.0		
LOS	A			B				A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 4	PM PEAK												
	2040 BUILD												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)				6		0		67	6	0	216		
Queue (ft)				29				0	0	0			
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	0.2			11.1				0.0			0.0		
LOS	A			B				A			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Crash Analysis

Crash data for the study area was gathered using the Iowa webSAVER crash software. A snapshot of crashes reported between 2008 and 2018 is provided as **Exhibit 4**. Refer to **Appendix N: Crash Diagram** for a schematic crash diagram. 31 crashes occurred during this period in Intersection 1. There were no crashes in Intersections 2-4. Additionally, there does not appear to be any crashes involving the nearby railroad.

Exhibit 4: Crash Locations

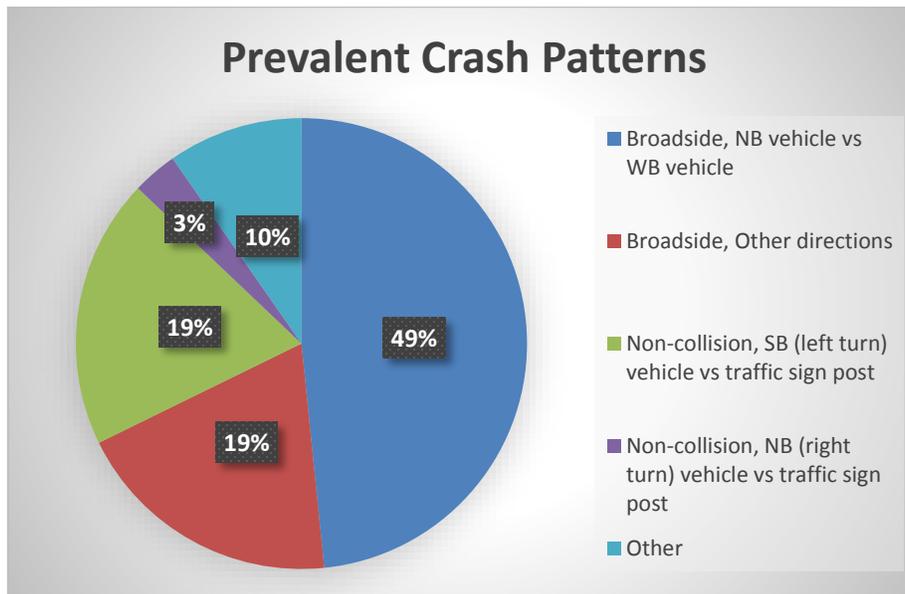


Table 23: Recorded Crashes and Severity Summary

Crash Severity	Number of Crashes
K – Fatal Injury	0
A – Incapacitating Injury	1
B – Non-Incapacitating Injury	5
C – Possible Injury	3
Property Damage	22

Crash Patterns

Exhibit 5: Prevalent Crash Patterns



Of the crashes in Intersection 1, approximately 2/3 of the crashes were broadside (front to side) type crashes and a 1/4 were non-collision (single vehicle) type crashes. There are no other patterns apparent in the crash data.

Of the broadside type crashes, the majority involved a vehicle traveling northbound and a vehicle traveling westbound. This broadside NB/WB vehicle collision type makes up 1/2 of all crashes at this intersection. Additionally, 8 of 9 injury crashes are within this grouping. The last injury crash occurred during a broadside NB/EB vehicle collision.

6 of 7 non-collision (single vehicle) type crashed were caused by southbound vehicles making a left-hand turn and colliding with a traffic sign support. None of these crashes resulted in injuries. The last non-collision type crash was caused by a northbound vehicle making a right-hand turn, colliding with a traffic sign support (property damage only).

Crash Rate

The crash rates at Intersection 1 are approximately twice the statewide average crash rates for similar type intersections. The calculated crash rate at Intersection 1 is 1.4 accidents per million entering vehicles (MEV), which is twice the average rate (0.7 accidents per MEV) for rural intersections with 5,000 to 9,999 entering vehicles per day. This statewide average rate is based on Iowa DOT data from 1983 thru 1987.

Looking at the crash rate from a linear perspective, the average crash rate and the average fatal + injury crash rate is 551 and 160 crashes per 100 Million Vehicle Miles Traveled (HMVMT), respectively (assuming a 0.5 mile length and an average AADT of 3080). According to the Iowa DOT's 10-year Averages (2007 – 2016), the average crash rate and the average fatal + injury crash rate for municipal Iowa highways is 296 HMVMT and 86 HMVMT, respectively. Intersection 1's overall crash rate and fatal + injury crash rate are approximately twice that of the state averages for similar roadways. **Table 24** below summarizes the Intersection and statewide average crash rates.

Table 24: Intersection 1 Crash Rate Comparison

Analysis Type	Intersection 1 Crash Rate	Statewide Average Crash Rate	Intersection 1 Rate / Statewide Average
All Crashes, Intersection	1.4 MEV	0.7 MEV	2.0
All Crashes, Road	551 HMVMT	296 HMVMT	1.9
Fatal + Injury Crashes, Road	160 HMVMT	86 HMVMT	1.9

Safety Summary

Addressing intersection safety, improvements should be made at Intersection 1. In particular the prevalence of the broadside type crashes occurring between the NB and WB vehicles indicates that drivers may be becoming impatient at the NB stop sign failing to yield to WB traffic that has the right-of-way, perhaps during the afternoon or evening peaks when there is more WB traffic than EB traffic. By changing the traffic control to a four-way stop or a traffic signal, drivers may be encouraged to yield to right-of-way and take less risks. Alternatively, changing the traffic control to a roundabout may force slower speeds and change the angle of crashes, resulting in less severe crashes.

To mitigate the crashes occurring between the SB left-turning traffic and the traffic sign post(s) the traffic sign placement should be reconsidered. Changing the traffic control at Intersection 1 may also alleviate the problem.

Minimum stopping site distances of 360 feet and 495 feet are generally provided for IA-110 and 90th Avenue, respectively. Minimum stopping site distance of 425 feet is generally provided for IA-7. View obstructions at intersection I include power poles, traffic signs, and light poles.

Level of Service and Delay Comparison

The following tables provide a side-by-side comparison in the change in delay and level of service for the studied intersections' approaches.

In the existing condition, Intersection 1 operates at an acceptable LOS for all movements and approaches. Phases I and II add traffic to the area network, negatively impacting Intersection 1 and causing failing northbound and southbound left-turn movements.

Table 25: LOS and Delay Comparison – Intersection 1

	INTERSECTION 1 IA-110/90th Ave & IA-7	AM PEAK												
		Overall	Eastbound			Westbound			Northbound			Southbound		
			L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	7	0.1			4.0			16.2			21.2		
	LOS	A	A			A			C			C		
Baseline 2020	Delay (sec)	8.2	0.1			4.0			17.9			23.3		
	LOS	A	A			A			C			C		
Phase I 2020	Delay (sec)	22.7	1.2			2.6			28.8			123.2		
	LOS	D	A			A			D			F		
Baseline 2024	Delay (sec)	10.7	0.1			4.0			21.8			28.9		
	LOS	A	A			A			C			D		
Phase II 2024	Delay (sec)	*	2.2			1.4			49.0			*		
	LOS	F	A			A			E			F		
Baseline 2040	Delay (sec)	*	0.0			4.2			*			*		
	LOS	F	A			A			F			F		
Build 2040	Delay (sec)	*	1.0			3.1			*			*		
	LOS	F	A			A			F			F		

	INTERSECTION 1 IA-110/90th Ave & IA-7	PM PEAK												
		Overall	Eastbound			Westbound			Northbound			Southbound		
			L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	6.9	0.1			2.4			15.4			20.2		
	LOS	A	A			A			C			C		
Baseline 2020	Delay (sec)	7.6	0.1			2.4			16.3			21.3		
	LOS	A	A			A			C			C		
Phase I 2020	Delay (sec)	17.2	0.9			1.9			18.1			67.7		
	LOS	C	A			A			C			F		
Baseline 2024	Delay (sec)	9.6	0.1			2.4			19.1			25.3		
	LOS	A	A			A			C			D		
Phase II 2024	Delay (sec)	*	2.2			1.4			30.5			*		
	LOS	F	A			A			D			F		
Baseline 2040	Delay (sec)	*	0.1			2.5			*			*		
	LOS	F	A			A			F			F		
Build 2040	Delay (sec)	*	0.8			2.0			*			*		
	LOS	F	A			A			F			F		

Table 26: LOS and Delay Comparison – Intersection 2

		INTERSECTION 2	AM PEAK												
		90th Ave & Drop Off Driveway	Overall	Eastbound			Westbound			Northbound			Southbound		
				L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2020	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase I 2020	Delay (sec)	1.9				10.0			0.0			0.9			
	LOS	A				A			A			A			
Baseline 2024	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase II 2024	Delay (sec)	3.5				12.4			0.0			2.4			
	LOS	A				B			A			A			
Baseline 2040	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Build 2040	Delay (sec)	3.2				15.5			0.0			1.4			
	LOS	A				C			A			A			

		INTERSECTION 2	PM PEAK												
		90th Ave & Drop Off Driveway	Overall	Eastbound			Westbound			Northbound			Southbound		
				L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2020	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase I 2020	Delay (sec)	1.1				9.7			0.0			0.3			
	LOS	A				A			A			A			
Baseline 2024	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase II 2024	Delay (sec)	2.0				10.9			0.0			0.5			
	LOS	A				B			A			A			
Baseline 2040	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Build 2040	Delay (sec)	1.6				12.5			0.0			0.5			
	LOS	A				B			A			A			

Table 27: LOS and Delay Comparison – Intersection 3

		INTERSECTION 3	AM PEAK												
		90th Ave & Parking Driveway	Overall	Eastbound			Westbound			Northbound			Southbound		
				L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2020	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase I 2020	Delay (sec)	0.2				0.0			0.0			0.5			
	LOS	A				A			A			A			
Baseline 2024	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase II 2024	Delay (sec)	0.4				0.0			0.0			1.1			
	LOS	A				A			A			A			
Baseline 2040	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Build 2040	Delay (sec)	0.3				0.0			0.0			0.7			
	LOS	A				A			A			A			

		INTERSECTION 3	PM PEAK												
		90th Ave & Parking Driveway	Overall	Eastbound			Westbound			Northbound			Southbound		
				L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2020	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase I 2020	Delay (sec)	1.7				9.5			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2024	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase II 2024	Delay (sec)	3.2				10.1			0.0			0.0			
	LOS	A				B			A			A			
Baseline 2040	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Build 2040	Delay (sec)	2.0				11.8			0.0			0.0			
	LOS	A				B			A			A			

Table 28: LOS and Delay Comparison – Intersection 4

		INTERSECTION 4	AM PEAK												
		90th Ave & Bus Driveway	Overall	Eastbound			Westbound			Northbound			Southbound		
				L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2020	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase I 2020	Delay (sec)	0.0				9.6			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2024	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase II 2024	Delay (sec)	0.2				10.3			0.0			0.0			
	LOS	A				B			A			A			
Baseline 2040	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Build 2040	Delay (sec)	0.2				10.3			0.0			0.0			
	LOS	A				B			A			A			

		INTERSECTION 4	PM PEAK												
		90th Ave & Bus Driveway	Overall	Eastbound			Westbound			Northbound			Southbound		
				L	T	R	L	T	R	L	T	R	L	T	R
Existing 2018	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2020	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase I 2020	Delay (sec)	0.3				9.4			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2024	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Phase II 2024	Delay (sec)	0.3				9.7			0.0			0.0			
	LOS	A				A			A			A			
Baseline 2040	Delay (sec)	0.0				0.0			0.0			0.0			
	LOS	A				A			A			A			
Build 2040	Delay (sec)	0.3				11.9			0.0			0.0			
	LOS	A				B			A			A			

Traffic Signal Warrant Analysis

The following table is a summary of the various traffic signal warrants as described in the Manual of Uniform Traffic Devices (MUTCD), and whether or not each warrant is satisfied for Intersection 1.

Table 29: Traffic Signal Warrant Analysis Summary

Warrant #	Warrant Name	Phase I (2020)	Phase II (2024)	Build
1	Eight-Hour Vehicular Volume	Possibly	Possibly	Warranted
2	Four-Hour Vehicular Volume	No	Warranted	Warranted
3	Peak Hour	Warranted	Warranted	Warranted
4	Pedestrian Four-Hour Volume	No	No	No
5	School Crossing	No	No	No
6	Coordinate Signal System	No	No	No
7	Crash Experience	No	No	No
8	Roadway Network	No	No	No
9	Intersection Near a Grade Crossing	Warranted	Warranted	Warranted

Warrant #1

Using the collected count data and traffic data available through the Iowa DOT, it was determined that, based on estimated 8-hour vehicle volumes (condition A) estimates for the Phase I (2020) and Phase II (2024) conditions, a signal may be used after adequate trial of other remedial measures. As a result of background traffic growth, warrant 1 is fulfilled in the Build (2040) condition. Prior to Phase II development, a 12-hour traffic count should be conducted to confirm these conclusions.

Warrant #2

The collected count data and traffic data available through the Iowa DOT were used to check if Warrant #2 is fulfilled. At Intersection 1, where the 85th-percentile speed on the major street exceeds 40 mph, it was determined that a signal is warranted to accommodate traffic in the Phase II (2024) and Build (2040) scenarios based on 4-hr vehicular volume estimates.

Warrant #3

The existing schools and proposed education facility attract and discharge a large number of vehicles in short time. Based on the expected traffic volumes at Intersection 1 during the AM peak, traffic signals are warranted to manage northbound and southbound traffic and prevent excessive delays on IA-110 and 90th Avenue.

Warrant #9

Considering the close proximity of the railroad crossing to and the vehicular volume of Intersection 1, a traffic signal is warranted to prevent conflicts with the existing rail crossing. Additionally, gate arms should be installed at the existing railroad crossing.

All-Way-Stop Control Warrant Analysis

Per MUTCD guidance, all-way-stop control is warranted for Intersection 1. The MUTCD describes when all-way-stop control may be appropriate for a particular intersection. The below text is taken from the MUTCD:

- A. *Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.*
- B. *Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.*
- C. *Minimum volumes:*
 - 1. *The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and*
 - 2. *The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but*
 - 3. *If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.*
- D. *Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.*

At Intersection 1, traffic control signals are justified to accommodate Phase I, Phase II, and Build conditions. All-way-stop control is an appropriate interim measure that can be installed immediately while arrangements can be made to install a traffic signal or other traffic control. Criterion A described above is satisfied.

On average, two crashes are reported a year that are susceptible to correction by an all-way-stop installation, so criterion B described above is not satisfied.

The average vehicular volume entering the intersection from the IA-7 (eastbound and westbound) in an 8-hr period during the Phase I, Phase II, and Build conditions is estimated to exceed 300 vehicles per hour. Additionally, the average vehicular volumes entering Intersection 1 from the side streets in the same 8-hr period during the Phase I, Phase II, and Build conditions is expected to exceed 100 vehicles per hour, where the average delay is greater than 30 seconds per vehicle during the peak hour.

Because Criteria A and C above are both satisfied, all-way-stop control is warranted for Intersection 1.

Opportunities for Improvement

Based on the modeled Baseline (2020) conditions described in this report and the existing crash data at Intersection 1, improvements to Intersection 1 are recommended at this time. 90th Avenue does not need to be widened, and no geometry changes to the site driveways are needed.

Changing the existing traffic control from two-way-stop controlled to an alternate traffic control type would address the needs for Phase I. All-way-stop control, traffic signal control, and roundabout control are all options that can be applied to Intersection for Phase I; however all-way-stop control is recommended.

- The eastbound IA-7 leg of Intersection 1 should be modified to accommodate two lanes, a left/thru-lane and a thru/right-lane.
- Additionally, the westbound IA-7 leg of Intersection 1 should be modified to accommodate two lanes, a left-turn lane and a right/thru-lane. On the westbound leg, a lane shift taper and additional pavement would be required to create this lane layout.

For Phase II, signal or roundabout control would be equally appropriate for the intersection, and all-way-stop control would not provide an acceptable level of service during the morning peak.

- If signals are chosen for Phase, II the intersection should be reconstructed to accommodate left-turn lanes in all direction and right-turn lanes for the eastbound, westbound, and northbound directions. Turn-lanes and tapers should be long enough to accommodate queued vehicles, and the signals should be timed for protected-permitted left-turns (solid green and flashing yellow arrows). Other acceptable geometric configurations and timing plans are available.
- If roundabout control is chosen for Phase II, then the intersection should be reconstructed to accommodate a 1-lane roundabout. No bypass lanes would be needed, but the roundabout should be place far enough away from the existing railroad to accommodate future right-turn bypass lanes. Further analysis would be required to estimate the right-of-way impacts of this alternative.
- All-way-stop control is not recommended for Phase II.

Based on the assumptions as described in this report, additional improvements are recommended between 2024 and the design year, 2040, in order to adapt to the growing and redistributing background traffic.

- If a signal were to be installed to accommodate Phase II traffic, the traffic signal should be retimed.
- If a roundabout were to be installed to accommodate Phase II traffic, a northbound right-turn bypass lane should be added to the roundabout.

Comparing Recommendations to Existing Study

This Early Childhood Education Facility study provides recommendations to be implemented by specific years: 2020, 2024, and 2040. The 2013 study's recommendation to construct left-turn lanes in both directions of IA-7 would be insufficient to provide acceptable levels of service and delay at Intersection 1 in 2020, 2024, and 2040. This Early Childhood Education Facility study's recommended option to install traffic signals, a northbound turn lane, and railroad crossing improvements is consistent with the 2013 study's recommendations. This Early Childhood Education Facility study recommends additional geometry improvements for the optional traffic signal and explores the option to construct a roundabout. A roundabout is not considered in the 2013 study.

Recommended Improvements

To accommodate Phase I traffic, all-way-stop traffic control is recommended. While temporary, this solution is the quickest to construct, most cost effective alternative of the three options available for Phase I. This solution also provides the City of Storm Lake time to choose a Phase II option and to secure funding for the chosen long-term solution.

The nearby railroad should be considered in all designs for improvement. At a minimum, gate arms should be installed at the existing crossing regardless of the long-term traffic control solution chosen. Although railroad related crashes have not occurred in the past according the crash data, the expected increase in northbound/southbound crossing vehicles, including school buses, may be grounds for installing the additional safety measure according to the *Railroad-Highway Grade Crossing Handbook*. Additionally, the MUTCD recommends that automatic gates should be included on the grade crossing when Warrant #9, Intersection near a Grade Crossing, is met and a traffic signal is justified.

This report assumes aggressive growth between the time of Phase II and the design year. These growth projections are subject to change dependent on a variety of political, environmental, and economic factors. Therefore, after Phase II development, this report recommends that the study area should be re-evaluated, as growth projections change or as residential subdivision development occurs.

Modeling the Improvements

Modeling shows that the suggested recommendation for Phase I improves the level of service at Intersection 1 and there is no change at Intersections 2-4. **Tables 30-35** summarize the studied Intersection 1’s conditions with the recommended improvements. The analysis worksheets are provided in **Appendix P: Recommendations – Phase I – Analysis Reports**. Both alternatives for Phase II improve the level of service at Intersection 1. The analysis worksheets for the Phase II and Build (2040) scenarios are provided in **Appendix Q: Recommendations – Phase II – Analysis Reports** and **Appendix R: Recommendations – Build (2040) – Analysis Reports** respectively.

Recommendations

Table 30: Recommendations LOS – Phase I – All-Way-Stop Control

INTERSECTION 1	AM PEAK												
	2020 PHASE I - AWSC												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
IA-110/90th Ave & IA-7													
Volume (veh)		35	274	73	57	83	28	18	80	156	24	44	20
Queue (ft)		64		46	34	54		84		79	45		44
Mvmt Delay (sec)		16.7		17.0	12.0	13.5		13.5		13.4	13.8		10.0
Mvmt LOS		C		C	B	B		B		B	B		A
Delay (sec)	14.8	16.9			13.0			13.4			13.3		
LOS	B	C			B			B			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2020 PHASE I - AWSC												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
IA-110/90th Ave & IA-7													
Volume (veh)		9	171	42	61	217	23	41	57	106	24	57	27
Queue (ft)		53		40	37	62		56		52	56		56
Mvmt Delay (sec)		12.6		12.4	11.8	17.3		12.5		12.9	14.3		9.8
Mvmt LOS		B		B	B	C		B		B	B		A
Delay (sec)	13.8	12.5			16.0			12.8			13.5		
LOS	B	B			C			B			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 31: Recommendations LOS – Phase II – All-Way-Stop Control

INTERSECTION 1	AM PEAK												
	2024 PHASE II - AWSC												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		105	284	47	38	87	81	1	108	156	56	51	60
Queue (ft)		65		40	51	49		58		0	39		38
Mvmt Delay (sec)		30.2		18.1	13.4	16.1		15.1		15.4	17.2		12.5
Mvmt LOS		D		C	B	D		C		C	C		B
Delay (sec)	19.2	25.0			15.2			15.3			17.7		
LOS	C	C			C			C			C		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2024 PHASE II - AWSC												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		24	177	32	49	225	43	37	70	111	73	76	65
Queue (ft)		49		33	65	44		65		53	36		52
Mvmt Delay (sec)		19.3		15.2	18.6	17.5		15.5		16.9	36.6		13.3
Mvmt LOS		C		C	C	C		C		C	E		B
Delay (sec)	21.1	17.6			18.0			16.4			30.0		
LOS	C	C			C			C			D		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 32: Recommendations LOS – Phase II – Roundabout

INTERSECTION 1	AM PEAK												
	2024 PHASE II - ROUNDABOUT												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		619			305			364			271		
Queue (ft)		59			46			70			38		
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	10.2	11.6			7.0			14.2			5.2		
LOS	B	B			A			B			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2024 PHASE II - ROUNDABOUT												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		360			403			360			480		
Queue (ft)		42			60			52			52		
Mvmt Delay (sec)													
Mvmt LOS													
Delay (sec)	10.1	9.7			7.4			12.6			10.7		
LOS	A	A			A			B			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 33: Recommendations LOS – Phase II – Signals

INTERSECTION 1	AM PEAK												
	2024 PHASE II - TRAFFIC SIGNALS												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		105	284	47	38	87	81	1	108	156	56	51	60
Queue (ft)		74	168	17	49	77	32	0	95	64	51	86	
Mvmt Delay (sec)		21.6	36.5	23.4	24.2	26.5	29.2	10.1	25.3	30.0	11.5	25.3	
Mvmt LOS		C	D	C	C	C	C	B	C	C	B	C	
Delay (sec)	28.1	32.6			27.6			27.9			18.5		
LOS	C	C			C			C			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2024 PHASE II - TRAFFIC SIGNALS												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		24	177	32	49	225	43	37	70	111	73	76	65
Queue (ft)		30	129	12	54	145	12	38	66	57	48	91	
Mvmt Delay (sec)		23.9	29.9	24.9	23.4	33.1	26.3	9.0	21.4	27.0	11.5	24.4	
Mvmt LOS		C	C	C	C	C	C	A	C	C	B	C	
Delay (sec)	24.0	27.8			30.1			23.4			16.6		
LOS	C	C			C			C			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 34: Recommendations LOS – Build (2040) – Roundabout

INTERSECTION 1	AM PEAK												
	2040 BUILD - ROUNDABOUT												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		650			261			959			408		
Queue (ft)		104			43			174			55		
Mvmt Delay (sec)								17.2		15.3			
Mvmt LOS								C		C			
Delay (sec)	15.6	22.1			8.9			16.2			8.3		
LOS	C	C			A			C			A		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2040 BUILD - ROUNDABOUT												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		357			449			800			501		
Queue (ft)		57			75			81			64		
Mvmt Delay (sec)								8.6		11.3			
Mvmt LOS								A		B			
Delay (sec)	11.2	9.2			9.8			10.2			15.4		
LOS	B	A			A			B			C		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Table 35: Recommendations LOS – Build (2040) – Signals

INTERSECTION 1	AM PEAK												
	2040 BUILD - TRAFFIC SIGNALS												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		55	328	80	68	100	31	49	248	365	34	182	30
Queue (ft)		50	180	17	50	66	15	33	121	130	38	107	
Mvmt Delay (sec)		15.3	31.4	19	17.5	18.2	17.8	13.9	22.5	53.1	14.3	21.4	
Mvmt LOS		B	C	B	B	B	B	B	C	D	B	C	
Delay (sec)	28.9	26.8			17.9			37.3			19.7		
LOS	C	C			B			D			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

INTERSECTION 1	PM PEAK												
	2040 BUILD - TRAFFIC SIGNALS												
	Overall	Eastbound			Westbound			Northbound			Southbound		
L		T	R	L	T	R	L	T	R	L	T	R	
Volume (veh)		9	205	50	72	259	26	96	139	244	35	232	34
Queue (ft)		22	110	19	66	119	23	72	75	83	43	120	
Mvmt Delay (sec)		17.7	24.9	19.5	17.5	22.4	17.6	11.3	15.3	36.8	10.9	18.4	
Mvmt LOS		B	C	B	B	C	B	B	B	D	B	B	
Delay (sec)	22.7	23.3			20.7			27.6			16.3		
LOS	C	C			C			C			B		

Source: Data collected by ISG September 2018 and analyzed using the Highway Capacity Manual 6th Edition and SimTraffic V10.

Conclusions + Recommendations

Summary of Roadway Link Analysis

The analysis shows that the existing roadway link network is sufficient for the existing traffic. No improvements are recommended at this time. As area traffic grows and redistributes, the studied area should be reviewed periodically.

Summary of Intersection Analysis

Intersection 1

Intersection 1 is currently operating acceptably (LOS A overall, LOS C for side streets, LOS A for IA-7), and without the proposed development Intersection 1 is expected to operate acceptably into the foreseeable future (6+ years). However, by 2040 a change in traffic control may be needed.

The addition of Phase I traffic causes unacceptable delays and level of service for the northbound and southbound approaches during both the morning and afternoon peak hours. The addition of Phase II traffic increases average delay to over 5 minutes for northbound and southbound approaches and left-turn movements.

Intersections 2-4

Intersections 2-4 are created by the proposed site driveways. All driveways are expected to operate acceptably (LOS A-C) after both Phase I and Phase II development and into the design year. Additional lanes on 90th Avenue are not warranted.

Summary of Recommended Improvements

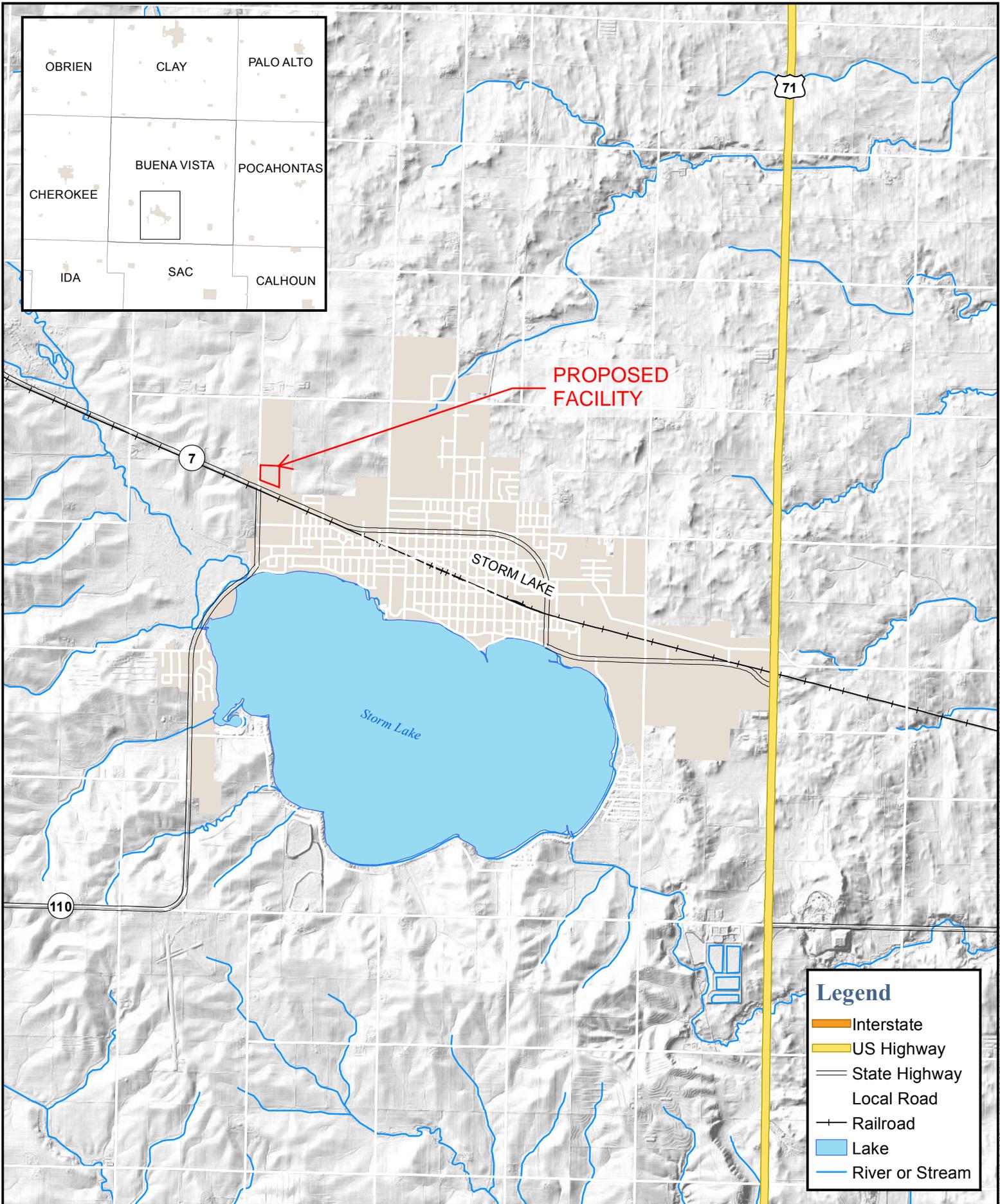
Based on the modeled conditions described in this report, improvements are recommended to accommodate proposed traffic. The following are recommended:

- Implement all-way-stop control at Intersection 1 prior to Phase I development.
 - Eastbound and westbound approaches should be modified to accommodate two lanes each direction: eastbound left/thru, eastbound thru/right, westbound left, westbound thru/right.
 - A lane shift taper and additional pavement is recommended east of Intersection 1 to accommodate the proposed layout.
- Install gate arms to the existing railroad crossing on IA-110.
- Immediately explore funding opportunities for a future traffic signal or roundabout.
- Implement traffic signals or roundabout control prior to Phase II development.
- As the area develops and as traffic growth projections change, the study area should be re-evaluated.

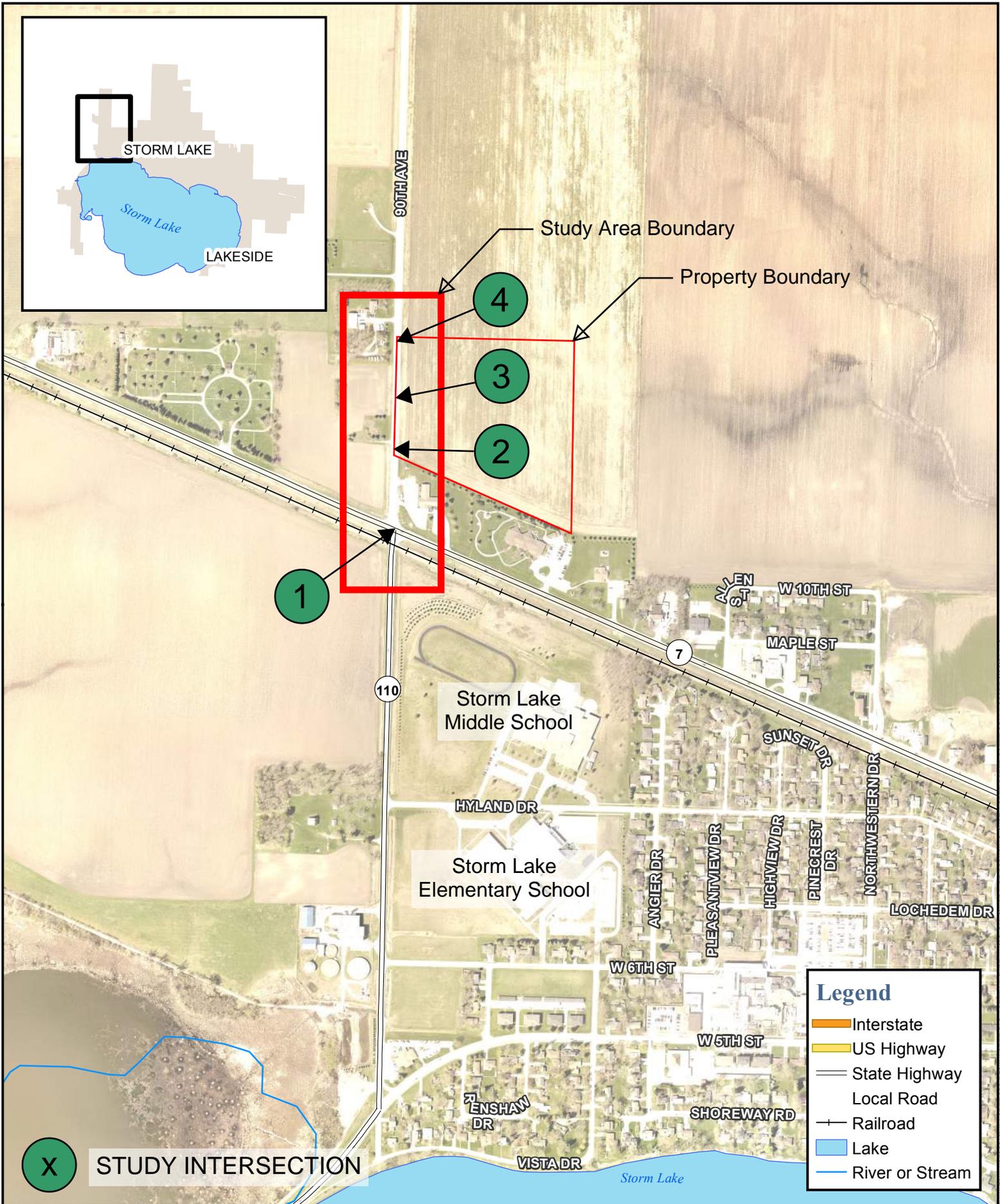
Appendices

- Appendix A: Study Area Overview + Intersection Map
- Appendix B: Land Use Maps
- Appendix C: Phase I Preliminary Plan
- Appendix D: Full Build Conceptual Site Plan
- Appendix E: Existing Traffic Counts + Analysis Reports
- Appendix F: Baseline (2020) – Traffic Volumes + Analysis Reports
- Appendix G: Baseline (2024) – Traffic Volumes + Analysis Reports
- Appendix H: Baseline (2040) – Traffic Volumes + Analysis Reports
- Appendix I: Detailed Trip Generation Notes
- Appendix J: Detailed Trip Distribution Diagrams
- Appendix K: Phase I (2020) – Traffic Volumes + Analysis Reports
- Appendix L: Phase II (2024) – Traffic Volumes + Analysis Reports
- Appendix M: Build (2040) – Traffic Volumes + Analysis Reports
- Appendix N: Crash Diagram
- Appendix O: Crash Details
- Appendix P: Recommendations – Phase I – Analysis Reports
- Appendix Q: Recommendations – Phase II – Analysis Reports
- Appendix R: Recommendations – Build (2040) – Analysis Reports
- Appendix S: Feed Mill Trip Distribution Diagrams

Appendix A: Study Area Overview + Intersection Map



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ISG PN: 18-22291 Source(s):
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 Rail and Roads: Iowa DOT (2017 and 2014)
 Lakes: Iowa DNR (2007)
 Cities and Counties: Iowa DOT (2016)

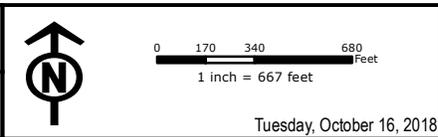
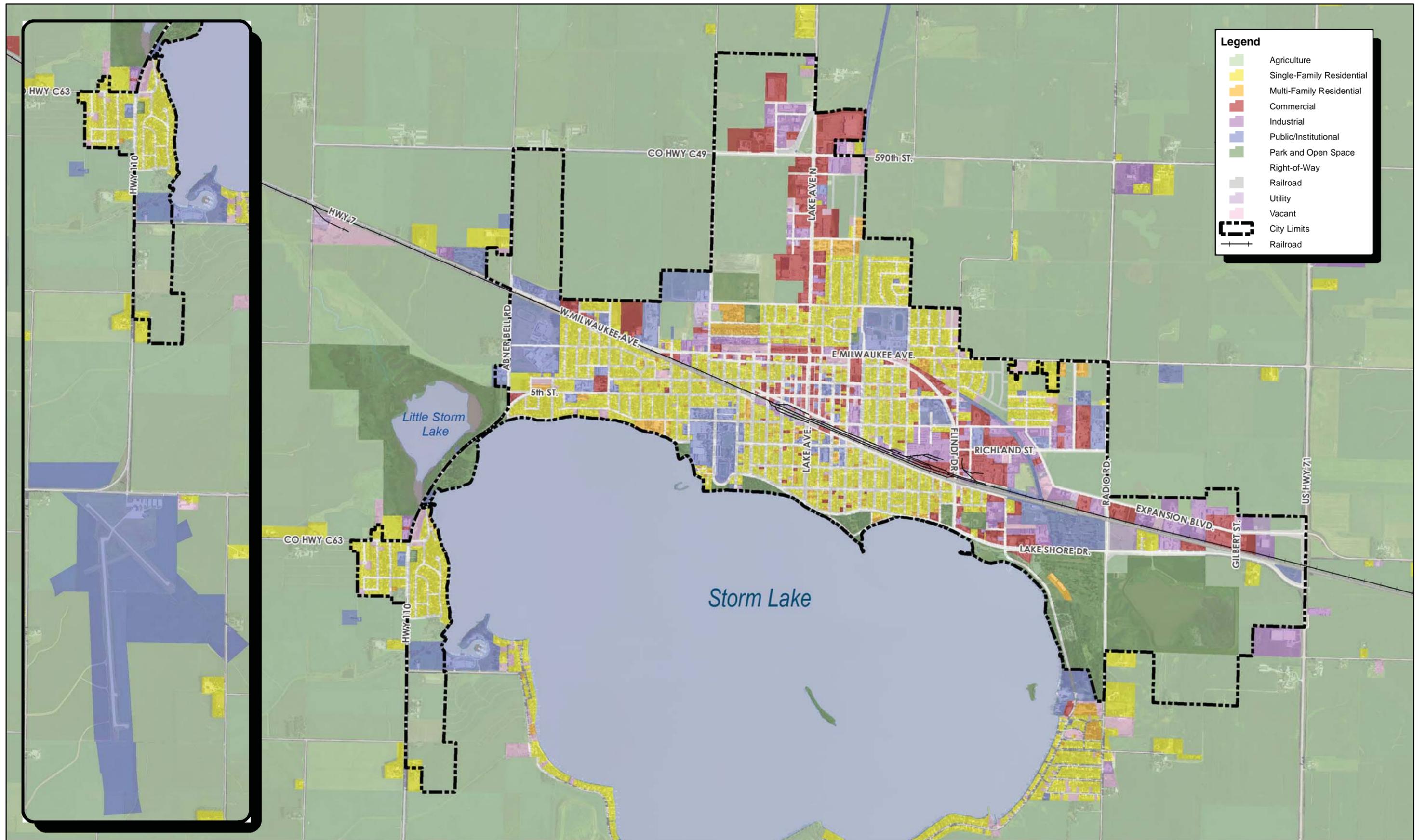


FIGURE
Study Area Map
 Proposed Early Childhood Education Facility
 Storm Lake, Iowa

Appendix B: Land Use Maps



Legend

- Agriculture
- Single-Family Residential
- Multi-Family Residential
- Commercial
- Industrial
- Public/Institutional
- Park and Open Space
- Right-of-Way
- Railroad
- Utility
- Vacant
- City Limits
- Railroad

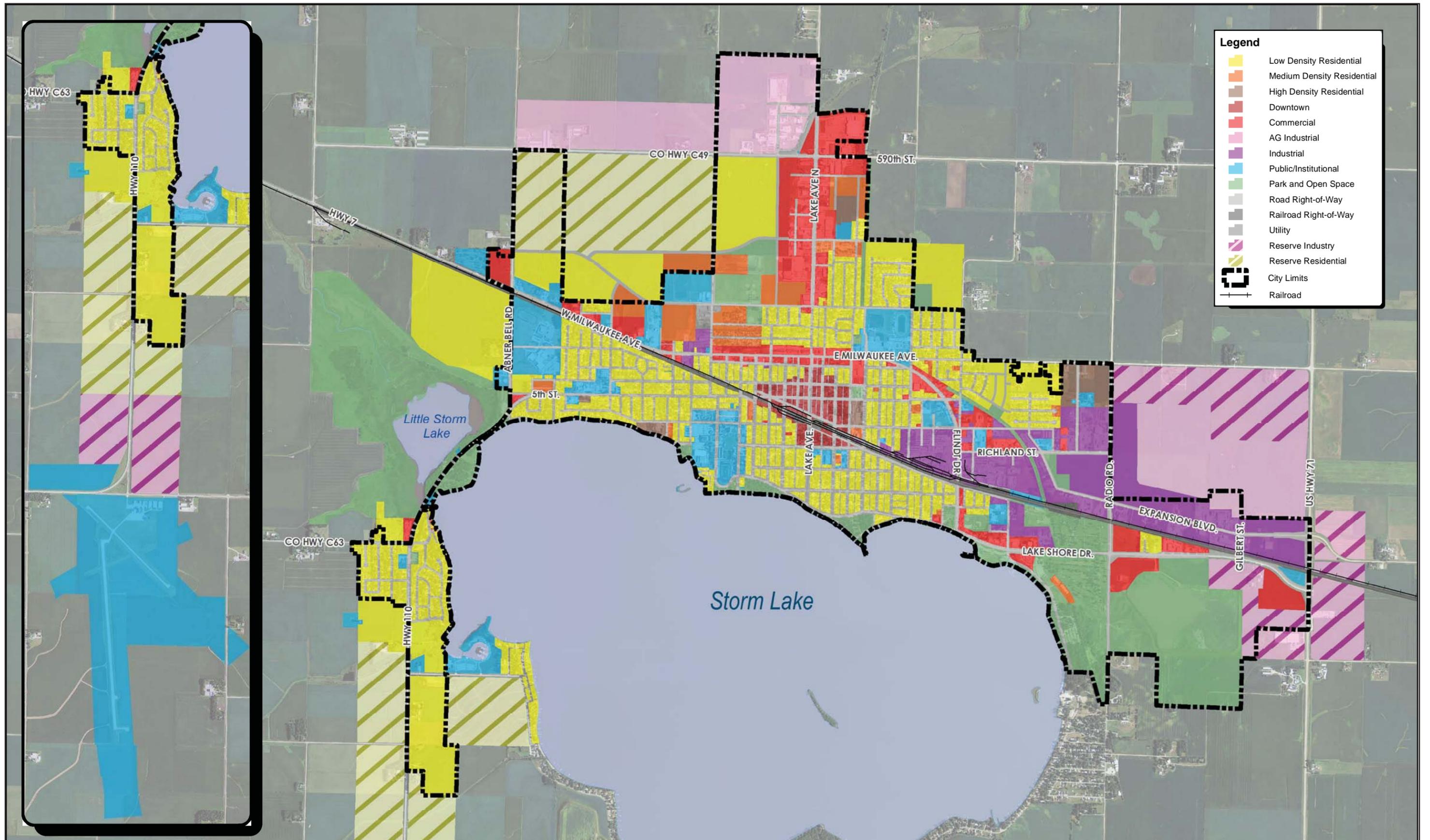
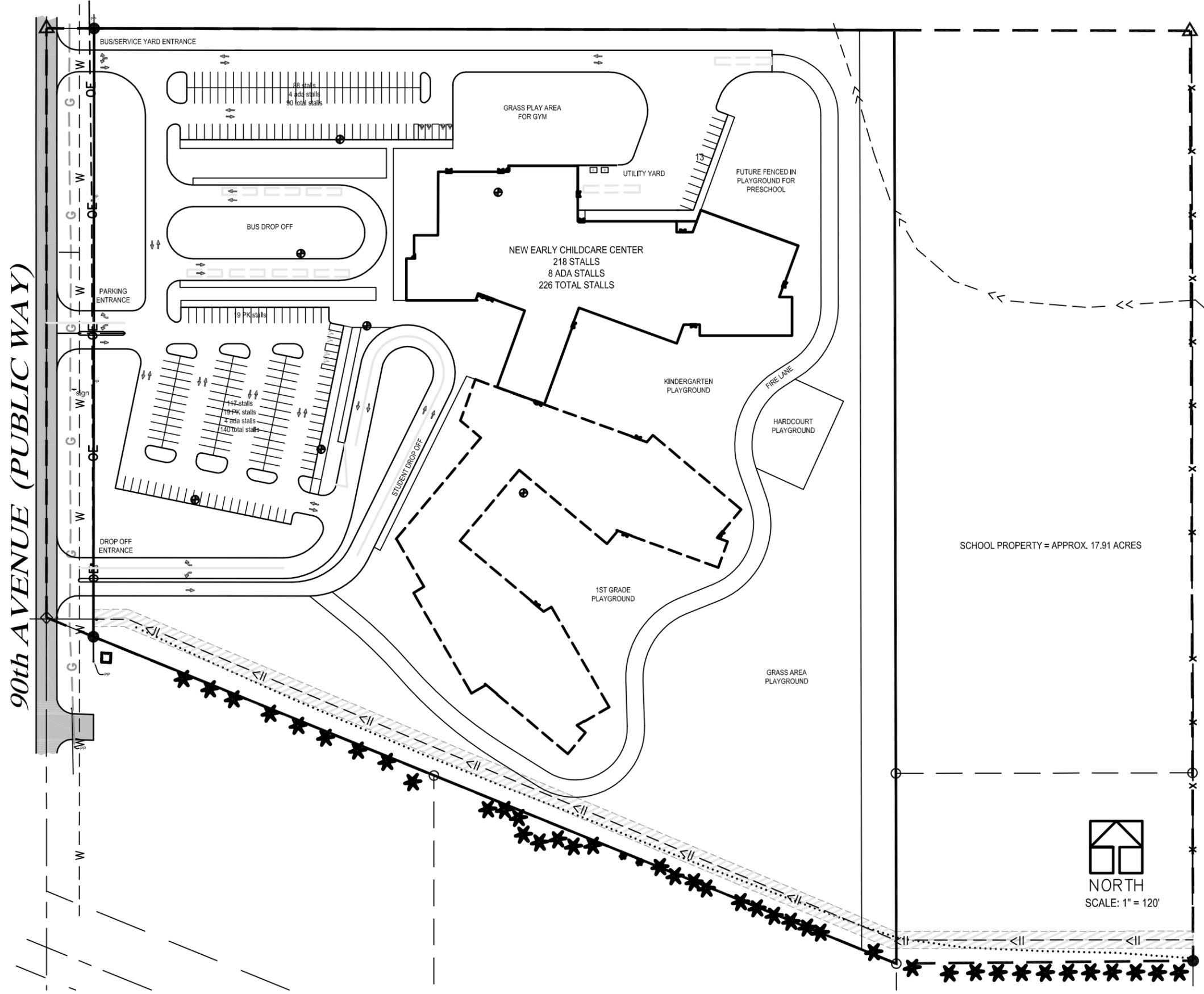


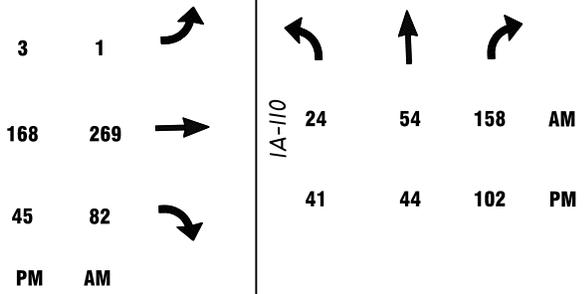
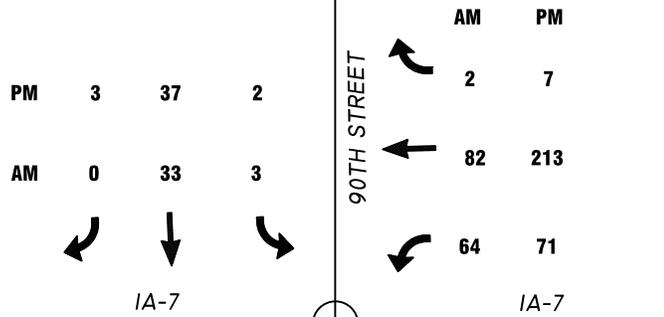
Figure 4-3 Future Land Use Map

Appendix C: Phase I Preliminary Plan

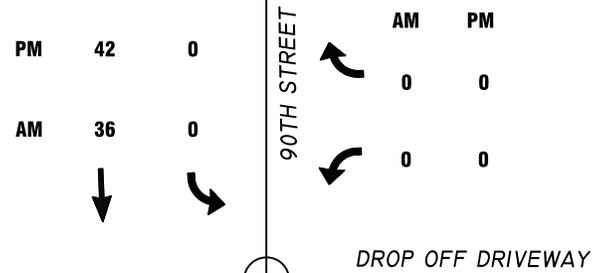
Appendix D: Full Build Conceptual Site Plan



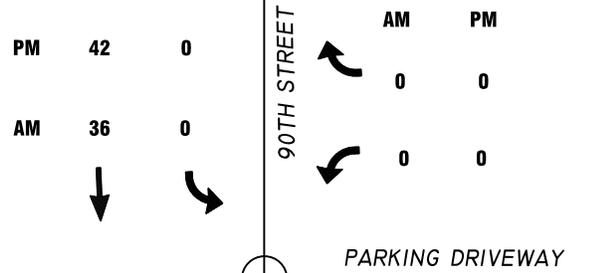
Appendix E: Existing Traffic Counts + Analysis Reports



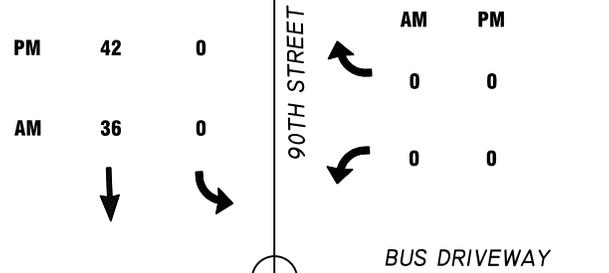
INTERSECTION #1 - IA-110/90TH ST & IA-7



INTERSECTION #2 - 90TH ST & DROP OFF DRIVEWAY



INTERSECTION #3 - 90TH ST & PARKING DRIVEWAY



INTERSECTION #4 - 90TH ST & BUS DRIVEWAY

EXISTING (2018)



Queuing and Blocking Report

Baseline

10/17/2018

Intersection: 1: IA-110/90th St & IA-7

Movement	EB	EB	WB	NB	NB	SB
Directions Served	LT	R	LTR	LT	R	LT
Maximum Queue (ft)	3	7	43	108	70	40
Average Queue (ft)	1	1	14	46	30	15
95th Queue (ft)	7	7	45	97	80	42
Link Distance (ft)	938		933	654		371
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)		400			50	
Storage Blk Time (%)				3	0	4
Queuing Penalty (veh)				4	0	0

Intersection

Int Delay, s/veh 7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Traffic Vol, veh/h	1	269	82	64	82	2	24	54	158	3	33	0
Future Vol, veh/h	1	269	82	64	82	2	24	54	158	3	33	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	76	60	76	93	25	46	68	75	38	63	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	354	137	84	88	8	52	79	211	8	52	0

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	96	0	0	491
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.12
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.218
Pot Cap-1 Maneuver	1498	-	-	1072
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1498	-	-	1072
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	4	16.2	21.2
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	342	690	1498	-	-	1072	-	-	282	-
HCM Lane V/C Ratio	0.385	0.305	0.003	-	-	0.079	-	-	0.214	-
HCM Control Delay (s)	22	12.5	7.4	0	-	8.6	0	-	21.2	0
HCM Lane LOS	C	B	A	A	-	A	A	-	C	A
HCM 95th %tile Q(veh)	1.8	1.3	0	-	-	0.3	-	-	0.8	-

Queuing and Blocking Report
Existing PM

10/17/2018

Intersection: 1: IA-110/90th St & IA-7

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	4	37	84	67	51	23
Average Queue (ft)	0	13	42	17	24	5
95th Queue (ft)	5	38	79	63	49	24
Link Distance (ft)	938	933	654		371	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				50		25
Storage Blk Time (%)			2	0	6	0
Queuing Penalty (veh)			2	0	0	0

Intersection

Int Delay, s/veh 6.9

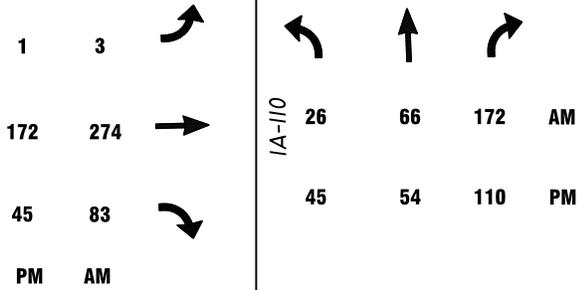
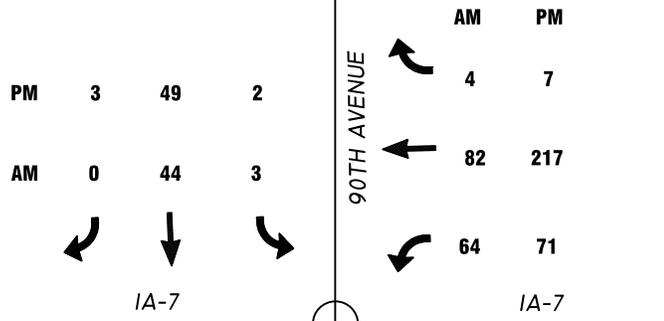
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕			↕	↕		↕	↕
Traffic Vol, veh/h	1	168	45	71	213	7	41	44	102	2	37	3
Future Vol, veh/h	1	168	45	71	213	7	41	44	102	2	37	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	87	66	87	58	93	65	51	25	71	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	215	52	108	245	12	44	68	200	8	52	4

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	257	0	0	267
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.12
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.218
Pot Cap-1 Maneuver	1308	-	-	1297
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1308	-	-	1297
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

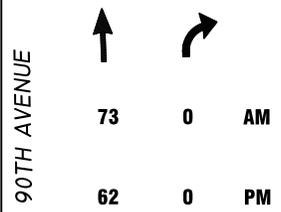
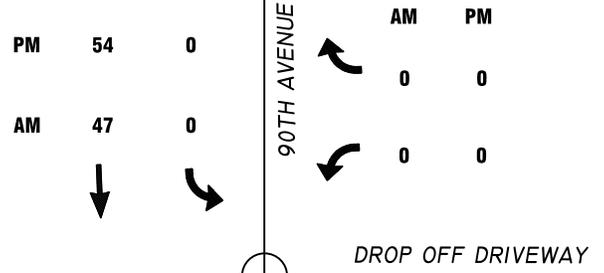
Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	2.4	15.4	20.2
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	305	825	1308	-	-	1297	-	-	286	788
HCM Lane V/C Ratio	0.366	0.242	0.003	-	-	0.083	-	-	0.21	0.005
HCM Control Delay (s)	23.5	10.8	7.8	0	-	8	0	-	20.9	9.6
HCM Lane LOS	C	B	A	A	-	A	A	-	C	A
HCM 95th %tile Q(veh)	1.6	0.9	0	-	-	0.3	-	-	0.8	0

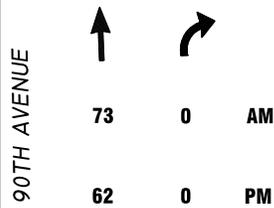
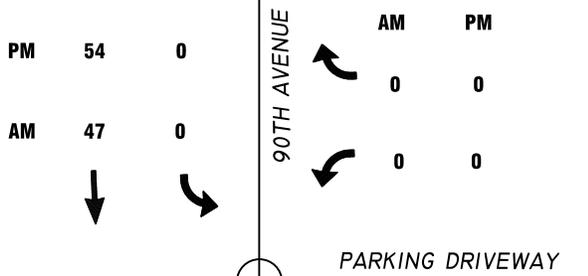
Appendix F: Baseline (2020) – Traffic Volumes + Analysis Reports



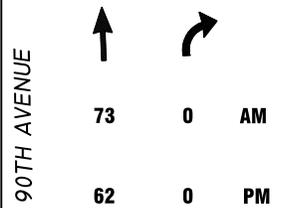
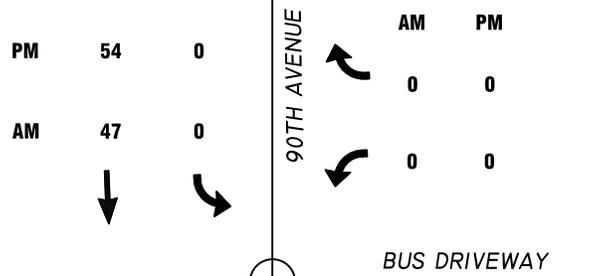
INTERSECTION #1 - IA-110/90TH AVE & IA-7



INTERSECTION #2 - 90TH AVE & DROP OFF DRIVEWAY



INTERSECTION #3 - 90TH AVE & PARKING DRIVEWAY



INTERSECTION #4 - 90TH AVE & BUS DRIVEWAY

BASELINE (2020)

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB
Directions Served	LT	R	LTR	LT	R	LT
Maximum Queue (ft)	3	3	40	95	67	50
Average Queue (ft)	0	0	16	49	20	20
95th Queue (ft)	5	5	42	92	64	50
Link Distance (ft)	938		933	654		371
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)		400			50	
Storage Blk Time (%)				5	0	5
Queuing Penalty (veh)				8	0	0

Intersection												
Int Delay, s/veh	8.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↖	↗		↖	↗
Traffic Vol, veh/h	3	274	83	64	82	4	26	66	172	3	44	0
Future Vol, veh/h	3	274	83	64	82	4	26	66	172	3	44	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	38	76	59	76	93	33	46	69	74	38	65	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	361	141	84	88	12	57	96	232	8	68	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	100	0	0	502	0	0	673	645	361	758	780	94
Stage 1	-	-	-	-	-	-	377	377	-	262	262	-
Stage 2	-	-	-	-	-	-	296	268	-	496	518	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1493	-	-	1062	-	-	369	391	684	324	327	963
Stage 1	-	-	-	-	-	-	644	616	-	743	691	-
Stage 2	-	-	-	-	-	-	712	687	-	556	533	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1493	-	-	1062	-	-	284	355	684	158	297	963
Mov Cap-2 Maneuver	-	-	-	-	-	-	284	355	-	158	297	-
Stage 1	-	-	-	-	-	-	639	611	-	737	633	-
Stage 2	-	-	-	-	-	-	582	629	-	307	529	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	4	17.9	23.3
HCM LOS			C	C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	325	684	1493	-	-	1062	-	-	272	-
HCM Lane V/C Ratio	0.468	0.34	0.005	-	-	0.079	-	-	0.278	-
HCM Control Delay (s)	25.5	12.9	7.4	0	-	8.7	0	-	23.3	0
HCM Lane LOS	D	B	A	A	-	A	A	-	C	A
HCM 95th %tile Q(veh)	2.4	1.5	0	-	-	0.3	-	-	1.1	-

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	73	0	0	47
Future Vol, veh/h	0	0	73	0	0	47
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	76	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	96	0	0	72

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	168	96	0	0	96	0
Stage 1	96	-	-	-	-	-
Stage 2	72	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	822	960	-	-	1498	-
Stage 1	928	-	-	-	-	-
Stage 2	951	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	822	960	-	-	1498	-
Mov Cap-2 Maneuver	822	-	-	-	-	-
Stage 1	928	-	-	-	-	-
Stage 2	951	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1498	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	73	0	0	47
Future Vol, veh/h	0	0	73	0	0	47
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	76	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	96	0	0	72

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	168	96	0	0	96
Stage 1	96	-	-	-	-
Stage 2	72	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	822	960	-	-	1498
Stage 1	928	-	-	-	-
Stage 2	951	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	822	960	-	-	1498
Mov Cap-2 Maneuver	822	-	-	-	-
Stage 1	928	-	-	-	-
Stage 2	951	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1498	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	0	0	73	0	0	47
Future Vol, veh/h	0	0	73	0	0	47
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	76	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	96	0	0	72

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	168	96	0	0	96
Stage 1	96	-	-	-	-
Stage 2	72	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	822	960	-	-	1498
Stage 1	928	-	-	-	-
Stage 2	951	-	-	-	-
Platoon blocked, %					
Mov Cap-1 Maneuver	822	960	-	-	1498
Mov Cap-2 Maneuver	822	-	-	-	-
Stage 1	928	-	-	-	-
Stage 2	951	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	1498	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	3	48	80	65	53	17
Average Queue (ft)	0	14	46	20	26	2
95th Queue (ft)	5	44	79	66	50	16
Link Distance (ft)	938	933	654		371	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				50		25
Storage Blk Time (%)			3	0	7	0
Queuing Penalty (veh)			4	0	0	0

Intersection												
Int Delay, s/veh	7.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Traffic Vol, veh/h	1	172	45	71	217	7	45	54	110	2	49	3
Future Vol, veh/h	1	172	45	71	217	7	45	54	110	2	49	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	87	66	88	58	94	71	51	25	77	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	221	52	108	247	12	48	76	216	8	64	4

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	259	0	0	273	0	0	730	704	221	762	750	253
Stage 1	-	-	-	-	-	-	229	229	-	469	469	-
Stage 2	-	-	-	-	-	-	501	475	-	293	281	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1306	-	-	1290	-	-	338	361	819	322	340	786
Stage 1	-	-	-	-	-	-	774	715	-	575	561	-
Stage 2	-	-	-	-	-	-	552	557	-	715	678	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1306	-	-	1290	-	-	261	324	819	180	305	786
Mov Cap-2 Maneuver	-	-	-	-	-	-	261	324	-	180	305	-
Stage 1	-	-	-	-	-	-	771	712	-	573	506	-
Stage 2	-	-	-	-	-	-	433	502	-	469	675	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			2.4			16.3			21.3		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	296	819	1306	-	-	1290	-	-	283	786
HCM Lane V/C Ratio	0.419	0.263	0.003	-	-	0.083	-	-	0.253	0.005
HCM Control Delay (s)	25.6	11	7.8	0	-	8	0	-	22	9.6
HCM Lane LOS	D	B	A	A	-	A	A	-	C	A
HCM 95th %tile Q(veh)	2	1.1	0	-	-	0.3	-	-	1	0

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	62	0	0	54
Future Vol, veh/h	0	0	62	0	0	54
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	78	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	79	0	0	72

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	151	79	0	0	79	0
Stage 1	79	-	-	-	-	-
Stage 2	72	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	841	981	-	-	1519	-
Stage 1	944	-	-	-	-	-
Stage 2	951	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	841	981	-	-	1519	-
Mov Cap-2 Maneuver	841	-	-	-	-	-
Stage 1	944	-	-	-	-	-
Stage 2	951	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1519	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	62	0	0	54
Future Vol, veh/h	0	0	62	0	0	54
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	78	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	79	0	0	72

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	151	79	0	0	79	0
Stage 1	79	-	-	-	-	-
Stage 2	72	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	841	981	-	-	1519	-
Stage 1	944	-	-	-	-	-
Stage 2	951	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	841	981	-	-	1519	-
Mov Cap-2 Maneuver	841	-	-	-	-	-
Stage 1	944	-	-	-	-	-
Stage 2	951	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1519	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

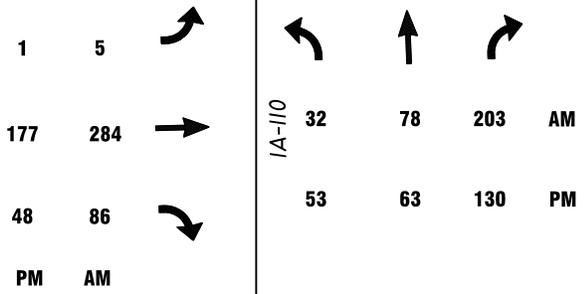
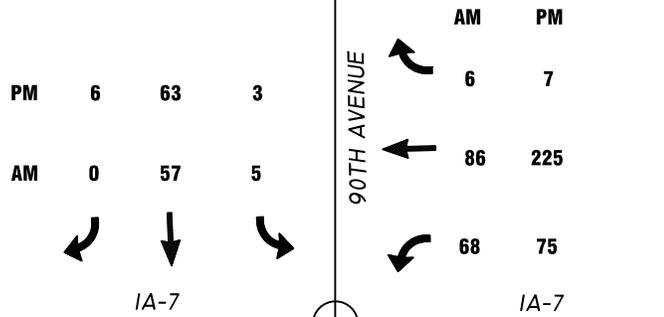
Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	0	0	62	0	0	54
Future Vol, veh/h	0	0	62	0	0	54
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	78	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	79	0	0	72

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	151	79	0	0	79	0
Stage 1	79	-	-	-	-	-
Stage 2	72	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	841	981	-	-	1519	-
Stage 1	944	-	-	-	-	-
Stage 2	951	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	841	981	-	-	1519	-
Mov Cap-2 Maneuver	841	-	-	-	-	-
Stage 1	944	-	-	-	-	-
Stage 2	951	-	-	-	-	-

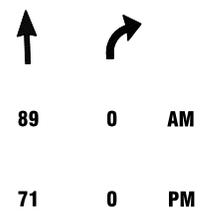
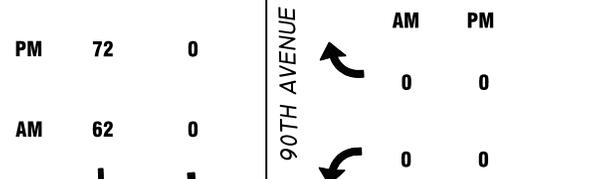
Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	1519	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

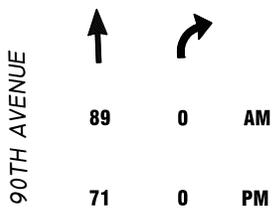
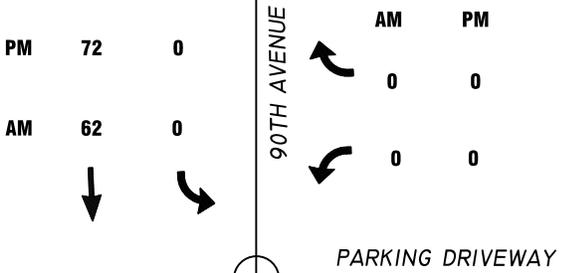
Appendix G: Baseline (2024) – Traffic Volumes + Analysis Reports



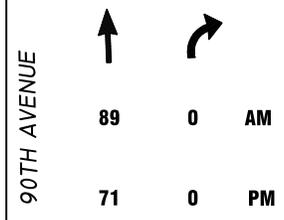
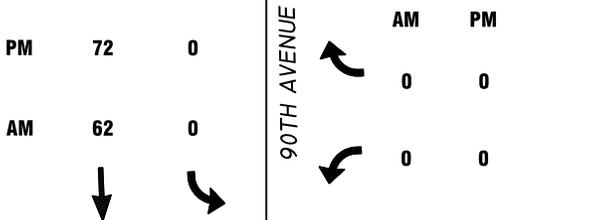
INTERSECTION #1 - IA-110/90TH AVE & IA-7



INTERSECTION #2 - 90TH AVE & DROP OFF DRIVEWAY



INTERSECTION #3 - 90TH AVE & PARKING DRIVEWAY



INTERSECTION #4 - 90TH AVE & BUS DRIVEWAY

BASELINE (2024)



Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB
Directions Served	LT	R	LTR	LT	R	LT
Maximum Queue (ft)	5	3	40	105	69	52
Average Queue (ft)	0	0	15	59	28	25
95th Queue (ft)	6	5	43	104	78	51
Link Distance (ft)	938		933	654		371
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)		400			50	
Storage Blk Time (%)				7	0	8
Queuing Penalty (veh)				15	0	0

Intersection												
Int Delay, s/veh	10.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Traffic Vol, veh/h	5	284	86	68	86	6	32	78	203	5	57	0
Future Vol, veh/h	5	284	86	68	86	6	32	78	203	5	57	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	63	76	60	77	93	50	47	70	75	42	65	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	374	143	88	92	12	68	111	271	12	88	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	104	0	0	517	0	0	708	670	374	791	807	98
Stage 1	-	-	-	-	-	-	390	390	-	274	274	-
Stage 2	-	-	-	-	-	-	318	280	-	517	533	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1488	-	-	1049	-	-	350	378	672	307	315	958
Stage 1	-	-	-	-	-	-	634	608	-	732	683	-
Stage 2	-	-	-	-	-	-	693	679	-	541	525	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1488	-	-	1049	-	-	248	342	672	127	285	958
Mov Cap-2 Maneuver	-	-	-	-	-	-	248	342	-	127	285	-
Stage 1	-	-	-	-	-	-	629	603	-	726	622	-
Stage 2	-	-	-	-	-	-	542	619	-	261	521	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			4			21.8			28.9		
HCM LOS							C			D		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	299	672	1488	-	-	1049	-	-	248	-
HCM Lane V/C Ratio	0.6	0.403	0.005	-	-	0.084	-	-	0.402	-
HCM Control Delay (s)	33.6	13.9	7.4	0	-	8.7	0	-	28.9	0
HCM Lane LOS	D	B	A	A	-	A	A	-	D	A
HCM 95th %tile Q(veh)	3.6	1.9	0	-	-	0.3	-	-	1.8	-

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↶	↷	↶			↷
Traffic Vol, veh/h	0	0	89	0	0	62
Future Vol, veh/h	0	0	89	0	0	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	120	0	0	95

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	215	120	0	0	120	0
Stage 1	120	-	-	-	-	-
Stage 2	95	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	773	931	-	-	1468	-
Stage 1	905	-	-	-	-	-
Stage 2	929	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	773	931	-	-	1468	-
Mov Cap-2 Maneuver	773	-	-	-	-	-
Stage 1	905	-	-	-	-	-
Stage 2	929	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1468
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	89	0	0	62
Future Vol, veh/h	0	0	89	0	0	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	120	0	0	95

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	215	120	0	0	120	0
Stage 1	120	-	-	-	-	-
Stage 2	95	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	773	931	-	-	1468	-
Stage 1	905	-	-	-	-	-
Stage 2	929	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	773	931	-	-	1468	-
Mov Cap-2 Maneuver	773	-	-	-	-	-
Stage 1	905	-	-	-	-	-
Stage 2	929	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1468
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	0	0	89	0	0	62
Future Vol, veh/h	0	0	89	0	0	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	120	0	0	95

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	215	120	0	0	120	0
Stage 1	120	-	-	-	-	-
Stage 2	95	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	773	931	-	-	1468	-
Stage 1	905	-	-	-	-	-
Stage 2	929	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	773	931	-	-	1468	-
Mov Cap-2 Maneuver	773	-	-	-	-	-
Stage 1	905	-	-	-	-	-
Stage 2	929	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	1468	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	3	3	67	103	65	43	36
Average Queue (ft)	0	0	20	50	21	29	7
95th Queue (ft)	5	5	58	102	69	47	30
Link Distance (ft)	938		933	654		371	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		400			50		25
Storage Blk Time (%)				6	0	11	0
Queuing Penalty (veh)				8	0	1	0

Intersection												
Int Delay, s/veh	9.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↖	↗		↖	↗
Traffic Vol, veh/h	1	177	48	75	225	7	53	63	130	3	63	6
Future Vol, veh/h	1	177	48	75	225	7	53	63	130	3	63	6
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	86	67	88	58	95	68	51	25	75	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	227	56	112	256	12	56	93	255	12	84	8

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	268	0	0	283	0	0	763	727	227	796	777	262
Stage 1	-	-	-	-	-	-	235	235	-	486	486	-
Stage 2	-	-	-	-	-	-	528	492	-	310	291	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1296	-	-	1279	-	-	321	351	812	305	328	777
Stage 1	-	-	-	-	-	-	768	710	-	563	551	-
Stage 2	-	-	-	-	-	-	534	548	-	700	672	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1296	-	-	1279	-	-	228	313	812	149	293	777
Mov Cap-2 Maneuver	-	-	-	-	-	-	228	313	-	149	293	-
Stage 1	-	-	-	-	-	-	765	707	-	561	494	-
Stage 2	-	-	-	-	-	-	393	492	-	416	669	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			2.4			19.1			25.3		
HCM LOS							C			D		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	275	812	1296	-	-	1279	-	-	261	777
HCM Lane V/C Ratio	0.54	0.314	0.003	-	-	0.088	-	-	0.368	0.01
HCM Control Delay (s)	32.4	11.4	7.8	0	-	8.1	0	-	26.6	9.7
HCM Lane LOS	D	B	A	A	-	A	A	-	D	A
HCM 95th %tile Q(veh)	3	1.3	0	-	-	0.3	-	-	1.6	0

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	71	0	0	72
Future Vol, veh/h	0	0	71	0	0	72
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	96	0	0	96

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	192	96	0	0	96	0
Stage 1	96	-	-	-	-	-
Stage 2	96	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	797	960	-	-	1498	-
Stage 1	928	-	-	-	-	-
Stage 2	928	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	797	960	-	-	1498	-
Mov Cap-2 Maneuver	797	-	-	-	-	-
Stage 1	928	-	-	-	-	-
Stage 2	928	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1498	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	71	0	0	72
Future Vol, veh/h	0	0	71	0	0	72
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	96	0	0	96

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	192	96	0	0	96	0
Stage 1	96	-	-	-	-	-
Stage 2	96	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	797	960	-	-	1498	-
Stage 1	928	-	-	-	-	-
Stage 2	928	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	797	960	-	-	1498	-
Mov Cap-2 Maneuver	797	-	-	-	-	-
Stage 1	928	-	-	-	-	-
Stage 2	928	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1498	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
4: 90th Ave & Bus Driveway

12/13/2018

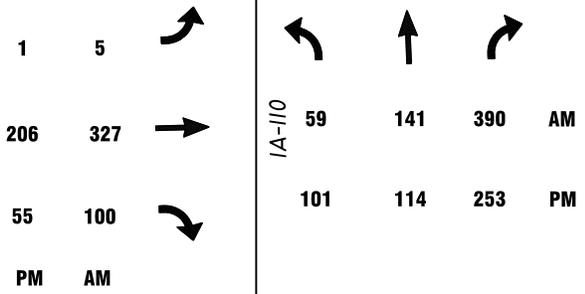
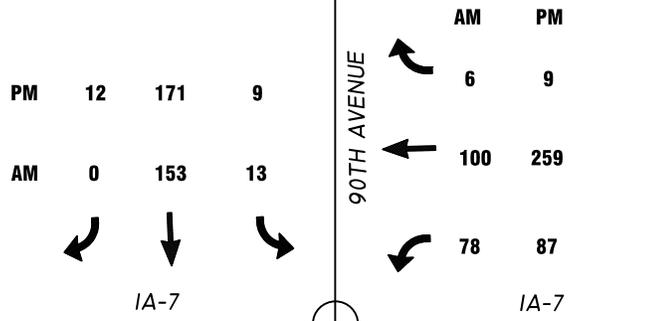
Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	71	0	0	72
Future Vol, veh/h	0	0	71	0	0	72
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	96	0	0	96

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	192	96	0	0	96
Stage 1	96	-	-	-	-
Stage 2	96	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	797	960	-	-	1498
Stage 1	928	-	-	-	-
Stage 2	928	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	797	960	-	-	1498
Mov Cap-2 Maneuver	797	-	-	-	-
Stage 1	928	-	-	-	-
Stage 2	928	-	-	-	-

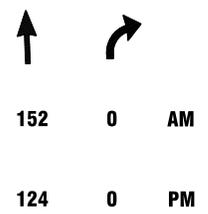
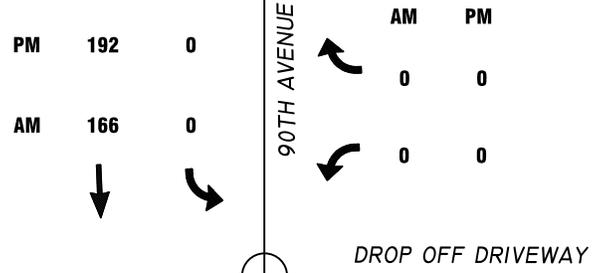
Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	1498
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

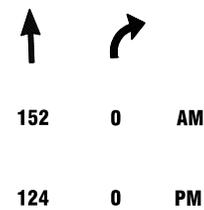
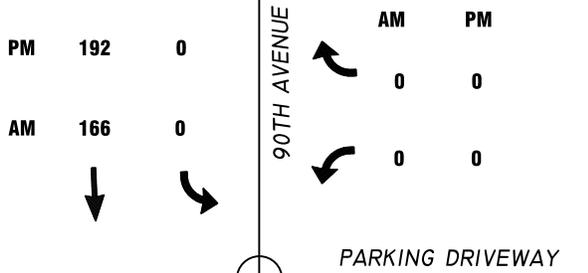
Appendix H: Baseline (2040) – Traffic Volumes + Analysis Reports



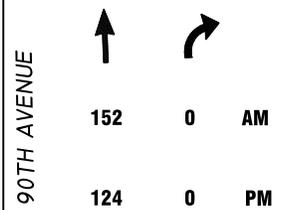
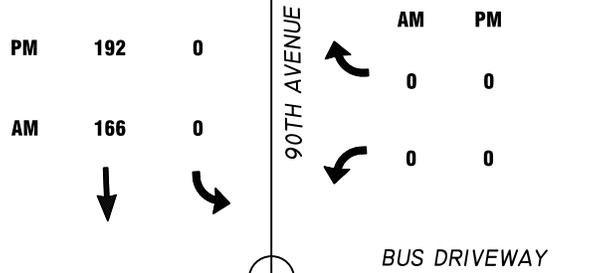
INTERSECTION #1 - IA-110/90TH AVE & IA-7



INTERSECTION #2 - 90TH AVE & DROP OFF DRIVEWAY



INTERSECTION #3 - 90TH AVE & PARKING DRIVEWAY



INTERSECTION #4 - 90TH AVE & BUS DRIVEWAY

BASELINE (2040)

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB
Directions Served	LT	R	LTR	LT	R	LT
Maximum Queue (ft)	8	10	48	354	75	96
Average Queue (ft)	1	1	20	200	64	50
95th Queue (ft)	8	8	48	410	101	88
Link Distance (ft)	938		933	654		371
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)		400			50	
Storage Blk Time (%)				30	1	37
Queuing Penalty (veh)				117	2	0

HCM 6th TWSC
1: IA-110/90th Ave & IA-7

12/13/2018

Intersection

Int Delay, s/veh 170.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Traffic Vol, veh/h	5	327	100	78	100	6	59	141	390	13	153	0
Future Vol, veh/h	5	327	100	78	100	6	59	141	390	13	153	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	63	76	61	75	93	50	46	69	74	36	64	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	8	430	164	104	108	12	128	204	527	36	239	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	120	0	0	594	0	0	888	774	430	952	932	114
Stage 1	-	-	-	-	-	-	446	446	-	322	322	-
Stage 2	-	-	-	-	-	-	442	328	-	630	610	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1468	-	-	982	-	-	264	329	625	239	266	939
Stage 1	-	-	-	-	-	-	591	574	-	690	651	-
Stage 2	-	-	-	-	-	-	594	647	-	470	485	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1468	-	-	982	-	-	289	625	~ 15	~ 234	939	
Mov Cap-2 Maneuver	-	-	-	-	-	-	289	-	~ 15	~ 234	-	
Stage 1	-	-	-	-	-	-	586	569	-	684	577	-
Stage 2	-	-	-	-	-	-	308	573	-	47	481	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	4.2		\$ 1208
HCM LOS			-	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	625	1468	-	-	982	-	-	80	-
HCM Lane V/C Ratio	-	0.843	0.005	-	-	0.106	-	-	3.44	-
HCM Control Delay (s)	-	34.1	7.5	0	-	9.1	0	-	\$ 1208	0
HCM Lane LOS	-	D	A	A	-	A	A	-	F	A
HCM 95th %tile Q(veh)	-	9.2	0	-	-	0.4	-	-	28.1	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↗	↖			↗
Traffic Vol, veh/h	0	0	152	0	0	166
Future Vol, veh/h	0	0	152	0	0	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	72	100	100	61
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	211	0	0	272

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	483	211	0	0	211	0
Stage 1	211	-	-	-	-	-
Stage 2	272	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	542	829	-	-	1360	-
Stage 1	824	-	-	-	-	-
Stage 2	774	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	542	829	-	-	1360	-
Mov Cap-2 Maneuver	542	-	-	-	-	-
Stage 1	824	-	-	-	-	-
Stage 2	774	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1360
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	152	0	0	166
Future Vol, veh/h	0	0	152	0	0	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	72	100	100	61
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	211	0	0	272

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	483	211	0	0	211	0
Stage 1	211	-	-	-	-	-
Stage 2	272	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	542	829	-	-	1360	-
Stage 1	824	-	-	-	-	-
Stage 2	774	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	542	829	-	-	1360	-
Mov Cap-2 Maneuver	542	-	-	-	-	-
Stage 1	824	-	-	-	-	-
Stage 2	774	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1360
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	0	0	152	0	0	166
Future Vol, veh/h	0	0	152	0	0	166
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	72	100	100	61
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	211	0	0	272

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	483	211	0	0	211	0
Stage 1	211	-	-	-	-	-
Stage 2	272	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	542	829	-	-	1360	-
Stage 1	824	-	-	-	-	-
Stage 2	774	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	542	829	-	-	1360	-
Mov Cap-2 Maneuver	542	-	-	-	-	-
Stage 1	824	-	-	-	-	-
Stage 2	774	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	1360	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	4	7	54	265	71	134	43
Average Queue (ft)	0	1	25	113	29	72	12
95th Queue (ft)	5	8	58	274	82	132	43
Link Distance (ft)	938		933	654		371	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		400			50		25
Storage Blk Time (%)				31	0	48	0
Queuing Penalty (veh)				79	1	6	0

HCM 6th TWSC
1: IA-110/90th Ave & IA-7

12/13/2018

Intersection

Int Delay, s/veh 614.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↖	↗		↖	↗
Traffic Vol, veh/h	1	206	55	87	259	9	101	114	253	9	171	12
Future Vol, veh/h	1	206	55	87	259	9	101	114	253	9	171	12
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	86	66	88	56	94	66	51	25	72	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	4	264	64	132	294	16	107	173	496	36	238	16

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	310	0	0	328
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.12
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.218
Pot Cap-1 Maneuver	1250	-	-	1232
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1250	-	-	1232
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	2.5	\$ 1269.2	\$ 498.6
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	34	775	1250	-	-	1232	-	-	137	738
HCM Lane V/C Ratio	8.24	0.64	0.003	-	-	0.107	-	-	1.996	0.022
HCM Control Delay (s)	\$ 3485.4	17.5	7.9	0	-	8.3	0	-	\$ 527.2	10
HCM Lane LOS	F	C	A	A	-	A	A	-	F	B
HCM 95th %tile Q(veh)	33.9	4.7	0	-	-	0.4	-	-	21.8	0.1

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th TWSC
 2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	124	0	0	192
Future Vol, veh/h	0	0	124	0	0	192
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	70	100	100	71
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	177	0	0	270

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	447	177	0	0	177	0
Stage 1	177	-	-	-	-	-
Stage 2	270	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	569	866	-	-	1399	-
Stage 1	854	-	-	-	-	-
Stage 2	775	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	569	866	-	-	1399	-
Mov Cap-2 Maneuver	569	-	-	-	-	-
Stage 1	854	-	-	-	-	-
Stage 2	775	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1399	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	124	0	0	192
Future Vol, veh/h	0	0	124	0	0	192
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	70	100	100	71
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	177	0	0	270

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	447	177	0	0	177	0
Stage 1	177	-	-	-	-	-
Stage 2	270	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	569	866	-	-	1399	-
Stage 1	854	-	-	-	-	-
Stage 2	775	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	569	866	-	-	1399	-
Mov Cap-2 Maneuver	569	-	-	-	-	-
Stage 1	854	-	-	-	-	-
Stage 2	775	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1399	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	0	-
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	0	0	124	0	0	192
Future Vol, veh/h	0	0	124	0	0	192
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	70	100	100	71
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	177	0	0	270

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	447	177	0	0	177	0
Stage 1	177	-	-	-	-	-
Stage 2	270	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	569	866	-	-	1399	-
Stage 1	854	-	-	-	-	-
Stage 2	775	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	569	866	-	-	1399	-
Mov Cap-2 Maneuver	569	-	-	-	-	-
Stage 1	854	-	-	-	-	-
Stage 2	775	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	1399
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	-	-	0	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	-	0

Appendix I: Detailed Trip Generation Notes

Early Childhood Education Center (Phase I)

	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	% Diverted Trips	% New Trips	# of Diverted Trips Entering	# of Diverted Trips Exiting	# of New Trips Entering	# of New Trips Exiting		
Weekday AM (AM Peak Hour of Generator)	142	61%	39%	86	56	35%	65%	25	25	61	31		
Weekday PM (PM Peak Hour of Generator)	94	34%	66%	32	62	28%	72%	13	13	19	49		

Early Childhood Education Center (Phase II)

	# of Generated Trips	% Entering	% Exiting	# of Generated Trips Entering	# of Generated Trips Exiting	% Diverted Trips	% New Trips	# of Diverted Trips Entering	# of Diverted Trips Exiting	# of New Trips Entering	# of New Trips Exiting		
Weekday AM (AM Peak Hour of Generator)	412	62%	38%	256	156	49%	51%	100	100	156	56		
Weekday PM (PM Peak Hour of Generator)	262	31%	69%	81	181	38%	62%	50	50	31	131		

Phase I New Trips

- 6 6 entering buses (buses that once only dropped off at the existing school must now also drop off at the new ECC)
- 6 6 exiting buses
- 30 30 new staff people
- 25 50% of 50 parents entering (assuming 50% the parents have additional children that need to be dropped off at the existing school).
- 25 50% 50 parents exiting
 - ** half as many pickups in the PM as drop offs in the AM due to after school programs

Diverted Trips

- 0 0 buses
- 0 0 entering staff (staff that once worked at the old complex now work here)
- 25 50% of 50 parents entering (assuming 50% of the parents that would've dropped off their child at the existing complex are instead dropping off their child)
- 25 50% of 50 parents exiting
 - ** half as many pickups in the PM as drop offs in the AM due to after school programs

Phase II New Trips

- 6 6 entering buses (buses that once only dropped off at the existing school must now also drop off at the new ECC)
- 6 6 exiting buses
- 100 100 entering staff (0 staff that once worked at the east side early childhood center now work here + 70 new staff)
- 50 33% of 600/4 parents entering (assuming 36% the parents have additional children that need to be dropped off at the existing school).
- 50 33% of 600/4 parents exiting
 - ** half as many pickups in the PM as drop offs in the AM due to after school programs

Diverted Trips

- 0 0 buses
- 0 0 entering staff (0 staff that once worked at the old complex now work here)
- 100 67% of 600/4 parents entering (assuming 63% of the parents that would've dropped off their child/children at the existing complex are instead dropping off their child/children)
- 100 67% of 600/4 parents exiting
 - ** half as many pickups in the PM as drop offs in the AM due to after school programs

Sample Population

# of children in family	Child 1	Child 2	Child 3	Child 4
1	4k			
1	k			
1	1			
1	4k			
1	k			
1	1			
2	4k	1		
2	age 3	k		
2	k	2		
2	4k	1		
2	age 3	k		
2	k	2		
3	k	2	4	
3	4k	1	3	
3	age 2	4k	1	
3	age 1	age 3	k	
4	k	2	4	6
4	age 2	4k	1	3

Each row is one family impacted by either Phase I or Phase II

Gray rows are families impacted by Phase I

Average family size = 2.2 children

Bold parent needs a 2nd drop off (4/9 in Phase I, 6/18 in Phase 2)

According to 2010 Census Data for Storm Lake, IA

3 person households - 12.1% of households

4 person households - 12.3% of households

5 person households - 7.9% of households

6 person households - 4.5% of households

other person households - 63.2

Appendix J: Detailed Trip Distribution Diagrams



PHASE I & II - NEW & DIVERTED PASSENGER VEHICLES







ALL PHASES - BUS DISTRIBUTION

Appendix K: Phase I (2020) – Traffic Volumes + Analysis Reports

Intersection: 1: IA-110/90th St & IA-7

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	31	35	91	66	55	36
Average Queue (ft)	6	13	47	26	30	17
95th Queue (ft)	26	39	83	72	55	45
Link Distance (ft)	938	933	654		371	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				50		25
Storage Blk Time (%)			4	0	14	0
Queuing Penalty (veh)			6	0	3	0

Intersection: 2: 90th St & Drop Off Driveway

Movement	WB	WB	SB
Directions Served	L	R	LT
Maximum Queue (ft)	60	31	10
Average Queue (ft)	30	8	1
95th Queue (ft)	62	31	11
Link Distance (ft)	235	235	232
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: 90th St & Parking Driveway

Movement	SB
Directions Served	LT
Maximum Queue (ft)	9
Average Queue (ft)	1
95th Queue (ft)	9
Link Distance (ft)	232
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 4: 90th St & Bus Driveway

Movement	WB
Directions Served	LR
Maximum Queue (ft)	20
Average Queue (ft)	5
95th Queue (ft)	23
Link Distance (ft)	203
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 9

Intersection												
Int Delay, s/veh	22.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↖	↗		↖	↗
Traffic Vol, veh/h	35	274	73	57	83	28	18	80	156	24	44	20
Future Vol, veh/h	35	274	73	57	83	28	18	80	156	24	44	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	38	76	59	76	93	33	46	69	74	38	65	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	361	124	75	89	85	39	116	211	63	68	20

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	174	0	0	485	0	0	861	869	361	947	951	132
Stage 1	-	-	-	-	-	-	545	545	-	282	282	-
Stage 2	-	-	-	-	-	-	316	324	-	665	669	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1403	-	-	1078	-	-	276	290	684	241	260	917
Stage 1	-	-	-	-	-	-	523	519	-	725	678	-
Stage 2	-	-	-	-	-	-	695	650	-	449	456	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1403	-	-	1078	-	-	181	243	684	93	218	917
Mov Cap-2 Maneuver	-	-	-	-	-	-	181	243	-	93	218	-
Stage 1	-	-	-	-	-	-	475	472	-	659	625	-
Stage 2	-	-	-	-	-	-	559	599	-	213	415	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	1.2			2.6			28.8			123.2		
HCM LOS							D			F		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	224	684	1403	-	-	1078	-	-	132	917
HCM Lane V/C Ratio	0.692	0.308	0.066	-	-	0.07	-	-	0.991	0.022
HCM Control Delay (s)	50.8	12.6	7.7	0	-	8.6	0	-	140.6	9
HCM Lane LOS	F	B	A	A	-	A	A	-	F	A
HCM 95th %tile Q(veh)	4.5	1.3	0.2	-	-	0.2	-	-	6.9	0.1

HCM 6th TWSC
2: 90th St & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	1.9					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	40	10	103	40	10	48
Future Vol, veh/h	40	10	103	40	10	48
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	76	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	40	10	136	40	10	74

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	250	156	0	0	176
Stage 1	156	-	-	-	-
Stage 2	94	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	739	890	-	-	1400
Stage 1	872	-	-	-	-
Stage 2	930	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	734	890	-	-	1400
Mov Cap-2 Maneuver	734	-	-	-	-
Stage 1	866	-	-	-	-
Stage 2	930	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10	0	0.9
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	734	890	1400
HCM Lane V/C Ratio	-	-	0.054	0.011	0.007
HCM Control Delay (s)	-	-	10.2	9.1	7.6
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.2	0	0

Intersection						
Int Delay, s/veh	0.2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	89	24	6	58
Future Vol, veh/h	0	0	89	24	6	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	76	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	117	24	6	89

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	230	129	0	0	141
Stage 1	129	-	-	-	-
Stage 2	101	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	758	921	-	-	1442
Stage 1	897	-	-	-	-
Stage 2	923	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	755	921	-	-	1442
Mov Cap-2 Maneuver	755	-	-	-	-
Stage 1	893	-	-	-	-
Stage 2	923	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0.5
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1442	-
HCM Lane V/C Ratio	-	-	-	0.004	-
HCM Control Delay (s)	-	-	0	0	7.5
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection						
Int Delay, s/veh	0.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	6	0	83	6	0	58
Future Vol, veh/h	6	0	83	6	0	58
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	76	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	109	6	0	89

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	201	112	0	0	115	0
Stage 1	112	-	-	-	-	-
Stage 2	89	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	788	941	-	-	1474	-
Stage 1	913	-	-	-	-	-
Stage 2	934	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	788	941	-	-	1474	-
Mov Cap-2 Maneuver	788	-	-	-	-	-
Stage 1	913	-	-	-	-	-
Stage 2	934	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.6	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	788	1474
HCM Lane V/C Ratio	-	-	0.008	-
HCM Control Delay (s)	-	-	9.6	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

Queuing and Blocking Report
Phase I PM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	16	31	73	60	61	49
Average Queue (ft)	3	11	39	12	32	23
95th Queue (ft)	15	32	69	51	53	56
Link Distance (ft)	938	933	654		371	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				50		25
Storage Blk Time (%)			2	0	11	0
Queuing Penalty (veh)			3	0	3	0

Intersection: 2: 90th Ave & Drop Off Driveway

Movement	WB	WB	SB
Directions Served	L	R	LT
Maximum Queue (ft)	35	25	5
Average Queue (ft)	18	5	0
95th Queue (ft)	44	24	7
Link Distance (ft)	235	235	232
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: 90th Ave & Parking Driveway

Movement	WB	WB
Directions Served	L	R
Maximum Queue (ft)	54	30
Average Queue (ft)	23	8
95th Queue (ft)	53	30
Link Distance (ft)	221	221
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: 90th Ave/90th St & Bus Driveway

Movement	WB
Directions Served	LR
Maximum Queue (ft)	30
Average Queue (ft)	5
95th Queue (ft)	24
Link Distance (ft)	203
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 6

Intersection												
Int Delay, s/veh	17.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Traffic Vol, veh/h	9	171	42	61	217	23	41	57	106	24	57	27
Future Vol, veh/h	9	171	42	61	217	23	41	57	106	24	57	27
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	87	66	88	58	94	71	51	25	77	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	36	219	48	92	247	40	44	80	208	96	74	36

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	287	0	0	267	0	0	779	762	219	806	790	267
Stage 1	-	-	-	-	-	-	291	291	-	451	451	-
Stage 2	-	-	-	-	-	-	488	471	-	355	339	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1275	-	-	1297	-	-	313	335	821	300	322	772
Stage 1	-	-	-	-	-	-	717	672	-	588	571	-
Stage 2	-	-	-	-	-	-	561	560	-	662	640	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1275	-	-	1297	-	-	218	296	821	162	285	772
Mov Cap-2 Maneuver	-	-	-	-	-	-	218	296	-	162	285	-
Stage 1	-	-	-	-	-	-	693	650	-	569	522	-
Stage 2	-	-	-	-	-	-	420	512	-	419	619	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.9			1.9			18.1			67.7		
HCM LOS							C			F		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	263	821	1275	-	-	1297	-	-	199	772
HCM Lane V/C Ratio	0.471	0.253	0.028	-	-	0.071	-	-	0.854	0.047
HCM Control Delay (s)	30.3	10.9	7.9	0	-	8	0	-	79.9	9.9
HCM Lane LOS	D	B	A	A	-	A	A	-	F	A
HCM 95th %tile Q(veh)	2.4	1	0.1	-	-	0.2	-	-	6.4	0.1

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	1.1					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	21	5	68	21	5	87
Future Vol, veh/h	21	5	68	21	5	87
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	78	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	21	5	87	21	5	116

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	224	98	0	0	108
Stage 1	98	-	-	-	-
Stage 2	126	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	764	958	-	-	1483
Stage 1	926	-	-	-	-
Stage 2	900	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	761	958	-	-	1483
Mov Cap-2 Maneuver	761	-	-	-	-
Stage 1	922	-	-	-	-
Stage 2	900	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.7	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	761	958	1483	-
HCM Lane V/C Ratio	-	-	0.028	0.005	0.003	-
HCM Control Delay (s)	-	-	9.9	8.8	7.4	0
HCM Lane LOS	-	-	A	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	0	-

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	1.7					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	31	6	73	0	0	61
Future Vol, veh/h	31	6	73	0	0	61
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	78	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	31	6	94	0	0	81

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	175	94	0	0	94	0
Stage 1	94	-	-	-	-	-
Stage 2	81	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	815	963	-	-	1500	-
Stage 1	930	-	-	-	-	-
Stage 2	942	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	815	963	-	-	1500	-
Mov Cap-2 Maneuver	815	-	-	-	-	-
Stage 1	930	-	-	-	-	-
Stage 2	942	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.5	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	815	963	1500
HCM Lane V/C Ratio	-	-	0.038	0.006	-
HCM Control Delay (s)	-	-	9.6	8.8	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	0

Intersection						
Int Delay, s/veh	0.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	6	0	67	6	0	55
Future Vol, veh/h	6	0	67	6	0	55
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	78	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	86	6	0	73

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	162	89	0	0	92
Stage 1	89	-	-	-	-
Stage 2	73	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	829	969	-	-	1503
Stage 1	934	-	-	-	-
Stage 2	950	-	-	-	-
Platoon blocked, %					
Mov Cap-1 Maneuver	829	969	-	-	1503
Mov Cap-2 Maneuver	829	-	-	-	-
Stage 1	934	-	-	-	-
Stage 2	950	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.4	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	829	1503
HCM Lane V/C Ratio	-	-	0.007	-
HCM Control Delay (s)	-	-	9.4	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

Appendix L: Phase II (2024) – Traffic Volumes + Analysis Reports

Queuing and Blocking Report
Phase II AM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	NB	SB	SB
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	58	42	93	40	92	52
Average Queue (ft)	16	11	59	15	46	34
95th Queue (ft)	49	38	103	55	86	60
Link Distance (ft)	938	933	654		371	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				50		25
Storage Blk Time (%)			12	0	30	1
Queuing Penalty (veh)			19	0	18	1

Intersection: 2: 90th Ave & Drop Off Driveway

Movement	WB	WB	NB	SB
Directions Served	L	R	TR	LT
Maximum Queue (ft)	61	38	3	36
Average Queue (ft)	39	22	0	9
95th Queue (ft)	59	46	4	34
Link Distance (ft)	235	235	371	232
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: 90th Ave & Parking Driveway

Movement	SB
Directions Served	LT
Maximum Queue (ft)	8
Average Queue (ft)	1
95th Queue (ft)	8
Link Distance (ft)	232
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 4: 90th Ave/90th St & Bus Driveway

Movement	WB
Directions Served	LR
Maximum Queue (ft)	30
Average Queue (ft)	6
95th Queue (ft)	26
Link Distance (ft)	203
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 38

Intersection

Int Delay, s/veh 294.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Traffic Vol, veh/h	105	284	47	38	87	81	1	108	156	56	51	60
Future Vol, veh/h	105	284	47	38	87	81	1	108	156	56	51	60
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	63	76	60	77	93	50	47	70	75	42	65	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	167	374	78	49	94	162	2	154	208	133	78	60

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	256	0	0	452
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.12
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.218
Pot Cap-1 Maneuver	1309	-	-	1109
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1309	-	-	1109
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.2	1.4	49	\$ 1615.6
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	174	672	1309	-	-	1109	-	-	41	868
HCM Lane V/C Ratio	0.899	0.31	0.127	-	-	0.045	-	-	5.166	0.069
HCM Control Delay (s)	97.2	12.7	8.2	0	-	8.4	0	\$ 2070.6	9.5	
HCM Lane LOS	F	B	A	A	-	A	A	-	F	A
HCM 95th %tile Q(veh)	6.6	1.3	0.4	-	-	0.1	-	-	24.6	0.2

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	3.5					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	120	30	174	120	30	47
Future Vol, veh/h	120	30	174	120	30	47
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	120	30	235	120	30	72

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	427	295	0	0	355
Stage 1	295	-	-	-	-
Stage 2	132	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	584	744	-	-	1204
Stage 1	755	-	-	-	-
Stage 2	894	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	569	744	-	-	1204
Mov Cap-2 Maneuver	569	-	-	-	-
Stage 1	735	-	-	-	-
Stage 2	894	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.4	0	2.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	569	744	1204
HCM Lane V/C Ratio	-	-	0.211	0.04	0.025
HCM Control Delay (s)	-	-	13	10	8.1
HCM Lane LOS	-	-	B	B	A
HCM 95th %tile Q(veh)	-	-	0.8	0.1	0.1

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0.4					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	124	80	20	77
Future Vol, veh/h	0	0	124	80	20	77
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	168	80	20	118

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	366	208	0	0	248
Stage 1	208	-	-	-	-
Stage 2	158	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	634	832	-	-	1318
Stage 1	827	-	-	-	-
Stage 2	871	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	624	832	-	-	1318
Mov Cap-2 Maneuver	624	-	-	-	-
Stage 1	814	-	-	-	-
Stage 2	871	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	1.1
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1318	-
HCM Lane V/C Ratio	-	-	-	0.015	-
HCM Control Delay (s)	-	-	0	0	7.8
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0	-

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0.2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	6	0	118	6	0	91
Future Vol, veh/h	6	0	118	6	0	91
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	65
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	159	6	0	140

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	302	162	0	0	165
Stage 1	162	-	-	-	-
Stage 2	140	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	690	883	-	-	1413
Stage 1	867	-	-	-	-
Stage 2	887	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	690	883	-	-	1413
Mov Cap-2 Maneuver	690	-	-	-	-
Stage 1	867	-	-	-	-
Stage 2	887	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.3	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	690	1413
HCM Lane V/C Ratio	-	-	0.009	-
HCM Control Delay (s)	-	-	10.3	0
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0	0

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	38	6	35	92	66	97	60
Average Queue (ft)	9	1	6	49	20	46	38
95th Queue (ft)	32	6	27	86	64	88	60
Link Distance (ft)	938		933	654		371	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		400			50		25
Storage Blk Time (%)				6	0	24	1
Queuing Penalty (veh)				7	0	16	1

Intersection: 2: 90th Ave & Drop Off Driveway

Movement	WB	WB	NB	SB
Directions Served	L	R	TR	LT
Maximum Queue (ft)	54	31	3	16
Average Queue (ft)	32	9	0	2
95th Queue (ft)	58	32	4	15
Link Distance (ft)	235	235	371	232
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: 90th Ave & Parking Driveway

Movement	WB	WB
Directions Served	L	R
Maximum Queue (ft)	65	35
Average Queue (ft)	34	16
95th Queue (ft)	61	42
Link Distance (ft)	221	221
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: 90th Ave & Bus Driveway

Movement	WB
Directions Served	LR
Maximum Queue (ft)	20
Average Queue (ft)	5
95th Queue (ft)	23
Link Distance (ft)	203
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 24

Intersection												
Int Delay, s/veh	263.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↖	↗		↖	↗
Traffic Vol, veh/h	24	177	32	49	225	43	37	70	111	73	76	65
Future Vol, veh/h	24	177	32	49	225	43	37	70	111	73	76	65
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	86	67	88	58	95	68	51	25	75	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	96	227	37	73	256	74	39	103	218	292	101	87

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	330	0	0	264	0	0	909	895	227	928	895	293
Stage 1	-	-	-	-	-	-	419	419	-	439	439	-
Stage 2	-	-	-	-	-	-	490	476	-	489	456	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1229	-	-	1300	-	-	256	280	812	~ 248	280	746
Stage 1	-	-	-	-	-	-	612	590	-	597	578	-
Stage 2	-	-	-	-	-	-	560	557	-	561	568	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1229	-	-	1300	-	-	134	237	812	~ 107	237	746
Mov Cap-2 Maneuver	-	-	-	-	-	-	134	237	-	~ 107	237	-
Stage 1	-	-	-	-	-	-	556	536	-	542	538	-
Stage 2	-	-	-	-	-	-	374	519	-	301	516	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	2.2			1.4			30.5			\$ 854.4		
HCM LOS							D			F		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	196	812	1229	-	-	1300	-	-	125	746
HCM Lane V/C Ratio	0.724	0.268	0.078	-	-	0.056	-	-	3.147	0.116
HCM Control Delay (s)	60.5	11	8.2	0	-	7.9	0	\$ 1040.3	10.5	
HCM Lane LOS	F	B	A	A	-	A	A	-	F	B
HCM 95th %tile Q(veh)	4.7	1.1	0.3	-	-	0.2	-	-	37.5	0.4

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	61	15	76	61	15	153
Future Vol, veh/h	61	15	76	61	15	153
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	61	15	103	61	15	204

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	368	134	0	0	164
Stage 1	134	-	-	-	-
Stage 2	234	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	632	915	-	-	1414
Stage 1	892	-	-	-	-
Stage 2	805	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	624	915	-	-	1414
Mov Cap-2 Maneuver	624	-	-	-	-
Stage 1	881	-	-	-	-
Stage 2	805	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.9	0	0.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	624	915	1414
HCM Lane V/C Ratio	-	-	0.098	0.016	0.011
HCM Control Delay (s)	-	-	11.4	9	7.6
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.3	0.1	0

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	3.2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	87	20	91	0	0	81
Future Vol, veh/h	87	20	91	0	0	81
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	87	20	123	0	0	108

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	231	123	0	0	123	0
Stage 1	123	-	-	-	-	-
Stage 2	108	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	757	928	-	-	1464	-
Stage 1	902	-	-	-	-	-
Stage 2	916	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	757	928	-	-	1464	-
Mov Cap-2 Maneuver	757	-	-	-	-	-
Stage 1	902	-	-	-	-	-
Stage 2	916	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.1	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	757	928	1464	-
HCM Lane V/C Ratio	-	-	0.115	0.022	-	-
HCM Control Delay (s)	-	-	10.4	9	0	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	0.4	0.1	0	-

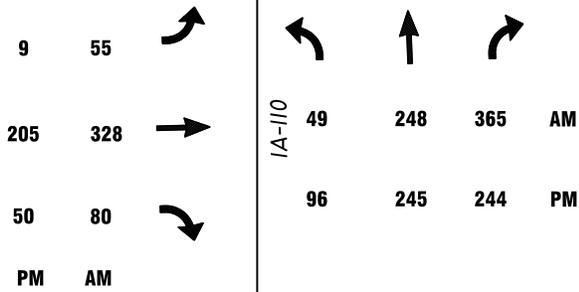
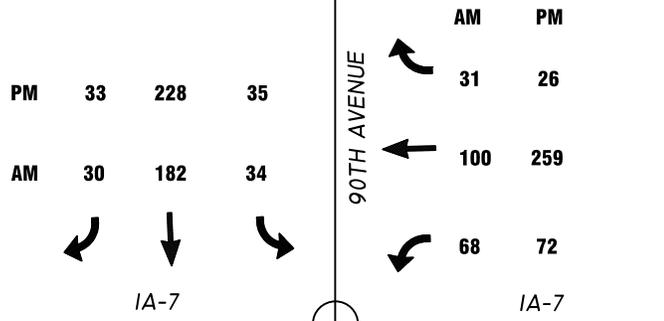
Intersection						
Int Delay, s/veh	0.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	6	0	85	6	0	75
Future Vol, veh/h	6	0	85	6	0	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	74	100	100	75
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	115	6	0	100

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	218	118	0	0	121	0
Stage 1	118	-	-	-	-	-
Stage 2	100	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	770	934	-	-	1467	-
Stage 1	907	-	-	-	-	-
Stage 2	924	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	770	934	-	-	1467	-
Mov Cap-2 Maneuver	770	-	-	-	-	-
Stage 1	907	-	-	-	-	-
Stage 2	924	-	-	-	-	-

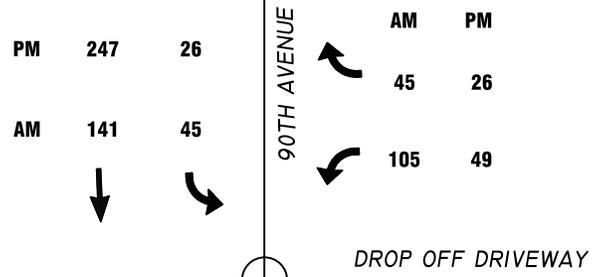
Approach	WB	NB	SB
HCM Control Delay, s	9.7	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	770	1467
HCM Lane V/C Ratio	-	-	0.008	-
HCM Control Delay (s)	-	-	9.7	0
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0	0

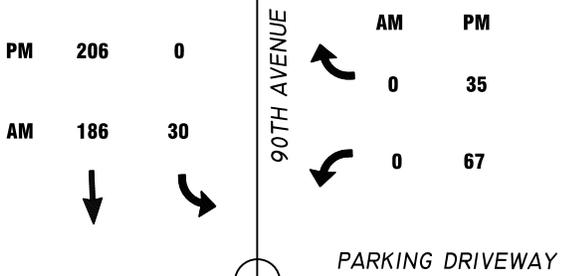
Appendix M: Build (2040) – Traffic Volumes + Analysis Reports



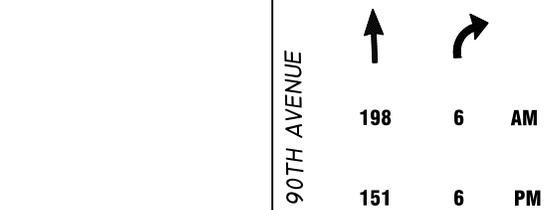
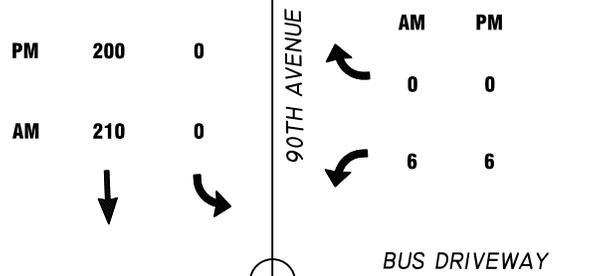
INTERSECTION #1 - IA-110/90TH AVE & IA-7



INTERSECTION #2 - 90TH AVE & DROP OFF DRIVEWAY



INTERSECTION #3 - 90TH AVE & PARKING DRIVEWAY



INTERSECTION #4 - 90TH AVE & BUS DRIVEWAY

BUILD (2040)

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	48	10	58	512	75	148	48
Average Queue (ft)	13	1	23	359	64	82	25
95th Queue (ft)	45	8	56	724	102	150	57
Link Distance (ft)	938		933	654		371	
Upstream Blk Time (%)				14			
Queuing Penalty (veh)				0			
Storage Bay Dist (ft)		400			50		25
Storage Blk Time (%)				57	1	56	0
Queuing Penalty (veh)				207	4	17	1

Intersection: 2: 90th Ave & Drop Off Driveway

Movement	WB	WB	NB	SB
Directions Served	L	R	TR	LT
Maximum Queue (ft)	63	56	4	38
Average Queue (ft)	38	28	0	10
95th Queue (ft)	64	55	5	37
Link Distance (ft)	235	235	371	232
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 3: 90th Ave & Parking Driveway

Movement	SB
Directions Served	LT
Maximum Queue (ft)	31
Average Queue (ft)	5
95th Queue (ft)	24
Link Distance (ft)	232
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 4: 90th Ave/90th St & Bus Driveway

Movement	WB
Directions Served	LR
Maximum Queue (ft)	30
Average Queue (ft)	5
95th Queue (ft)	22
Link Distance (ft)	203
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 229

Intersection

Int Delay, s/veh 0.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕			↕	↕		↕	↕
Traffic Vol, veh/h	55	328	80	68	100	31	49	248	365	34	182	30
Future Vol, veh/h	55	328	80	68	100	31	49	248	365	34	182	30
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	63	76	61	75	93	50	46	69	74	36	64	100
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	87	432	131	91	108	62	107	359	493	94	284	30

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	170	0	0	563
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Critical Hdwy	4.12	-	-	4.12
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-
Follow-up Hdwy	2.218	-	-	2.218
Pot Cap-1 Maneuver	1407	-	-	1008
Stage 1	-	-	-	-
Stage 2	-	-	-	-
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1407	-	-	1008
Mov Cap-2 Maneuver	-	-	-	-
Stage 1	-	-	-	-
Stage 2	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1	3.1		
HCM LOS			-	-

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	624	1407	-	-	1008	-	-	-	909
HCM Lane V/C Ratio	-	0.79	0.062	-	-	0.09	-	-	-	0.033
HCM Control Delay (s)	-	29	7.7	0	-	8.9	0	-	-	9.1
HCM Lane LOS	-	D	A	A	-	A	A	-	-	A
HCM 95th %tile Q(veh)	-	7.7	0.2	-	-	0.3	-	-	-	0.1

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	3.2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	105	45	229	105	45	141
Future Vol, veh/h	105	45	229	105	45	141
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	72	100	100	61
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	105	45	318	105	45	231

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	692	371	0	0	423
Stage 1	371	-	-	-	-
Stage 2	321	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	410	675	-	-	1136
Stage 1	698	-	-	-	-
Stage 2	735	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	392	675	-	-	1136
Mov Cap-2 Maneuver	392	-	-	-	-
Stage 1	667	-	-	-	-
Stage 2	735	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	15.5	0	1.4
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	392	675	1136
HCM Lane V/C Ratio	-	-	0.268	0.067	0.04
HCM Control Delay (s)	-	-	17.5	10.7	8.3
HCM Lane LOS	-	-	C	B	A
HCM 95th %tile Q(veh)	-	-	1.1	0.2	0.1

Intersection						
Int Delay, s/veh	0.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	0	204	70	30	186
Future Vol, veh/h	0	0	204	70	30	186
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	72	100	100	61
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	283	70	30	305

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	683	318	0	0	353
Stage 1	318	-	-	-	-
Stage 2	365	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	415	723	-	-	1206
Stage 1	738	-	-	-	-
Stage 2	702	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	403	723	-	-	1206
Mov Cap-2 Maneuver	403	-	-	-	-
Stage 1	716	-	-	-	-
Stage 2	702	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	-	1206	-
HCM Lane V/C Ratio	-	-	-	0.025	-
HCM Control Delay (s)	-	-	0	0	8.1
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	-	0.1	-

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0.1					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	6	0	198	6	0	210
Future Vol, veh/h	6	0	198	6	0	210
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	72	100	100	61
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	275	6	0	344

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	622	278	0	0	281
Stage 1	278	-	-	-	-
Stage 2	344	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	450	761	-	-	1282
Stage 1	769	-	-	-	-
Stage 2	718	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	450	761	-	-	1282
Mov Cap-2 Maneuver	450	-	-	-	-
Stage 1	769	-	-	-	-
Stage 2	718	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.1	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	450	1282
HCM Lane V/C Ratio	-	-	0.013	-
HCM Control Delay (s)	-	-	13.1	0
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0	0

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	17	10	63	336	75	228	49
Average Queue (ft)	3	1	27	165	49	128	26
95th Queue (ft)	15	8	63	373	96	239	60
Link Distance (ft)	938		933	654		371	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		400			50		25
Storage Blk Time (%)				52	1	72	1
Queuing Penalty (veh)				127	2	24	1

Intersection: 2: 90th Ave & Drop Off Driveway

Movement	WB	WB	SB
Directions Served	L	R	LT
Maximum Queue (ft)	35	34	32
Average Queue (ft)	28	18	5
95th Queue (ft)	46	43	25
Link Distance (ft)	235	235	232
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 3: 90th Ave & Parking Driveway

Movement	WB	WB
Directions Served	L	R
Maximum Queue (ft)	54	51
Average Queue (ft)	32	23
95th Queue (ft)	56	53
Link Distance (ft)	221	221
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 4: 90th Ave/90th St & Bus Driveway

Movement	WB
Directions Served	LR
Maximum Queue (ft)	25
Average Queue (ft)	6
95th Queue (ft)	27
Link Distance (ft)	203
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 154

Intersection												
Int Delay, s/veh	930											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↔			↖	↗		↖	↗
Traffic Vol, veh/h	9	205	50	72	259	26	96	145	244	35	228	33
Future Vol, veh/h	9	205	50	72	259	26	96	145	244	35	228	33
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	Stop	-	-	Stop
Storage Length	-	-	400	-	-	-	-	-	50	-	-	25
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	78	86	66	88	56	94	66	51	25	72	75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	36	263	58	109	294	46	102	220	478	140	317	44

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	340	0	0	321	0	0	1029	893	263	1009	928	317
Stage 1	-	-	-	-	-	-	335	335	-	535	535	-
Stage 2	-	-	-	-	-	-	694	558	-	474	393	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1219	-	-	1239	-	-	212	281	776	219	~268	724
Stage 1	-	-	-	-	-	-	679	643	-	529	524	-
Stage 2	-	-	-	-	-	-	433	512	-	571	606	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1219	-	-	1239	-	-	-	241	776	~16	~230	724
Mov Cap-2 Maneuver	-	-	-	-	-	-	-	241	-	~16	~230	-
Stage 1	-	-	-	-	-	-	655	620	-	510	467	-
Stage 2	-	-	-	-	-	-	117	456	-	~136	584	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.8	2		\$ 3912.6
HCM LOS			-	F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	-	776	1219	-	-	1239	-	-	45	724
HCM Lane V/C Ratio	-	0.617	0.03	-	-	0.088	-	-	10.148	0.061
HCM Control Delay (s)	-	16.8	8	0	-	8.2	0		\$ 4288.6	10.3
HCM Lane LOS	-	C	A	A	-	A	A	-	F	B
HCM 95th %tile Q(veh)	-	4.3	0.1	-	-	0.3	-	-	54.6	0.2

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

HCM 6th TWSC
2: 90th Ave & Drop Off Driveway

12/13/2018

Intersection						
Int Delay, s/veh	1.6					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	49	26	131	49	26	247
Future Vol, veh/h	49	26	131	49	26	247
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	70	100	100	71
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	49	26	187	49	26	348

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	612	212	0	0	236
Stage 1	212	-	-	-	-
Stage 2	400	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	456	828	-	-	1331
Stage 1	823	-	-	-	-
Stage 2	677	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	445	828	-	-	1331
Mov Cap-2 Maneuver	445	-	-	-	-
Stage 1	803	-	-	-	-
Stage 2	677	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.5	0	0.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	445	828	1331
HCM Lane V/C Ratio	-	-	0.11	0.031	0.02
HCM Control Delay (s)	-	-	14.1	9.5	7.8
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.4	0.1	0.1

HCM 6th TWSC
3: 90th Ave & Parking Driveway

12/13/2018

Intersection						
Int Delay, s/veh	2					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	67	35	157	0	0	206
Future Vol, veh/h	67	35	157	0	0	206
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	70	100	100	71
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	67	35	224	0	0	290

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	514	224	0	0	224
Stage 1	224	-	-	-	-
Stage 2	290	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	521	815	-	-	1345
Stage 1	813	-	-	-	-
Stage 2	759	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	521	815	-	-	1345
Mov Cap-2 Maneuver	521	-	-	-	-
Stage 1	813	-	-	-	-
Stage 2	759	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.8	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	WBLn2	SBL	SBT
Capacity (veh/h)	-	-	521	815	1345
HCM Lane V/C Ratio	-	-	0.129	0.043	-
HCM Control Delay (s)	-	-	12.9	9.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.4	0.1	0

HCM 6th TWSC
4: 90th Ave/90th St & Bus Driveway

12/13/2018

Intersection						
Int Delay, s/veh	0.1					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	6	0	151	6	0	200
Future Vol, veh/h	6	0	151	6	0	200
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	70	100	100	71
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	216	6	0	282

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	501	219	0	0	222
Stage 1	219	-	-	-	-
Stage 2	282	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	530	821	-	-	1347
Stage 1	817	-	-	-	-
Stage 2	766	-	-	-	-
Platoon blocked, %					
Mov Cap-1 Maneuver	530	821	-	-	1347
Mov Cap-2 Maneuver	530	-	-	-	-
Stage 1	817	-	-	-	-
Stage 2	766	-	-	-	-

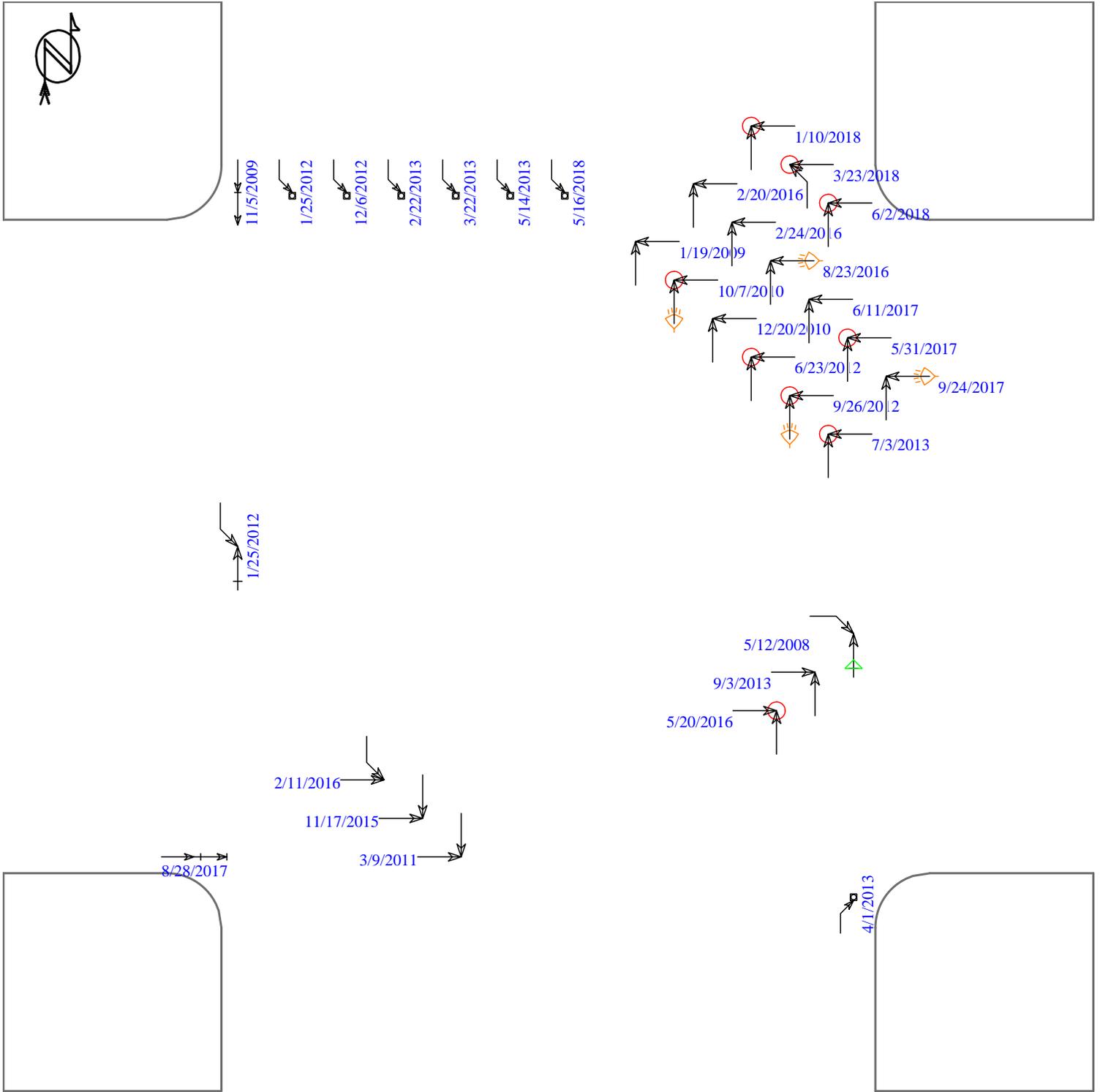
Approach	WB	NB	SB
HCM Control Delay, s	11.9	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	530	1347
HCM Lane V/C Ratio	-	-	0.011	-
HCM Control Delay (s)	-	-	11.9	0
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0	0

Appendix N: Crash Diagram

31 Crashes

Clear



(0) crashes could not be placed in this schematic

- ← Straight
- ←| Stopped
- ← Unknown
- ↔ Backing
- ↔ Overtaking
- ↔ Sideswipe

- ▭ Parked
- ↔ Erratic
- ↔ Out of control
- ↗ Right turn
- ↖ Left turn
- ↪ U-turn

- ⊗ Pedestrian
- ⊗ Bicycle
- Injury
- Fatality
- ⚡ Nighttime
- ⚡ DUI

Fixed objects:

- General
- ▣ Signal
- ▣ Tree
- ▣ Pole
- ▣ Curb
- ⊗ Animal
- ◁ 3rd vehicle
- * Extra data

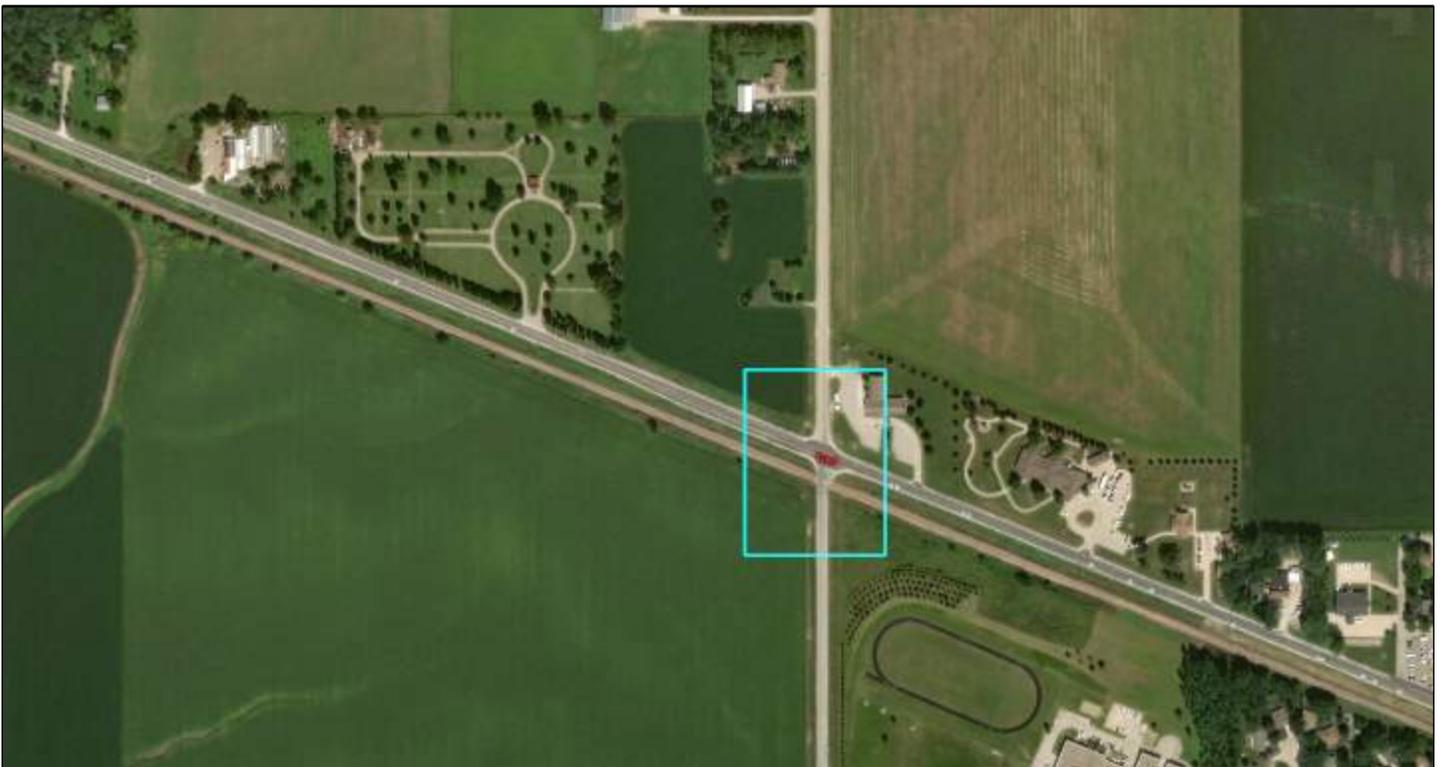
Appendix O: Crash Details

Crash Severity	31
Fatal	0
Major Injury	1
Minor Injury	5
Possible/Unknown	3
Property Damage Only	22

Injury Status Summary	14
Fatal	0
Suspected serious/incapacitating	1
Suspected minor/non-incapacitating	5
Possible (complaint of pain/injury)	8
Uninjured	0
Fatal, not crash-related	0
Unknown	0
Not reported	0

Property/Vehicles/Occupants	
Property Damage Total (dollars):	231,830.00
Average (per crash dollars):	7,478.39
Total Vehicles:	56.00
Average (per crash):	1.81
Total Occupants:	79.00
Average (per crash):	2.55

Average Severity	
Fatalities/Fatal Crash:	0.00
Fatalities/Crash:	0.00
Injuries/Crash:	0.45
Major Injuries/Crash:	0.03
Minor Injuries/Crash:	0.16
Possible/Unknown Injuries/Crash:	0.26





Iowa Crash Analysis Tool
Quick Report
2008-2018

Major Cause			30
Animal	0	Ran traffic signal	0
Ran stop sign	3	Failed to yield to emergency vehicle	0
FTYROW: At uncontrolled intersection	0	FTYROW: Making right turn on red signal	1
FTYROW: From stop sign	13	FTYROW: From yield sign	0
FTYROW: Making left turn	1	FTYROW: From driveway	0
FTYROW: From parked position	0	FTYROW: To pedestrian	0
FTYROW: Other	0	Drove around RR grade crossing gates	0
Disregarded RR Signal	0	Crossed centerline (undivided)	1
Crossed median (divided)	0	Traveling wrong way or on wrong side of road	0
Aggressive driving/road rage	0	Driving too fast for conditions	0
Exceeded authorized speed	0	Improper or erratic lane changing	0
Operating vehicle in an reckless, erratic, ca...	0	Followed too close	0
Passing: On wrong side	0	Passing: Where prohibited by signs/markings	0
Passing: With insufficient distance/inadequa...	0	Passing: Through/around barrier	0
Passing: Other passing	0	Made improper turn	1
Driver Distraction: Manual operation of an e...	2	Driver Distraction: Talking on a hand-held d...	0
Driver Distraction: Talking on a hands free ...	0	Driver Distraction: Adjusting devices (radio...	0
Driver Distraction: Other electronic device ...	0	Driver Distraction: Passenger	0
Driver Distraction: Unrestrained animal	0	Driver Distraction: Reaching for object(s)/f...	0
Driver Distraction: Inattentive/lost in thou...	0	Driver Distraction: Other interior distracti...	0
Driver Distraction: Exterior distraction	1	Ran off road - right	0
Ran off road - straight	0	Ran off road - left	0
Lost control	0	Swerving/Evasive Action	0
Over correcting/over steering	1	Failed to keep in proper lane	0
Failure to signal intentions	1	Traveling on prohibited traffic way	0
Vehicle stopped on railroad tracks	0	Other: Vision obstructed	0
Other: Improper operation	0	Other: Disregarded warning sign	0
Other: Disregarded signs/road markings	0	Other: Illegal off-road driving	0
Downhill runaway	0	Separation of units	0
Towing improperly	0	Cargo/equipment loss or shift	0
Equipment failure	0	Oversized load/vehicle	0
Other: Getting off/out of vehicle	0	Failure to dim lights/have lights on	0
Improper backing	0	Improper starting	0
Illegally parked/unattended	0	Driving less than the posted speed limit	0
Operator inexperience	0	Other	5
Unknown	0	Not reported	0
Other: No improper action	0		



**Iowa Crash Analysis Tool
Quick Report
2008-2018**

Time of Day/Day of Week														
Day of Week	12 AM to 2 AM	2 AM to 4 AM	4 AM to 6 AM	6 AM to 8 AM	8 AM to 10 AM	10 AM to Noon	Noon to 2 PM	2 PM to 4 PM	4 PM to 6 PM	6 PM to 8 PM	8 PM to 10 PM	10 PM to 12 AM	Not reported	Total
Sunday	0	1	0	0	0	0	0	0	1	0	0	0	0	2
Monday	0	0	0	0	0	1	1	0	2	1	0	0	0	5
Tuesday	0	0	0	2	0	0	1	0	1	0	0	0	0	4
Wednesday	0	0	1	0	1	0	4	1	1	1	0	0	0	9
Thursday	0	0	0	1	1	1	0	1	0	0	0	0	0	4
Friday	0	0	0	0	2	0	2	0	0	0	0	0	0	4
Saturday	0	0	0	0	1	1	0	1	0	0	0	0	0	3
Total	0	1	1	3	5	3	8	3	5	2	0	0	0	31

Manner of Crash Collision	31
Non-collision (single vehicle)	7
Head-on (front to front)	0
Rear-end (front to rear)	2
Angle, oncoming left turn	1
Broadside (front to side)	21
Sideswipe, same direction	0
Sideswipe, opposite direction	0
Rear to rear	0
Rear to side	0
Not reported	0
Other	0
Unknown	0

Surface Conditions	31
Dry	25
Wet	3
Ice/frost	0
Snow	3
Slush	0
Mud, dirt	0
Water (standing or moving)	0
Sand	0
Oil	0
Gravel	0
Not reported	0
Other	0
Unknown	0

Fixed Object Struck	56
Bridge overhead structure	0
Bridge/bridge rail parapet	0
Ditch	1
Ground	0
Guardrail - face	0
Concrete traffic barrier (median or right sid...	0
Cable barrier	0
Utility pole/light support	0
Traffic signal support	0
Fire hydrant	0
Tree	0
Snow bank	0
Wall	0
Other fixed object	0
Bridge pier or support	0
Curb/island/raised median	0
Embankment	0
Culvert/pipe opening	0
Guardrail - end	0
Other traffic barrier	0
Impact attenuator/crash cushion	0
Traffic sign support	7
Other post/pole/support	0
Mailbox	0
Landscape/shrubbery	0
Fence	0
Building	0
None (no fixed object struck)	48



Iowa Crash Analysis Tool
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Driver Age/Driver Gender					
Driver Age - 5 year Bins	Female	Male	Not reported	Unknown	Total
< 14	0	0	0	0	0
= 14	0	0	0	0	0
= 15	0	0	0	0	0
= 16	0	0	0	0	0
= 17	1	0	0	0	1
= 18	0	1	0	0	1
= 19	0	1	0	0	1
= 20	0	0	0	0	0
>= 21 and <= 24	1	1	0	0	2
>= 25 and <= 29	7	1	0	0	8
>= 30 and <= 34	6	2	0	0	8
>= 35 and <= 39	2	3	0	0	5
>= 40 and <= 44	3	3	0	0	6
>= 45 and <= 49	0	2	0	0	2
>= 50 and <= 54	1	4	0	0	5
>= 55 and <= 59	2	1	0	0	3
>= 60 and <= 64	0	1	0	0	1
>= 65 and <= 69	1	4	0	0	5
>= 70 and <= 74	1	2	0	0	3
>= 75 and <= 79	0	0	0	0	0
>= 80 and <= 84	1	2	0	0	3
>= 85 and <= 89	0	2	0	0	2
>= 90 and <= 94	0	0	0	0	0
>= 95	0	0	0	0	0
Not reported	0	0	0	0	0
Unknown	0	0	0	0	0
Total	26	30	0	0	56

Alcohol Test Given	56
None	55
Blood	0
Urine	0
Breath	0
Vitreous	0
Refused	0
Not reported	1

Drug Test Given	56
None	55
Blood	0
Urine	0
Breath	0
Vitreous	0
Refused	0
Not reported	1

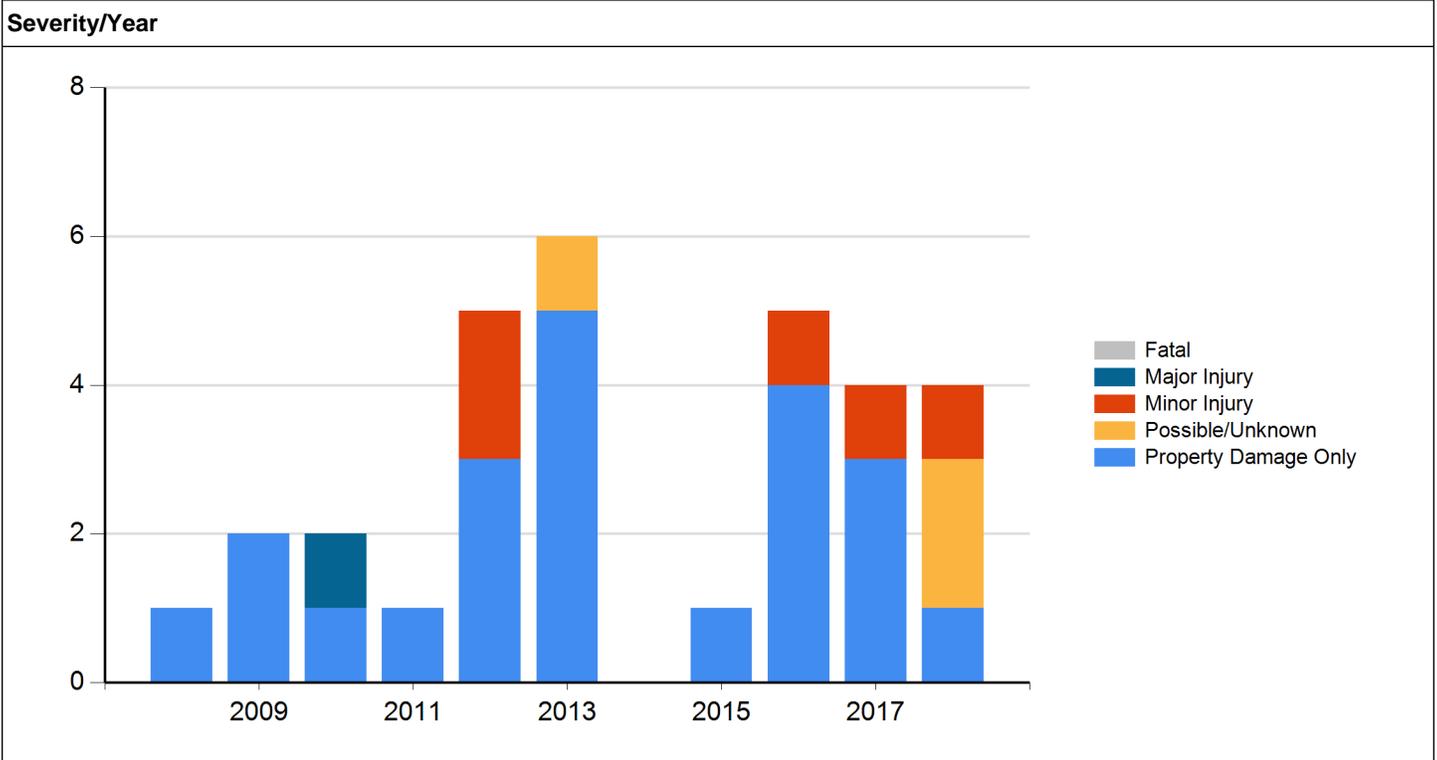
Drug Test Result	56
Negative	0
Cannabis	0
Central Nervous System depressants	0
Central Nervous System stimulants	0
Hallucinogens	0
Inhalants	0
Narcotic Analgesics	0
Dissociative Anesthetic (PCP)	0
Prescription Drug	0
Not reported	56
Other	0

Drug/Alcohol Related	31
Drug	0
Alcohol (< Statutory)	0
Alcohol (Statutory)	0
Drug/Alcohol (< Statutory)	0
Drug/Alcohol (Statutory)	0
Refused	0
Under Influence of Alcohol/Drugs/Medications	0
None Indicated	31



Iowa Crash Analysis Tool
Quick Report
2008-2018

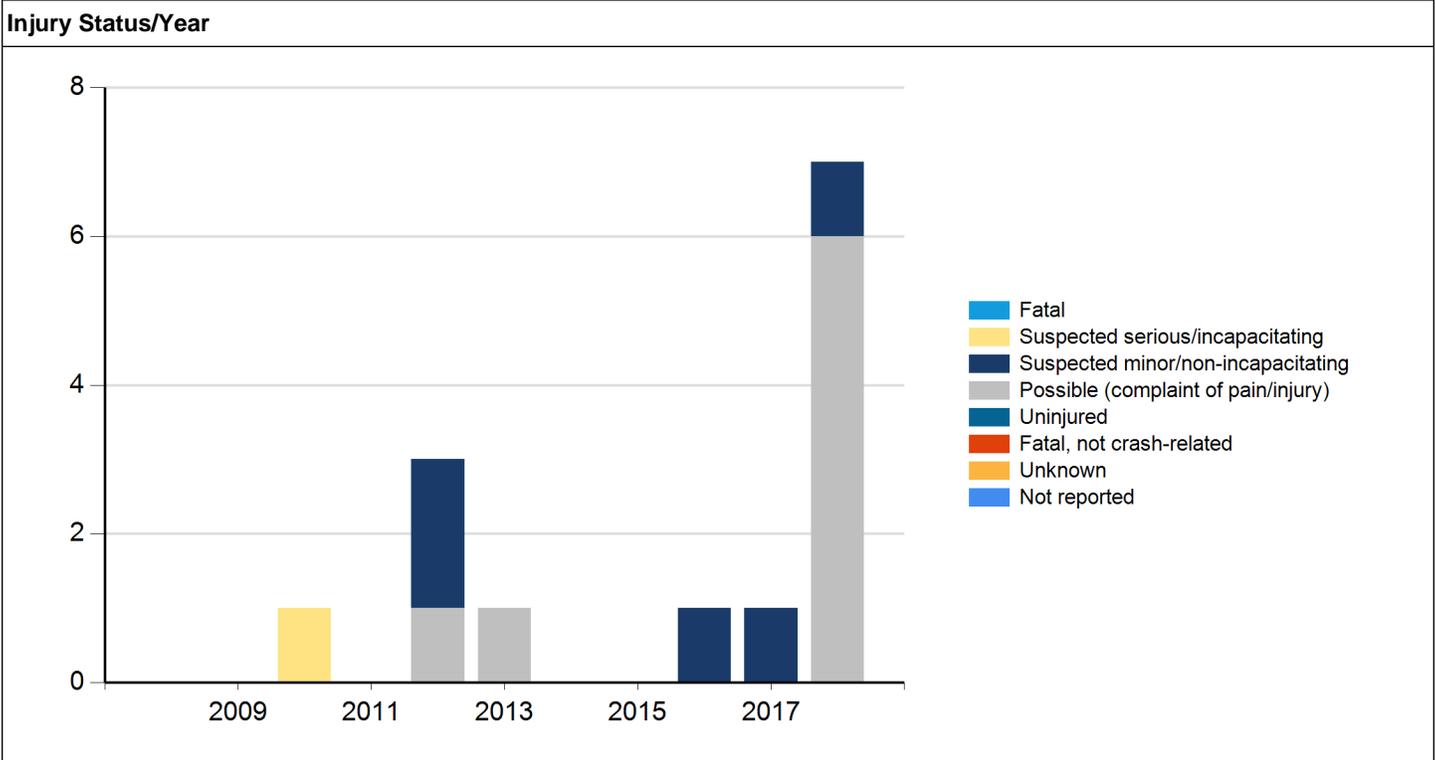
Crash Severity - Annual							
Crash Year	Fatal	Major Injury	Minor Injury	Possible/Unknown	Property Damage Only	Total	
2008	0	0	0	0	1	1	
2009	0	0	0	0	2	2	
2010	0	1	0	0	1	2	
2011	0	0	0	0	1	1	
2012	0	0	2	0	3	5	
2013	0	0	0	1	5	6	
2014	0	0	0	0	0	0	
2015	0	0	0	0	1	1	
2016	0	0	1	0	4	5	
2017	0	0	1	0	3	4	
2018	0	0	1	2	1	4	
Total	0	1	5	3	22	31	





Iowa Crash Analysis Tool
Quick Report
2008-2018

Injury Status - Annual								
Crash Year	Fatal	Suspected serious/incapacitating	Suspected minor/non-incapacitating	Possible (complaint of pain/injury)	Uninjured	Fatal, not crash-related	Unknown	Total
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	1	0	0	0	0	0	1
2011	0	0	0	0	0	0	0	0
2012	0	0	2	1	0	0	0	3
2013	0	0	0	1	0	0	0	1
2014	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0
2016	0	0	1	0	0	0	0	1
2017	0	0	1	0	0	0	0	1
2018	0	0	1	6	0	0	0	7
Total	0	1	5	8	0	0	0	14





Iowa Crash Analysis Tool
Quick Report
2008-2018

Meeting the following criteria

Jurisdiction: Counties (Buena Vista)
Year: 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018
Map Selection: Yes
Filter: None

Analyst Information

Appendix P: Recommendations – Phase I – Analysis Reports

Intersection: 1: IA-110/90th St & IA-7

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	L	TR	LT	R	LT	R
Maximum Queue (ft)	65	52	32	57	96	72	44	36
Average Queue (ft)	42	28	21	31	46	34	27	16
95th Queue (ft)	64	46	34	54	84	79	45	44
Link Distance (ft)	936	936	930	930	636		366	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						50		25
Storage Blk Time (%)					3	0	6	0
Queuing Penalty (veh)					4	0	1	0

Intersection

Intersection Delay, s/veh	14.8
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔		↔	↔			↔	↔		↔	↔
Traffic Vol, veh/h	35	274	73	57	83	28	18	80	156	24	44	20
Future Vol, veh/h	35	274	73	57	83	28	18	80	156	24	44	20
Peak Hour Factor	0.38	0.76	0.59	0.76	0.93	0.33	0.46	0.69	0.74	0.38	0.65	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	92	361	124	75	89	85	39	116	211	63	68	20
Number of Lanes	0	2	0	1	1	0	0	1	1	0	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	2	2
HCM Control Delay	16.9	13	13.4	13.3
HCM LOS	C	B	B	B

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2
Vol Left, %	18%	0%	20%	0%	100%	0%	35%	0%
Vol Thru, %	82%	0%	80%	65%	0%	75%	65%	0%
Vol Right, %	0%	100%	0%	35%	0%	25%	0%	100%
Sign Control	Stop							
Traffic Vol by Lane	98	156	172	210	57	111	68	20
LT Vol	18	0	35	0	57	0	24	0
Through Vol	80	0	137	137	0	83	44	0
RT Vol	0	156	0	73	0	28	0	20
Lane Flow Rate	155	211	272	304	75	174	131	20
Geometry Grp	7	7	7	7	7	7	7	7
Degree of Util (X)	0.317	0.384	0.518	0.552	0.162	0.342	0.286	0.039
Departure Headway (Hd)	7.368	6.558	6.851	6.533	7.773	7.08	7.871	6.969
Convergence, Y/N	Yes							
Cap	488	548	526	556	462	508	457	514
Service Time	5.107	4.297	4.585	4.233	5.517	4.823	5.615	4.714
HCM Lane V/C Ratio	0.318	0.385	0.517	0.547	0.162	0.343	0.287	0.039
HCM Control Delay	13.5	13.4	16.7	17	12	13.5	13.8	10
HCM Lane LOS	B	B	C	C	B	B	B	A
HCM 95th-tile Q	1.3	1.8	2.9	3.3	0.6	1.5	1.2	0.1

Queuing and Blocking Report
Phase I PM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	L	TR	LT	R	LT	R
Maximum Queue (ft)	61	42	34	62	59	60	46	49
Average Queue (ft)	33	24	22	38	35	14	30	21
95th Queue (ft)	53	40	37	62	56	52	56	56
Link Distance (ft)	936	936	930	930	636		366	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						50		25
Storage Blk Time (%)					1	0	6	1
Queuing Penalty (veh)					1	0	2	1

Intersection	
Intersection Delay, s/veh	13.8
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔		↔	↔			↔	↔		↔	↔
Traffic Vol, veh/h	9	171	42	61	217	23	41	57	106	24	57	27
Future Vol, veh/h	9	171	42	61	217	23	41	57	106	24	57	27
Peak Hour Factor	0.25	0.78	0.87	0.66	0.88	0.58	0.94	0.71	0.51	0.25	0.77	0.75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	36	219	48	92	247	40	44	80	208	96	74	36
Number of Lanes	0	2	0	1	1	0	0	1	1	0	1	1

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	2	2
HCM Control Delay	12.5	16	12.8	13.5
HCM LOS	B	C	B	B

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2
Vol Left, %	42%	0%	10%	0%	100%	0%	30%	0%
Vol Thru, %	58%	0%	90%	67%	0%	90%	70%	0%
Vol Right, %	0%	100%	0%	33%	0%	10%	0%	100%
Sign Control	Stop							
Traffic Vol by Lane	98	106	95	128	61	240	81	27
LT Vol	41	0	9	0	61	0	24	0
Through Vol	57	0	86	86	0	217	57	0
RT Vol	0	106	0	42	0	23	0	27
Lane Flow Rate	124	208	146	158	92	286	170	36
Geometry Grp	7	7	7	7	7	7	7	7
Degree of Util (X)	0.252	0.369	0.286	0.298	0.189	0.54	0.353	0.066
Departure Headway (Hd)	7.329	6.399	7.075	6.79	7.373	6.794	7.475	6.606
Convergence, Y/N	Yes							
Cap	491	563	508	529	487	532	481	542
Service Time	5.067	4.137	4.814	4.53	5.111	4.532	5.216	4.347
HCM Lane V/C Ratio	0.253	0.369	0.287	0.299	0.189	0.538	0.353	0.066
HCM Control Delay	12.5	12.9	12.6	12.4	11.8	17.3	14.3	9.8
HCM Lane LOS	B	B	B	B	B	C	B	A
HCM 95th-tile Q	1	1.7	1.2	1.2	0.7	3.2	1.6	0.2

Appendix Q: Recommendations – Phase II – Analysis Reports

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	WB	NB	SB	SB
Directions Served	LT	TR	LT	TR	LT	LT	TR
Maximum Queue (ft)	70	41	57	56	62	43	33
Average Queue (ft)	38	21	32	27	36	27	13
95th Queue (ft)	65	40	51	49	58	39	38
Link Distance (ft)	920	920	932	932	642	354	354
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)							
Storage Blk Time (%)							
Queuing Penalty (veh)							

Intersection	
Intersection Delay, s/veh	19.2
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔	↔		↔	
Traffic Vol, veh/h	105	284	47	38	87	81	1	108	156	56	51	60
Future Vol, veh/h	105	284	47	38	87	81	1	108	156	56	51	60
Peak Hour Factor	0.63	0.76	0.60	0.77	0.93	0.50	0.47	0.70	0.75	0.42	0.65	1.00
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	167	374	78	49	94	162	2	154	208	133	78	60
Number of Lanes	0	2	0	0	2	0	0	1	1	0	2	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	2	2
HCM Control Delay	25	15.2	15.3	15.5
HCM LOS	C	C	C	C

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2
Vol Left, %	1%	0%	43%	0%	47%	0%	69%	0%
Vol Thru, %	99%	0%	57%	75%	53%	35%	31%	30%
Vol Right, %	0%	100%	0%	25%	0%	65%	0%	70%
Sign Control	Stop							
Traffic Vol by Lane	109	156	247	189	82	125	82	86
LT Vol	1	0	105	0	38	0	56	0
Through Vol	108	0	142	142	44	44	26	26
RT Vol	0	156	0	47	0	81	0	60
Lane Flow Rate	156	208	354	265	96	209	173	99
Geometry Grp	7	7	7	7	7	7	7	7
Degree of Util (X)	0.35	0.423	0.751	0.534	0.22	0.437	0.41	0.212
Departure Headway (Hd)	8.047	7.32	7.65	7.253	8.249	7.538	8.558	7.695
Convergence, Y/N	Yes							
Cap	446	491	474	496	434	476	419	465
Service Time	5.812	5.085	5.413	5.016	6.02	5.309	6.327	5.464
HCM Lane V/C Ratio	0.35	0.424	0.747	0.534	0.221	0.439	0.413	0.213
HCM Control Delay	15.1	15.4	30.2	18.1	13.4	16.1	17.2	12.5
HCM Lane LOS	C	C	D	C	B	C	C	B
HCM 95th-tile Q	1.5	2.1	6.3	3.1	0.8	2.2	2	0.8

Queuing and Blocking Report
Phase II AM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	57	48	75	36
Average Queue (ft)	22	16	34	12
95th Queue (ft)	59	46	70	38
Link Distance (ft)	916	916	636	352
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

HCM 6th Roundabout
1: IA-110/90th Ave & IA-7

12/13/2018

Intersection				
Intersection Delay, s/veh	10.2			
Intersection LOS	B			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	619	305	364	271
Demand Flow Rate, veh/h	631	311	371	277
Vehicles Circulating, veh/h	266	329	687	148
Vehicles Exiting, veh/h	159	729	210	492
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	11.6	7.0	14.2	5.2
Approach LOS	B	A	B	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	631	311	371	277
Cap Entry Lane, veh/h	1052	987	685	1187
Entry HV Adj Factor	0.980	0.981	0.981	0.980
Flow Entry, veh/h	619	305	364	271
Cap Entry, veh/h	1031	968	672	1163
V/C Ratio	0.600	0.315	0.542	0.233
Control Delay, s/veh	11.6	7.0	14.2	5.2
LOS	B	A	B	A
95th %tile Queue, veh	4	1	3	1

Queuing and Blocking Report
Phase II AM

12/13/2018

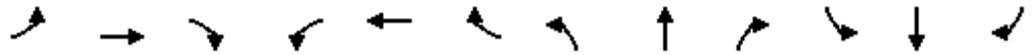
Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	R	L	T	R	T	R	L	TR
Maximum Queue (ft)	74	164	16	56	75	38	94	59	51	85
Average Queue (ft)	37	102	5	19	39	9	52	40	22	43
95th Queue (ft)	74	168	17	49	77	32	95	64	51	86
Link Distance (ft)	921	921		907	907	907	636		356	356
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	400			150						
Storage Blk Time (%)										
Queuing Penalty (veh)										

HCM 6th Signalized Intersection Summary

1: IA-110/90th Ave & IA-7

12/13/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	105	284	47	38	87	81	1	108	156	56	51	60
Future Volume (veh/h)	105	284	47	38	87	81	1	108	156	56	51	60
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	167	374	78	49	94	162	2	154	208	133	78	60
Peak Hour Factor	0.63	0.76	0.60	0.77	0.93	0.50	0.47	0.70	0.75	0.42	0.65	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	416	433	367	210	345	292	748	452	383	705	237	182
Arrive On Green	0.09	0.23	0.23	0.04	0.18	0.18	0.24	0.24	0.24	0.24	0.24	0.24
Sat Flow, veh/h	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	980	754
Grp Volume(v), veh/h	167	374	78	49	94	162	2	154	208	133	0	138
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	0	1735
Q Serve(g_s), s	5.5	14.3	3.0	1.6	3.2	6.9	0.0	5.1	8.5	3.1	0.0	4.9
Cycle Q Clear(g_c), s	5.5	14.3	3.0	1.6	3.2	6.9	0.0	5.1	8.5	3.1	0.0	4.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.43
Lane Grp Cap(c), veh/h	416	433	367	210	345	292	748	452	383	705	0	420
V/C Ratio(X)	0.40	0.86	0.21	0.23	0.27	0.55	0.00	0.34	0.54	0.19	0.00	0.33
Avail Cap(c_a), veh/h	416	528	447	253	485	411	748	452	383	705	0	420
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	21.0	27.5	23.1	23.7	26.1	27.6	10.1	23.3	24.6	10.9	0.0	23.2
Incr Delay (d2), s/veh	0.6	12.0	0.3	0.6	0.4	1.6	0.0	2.0	5.4	0.6	0.0	2.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	7.0	1.0	0.6	1.3	2.4	0.0	2.2	3.4	1.1	0.0	2.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.6	39.5	23.4	24.2	26.5	29.2	10.1	25.3	30.0	11.5	0.0	25.3
LnGrp LOS	C	D	C	C	C	C	B	C	C	B	A	C
Approach Vol, veh/h		619			305			364				271
Approach Delay, s/veh		32.6			27.6			27.9				18.5
Approach LOS		C			C			C				B
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	22.5	22.5	7.7	21.7	22.5	22.5	11.2	18.2				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	18.0	18.0	5.0	21.0	18.0	18.0	6.7	19.3				
Max Q Clear Time (g_c+I1), s	5.1	10.5	3.6	16.3	2.0	6.9	7.5	8.9				
Green Ext Time (p_c), s	0.2	0.8	0.0	0.9	0.0	0.4	0.0	0.6				

Intersection Summary

HCM 6th Ctrl Delay	28.1
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Queuing and Blocking Report
Phase II PM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	TR	LT	TR	LT	R	LT	TR
Maximum Queue (ft)	52	38	66	45	59	64	36	56
Average Queue (ft)	29	16	42	29	39	13	26	19
95th Queue (ft)	49	33	65	44	65	53	36	52
Link Distance (ft)	920	920	932	932	642		354	354
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)						50		
Storage Blk Time (%)					1	0		
Queuing Penalty (veh)					1	0		

Intersection	
Intersection Delay, s/veh	21.3
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔	↔		↔	
Traffic Vol, veh/h	24	177	32	49	225	43	37	70	111	73	76	65
Future Vol, veh/h	24	177	32	49	225	43	37	70	111	73	76	65
Peak Hour Factor	0.25	0.78	0.86	0.67	0.88	0.58	0.95	0.68	0.51	0.25	0.75	0.75
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	96	227	37	73	256	74	39	103	218	292	101	87
Number of Lanes	0	2	0	0	2	0	0	1	1	0	2	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	2	2	2	2
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	2	2	2	2
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	2	2	2	2
HCM Control Delay	17.7	18.1	16.4	30.2
HCM LOS	C	C	C	D

Lane	NBLn1	NBLn2	EBLn1	EBLn2	WBLn1	WBLn2	SBLn1	SBLn2
Vol Left, %	35%	0%	21%	0%	30%	0%	66%	0%
Vol Thru, %	65%	0%	79%	73%	70%	72%	34%	37%
Vol Right, %	0%	100%	0%	27%	0%	28%	0%	63%
Sign Control	Stop							
Traffic Vol by Lane	107	111	113	121	162	156	111	103
LT Vol	37	0	24	0	49	0	73	0
Through Vol	70	0	89	89	113	113	38	38
RT Vol	0	111	0	32	0	43	0	65
Lane Flow Rate	142	218	209	151	201	202	343	137
Geometry Grp	7	7	7	7	7	7	7	7
Degree of Util (X)	0.337	0.462	0.494	0.343	0.472	0.454	0.797	0.289
Departure Headway (Hd)	8.552	7.647	8.497	8.193	8.456	8.099	8.368	7.573
Convergence, Y/N	Yes							
Cap	419	468	421	437	424	442	432	472
Service Time	6.351	5.445	6.295	5.991	6.253	5.895	6.158	5.361
HCM Lane V/C Ratio	0.339	0.466	0.496	0.346	0.474	0.457	0.794	0.29
HCM Control Delay	15.7	16.9	19.4	15.3	18.7	17.5	37	13.4
HCM Lane LOS	C	C	C	C	C	C	E	B
HCM 95th-tile Q	1.5	2.4	2.7	1.5	2.5	2.3	7.1	1.2

Queuing and Blocking Report
Phase II PM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	48	62	51	50
Average Queue (ft)	13	21	20	23
95th Queue (ft)	42	60	52	52
Link Distance (ft)	916	916	636	352
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

HCM 6th Roundabout
1: IA-110/90th Ave & IA-7

12/13/2018

Intersection				
Intersection Delay, s/veh	10.1			
Intersection LOS	B			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	360	403	360	480
Demand Flow Rate, veh/h	368	410	367	490
Vehicles Circulating, veh/h	475	243	628	375
Vehicles Exiting, veh/h	390	752	215	278
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	9.7	7.4	12.6	10.7
Approach LOS	A	A	B	B
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	368	410	367	490
Cap Entry Lane, veh/h	850	1077	727	941
Entry HV Adj Factor	0.979	0.983	0.981	0.980
Flow Entry, veh/h	360	403	360	480
Cap Entry, veh/h	833	1058	713	922
V/C Ratio	0.433	0.381	0.505	0.521
Control Delay, s/veh	9.7	7.4	12.6	10.7
LOS	A	A	B	B
95th %tile Queue, veh	2	2	3	3

Queuing and Blocking Report
Phase II PM

12/13/2018

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	38	140	16	52	157	14	42	67	63	47	100
Average Queue (ft)	11	71	3	21	76	3	13	30	31	23	49
95th Queue (ft)	30	129	12	54	145	12	38	66	57	48	91
Link Distance (ft)	921	921		907	907	907	636	636		356	356
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	400					150					
Storage Blk Time (%)											
Queuing Penalty (veh)											

HCM 6th Signalized Intersection Summary

1: IA-110/90th Ave & IA-7

12/13/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	24	177	32	49	225	43	37	70	111	73	76	65
Future Volume (veh/h)	24	177	32	49	225	43	37	70	111	73	76	65
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	96	227	37	73	256	74	39	103	218	292	101	87
Peak Hour Factor	0.25	0.78	0.86	0.67	0.88	0.58	0.95	0.68	0.51	0.25	0.75	0.75
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	252	335	284	269	321	272	757	496	420	783	246	212
Arrive On Green	0.06	0.18	0.18	0.05	0.17	0.17	0.25	0.27	0.27	0.25	0.27	0.27
Sat Flow, veh/h	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	928	799
Grp Volume(v), veh/h	96	227	37	73	256	74	39	103	218	292	0	188
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	0	1727
Q Serve(g_s), s	3.1	8.1	1.4	2.4	9.4	2.9	0.8	3.1	8.4	6.8	0.0	6.4
Cycle Q Clear(g_c), s	3.1	8.1	1.4	2.4	9.4	2.9	0.8	3.1	8.4	6.8	0.0	6.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.46
Lane Grp Cap(c), veh/h	252	335	284	269	321	272	757	496	420	783	0	458
V/C Ratio(X)	0.38	0.68	0.13	0.27	0.80	0.27	0.05	0.21	0.52	0.37	0.00	0.41
Avail Cap(c_a), veh/h	279	504	427	316	509	431	757	496	420	783	0	458
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	23.0	27.5	24.7	22.9	28.5	25.8	8.9	20.5	22.4	10.1	0.0	21.7
Incr Delay (d2), s/veh	1.0	2.4	0.2	0.5	4.6	0.5	0.1	0.9	4.5	1.4	0.0	2.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	3.4	0.5	0.9	4.1	1.0	0.3	1.3	3.2	2.3	0.0	2.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.9	29.9	24.9	23.4	33.1	26.3	9.0	21.4	27.0	11.5	0.0	24.4
LnGrp LOS	C	C	C	C	C	C	A	C	C	B	A	C
Approach Vol, veh/h		360			403			360			480	
Approach Delay, s/veh		27.8			30.1			23.4			16.6	
Approach LOS		C			C			C			B	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	22.5	23.5	8.3	17.4	22.5	23.5	8.9	16.8				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	18.0	19.0	5.7	19.3	18.0	19.0	5.5	19.5				
Max Q Clear Time (g_c+I1), s	8.8	10.4	4.4	10.1	2.8	8.4	5.1	11.4				
Green Ext Time (p_c), s	0.5	0.8	0.0	0.8	0.0	0.6	0.0	0.9				

Intersection Summary

HCM 6th Ctrl Delay	24.0
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Appendix R: Recommendations – Build (2040) – Analysis Reports

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	97	44	179	51
Average Queue (ft)	55	19	85	23
95th Queue (ft)	104	43	174	55
Link Distance (ft)	916	902	622	352
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

HCM 6th Roundabout
1: IA-110/90th Ave & IA-7

12/13/2018

Intersection					
Intersection Delay, s/veh	15.6				
Intersection LOS	C				
Approach	EB	WB	NB	SB	
Entry Lanes	1	1	1	1	
Conflicting Circle Lanes	1	1	1	1	
Adj Approach Flow, veh/h	650	261	959	408	
Demand Flow Rate, veh/h	664	266	978	417	
Vehicles Circulating, veh/h	479	564	626	312	
Vehicles Exiting, veh/h	250	537	517	518	
Ped Vol Crossing Leg, #/h	0	0	0	0	
Ped Cap Adj	1.000	1.000	1.000	1.000	
Approach Delay, s/veh	22.1	8.9	16.2	8.3	
Approach LOS	C	A	C	A	
Lane	Left	Left	Left	Bypass	Left
Designated Moves	LTR	LTR	LT	R	LTR
Assumed Moves	LTR	LTR	LT	R	LTR
RT Channelized				Yield	
Lane Util	1.000	1.000	1.000		1.000
Follow-Up Headway, s	2.609	2.609	2.609		2.609
Critical Headway, s	4.976	4.976	4.976	503	4.976
Entry Flow, veh/h	664	266	475	798	417
Cap Entry Lane, veh/h	847	776	729	0.980	1004
Entry HV Adj Factor	0.979	0.981	0.981	493	0.979
Flow Entry, veh/h	650	261	466	782	408
Cap Entry, veh/h	829	761	715	0.630	983
V/C Ratio	0.784	0.343	0.652	15.3	0.415
Control Delay, s/veh	22.1	8.9	17.2	C	8.3
LOS	C	A	C	5	A
95th %tile Queue, veh	8	2	5		2

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	53	184	23	51	65	19	31	138	135	34	116
Average Queue (ft)	23	107	6	25	27	3	14	64	76	15	61
95th Queue (ft)	50	180	17	50	66	15	33	121	130	38	107
Link Distance (ft)		920		907	907		636	636		356	356
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	150		400			150			150		
Storage Blk Time (%)		3						0	0		
Queuing Penalty (veh)		4						1	1		

HCM 6th Signalized Intersection Summary

1: IA-110/90th Ave & IA-7

12/13/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	328	80	68	100	31	49	248	365	34	182	30
Future Volume (veh/h)	55	328	80	68	100	31	49	248	365	34	182	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	87	432	131	91	108	62	107	359	493	94	284	30
Peak Hour Factor	0.63	0.76	0.61	0.75	0.93	0.50	0.46	0.69	0.74	0.36	0.64	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	498	506	429	268	509	431	422	604	511	330	532	56
Arrive On Green	0.06	0.27	0.27	0.06	0.27	0.27	0.07	0.32	0.32	0.06	0.32	0.32
Sat Flow, veh/h	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	1663	176
Grp Volume(v), veh/h	87	432	131	91	108	62	107	359	493	94	0	314
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	0	1839
Q Serve(g_s), s	2.2	14.0	4.2	2.3	2.9	1.9	2.5	10.3	19.6	2.2	0.0	9.0
Cycle Q Clear(g_c), s	2.2	14.0	4.2	2.3	2.9	1.9	2.5	10.3	19.6	2.2	0.0	9.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.10
Lane Grp Cap(c), veh/h	498	506	429	268	509	431	422	604	511	330	0	588
V/C Ratio(X)	0.17	0.85	0.31	0.34	0.21	0.14	0.25	0.59	0.96	0.28	0.00	0.53
Avail Cap(c_a), veh/h	530	627	531	295	624	529	442	604	511	356	0	588
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	15.1	22.2	18.6	16.7	18.0	17.7	13.6	18.2	21.4	13.8	0.0	17.9
Incr Delay (d2), s/veh	0.2	9.3	0.4	0.7	0.2	0.2	0.3	4.3	31.8	0.5	0.0	3.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	6.3	1.3	0.8	1.1	0.6	0.8	4.4	10.3	0.7	0.0	3.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	15.3	31.4	19.0	17.5	18.2	17.8	13.9	22.5	53.1	14.3	0.0	21.4
LnGrp LOS	B	C	B	B	B	B	B	C	D	B	A	C
Approach Vol, veh/h		650			261			959			408	
Approach Delay, s/veh		26.8			17.9			37.3			19.7	
Approach LOS		C			B			D			B	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	8.6	25.2	8.5	21.9	8.8	25.0	8.4	21.9				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	5.0	20.5	5.0	21.5	5.0	20.5	5.1	21.4				
Max Q Clear Time (g_c+I1), s	4.2	21.6	4.3	16.0	4.5	11.0	4.2	4.9				
Green Ext Time (p_c), s	0.0	0.0	0.0	1.3	0.0	1.0	0.0	0.5				

Intersection Summary

HCM 6th Ctrl Delay	28.9
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	WB	NB	SB
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	54	75	85	63
Average Queue (ft)	27	35	37	34
95th Queue (ft)	57	75	81	64
Link Distance (ft)	916	902	622	352
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

HCM 6th Roundabout
1: IA-110/90th Ave & IA-7

12/13/2018

Intersection					
Intersection Delay, s/veh	11.4				
Intersection LOS	B				
Approach	EB	WB	NB	SB	
Entry Lanes	1	1	1	1	
Conflicting Circle Lanes	1	1	1	1	
Adj Approach Flow, veh/h	357	449	800	501	
Demand Flow Rate, veh/h	364	458	816	511	
Vehicles Circulating, veh/h	577	365	448	515	
Vehicles Exiting, veh/h	449	411	493	308	
Ped Vol Crossing Leg, #/h	0	0	0	0	
Ped Cap Adj	1.000	1.000	1.000	1.000	
Approach Delay, s/veh	11.4	9.8	10.2	14.9	
Approach LOS	B	A	B	B	
Lane	Left	Left	Left	Bypass	Left
Designated Moves	LTR	LTR	LT	R	LTR
Assumed Moves	LTR	LTR	LT	R	LTR
RT Channelized				Yield	
Lane Util	1.000	1.000	1.000		1.000
Follow-Up Headway, s	2.609	2.609	2.609		2.609
Critical Headway, s	4.976	4.976	4.976	488	4.976
Entry Flow, veh/h	364	458	328	907	511
Cap Entry Lane, veh/h	766	951	874	0.980	816
Entry HV Adj Factor	0.980	0.981	0.981	478	0.980
Flow Entry, veh/h	357	449	322	890	501
Cap Entry, veh/h	751	933	857	0.537	800
V/C Ratio	0.475	0.482	0.375	11.3	0.626
Control Delay, s/veh	11.4	9.8	8.6	B	14.9
LOS	B	A	A	3	B
95th %tile Queue, veh	3	3	2		4

Intersection: 1: IA-110/90th Ave & IA-7

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	R	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	25	107	16	68	124	28	77	75	84	47	120
Average Queue (ft)	6	60	5	32	67	5	35	37	44	16	72
95th Queue (ft)	22	110	19	66	119	23	72	75	83	43	120
Link Distance (ft)		921			907			636			357
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	150		400	150		150	150		150	150	
Storage Blk Time (%)		0			0						0
Queuing Penalty (veh)		0			0						0

HCM 6th Signalized Intersection Summary

1: IA-110/90th Ave & IA-7

12/13/2018



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑	↗	↖	↑	↗	↖	↑	↗	↖	↗	↖
Traffic Volume (veh/h)	9	205	50	72	259	26	96	145	244	35	228	33
Future Volume (veh/h)	9	205	50	72	259	26	96	145	244	35	228	33
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	36	263	58	109	294	46	102	220	478	140	317	44
Peak Hour Factor	0.25	0.78	0.86	0.66	0.88	0.56	0.94	0.66	0.51	0.25	0.72	0.75
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	275	347	294	315	412	349	447	634	537	458	558	77
Arrive On Green	0.04	0.19	0.19	0.07	0.22	0.22	0.07	0.34	0.34	0.08	0.35	0.35
Sat Flow, veh/h	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	1607	223
Grp Volume(v), veh/h	36	263	58	109	294	46	102	220	478	140	0	361
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1781	1870	1585	1781	1870	1585	1781	0	1830
Q Serve(g_s), s	0.9	7.4	1.7	2.7	8.1	1.3	2.0	4.9	15.9	2.8	0.0	8.9
Cycle Q Clear(g_c), s	0.9	7.4	1.7	2.7	8.1	1.3	2.0	4.9	15.9	2.8	0.0	8.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.12
Lane Grp Cap(c), veh/h	275	347	294	315	412	349	447	634	537	458	0	636
V/C Ratio(X)	0.13	0.76	0.20	0.35	0.71	0.13	0.23	0.35	0.89	0.31	0.00	0.57
Avail Cap(c_a), veh/h	367	604	512	344	604	512	480	634	537	480	0	636
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	17.5	21.5	19.2	16.9	20.1	17.5	11.0	13.8	17.4	10.5	0.0	14.8
Incr Delay (d2), s/veh	0.2	3.4	0.3	0.7	2.3	0.2	0.3	1.5	19.4	0.4	0.0	3.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	3.0	0.5	0.9	3.1	0.4	0.6	1.9	7.1	0.8	0.0	3.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	17.7	24.9	19.5	17.5	22.4	17.6	11.3	15.3	36.8	10.9	0.0	18.4
LnGrp LOS	B	C	B	B	C	B	B	B	D	B	A	B
Approach Vol, veh/h		357			449			800			501	
Approach Delay, s/veh		23.3			20.7			27.6			16.3	
Approach LOS		C			C			C			B	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	8.9	23.4	8.6	14.8	8.5	23.9	6.6	16.8				
Change Period (Y+Rc), s	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5				
Max Green Setting (Gmax), s	5.1	18.9	5.0	18.0	5.0	19.0	5.0	18.0				
Max Q Clear Time (g_c+I1), s	4.8	17.9	4.7	9.4	4.0	10.9	2.9	10.1				
Green Ext Time (p_c), s	0.0	0.3	0.0	0.9	0.0	1.1	0.0	0.9				
Intersection Summary												
HCM 6th Ctrl Delay					22.7							
HCM 6th LOS					C							

Appendix S: Feed Mill Trip Distribution Diagrams



