CORE FIRE HALL ACCESS MANAGEMENT STUDY

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1.0 INTRODUCTION

1.1 BACKGROUND

The Core Fire Hall Development is a proposed fire and emergency response station located at the intersection of Portage Avenue and Century Street in the Polo Park area of Winnipeg. The proposed location of the development is within an interchange loop on the northwest corner of the junction.

Stantec Consulting Ltd. has been retained by Shindico Realty Inc. on behalf of Winnipeg Fire Paramedic Service to conduct an Access Management and Traffic Impact Study for the proposed Core Fire Hall. The primary goal of the study is to assess the impact of the proposed development and associated site accesses on traffic safety and roadway operations.

The proposed Core Fire Hall location presents the unusual circumstance of a development located within the right-of-way of an interchange off ramp loop. There are rare instances around the world where this has been done, but to our knowledge this has never been done in Canada. Emergency egress from the site and all employee access occurs within a weaving area along westbound Portage Avenue between two interchange loops. A portion of the emergency return traffic involves crossing an interchange ramp. Both of these factors will complicate the already complex task of driving through an interchange.

1.2 STUDY OBJECTIVES

The purpose of this Access Management Study is to evaluate the impact of the project on the surrounding traffic network. The principal objectives of the study include:

- Review existing transportations systems and weekday peak hour traffic conditions in the study area;
- Estimate the magnitude and characteristics of new traffic activity generated by the proposed development during the weekday PM peak hour;
- Assign the development generated traffic to the adjacent street system at proposed access points;
- Evaluate pre and post-development traffic control, levels of service and turn lane storage requirements for all intersections and site accesses;
- Identify any changes to existing or proposed access, intersection or roadway geometry and/or traffic control improvements required to properly accommodate pre and post-development traffic volumes and mitigate unacceptable impacts;
- Review on-site circulation patterns and access as they impact the public right-of-way and traffic operations within the area.

- Review traffic safety concerns present with proposed development access;
- Present recommendations for access management, traffic control requirements, and traffic safety improvements.

2.0 SITE CONTEXT

2.1 PROJECT STUDY AREA

A vicinity map illustrated in Figure 2.2 shows the location of the proposed Core Fire Hall development within Winnipeg, Manitoba. The project study area is illustrated in Figure 2.2.

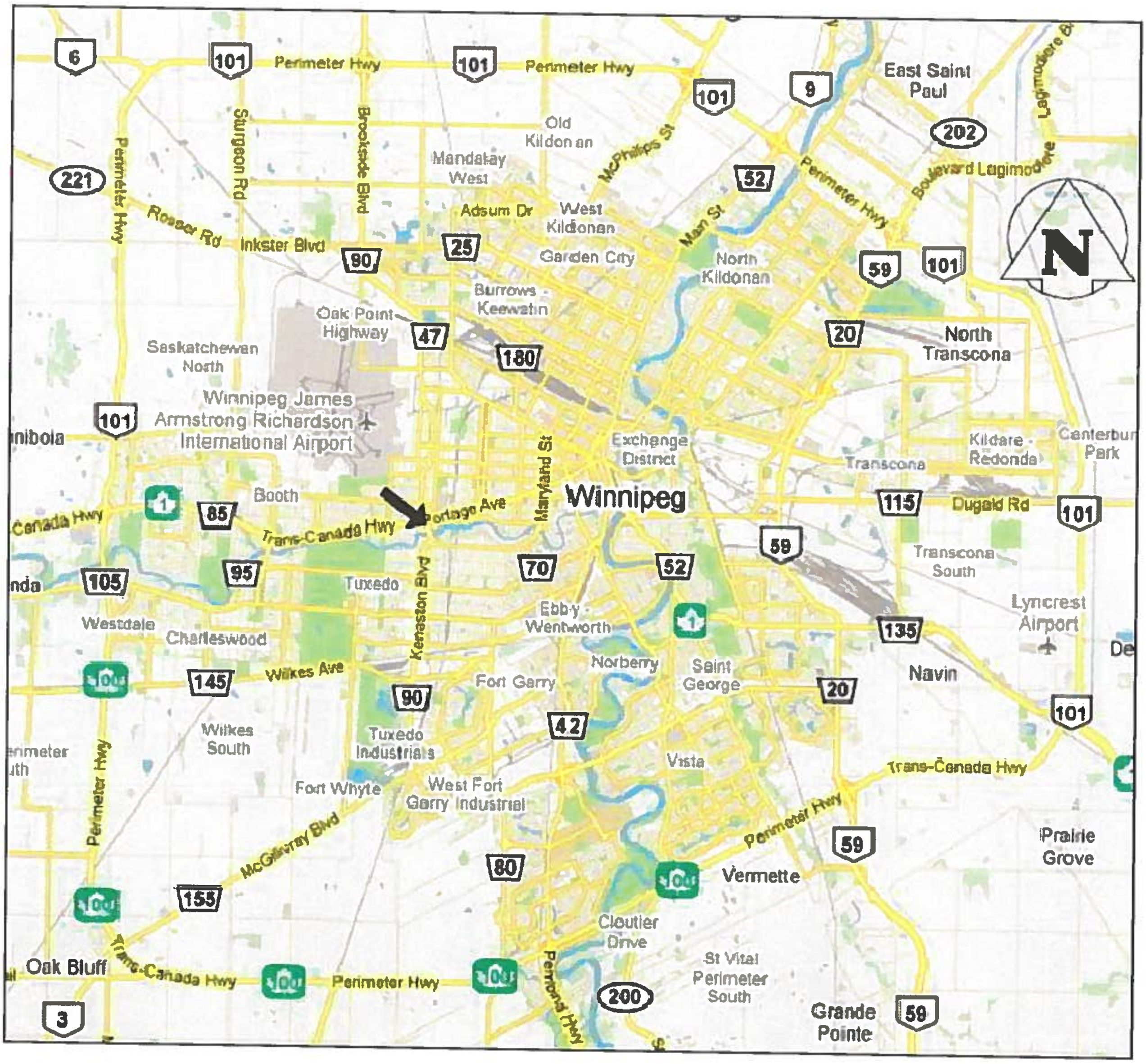


Figure 2.1: Core Fire Hall Vicinity Map

Figure 2.2: Core Fire Hall Study Area

The Core Fire Hall would be located in the northwest loop of the Portage Avenue at Century Street Interchange. The study area is bounded by St. James Street to the east and Queen Street to the west along Portage Avenue; the southbound to westbound ramp from Century Street to Portage Avenue and by Portage Avenue to the south. The distance from Queen Street to St. James Street is approximately 445m.

2.2 EXISTING TRANSPORTATION SYSTEMS

2.2.1 STUDY AREA ROADWAYS

The primary transportation facilities in the study area include Portage Avenue, Century Street, Queen Street, and St. James Street:

- **Portage Avenue** – Portage Avenue is an eight-lane roadway that runs east/west in the study area. There are four travel lanes in each direction. The speed limit is 60km/h within the study area.

- **Century Street** – Century Street is a six-lane roadway that runs north/south in the study area. There are three travel lanes in each direction. Century Street travels under Portage Avenue. The speed limit is 70km/h within the study area.
- **Queen Street** – Queen Street is a two-lane roadway that runs north/south in the study area. Queen Street terminates at Portage Avenue in a "T" intersection. The speed limit is 50km/h.
- **St. James Street** – St. James Street runs north/south in the study area. St. James Street is a five-lane roadway north of Portage Avenue, with two travel lanes in each direction and a centre two-way left turn lane. South of Portage Avenue it is a two-lane roadway. The speed limit of St. James Street north and south of Portage Avenue are 60km/h and 50km/h, respectively.

2.2.2 STUDY AREA INTERSECTIONS

- Portage Avenue at Queen Street – This is a T-intersection under traffic signal control with a cycle length of 120 seconds. It is located approximately 159m west of the proposed south approach for the Fire Hall. The westbound leg of Portage Avenue has four through lanes with one shared through and right turn lane. The eastbound leg of Portage Avenue has four through lanes with one shared through and left turn lane. Although unmarked, southbound traffic on Queen Street operates with separate southbound left and southbound right turn lanes. During the AM peak, eastbound to northbound left turns from Portage Avenue are prohibited.

  The intersection is offset to the west approximately 24 m to allow signalized access from northbound Riverbend Crescent, a two-lane local street running south from Portage Avenue with a speed limit of 50 km/h. Left and right turns are allowed from Riverbend Crescent with no through movements.
- Portage Avenue at St. James Street – This intersection is approximately 291m east of proposed south approach for the Fire Hall and is traffic signal controlled with a cycle length of 120 seconds. The westbound leg of Portage Avenue has four through lanes, a diamond lane controlled by a bus priority signal, and a separate right turn lane. The eastbound leg of Portage Avenue has four through lanes with one shared through and right turn lane. Eastbound and westbound left turns from Portage Avenue are prohibited at this intersection. The southbound to eastbound left turn at the intersection has a leading left turn indication.

The study area intersection lane configurations are shown in Figure 2.3.

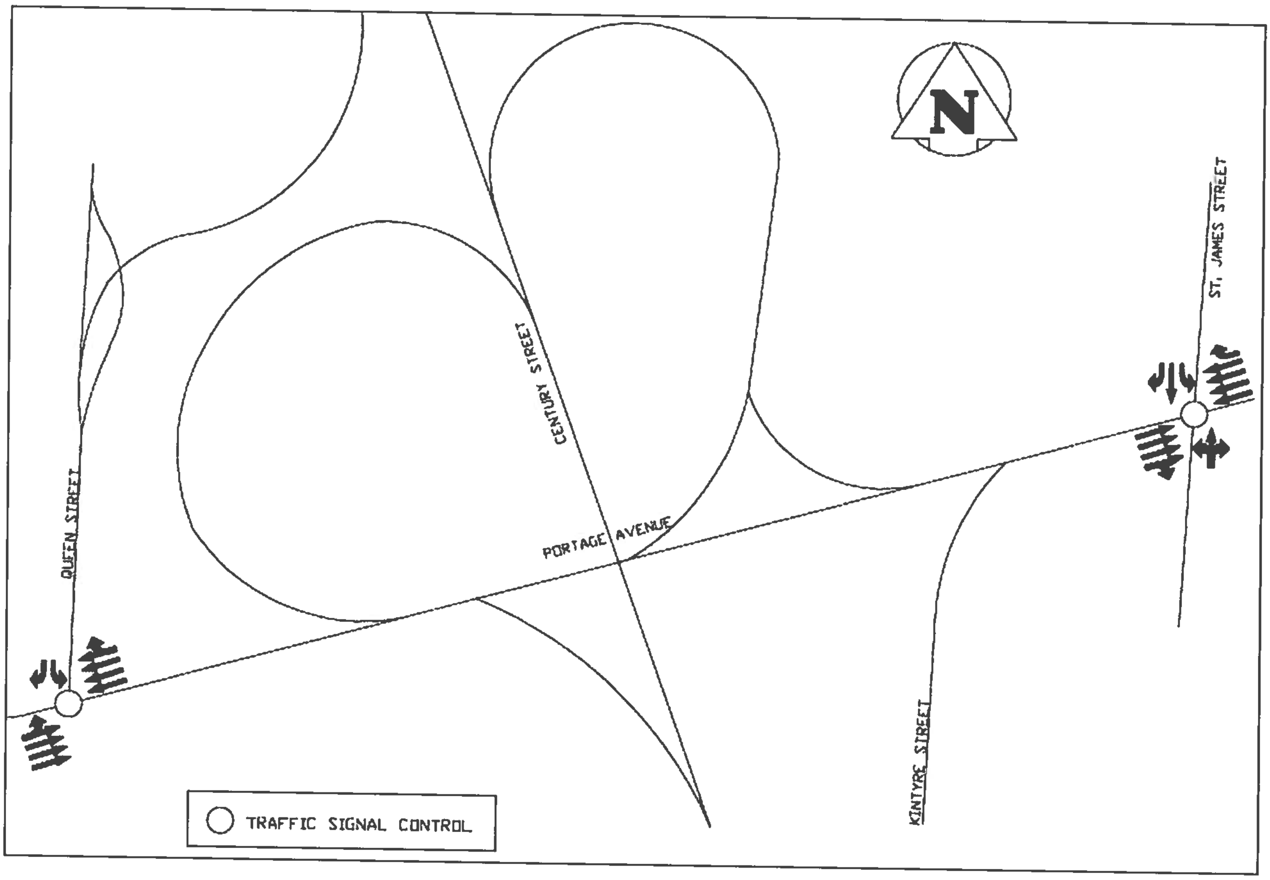


Figure 2.3: Intersection Lane Configurations

2.2.3 PRIMARY RAMPS AND APPROACHES

The study area between Queen Street and St. James Street includes the interchange at Portage Avenue and Century Street, of which contains the ramps listed below (all dimensions refer to Queen Street):

- Southbound Century Street to Portage Avenue via Queen Street off-ramp. This ramp intersects Queen Street approximately 150 m north of Portage Avenue. Ramp traffic has the right-of-way and northbound/southbound traffic on Queen Street at this location is under stop control. Field observations indicate the average running speed on this ramp is approximately 56 km/h.
- Westbound to southbound off-ramp from Portage Avenue to Century Street located approximately 96m east. Field observations indicate the average running speed on this ramp is approximately 43km/h. Note, the separation between this ramp and the southbound century street to Queen Street ramp is approximately 6.0 m.

- Eastbound to southbound off-ramp from Portage Avenue to Century Street located approximately 175m east.
- Northbound to westbound on-ramp from Century Street to Portage Avenue located approximately 249m east.
- Westbound to northbound off-ramp from Portage Avenue to Century Street located approximately 302m east.
- Northbound to eastbound off-ramp from Century Street to Portage Avenue via Kintyre Street located approximately 354m east.

3.0 PROPOSED DEVELOPMENT

3.1 CORE FIRE HALL

The proposed fire hall will be a two story building with four (4) emergency vehicle bays in the west half of the first floor. To take advantage of the terrain of the interchange loop which reduces in elevation toward the east property limit, parking will be located on the east side of the development beneath the first floor. Twenty-one (21) employee parking stalls will be provided on-site. Garbage pickup will be located at the rear of the building, behind the northwest corner. A service vehicle parking spot will also be provided at the rear of the building.

As originally proposed, the Core Fire Hall also has a museum display on the southeast corner of the building that is visible from both Portage Avenue and Century Street. To accommodate visitors (i.e. school field trips), bus parking will be provided immediately west of the emergency vehicle exit onto Portage Avenue.

3.2 PROPOSED ACCESS

As originally proposed, the Core Fire Hall will include three separate accesses:

- A right in/out driveway on Portage Avenue for employee and delivery access,
- A one-way southbound exit onto Portage Avenue for emergency vehicles only,
- A one-way southbound entrance located on the westbound to southbound off-ramp loop on the north side of the site for returning emergency vehicles.

Both driveways off Portage Avenue will be located in the middle of a weaving area between interchange on and off ramps. The rear access requires construction of an access lane located between the southbound to Queen Street off-ramp from Century Street and the westbound to southbound loop ramp from Portage Avenue. This lane will provide access to the rear of the fire hall site for traffic on both northbound Queen Street and on the southbound to Queen Street off-ramp from Century Street. All traffic using this access lane would be required to stop and wait for a gap in loop ramp traffic before crossing the westbound to southbound loop to enter the Core Fire Hall site on the north side of the development.

The originally proposed access for the Core Fire Hall is illustrated in Figure 3.1 and summarized below:

3.2.1 Outbound Emergency Traffic

All outbound emergency vehicles will exit from the one-way southbound emergency access onto Portage Avenue. This allows the following movements for emergency vehicles:

- An immediate right turn allows access to the west.

- A median cut on Portage Avenue across from the emergency exit allows access to the east, and access to the south via the eastbound to southbound off-ramp from Portage Avenue to Century Street.
- Emergency traffic travelling to the north will exit onto Portage Avenue and then use Queen/Berry Street and/or St. James Street.

To allow emergency vehicles to exit the Core Fire Hall safely and efficiently, emergency activated signals are proposed for Portage Avenue. These would be activated from within the fire hall and will stop all east and westbound traffic on Portage Avenue for sufficient time to allow emergency vehicles to exit the site eastbound/westbound on Portage Avenue or southbound on Century Street. Signal heads will face eastbound/westbound traffic on Portage Avenue and the southbound emergency vehicle exit will be controlled with a stop sign.

3.2.2 Inbound Emergency Traffic

All inbound emergency vehicle traffic will re-enter the site via a one-way southbound access located on the north side of the development off the westbound to southbound Portage Avenue off-ramp:

- All emergency vehicles approaching from the east would use the westbound to southbound off-ramp from Portage Avenue and then make a right turn into the north access.
- Emergency vehicles approaching from the south would use the northbound to westbound on-ramp to Portage Avenue and continue westerly to the westbound to southbound off-ramp from Portage Avenue and make a right turn into the north access.
- Emergency vehicles approaching from the west on Portage Avenue would make a left turn onto Queen Street and use the proposed access lane located between the southbound Century Street to Queen Street off-ramp and the westbound to southbound Century Street off-ramp from Portage Avenue. This will require modification of the AM peak eastbound left turn prohibition at the Queen Street and Portage Avenue intersection. The prohibition must be removed or modified to allow this movement by emergency vehicles.
- All emergency vehicles approaching from the from the north would exit Century Street using the southbound to Queen Street off-ramp and turn onto the proposed access lane before waiting to cross the westbound to southbound loop ramp.

The access lane off Queen Street and off the southbound Century Street exit ramp would be signed for emergency vehicles only. Use by all other vehicles traffic would be prohibited.

3.2.3 Employee/Delivery Access

All staff and delivery vehicles would enter using the right in/out driveway on Portage Avenue. Left turns from this driveway through the proposed median opening would be prohibited.

As originally proposed the garbage pickup is located on the north side of the site. This requires garbage trucks to access the site using the rear entrance from the loop ramp and exit onto the same ramp heading southbound on Century Street. Use of the proposed access lane by garbage trucks would be prohibited.

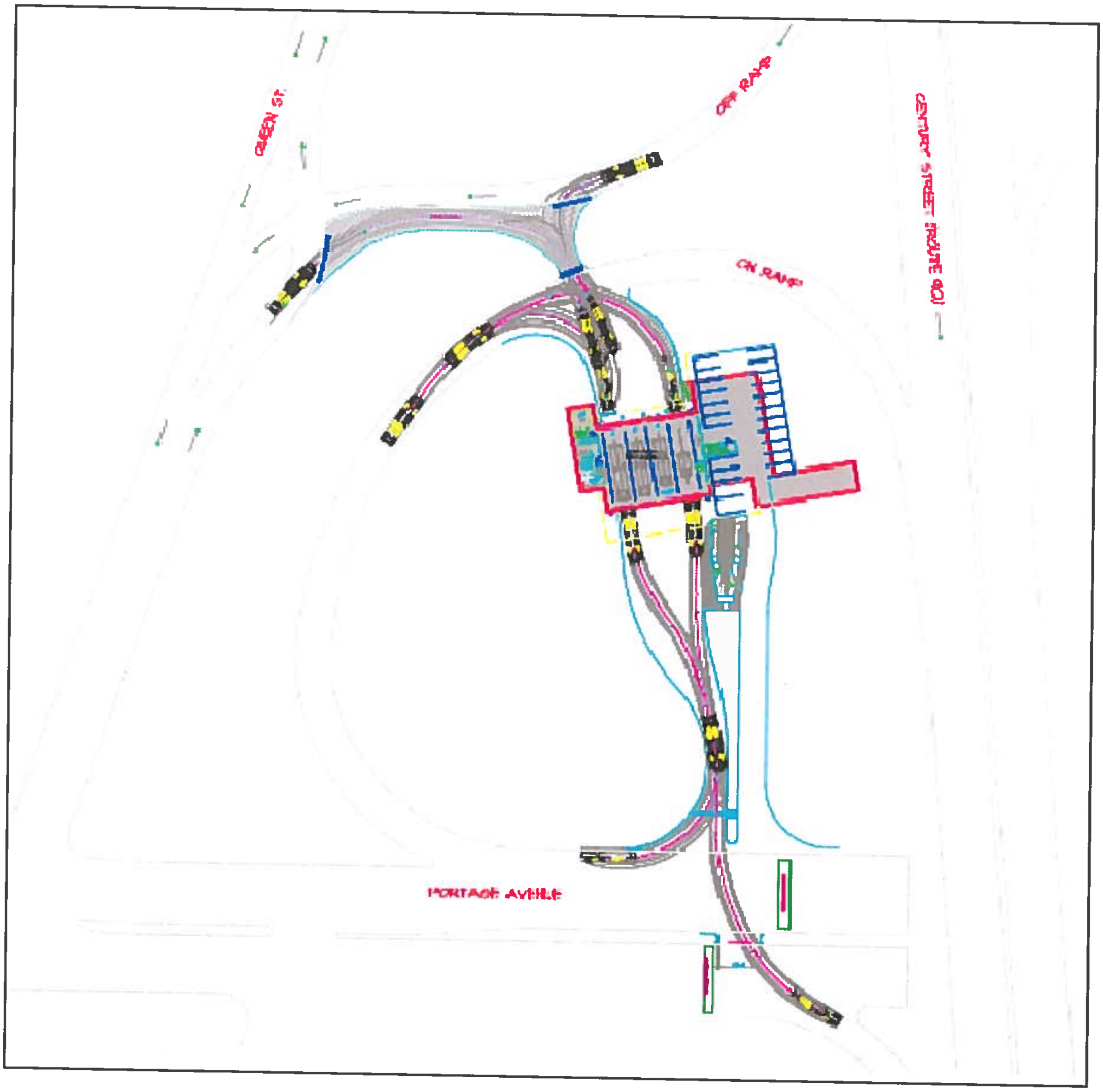


Figure 3.1: Proposed Site Access

4.0 EXISTING TRAFFIC CONDITIONS

4.1 EXISTING TRAFFIC VOLUMES

In order to determine existing traffic conditions within the study area, intersection turning movement counts (TMC) were provided by the City of Winnipeg at the locations listed below:

- Portage Avenue at Queen Street (June 16, 2010)
- Portage Avenue at St. James Street (March 14, 2011)

Only PM peak counts were included in the analysis as they represent the busiest traffic period in the study area. Vehicle classification counts were included in the data provided and used to determine the amount of heavy vehicle traffic at existing intersections. The City also provided 2009 PM peak interchange ramp traffic data developed as part of the on-going Kenaston Boulevard study being conducted by MMM. This data was used in conjunction with the intersection TMC to develop pre-development peak hour traffic volumes for the study area.

Since traffic volume on commuter routes in urban areas is usually consistent throughout the year, seasonalization of the TMC data was considered unnecessary. In addition, there has been no significant area development in the past year and the June 2010 count at Queen Street was assumed to represent existing traffic conditions. Similarly the 2009 ramp intersection volumes were assumed to represent existing traffic volumes.

All count data used in the analysis is provided in *Appendix A.*

4.2 PEAK HOUR TRAFFIC VOLUME

The existing PM peak hour traffic volumes at intersection within the study area are illustrated in Figure 4.1.

4.2.1 Peak Hour Factor

Based on the TMC data, individual peak hour factors (PHF) were calculated for each intersection and are listed in Table 4.1. Since no 15 minute interval count data was available for ramp intersections, a PHF of 0.96 was assumed for all interchange ramps. These PHF were used to analyze existing traffic conditions.

Table 4.1: Intersection Peak Hour Factors – PM Peak

Study Area Intersection	PM Peak PHF
Portage Avenue at Queen Street	0.96
Portage Avenue at St. James Street	0.96

4.2.2 Traffic Volume Expansion

Because the available peak hour traffic volumes were collected in different years they must be expanded to develop existing (2011) traffic conditions. Similarly, the volumes must be expanded to 2012 to project background traffic conditions for the expected completion of the Core Fire Hall.

Based on similar studies in the surrounding area, an average annual growth rate of 1.0% was assumed. Equation (a) listed below was used to develop expansion factors applicable to the available count data year.

$$E_f = (1 + G_r)^n \qquad \text{equation (a)}$$

where: E_f = expansion factor
G_r = annual growth rate
n = no. of years

4.2.3 Traffic Volume Balancing

Because there are various commercial establishments and local streets between the intersections of Portage Avenue at Queen Street and St. James Street, traffic volume balancing between the two intersections was not considered necessary. The commercial land uses and local street intersections along Portage Avenue will act as sources/sinks of vehicle trips and will account for the unbalanced volumes between the two.

4.2.4 Design Year Traffic Volume

The 2012 PM peak Pre-Development design year traffic volume at study area intersections is provided in Figure 4.2. The annual 1.0% growth rate was also used to develop 2022 pre-development volumes to allow a 10 year design horizon. The 2022 design year traffic is illustrated in Figure 4.3.

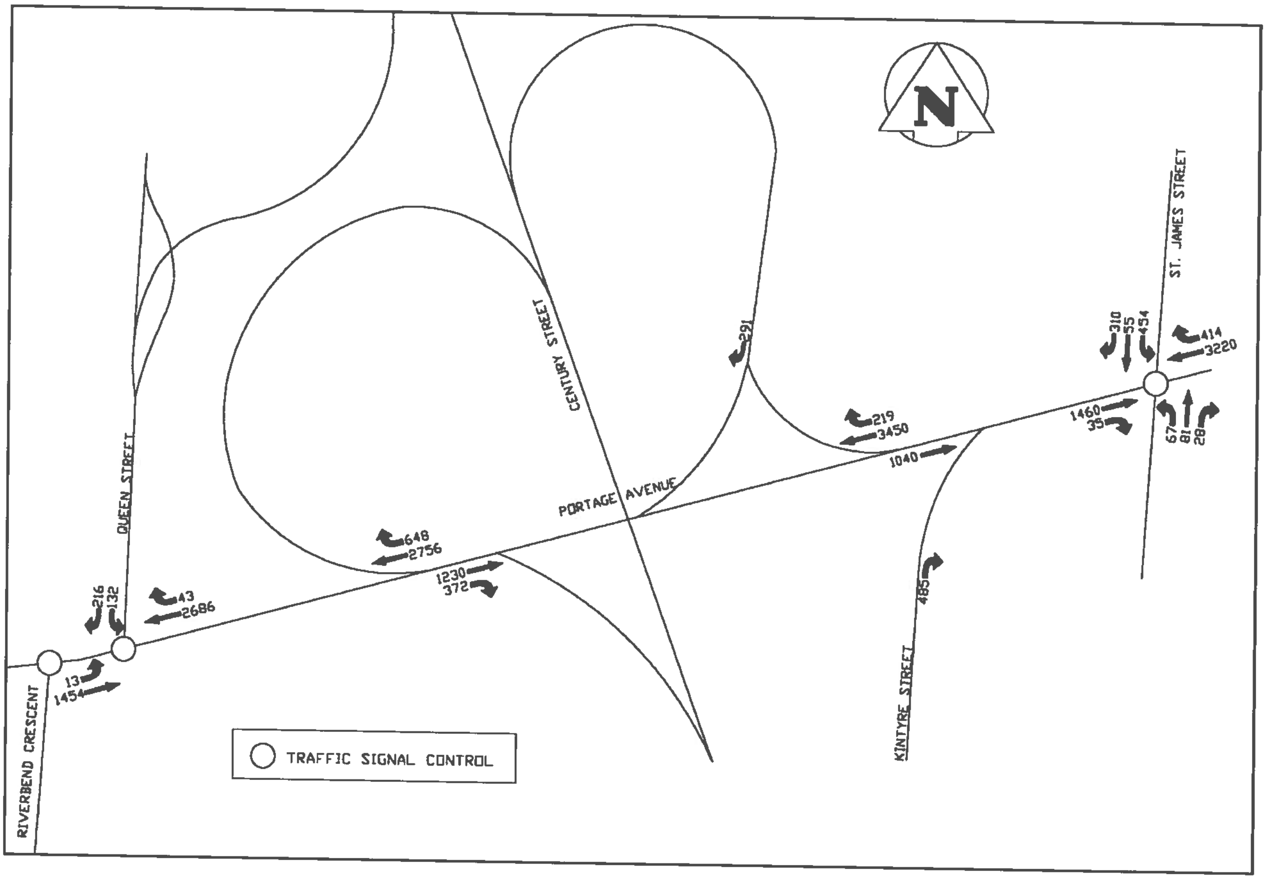


Figure 4.1: 2011 PM Peak Existing Traffic Conditions

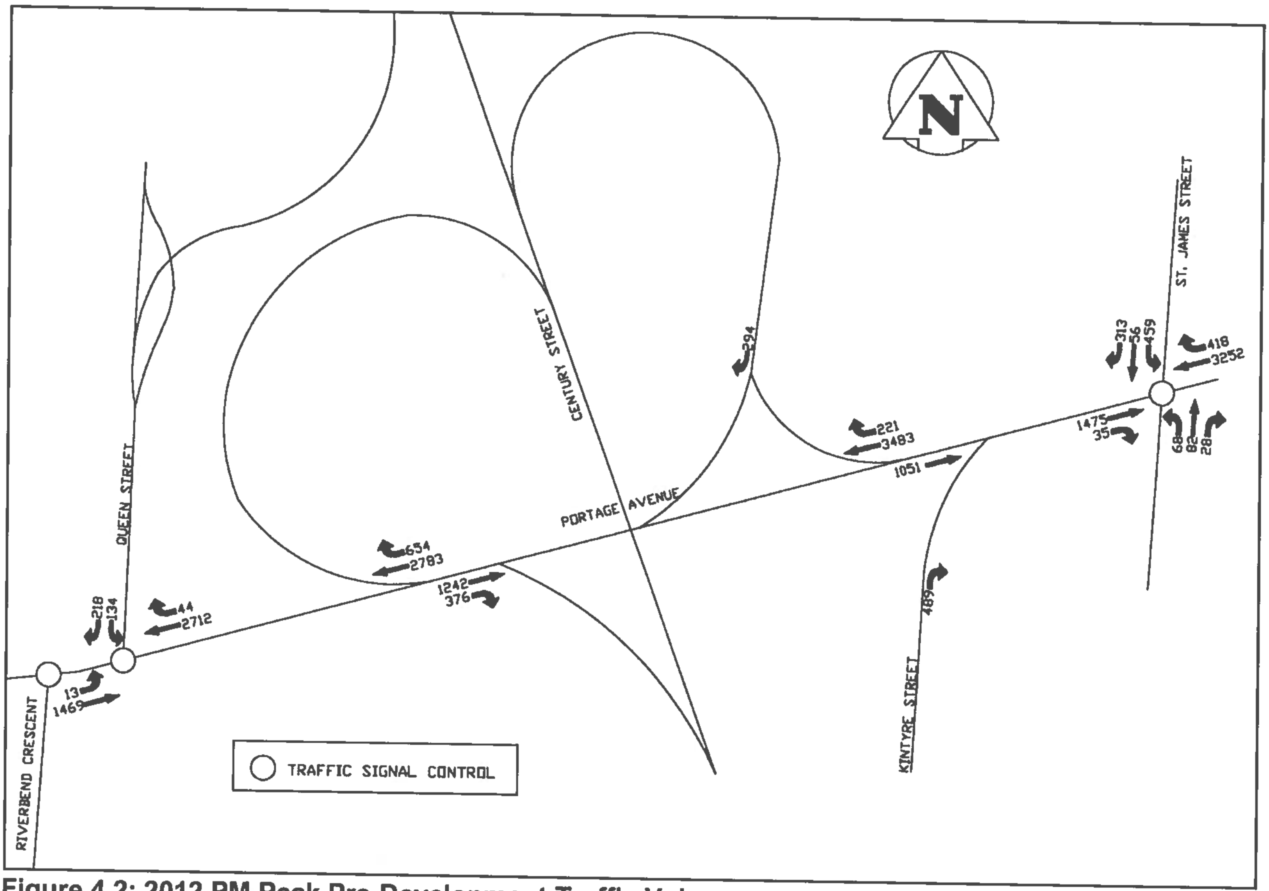


Figure 4.2: 2012 PM Peak Pre-Development Traffic Volume

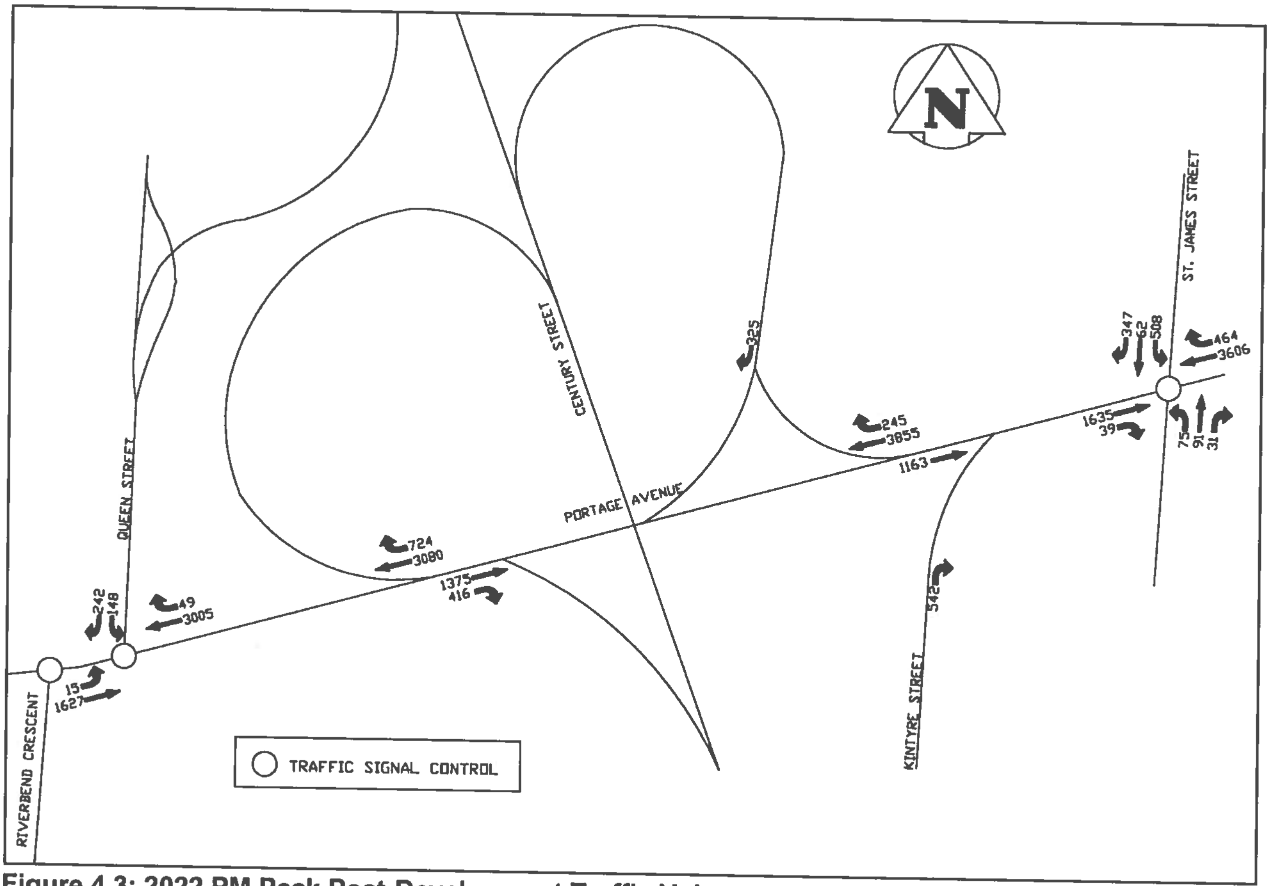


Figure 4.3: 2022 PM Peak Post-Development Traffic Volume

5.0 DEVELOPMENT TRIP GENERATION

5.1 TRIP GENERATION

Based on information provided by Winnipeg Fire Paramedic Service (WFPS), the number of employees at the proposed Core Fire Hall will be approximately 15 per shift. Emergency staff work 10 to 14 hour shifts with start and end times that typically do not coincide with peak traffic on the adjacent streets. Because of the low number of employee trips during peak periods, it was assumed that employee generated traffic would not significantly impact traffic operations during the AM and PM peak. Similarly, deliveries to the fire hall will likely be infrequent and can be scheduled to avoid peak traffic periods on the adjacent streets.

However, with the proposed emergency activated signals emergency response during peak traffic periods will disrupt traffic operations on Portage Avenue. Similarly, emergency vehicle return trips will impact operations on the westbound to southbound loop ramp during congested traffic periods. The number of fire related emergency dispatches in 2010 responded to by the existing Station 11 fire hall on Berry Street was provided by WFPS and is listed in Table 5.1 and illustrated in Figure 5.1.

Table 4.1: 2010 Responses from Station 11 – All Fire Calls

Unit	NW (North of Assiniboine River and west of Route 90)	NE (North of Assiniboine River and east of Route 90)	South (South of Assiniboine River)	Total Dispatches
E11	390	409	307	1,106
R11	820	357	511	1,688
Station 11 Total	**1,210**	**766**	**818**	**2,794**

In discussions with WFPS, based on projected needs over the life of the new Core Fire Hall it is expected that the response rate for both fire and medical emergencies could increase to as much as 6,000 – 7,000 per year. Since these calls are random throughout the day it is difficult to determine how many are likely to occur during peak traffic periods.

On an average basis with 7,000 dispatches per year we can expect 19 calls per day or 0.8 calls per hour. In order to be conservative, this was increased to a maximum of three (3) calls during the PM peak to gauge the impact of operating the Portage Avenue emergency signal on traffic operations.

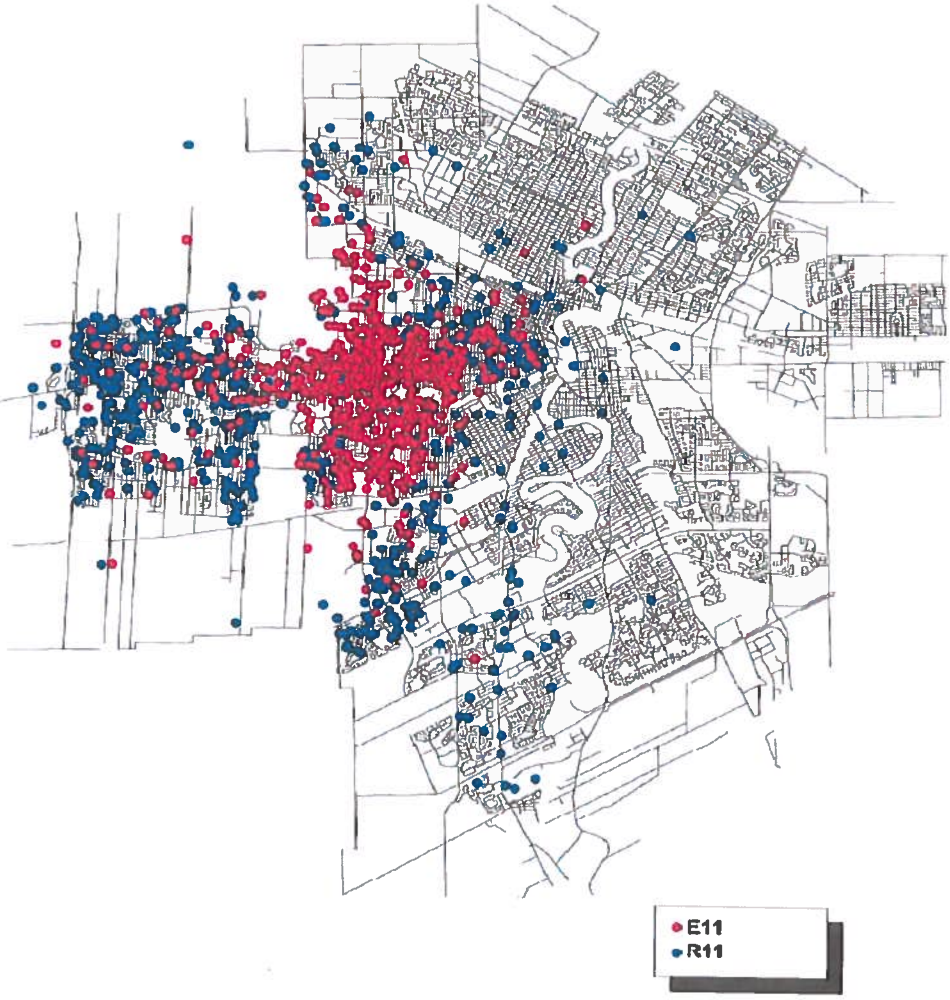


Figure 5.1: 2010 Response from Station 11 – All Fire Calls

5.2 TRIP DIRECTIONAL DISTRIBUTION

The directional distribution of emergency response trips was predicted by analyzing the existing dispatch patterns for the Berry Street fire hall and based on discussions with WFPS. These discussions indicate additional calls to the north River Heights area are anticipated as a result of relocating the existing Grosvenor Fire Hall to Taylor Avenue. The resulting trip distribution is as follows:

- North and west of the proposed site using Portage Avenue, 33%
- North and east of the proposed site using Portage Avenue, 33%
- South of the proposed site using Century Street, 33%

5.3 DESIGN YEAR TRAFFIC VOLUMES

The expected maximum of 3 emergency dispatches during the PM peak hour was added to the 2012 and 2022 pre-development volume using the trip directional distribution listed above to allow analysis of the impact on traffic operations.

6.0 ACCESS ANALYSIS

Prior to analyzing the impact of the proposed fire hall on traffic operations, the proposed access and site layout was analyzed to identify potential safety and/or operational issues. These are discussed below along with recommended access and/or site layout modifications.

6.1 ORIGINAL PROPOSED SITE ACCESS

Upon review of the proposed site access, the issues listed below were identified as having the potential to create safety and/or operational problems:

- Returning emergency vehicles from the north using the southbound Century Street to Queen Street off-ramp may create a safety concern. This is due to the relatively high running speed of vehicles on the off-ramp (56 km/h) and the short distance to the proposed access lane intersection (65 m). It was felt there is insufficient stopping sight distance which would increase the possibility of rear end collisions at this location.
- With the access lane being located on the outside of southbound Century Street to Queen Street ramp curve, traffic may turn onto the new roadway instead of following the ramp alignment.
- Emergency vehicles using the Queen Street access crossing the westbound to southbound Portage Avenue off-ramp to enter the north approach can result in collisions with vehicles travelling on the ramp. Even if proper stopping sight distance is available, drivers are busy negotiating the ramp curve and are not looking down the ramp or anticipating a vehicle crossing in front of them.
- Non-emergency vehicles may use the access lane from Queen Street to short-cut the westbound to southbound loop ramp.
- The proposed Queen Street access lane increases the pedestrian crossing distance on the east sidewalk along Queen Street.
- Vehicles exiting from the north approach of the site onto the loop ramp (i.e. garbage trucks) to go south on Century Street will have difficulty seeing far enough up the ramp to make the turn safely. This will be a particular problem in winter with large snowpiles blocking drivers view.
- Northbound traffic on Queen Street may inadvertently drive into the emergency access lane.
- The south approaches are located along the weaving lane of Portage Avenue, which causes conflict with vehicles entering/exiting the interchange.
- The proposed median cut on Portage Avenue for exiting emergency vehicles may result in fire hall employees and/or delivery vehicles making an illegal left turn to go eastbound on Portage Avenue.

- The emergency signals on Portage Avenue may create a demand for an additional pedestrian crossing at this mid-block location.
- Staff and delivery scheduling may conflict with peak hour volumes of traffic.
- The museum display at the southeast corner of the building could cause a visual distraction for drivers on Portage Avenue and Route 90. In particular, southbound drivers on Century Street may be distracted at the exact location where loop ramp traffic is merging into southbound traffic with a short acceleration lane.
- Travelling eastbound on Portage Avenue on the south side, Viscount Hotel has an electric sign that could diminish visibility of a proposed emergency activated signal in the curb lane.
- Travelling eastbound on Portage Avenue in the median lane at Queen Street, visibility of proposed signals in the median is reduced due to the two traffic signals and a No-U-Turn sign in the median.
- Westbound on Portage Avenue before the proposed south in/out approach an overhead sign may diminish visibility of a proposed emergency activated signal in the curb lane for vehicles driving in the curb lane.
- Providing a lane adjacent to the current weaving lane on westbound Portage Avenue for school bus parking can result in users maneuvering into the lane when it is not being used assuming it is the start of the westbound to southbound off ramp. Also, school buses exiting the lane into a weaving lane are a hazard.

Each of these issues must be addressed in order to minimize safety concerns and mitigate operational issues resulting from the proposed fire hall development. It is interesting to note that although accesses on interchange ramps and loops are very unusual, one such access already exists within the Portage Avenue at Century Street interchange. A private approach to a commercial development is located on the westbound to northbound off-ramp from Portage Avenue to Century Street. This access likely dates back to the original construction of the interchange at a time when design standards were much different than today.

6.2 ACCESS MODIFICATIONS

Several access modifications have been developed which address or mitigate the issues listed above. These are presented below and can form the basis for continued discussion on safe and appropriate access for the proposed Core Fire Hall:

- Emergency activated traffic signals have been proposed for eastbound/westbound Portage Avenue at the proposed one-way southbound emergency access. These could be controlled from within the Fire Hall and would only be activated to provide a gap for exiting emergency vehicles. Three options are available for the emergency signals:
    1. Typical three-section traffic control signal that would stay green until activated by an emergency and sequence through an amber clearance interval to a steady red indication for sufficient time to allow an emergency vehicle to safely exit the

site. Use of a typical signal at this location may create demand for mid-block pedestrian crossing.

2. A fire truck entrance traffic control (Canada MUTCDC) consisting of a red ball indication above an amber ball indication mounted within a yellow backboard. Accompanying the signal is a tab sign (ID-22SR or ID22SL) mounted below indicating the direction the emergency vehicle would enter the road. This signal is not illuminated until activated by an emergency. Typical signal sequencing is a short flashing amber followed by a steady amber clearance interval and a flashing red ball indication for sufficient time to allow an emergency vehicle to safely exit the site.
3. An emergency vehicle hybrid beacon (US MUTCD) consisting of two red ball indications above an amber ball indication mounted on a black backboard. This signal is not illuminated until activated by an emergency. Typical signal sequencing is a short flashing amber followed by a steady amber clearance interval and alternating (wig-wag) flashing red ball indications for sufficient time to allow an emergency vehicle to safely exit the site. Use of this device will require Highway Traffic Board approval.

Under all three options a stop sign would face southbound exiting emergency vehicle traffic.

- Return of emergency vehicles via the southbound Century Street to Queen Street ramp from Century could have an extended access lane adjacent to the off ramp to taper their speed and eliminate the originally proposed left turn off of the ramp that would cause abrupt stopping by traffic exiting Century Street.
- Eliminate the access from the southbound Century Street to Queen Street ramp to prevent collisions with high speed traffic exiting Century Street and the possibility of traffic entering the new lane. This will require emergency vehicles from the north navigating to an alternate route to return to the fire hall via the access lane off Queen Street or via the westbound to southbound loop ramp.
- Provide a median separation between the proposed Queen Street access lane and the adjacent southbound Century Street to Queen Street off ramp to increase safety while providing a refuge for pedestrians crossing the two lanes along the east sidewalk of Queen Street. Providing a median separation while maintaining adequate lane width for a fire truck likely requires purchase of additional right-of-way from the parking lot of the adjacent St. James Hotel.
- To prevent collisions with emergency vehicles crossing the westbound to southbound loop ramp from Portage Avenue, a signal could be implemented at this crossing. Activation of the signal could be via a vehicle detection system installed in the access lane or from within the fire hall. The location of the signal should be far enough from the crossing to minimize potential for collisions at the crossing, while making sure the crossing is visible, but not far enough back that traffic would be backing up into the weaving lane during peak hours. To provide warning of emergency vehicle crossing at

the rear due to the variability of sight lines along the curve of the westbound to southbound off ramp, advance warning beacons can be provided.

- To prevent unauthorized use of the Queen Street access lane by short-cutting traffic a gate system could be installed across the lane at Queen Street. This could be activated from within the fire truck or from within the fire hall. Alternately a mountable curb could be installed at the Queen Street entrance along with emergency use only signs to discourage use by the public.
- Move garbage pickup to the front and provide a service vehicle parking stall from the front building access to have all rear entrance traffic restricted to emergency vehicles only. The size and type of these vehicles needs to be determined in order to provide adequate height and maneuvering space.
- To prevent the public from inadvertently entering emergency paths and entrances the use of mountable curbs could be implemented to identify emergency vehicle only access.
- To prevent non-emergency vehicles from attempting to exit from the south approach and making a southbound to eastbound left turn the median cut could be shifted west to assure that access can only be gained by emergency vehicles exiting the one-way emergency south approach. In addition, mountable curbs and/or gating systems could be installed to discourage use by the public.
- Scheduling staff shift changes and deliveries around peak times will reduce conflict with the weaving lane.
- Relocating the museum display to the west side of the building will prevent visual distractions along Century Street, but still impacts traffic on Portage Avenue in the weaving lane. This is an already complex area for drivers who do not expect accesses within an interchange.
- Eliminating the museum display would greatly reduce visual distractions from both Portage Avenue and Century Street.
- Eliminate the school bus parking adjacent to the weaving lane to minimize potential safety impacts.
- To make a proposed signal in the curb lane eastbound on Portage Avenue more visible a larger backboard could be used.

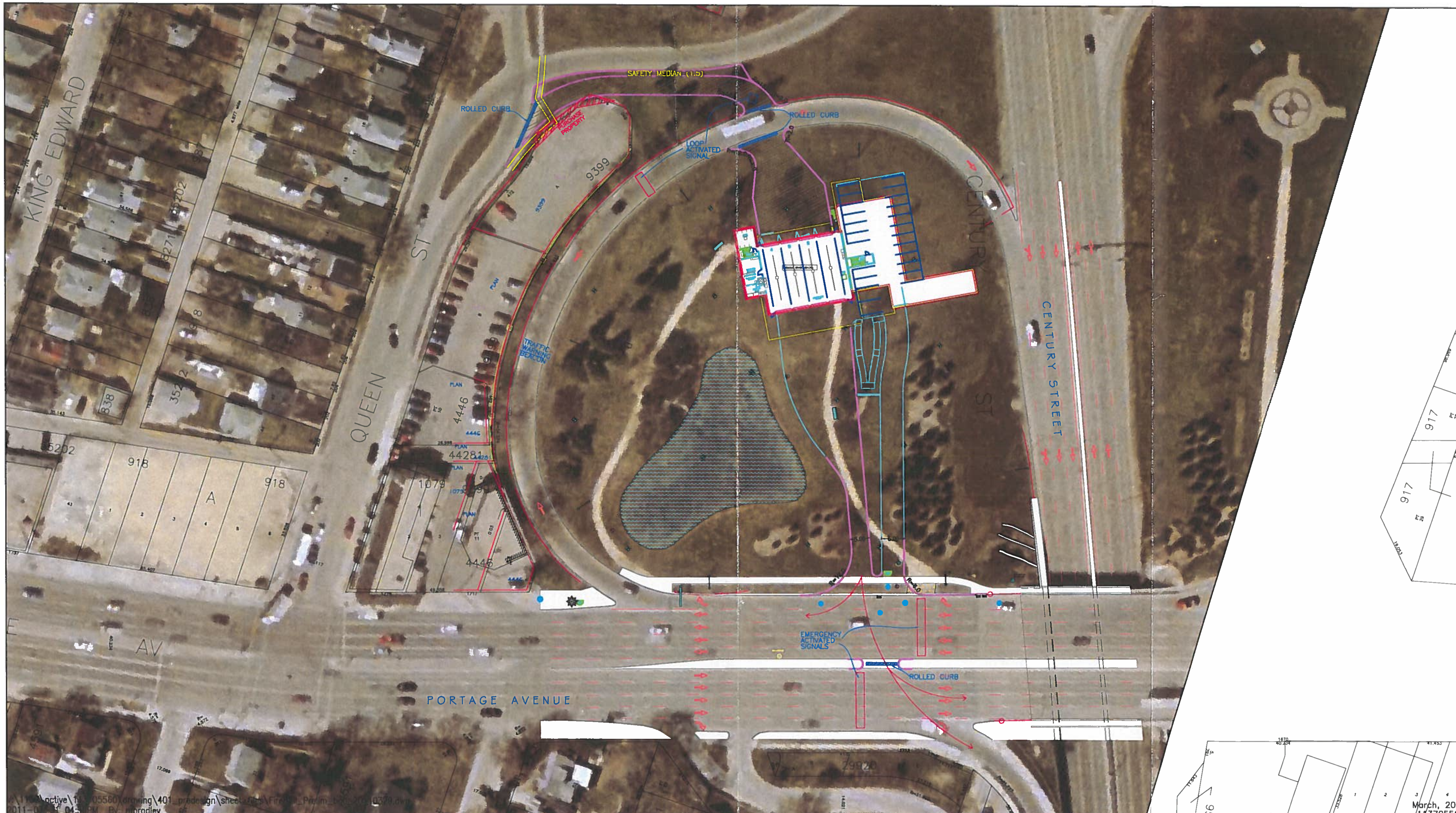
6.3 ACCESS RECOMMENDATIONS

Based on the access and traffic control modifications listed above, Stantec recommends the following be implemented:

- The use of option 2 or 3 for the emergency activated signal at the south approach is recommended as it is felt that these two types of signals would be more effective in alerting users of Portage Avenue of crossing emergency vehicles. Also, signals of this type should minimize demand for mid-block pedestrian crossing.

- Emergency activated signals on Portage Avenue should be located in both the median and boulevards with a minimum of two signal faces per approach to ensure signals are visible from all lanes of traffic.
- Return of emergency vehicles via the southbound to westbound ramp from Century has been eliminated. It was felt that southbound traffic exiting Century would be travelling too fast to slow down safely for emergency vehicles turning onto a separate lane. Also, with the separate lane being located on the outside of the ramp curve, traffic may turn onto the new roadway instead of following the ramp alignment.
- The proposed access lane from Queen Street was retained; however a minimum 1.5 m safety median was included to improve separation with the southbound Century Street to Queen Street off ramp. Also, the widened median provides a refuge for pedestrians crossing the Queen Street emergency access lane and the southbound Century Street to Queen Street ramp, along the east sidewalk on Queen Street. To maintain a 5.0 m access lane will likely require purchase of an approximately 2.0 m wide strip of land from the parking lot of the St. James Hotel.
- The entrance and exit to the access lane off Queen Street would include mountable curbing or similar to deter use by the public. Similarly the rear access and the Portage median opening would include mountable curb. In addition, these accesses would be signed for emergency vehicle use only.
- A traffic signal is proposed for the westbound to southbound Portage Avenue off ramp. This would be controlled by a vehicle detector located in the access lane off Queen Street. Due to available sightlines, an advance warning beacon would also be required on the loop ramp. Location of the signal will have to be further assessed to allow for safe and comfortable stopping for traffic using the ramp.
- Garbage pickup would be relocated to the front of the site. In this way all employee/delivery/garbage access would be via the right in / right out off Portage with the rear access only being used by returning emergency vehicles.
- Locate the median curb cut so that it is only accessible by emergency vehicles exiting the one-way south approach exit, as well as having proper signage indicating emergency vehicle access only.
- Recommend to the Fire Hall to schedule shift changes and deliveries around peak hour volumes to minimize conflict with traffic.
- The museum display and need for school bus parking would be eliminated to minimize distractions to traffic along Century Street and Portage Avenue within the interchange.

These changes are illustrated in Figure 6.1.



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Client/Project
Shindico
Core Fire Hall
Access Study (DRAFT)

Figure No.
6.1

Title
Recommended Access Management Plan

7.0 TRAFFIC ANALYSIS

7.1 ANALYSIS BACKGROUND

The purpose of this task is to analyze traffic operations on the roadway network adjacent to the Core Fire Hall, assess the impact of anticipated emergency response traffic and develop appropriate mitigation and traffic control strategies. The traffic analysis includes projected background traffic growth over the 2012 design year, and analysis of 2022 pre and post-development traffic conditions.

7.1.1 Vehicle Delay Based Intersection Analysis (Highway Capacity Manual Methodology)

Traffic analyses for signalized and unsignalized intersections are typically conducted according to methodology developed by the Transportation Research Board (TRB) and as published in the *2000 Highway Capacity Manual* (HCM). Most of the analyses concern estimates of vehicle delay under various traffic volumes, roadway configurations and traffic control strategies. The delay estimates are used as the basis for determining intersection performance. According to the HCM, the relative performance of an intersection depends on a number of different factors including:

- **Level of Service (LOS)** - measures the average delay per vehicle during a 15-minute analysis period. Levels of service range from A to F (minimal delay to unacceptable delay) and may be measured on an intersection, approach, or per movement basis.
- **Degree of Saturation** - measured in terms of a ratio of demand flow rate (v) to maximum capacity (c); intersections with volume to capacity (v/c) ratios ≥ 1.0 are at full capacity and likely experience severe congestion.
- **Vehicle Delay** – average vehicle delay on an intersection, approach or per movement basis. Measured in seconds per vehicle or total hours of delay during the peak hour under analysis.

For design and planning purposes, LOS of D or better are usually considered acceptable under peak hour traffic conditions. Tables 7.1 and 7.2 summarize the LOS for signalized and unsignalized intersections respectively as listed in the 2000 edition of the HCM.

Table 7.1: Signalized Intersections - HCM Level of Service Characteristics

HCM Level of Service	Average Signal Delay per Vehicle (sec/veh)	Characteristics
A	≤ 10	Free flow, low volumes and high speeds, most drivers can select own speed
B	> 10 and ≤ 20	Stable flow, speed restricted slightly by traffic
C	> 20 and ≤ 35	Stable flow, speed controlled by traffic
D	> 35 and ≤ 55	Approaching unstable flow, low speed
E	> 55 and ≤ 80	Unstable flow & speeds, volumes at/near capacity
F	> 80	Forced flow, low speed, volume above capacity

Table 7.2: Unsignalized Two-Way and All-Way Stop Control Intersections - HCM Level of Service Characteristics

HCM Level of Service	Total Delay (sec/veh)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

7.2 ANALYSIS METHODOLOGY

The intersections within the study area were analyzed using the computer program SYNCHRO ver. 7.0. SYNCHRO analyzes both signalized and unsignalized intersections in terms of LOS, delay and queues according to the methodology detailed in the 2000 edition of the HCM. It can be used to evaluate existing operations or to optimize traffic signal phase configurations, timing splits, and cycle lengths. The program also optimizes coordinated signal networks and their associated cycle offsets. For purposes of this study, SYNCHRO was used to analyze intersection operations and to optimize signal phasing, offsets and arterial coordination under existing and projected volume conditions.

7.2.1 Traffic Analysis Assumptions

In order to perform the capacity analysis and network optimizations, it was necessary to make a number of assumptions regarding existing traffic conditions at intersections in the study area. These include:

- Available heavy vehicle data from classification count data was used at all locations. Where no data was available a minimum heavy vehicle percentage of 2% was assumed.

- On street parking was allowed where permitted during the peak hours under analysis
- Ideal saturated flow for HCM analysis method = 1900 veh/hr (equivalent to 1800 pcu/hr in Canadian Capacity Guide)
- Minimum yellow clearance interval = 4 sec.
- Minimum all-red clearance interval = 1 sec.
- Lost time = 5 seconds (4 sec. yellow + 1 sec. all-red)
- Right turns on red are permitted movements
- All lanes were assumed to be minimum 3.7 m wide
- Minimum 10 pedestrian calls per hour on all cross movements.
- Pedestrian walk speed of 1.2 m/sec.

7.2.2 Traffic Control Assumptions

Based on the traffic control data gathered for the study, all major intersections in the study area operate under signal control with a cycle length of 120 seconds. The existing cycle length was used to analyze 2012 pre-development traffic volumes, however, both cycle length and phasing were optimized under 2022 pre and post-development conditions.

7.2.3 Traffic Simulation

In addition to the intersection/network analysis and optimizations, a traffic simulation program, SIMTRAFFIC, was used to validate roadway geometry and traffic control to ensure actual conditions were modeled as accurately as possible. It also provided a means for determining the suitability of various traffic control and geometric improvement alternatives. The primary benefit of traffic simulation is the identification of locations where significant queuing creates spillback that blocks adjacent lanes and/or affects upstream intersection operations. The HCM methodology does not include the potential for spillback in its intersection evaluations.

7.3 PM PEAK TRAFFIC ANALYSIS RESULTS

The existing roadway and intersection geometry, and traffic control were used as the basis for all analyses. This includes operating the southbound left turn at St. James Street as a protected-permitted movement. Since no specific information is available regarding actuated signal control including detector location, gap reduction or recall modes, all signals were assumed to operate as pre-timed. Due to limitations with the Synchro model which limit the maximum cycle length to 900 seconds, the emergency signal was analyzed with four actuations per hour. This equates to four emergency dispatches during the PM peak rather than the three anticipated but will result in a more conservative evaluation of possible impacts.

The street network was analyzed under 2012 pre and post-development conditions to determine the impact of the emergency signal and returning emergency vehicle traffic on roadway operations. The 2022 design year was also analyzed with and without the emergency vehicle signal in operation to determine the impact on future roadway traffic. All recommended access modifications listed in Section 6.3 above were also included in the Synchro model.

The calculated LOS is provided on an intersection basis below along with delays per vehicle and maximum volume to capacity ratios. Critical movements with LOS of D or worse are described along with potential mitigation measures. Unless noted otherwise, all queues remain within existing storage lanes with no blocking of adjacent through lanes. Detailed analysis results are provided in *Appendix C*.

7.3.1 Portage Avenue at Queen Street

The traffic analysis results for the signal controlled intersection of Portage Avenue at Queen Street are listed in Table 7.3

Table 7.3: Portage Avenue at Queen Street Intersection Analysis Results

Design Year	PM Peak Hour		
	LOS	Delay (sec/veh)	v/c Ratio
2012 Pre-Development	A	8.1	0.67
2012 Post-Development	B	15.6	0.68
2022 Pre-Development	A	8.4	0.74
2022 Post-Development	B	16.9	0.75

Existing intersection operation and the impact of the development-generated trips can be summarized as follows:

- Under 2012 pre-development traffic volumes the signal controlled intersection operates at LOS A with acceptable delays. The v/c ratio indicates there is capacity remaining to accept additional traffic loading. Portage Avenue east and westbound operate at LOS A with delays of 10 sec/veh or less while southbound movements on Queen Street operate at an acceptable LOS D with delays of 40.4 sec/veh. The delay on Queen Street is a consequence of the long (120 second) existing cycle length at this location.
- Under 2012 post-development conditions intersection LOS reduces from A to B and intersection delay increases from 8.2 to 15.6 sec/veh. Eastbound and westbound Portage Avenue operate at LOS B with approach delays of 10.6 and 15.0 sec/veh respectively. Southbound Queen Street continues to operate at LOS D with delays of 40.5 sec/veh.
- Under 2022 pre-development conditions the intersection operates at LOS A. The eastbound approach on Portage is at LOS B with delays of 10.2 sec/veh while the westbound approach remains at LOS A. Southbound Queen Street remains at LOS D with delays of 42.0 sec/veh.

- Under 2022 post-development conditions the intersection operates at LOS B. The eastbound and westbound approaches on Portage are at LOS B with delays of 10.7 sec/veh and 16.8 sec/veh respectively. Southbound Queen Street remains at LOS D with delays of 43.4 sec/veh.

Under both pre and post-development conditions the intersection operates at an overall LOS B or better. Movements on Queen Street operate at LOS D under all traffic conditions but this is a consequence of the long cycle length at this location. The reduction in LOS from A to B on the Portage Avenue approaches and the increase in overall intersection delay under post-development volumes is a result of the emergency signal. This actuates randomly four times per hour which impacts coordinated signal operations along Portage. After passage of the emergency vehicle it may take 3-4 cycles to re-synchronize east and westbound vehicle platoons on Portage Avenue.

7.3.2 Portage Avenue at St. James Street

The traffic analysis results for the signal controlled intersection of Portage Avenue at St. James Street are listed in Table 7.4 (PTH 16 east-west, Co-op Driveway north-south).

Table 7.4: Portage Avenue at St. James Street Intersection Analysis Results

Design Year	PM Peak Hour		
	LOS	Delay (sec/veh)	v/c Ratio
2012 Pre-Development	C	30.7	0.97
2012 Post-Development	C	33.6	0.98
2022 Pre-Development	D	43.7	1.06
2022 Post-Development	D	48.9	1.10

Existing intersection operation and the impact of the development-generated trips can be summarized as follows:

- Under 2012 pre-development traffic volumes the intersection operates at LOS C. The high v/c ratios of the westbound through (0.97) and the southbound left (0.91) indicate this intersection is near saturation. Both the westbound through and the southbound left operate at LOS D with delays of 35.8 and 54.8 sec/veh respectively. The relatively low volume northbound approach operates at LOS E with delays of 63.7 sec/veh. This movement is penalized in terms of available cycle time to minimize delays on Portage Avenue and southbound St. James Street.
- Under 2012 post-development conditions the intersection continues to operate at LOS C. The v/c ratios of the westbound through and the southbound left increase slightly to 0.98 and 0.95 respectively. The westbound through remains at LOS D with delays increasing from 35.8 to 39.1 sec/veh. Delay on the southbound left increases from 54.8 to 62.5 sec/veh and the LOS drops from D to E. The northbound approach remains at LOS E with delays increasing to 68.9 sec/veh.

- Under 2022 pre-development conditions the intersection LOS is D. The westbound approach operates at LOS D with delays of 47.7 sec/veh, however, the v/c ratio for this movement increases to 1.04 indicating it is above capacity and likely experiences longer delays than calculated. The southbound left has LOS F with delays greater than 90 sec/veh and a v/c ratio of 1.06. The northbound approach also operates at LOS F with delays of 103.1 sec/veh and a v/c of 0.96.
- Under 2022 post-development conditions the intersection LOS remains D however intersection delays increase from 43.7 to 48.9 sec/veh. The westbound approach LOS remains at D but delays increase from 47.7 to 53.2 sec/veh. The v/c ratio for this movement is 1.05 which is similar to that under pre-development conditions. The southbound left remains at LOS F but delays increase to 102.8 sec/veh and the v/c ratio increases from 1.06 to 1.10. The northbound approach remains at LOS F with delays increasing from 103.1 to 120.4 sec/veh and a v/c of 1.02.

Under 2012 pre-development conditions, this intersection is at or near full capacity with little capacity remaining to accommodate additional traffic. As at the Queen Street intersection, actuation of the emergency signal impacts traffic progression along Portage Avenue. Since this location is already congested with very high v/c ratios on multiple movements, the lack of coordination impacts delays on several movements. However, intersection operations under the 2012 post-development traffic are similar to those currently experienced.

After adding the expected background growth over the 10 year design horizon, several movements at this location exceed the available capacity and long delays are likely. This is made worse by the emergency signal disrupting coordinated traffic along Portage Avenue. A possible geometric improvement was investigated to determine if traffic operations could be improved at this location under the projected 2022 design volumes. This involved the following:

- Eliminate the southbound through movement in order to provide dual protected southbound lefts (all throughs were added to the southbound left turn).
- Eliminate the northbound left and through movements and operate the northbound approach with a single right turn only lane (all left and throughs were added to the northbound right turn).

With the modified geometry, the intersection operation under 2022 pre and post-development volumes is provided in Table 7.5 below:

Table 7.5: Portage Avenue at St. James Street - Modified Geometry (dual SB lefts, single NB right turn only)

Design Year	PM Peak Hour		
	LOS	Delay (sec/veh)	v/c Ratio
2022 Pre-Development – modified geometry	D	40.8	1.04
2022 Post-Development – modified geometry	D	45.4	1.05

As a whole the intersection operated similarly with both the existing and the modified geometry. However, several critical movements are improved as described below:

- Under 2022 pre-development conditions the intersection LOS is D but delays reduce from 43.7 to 40.8 sec/veh. The westbound approach remains at LOS D with delays of 47.7 sec/veh and a v/c ratio of 1.04. The southbound left improves from LOS F to LOS E and delays reduce from 90.7 to 59.6 sec/veh with v/c dropping from 1.06 to 0.86. The LOS on the northbound approach also improves from F to E with delays reducing from 103.1 to 73.3 sec/veh and v/c reducing from 0.96 to 0.83.
- Under 2022 post-development conditions the intersection LOS remains D but delays reduce from 48.9 to 45.4 sec/veh. The westbound approach is unchanged compared to the original intersection geometry with LOS D, delays of 53.2 sec/veh and a v/c ratio of 1.05. However, the southbound left improves from LOS F to E, delays reduce from 102.8 to 64.4 sec/veh, and v/c drops from 1.06 to 0.89. The northbound approach remains at LOS F but delays reduce from 120.4 to 83.7 sec/veh and the v/c reduces from 1.02 to 0.89.

The modified intersection geometry improves southbound and northbound operations significantly but does not result in similar benefits for traffic on Portage Avenue. In particular, the westbound movement remains over capacity with long delays likely.

The improvements could be implemented without major widening on St. James Street but would likely require construction of channelization islands. It would also have a large impact on access to the existing commercial and residential developments south of Portage Avenue.

7.3.3 Loop Ramp at Rear Access Signal

The traffic analysis results for the signal controlled intersection on the westbound to southbound loop ramp from Portage Avenue to Century Street are listed in Table 7.6.

Table 7.6: Loop Ramp at Rear Access Intersection Analysis Results

Design Year	PM Peak Hour		
	LOS	Delay (sec/veh)	v/c Ratio
2012 Post-Development	A	3.1	0.38
2022 Post-Development	A	3.5	0.41

In terms of delay, the proposed traffic signal at the rear access does not have an impact on ramp operations. As discussed above, it may create a safety concern if sightlines are inadequate for approaching traffic to stop safely.

7.4 TRAFFIC ANALYSIS SUMMARY

The analysis results listed above regarding the impact of the proposed Core Fire Hall during PM peak hour traffic conditions are summarized below. Please recall that the analysis results are based on four emergency signal actuations instead of the maximum of 3 emergency responses expected. Also, that the three responses per hour is a very conservative estimate; based on averages throughout the day, only 0.8 responses per hour are expected. As such the analysis results represent a worst case scenario in terms of the impact of the proposed access and traffic control on peak hour traffic operations.

- Under 2012 traffic conditions, operation of the emergency actuated signal on Portage Avenue will have only a small impact on overall traffic operations on Portage Avenue or at adjacent signalized intersections. However, each actuation of the emergency signal will disrupt traffic coordination while emergency vehicles are entering Portage Avenue and for 3-4 cycles afterward while signal operations become re-synchronized. The actuations are expected to be a maximum of three per hour and with a 120 second cycle length, there is a potential to disrupt coordinated east-west operations for 30-40% of the time during the peak hour. This accounts for the intersection delay increases under post-development traffic conditions.
- Under 2022 traffic conditions without the emergency actuated signal on Portage Avenue, the St. James Street intersection is operating at or beyond capacity and will likely experience long delays and severe congestion. Several movements have v/c ratios greater than 1.0 with poor LOS and delays longer the 90.0 sec/veh.
- Under 2022 traffic conditions with the emergency actuated signal, the disruption in coordinated east-west traffic results in only small increases in overall delay at the Queen Street intersection. However, since the St. James Street intersection is already at or over capacity, the disruption to traffic coordination has a larger impact than expected, in particular for northbound and southbound movements.
- Geometric improvements at the St. James Street intersection will likely be needed within the 10 year design horizon to improve traffic operations. In particular, the southbound left is expected to be more than 500 veh/hr which will likely require a dual left turn lane to avoid significant traffic delays. If improvements at this location are made, operation of the emergency actuated signal at the fire hall will have only a small impact on overall traffic operations.
- From a traffic analysis perspective, the installation of a signal on the westbound to southbound loop ramp from Portage Avenue to Century Street will have no significant impact on traffic operations or delays.

One method to minimize the disruption in traffic coordination along Portage Avenue is to tie operation of the signals at Queen Street and St. James Street into those at the emergency actuated signal using a pre-emption program. This is described as follows:

- Upon actuation of the emergency signal which stops east-west traffic on Portage Avenue at the fire hall exit, a pre-emption call would be placed to the signals at Queen and St. James Street.
- The pre-emption would return to or extend east-west green indication to allow any queues to disperse prior to the arrival of the emergency equipment.
- The east-west green time would be extended after departure of the emergency vehicle to allow vehicles queued at the emergency signal to arrive and pass through the intersection without causing signal starvation.
- Both signals at Queen and St. James Street would return to normal operation once the extended green hit the appropriate offset point in the cycle.

In this way disruption would be limited to 1-2 cycles only with the tradeoff being increased sidestreet delay.

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 STUDY CONCLUSIONS

Based on the analysis described above, the following conclusions can be drawn regarding the impact of the proposed Core Fire Hall on existing traffic operations:

- The Core Fire Hall Development is a proposed fire and emergency response station located within an interchange loop on the northwest corner of the Portage Avenue at Century Street interchange.
- Locating a development of any kind within an interchange does not comply with industry accepted standards regarding traffic operations and traffic safety. Interchanges are areas of high complexity for drivers with multiple on/off ramps and weaving areas. Introduction of development accesses within these areas has the potential to create serious safety and operational problems. There are examples of where this has been done but it remains very unusual.
- As originally proposed, access to the fire hall included a right in/out from Portage Avenue for employee/delivery traffic; a one-way southbound exit for emergency vehicles and a one-way southbound entrance at the rear of the site accessed from Queen Street northbound, the westbound to southbound off-ramp from Portage Avenue to Century Street and the southbound to Queen Street off-ramp from Century Street.
- The proposed development plan included accommodation for school bus parking in a lay-by lane adjacent to westbound Portage Avenue, a static museum display adjacent Century Street and rear garbage pick-up using the rear one-way access.
- Due to the nature of the development being considered, the number of trips generated during peak periods is extremely small. Based on a projected demand for emergency responses from the proposed fire hall of 19 per day, the average number of calls per hour will be 0.8. In order to be conservative this was increased to a maximum of 3 calls per hour during the PM peak.
- Several changes to the proposed access and traffic control were recommended. These include restricting the one-way inbound/outbound accesses to emergency vehicles only, an additional signal control at the rear access and changes to the routing of returning vehicles to minimize potential safety problems.
- Due to the volume of traffic on eastbound and westbound Portage Avenue a signalized intersection is required for emergency vehicles to exit the site safely.

- The speed at which vehicles travel the southbound Century Street to Queen Street off ramp, approximately 56 km/h, creates a safety hazard if returning emergency vehicles from the north are to enter the rear of the building after entering the off ramp.
- With no separation between the proposed Queen Street rear access path and the adjacent southbound Century Street to Queen Street off ramp there is possibility of vehicles on the off ramp travelling into the new lane instead of following the ramp geometry.
- The location of the access path in the rear and median curb cut on Portage Avenue may cause confusion for the public and they may inadvertently enter these areas.
- The variability of sight lines along the westbound to southbound Portage Avenue off ramp is a safety concern with the proposed Queen Street emergency access path that would require emergency vehicles to cross in front of the traffic on the ramp.
- Depending on lane of travel on Portage Avenue, the proposed signals may be obscured by current signage.
- Allowing non-emergency vehicles at the rear of the building creates conflicts with loop ramp traffic when these vehicles exit onto the loop at the rear access.
- The south accesses conflict with the weaving lane on westbound Portage Avenue.
- Shift changes and deliveries should be scheduled outside of peal traffic periods to minimize problems with traffic using the Portage Avenue weaving lane.
- There is minimal impact on traffic operations due to the development during the peak hour. However, east-west coordination may be disrupted by the emergency actuated signal 30-40% of the time.
- Disruption to traffic coordination can be mitigated using a pre-emption program that ties operation of the signals at Queen and St. James Street to those at the fire hall emergency exit onto Portage Avenue.

8.2 STUDY RECOMMENDATIONS

Based on industry accepted design standards, under normal circumstances development of any kind within an interchange would not be recommended. As stated above, accesses within an interchange create the potential for serious safety concerns and operational problems.

However, assuming development of the Core Fire Hall does occur within the loop ramp as currently proposed, a number of recommendations regarding site access and traffic control have been developed to help mitigate potential safety concerns and operational problems. These include the following:

- The use of either a fire truck entrance traffic control (Canada MUTCDC) or an emergency vehicle hybrid beacon (US MUTCD) for the emergency activated signal at the south approach is recommended. It is felt that these two types of signals are more effective in alerting users to emergency vehicles crossing Portage Avenue compared with typical red/yellow/green signals which. Also, signals of this type should minimize demand for mid-block pedestrian crossing.
- The emergency actuated signals on Portage Avenue should be located in both the median and boulevards with a minimum of two signal faces per approach to ensure signals are visible from all lanes of traffic. Large signal backboards should be used to improve signal visibility.
- Implement a pre-emption signal system that ties operation at the emergency actuated signal to that at Queen and St. James Street. Extend east-west green time on Portage Avenue at Queen and St. James Street upon activation of the emergency signal to allow passage of emergency vehicles and clear any traffic queues.
- Eliminate the return of emergency vehicles via the southbound to westbound ramp from Century Street. Southbound traffic exiting Century Street would be travelling too fast to slow down safely for emergency vehicles turning onto a separate lane. Also, with the separate lane being located on the outside of the ramp curve, traffic may turn onto the new roadway instead of following the ramp alignment.
- Provide a minimum 1.5 m safety median at the proposed Queen Street rear access lane to improve separation with the southbound Century Street to Queen Street off ramp. The widened median provides a refuge for pedestrians crossing the Queen Street access lane and the southbound Century Street to Queen Street ramp, along the east sidewalk on Queen Street. This recommendation will likely require purchase of additional right-of-way from the parking area of the St. James Hotel.
- Install a traffic signal on the westbound to southbound Portage Avenue off ramp to allow emergency vehicles to safely cross the loop ramp to re-enter the fire hall at the north access. The signal would be controlled by a vehicle detector located in the access lane off Queen Street. Due to available sightlines, an advance warning beacon would also be required on the loop ramp.
- Provide mountable curbs at the Queen Street access lane entrance, the rear site access and the Portage Avenue median curb cut along with signage indicating emergency vehicle only use to deter the public from using these accesses. If these measures prove insufficient to deter use by the public, consideration should be given to gating the Queen Street access lane and/or the Portage Avenue median opening.
- Relocate garbage pickup to the front of the site. In this way all employee/delivery/garbage access would be via the right in / right out off Portage Avenue with the rear access being used only by returning emergency vehicles.
- Eliminate the museum static display to minimize distractions to traffic along Century Street and Portage Avenue within the interchange.

- Eliminate the school bus parking adjacent to Portage Avenue to minimize conflicts with traffic in the weaving lane.
- Schedule shift changes and deliveries outside peak traffic periods to minimize conflicts with traffic in the weaving lane.

APPENDIX A

TRAFFIC COUNT DATA

Stantec

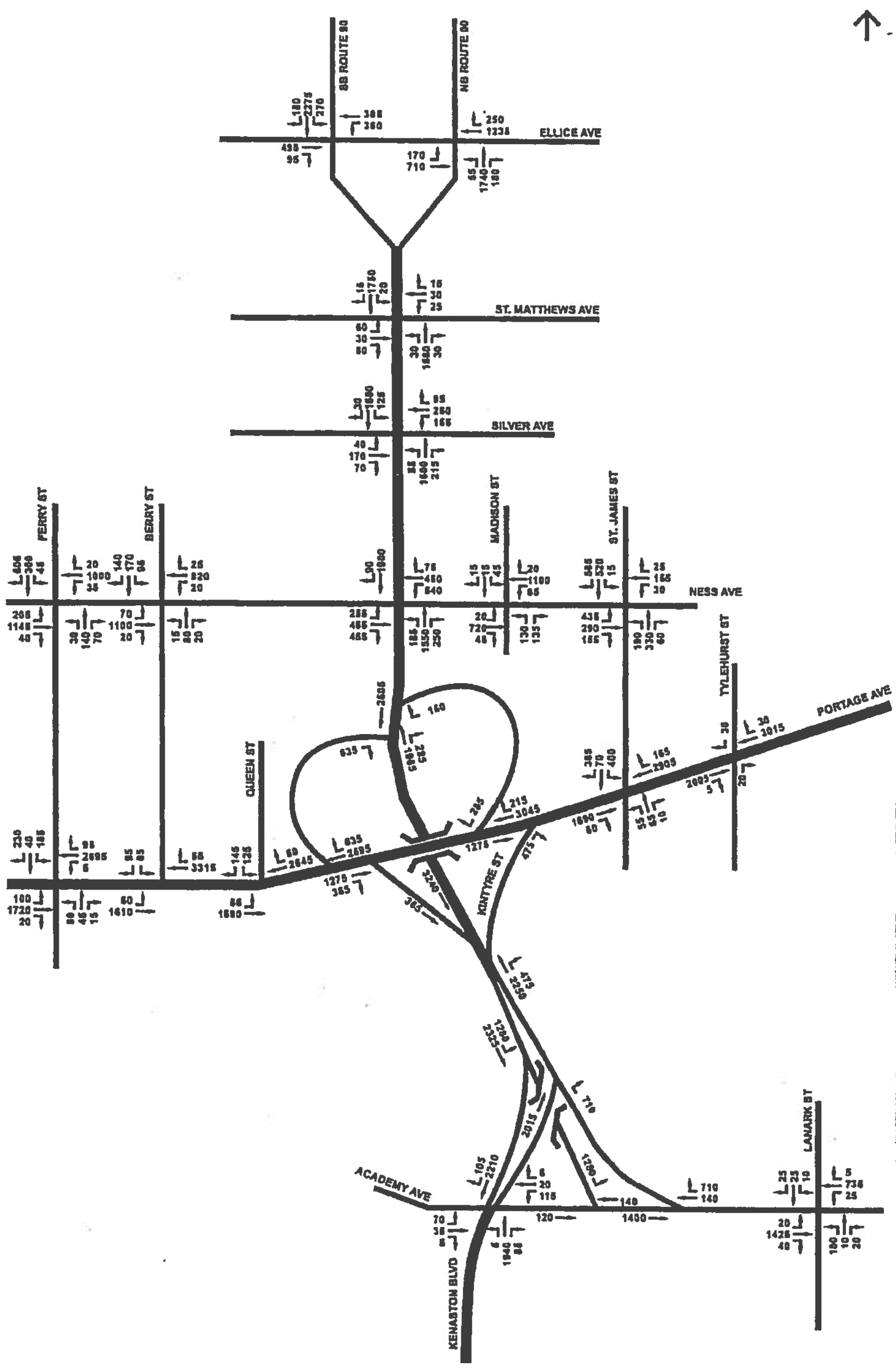

Figure 5.2A: Year 2009 Weekday PM Peak Hour Traffic Volumes

THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT

4 Hour (2+0+2) Manual Vehicle Count
Intersection Turning Movement

Traffic Studies
Phone: 986-5034

Time Start 7:00	NORTHBOUND ON St. James St.				SOUTHBOUND ON St. James St.				EASTBOUND ON Portage Ave.				WESTBOUND ON Portage Ave.				Previous Count None
Time Ending	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	TOTAL
7:15		4	9	4		36	1	9			450	4			228	45	790
7:30		5	12	9		58	3	18			601	5			267	59	1,037
7:45		10	26	31		76	3	24			666	2			303	80	1,221
8:00		10	35	52		83	5	24			681	4			327	67	1,288
8:15		14	18	76		89	6	17			682				335	65	1,302
8:30		14	14	56		94	4	26			675	3			316	62	1,264
8:45		13	20	71		87	9	32			698	4			344	48	1,326
9:00		15	16	16		72	5	32			615	7			330	66	1,174
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16:00		12	32	10		118	6	52			412	7			573	81	1,303
16:15		11	22	4		96	13	60			357	4			651	89	1,307
16:30		15	18	10		123	9	70			419	10			756	103	1,533
16:45		16	20	5		109	14	90			335	11			798	114	1,512
17:00		13	21	9		111	17	75			369	5			886	94	1,600
17:15		23	22	4		111	15	75			337	9			780	103	1,479
17:30		10	32	7		100	22	69			348	16			729	89	1,422
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4 hr. TOTAL		205	338	368		1,454	140	731			8,026	101			8,155	1,242	20,760
		911				2,325					8,127				9,397		
AM Peak Hour	AM Peak Hour (between 7:00 and 9:00), based on total volume, is from:													7:45 - 8:45			
		51	87	255		353	24	99			2,736	11			1,322	242	5,238
																	5,180
PM Peak Hour	PM Peak Hour (between 15:30 and 17:30), based on total volume, is from:													16:15 - 17:15			
		67	81	28		454	55	310			1,460	35			3,220	414	6,267
																	6,124
Peak 15 Minute Time & PHF	8:00 - 8:15				8:30 - 8:45				8:30 - 8:45				8:00 - 8:15				
		0.93	0.66	0.84		0.94	0.67	0.84			0.98	0.54			0.96	0.86	A.M. Peak PHF
	15:45 - 16:00				16:30 - 16:45				16:15 - 16:30				16:45 - 17:00				
		0.73	0.74	0.73		0.92	0.77	0.86			0.94	0.64			0.91	0.91	P.M. Peak PHF

Ratio: E/W to N/S = 5.42
E/W = 84.4%
N/S = 15.6%

Shift	AM	PM	EVE
Weather:	Clear	Cloudy	
Temperature:	1C	-2C	
Counted/Compiled By:	SD-DL/SD		
Count Date:	20110315	20110314	
Requested By:	DT		

Location:
St. James St. & Portage Ave.

St. James St. & Portage Ave.

North Street
St. James St.

Total From North: 819

Right	Thru	Left	U Turn
310	55	454	0

Total to North: 495

Count Date(s):
20110314
PM Shift

Total to West: 3,597

West Street
Portage Ave.

U-Turn	0
Left	0
Thru	1,460
Right	35

Total From West: 1,495

PM Peak Hour Volume

16:15 - 17:15

414	Right
3,220	Thru
0	Left
0	U-Turn

Total from East: 3,634

East Street
Portage Ave.

Total to East: 1,942

U Turn	Left	Thru	Right
0	67	81	28

Total to South: 90

Total From South: 176

St. James St.
South Street

TRUCK

North Street
St. James St.

Total From North: 2

Right	Thru	Left	U Turn
1	0	1	0

Total to North: 2

Count Date(s):
20110314
PM Shift

Total to West: 24

West Street

U-Turn	0
Left	0
Thru	27
Right	0

Total From West: 27

PM Peak Hour Truck Volume

15:45 - 16:45

2	Right
20	Thru
0	Left
0	U-Turn

Total from East: 22

East Street

Total to East: 28

U Turn	Left	Thru	Right
0	3	0	0

Total to South: 0

Total From South: 3

South Street

THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT

8 Hour Manual Vehicle Count
Intersection Turning Movement

Traffic Studies
Phone: 986-5034

Previous Count: None

Time Start 7:00	NORTHBOUND ON Tylehurst Street				SOUTHBOUND ON Tylehurst Street				EASTBOUND ON Portage Avenue				WESTBOUND ON Portage Avenue				
Time Ending	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	TOTAL
7:15				1							467	4					472
7:30				4							585	1					590
7:45				13							678	1					692
8:00				13							643	2					658
8:15				31							615	1					647
8:30				29							543	1					573
8:45				32							607	1					640
9:00				10							535	2					547
9:15				4							331						335
9:30				12							459	1					472
9:45				2							342						344
10:00				1							363						364
10:15											333	1					334
10:30				1							342						343
10:45				4							334	3					341
11:00											299	1					300
11:15																	
11:30																	
11:45																	
12:00																	
12:15																	
12:30																	
12:45																	
13:00																	
13:15																	
13:30																	
13:45																	
14:00																	
14:15				2							353	1					356
14:30											383	2					385
14:45											391						391
15:00				2							385	1					388
15:15				3							403	1					407
15:30				5							412	2					419
15:45				5							411	1					417
16:00				3							399	2					404
16:15				5						1	419						425
16:30				3							453	1					457
16:45				5							430	2					437
17:00				6							362	2					370
17:15				6							389	4					399
17:30				3							353	3					359
17:45				3							331	1					335
18:00				3							257	1					261
18:15																	
18:30																	
18:45																	
19:00																	
19:15																	
19:30																	
19:45																	
20:00																	
20:15																	
20:30																	
20:45																	
21:00																	
21:15																	
21:30																	
21:45																	
22:00																	
8 hr.				211						1	13,607	43					
TOTAL	211								13,651								13,862
12 hr. Est.				306						1	19,730	62					
1.45	306								19,793								20,099
24 hr. est.				407						1	26,241	82					
1.33	407								26,324								26,731
AM Peak	AM Peak Hour (between 7:00 and 9:00), based on total volume, is from:												7:15 - 8:15				
Hour				61							2,521	5					2,634
Off-Peak	Highest Off-Peak Hour (between 9:00 and 15:00) is from:												14:00 - 15:00				2,587
Hour				4							1,512	4					1,536
PM Peak	PM Peak Hour (between 15:00 and 18:00), based on total volume, is from:												15:45 - 16:45				1,520
Hour				16						1	1,701	5					1,733
																	1,723
Peak 15 Minute Time & PHF	8:30 - 8:45				7:00 - 7:15				7:30 - 7:45				7:00 - 7:15				A.M. Peak PHF
				0.82							0.93	0.50					
	9:15 - 9:30				9:00 - 9:15				9:15 - 9:30				9:00 - 9:15				Average PHF
				0.40							0.82	0.42					
	16:45 - 17:00				15:00 - 15:15				16:15 - 16:30				15:00 - 15:15				P.M. Peak PHF
				0.83						0.25	0.94	0.69					

Ratio: E/W to N/S = 64.70
E/W = 98.5%
N/S = 1.5%

Please Enter Lane Use on Critical Load Sheet!

Location:
Tylehurst Street & Portage Avenue

Shift	AM	PM	EVE
Weather:	Cold	Cold	
Temperature:	-25C	-20C	
Counted/Compiled By:	RA/RW/RA/RW		
Count Date:	January 6/2009	January 5/2009	
Requested By:	David Tang		

Tylehurst Street & Portage Avenue

North Street
Tylehurst Street

Count Date(s):
January 5/2009
PM Shift

Total From North	Total to North
0	1

Right	Thru	Left	U Turn
0	0	0	0

Total to West 0

West Street
Portage Avenue

U-Turn	0
Left	1
Thru	1,701
Right	5

Total From West 1,707

PM Peak Hour Total Volume

15:45 - 16:45

0	Right
0	Thru
0	Left
0	U-Turn

Total from East 0

East Street
Portage Avenue

Total to East 1,717

U Turn	Left	Thru	Right
0	0	0	16

Total to South 5

Total From South 16

Tylehurst Street
South Street

North Street
Tylehurst Street

Count Date(s):
January 5/2009
PM Shift

Total From North	Total to North
0	0

Right	Thru	Left	U Turn
0	0	0	0

Total to West 0

West Street

U-Turn	0
Left	0
Thru	4
Right	0

Total From West 4

PM Peak Truck Volume

15:30 - 16:30

0	Right
0	Thru
0	Left
0	U-Turn

Total from East 0

East Street

Total to East 4

U Turn	Left	Thru	Right
0	0	0	0

Total to South 0

Total From South 0

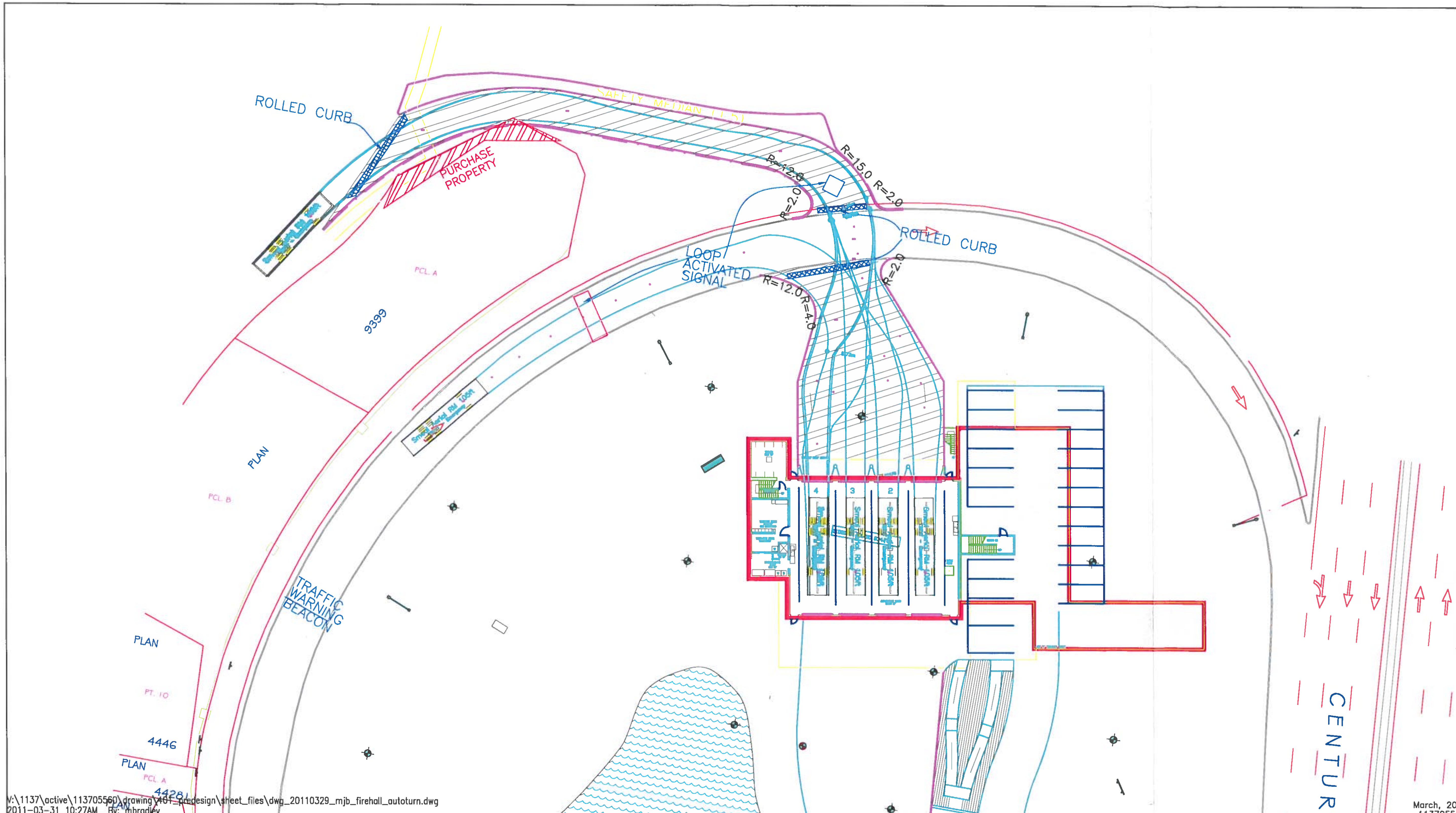
South Street

APPENDIX B

AUTOTURN ANALYSIS

Stantec

ORIGINAL SHEET – ANSI B



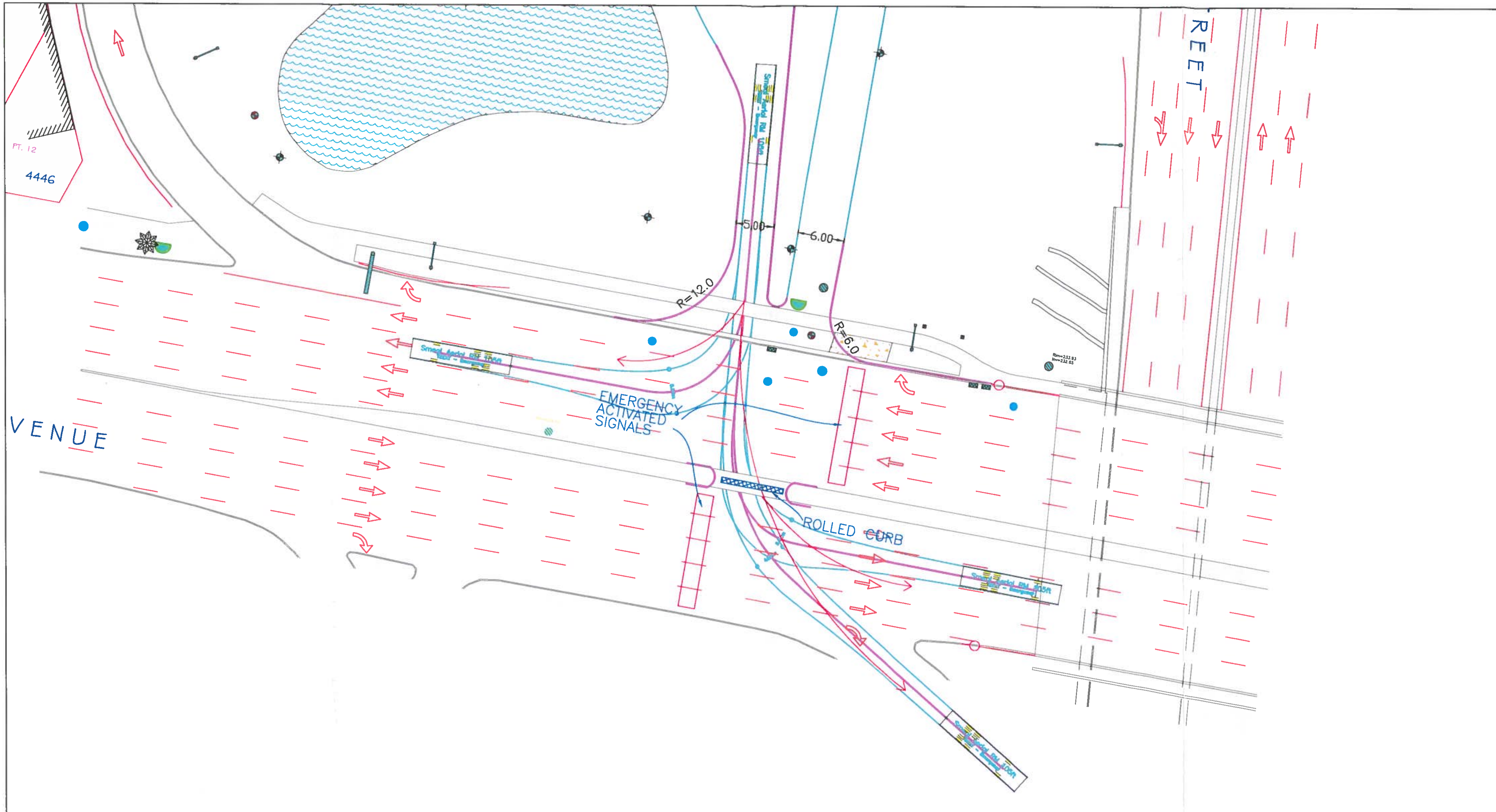
Stantec

Stantec Consulting Ltd.
905 Waverley Street
Winnipeg MB Canada
R3T 5P4
Tel. 204.489.5900
Fax. 204.453.9012
www.stantec.com

Client/Project
Shindico
Core Fire Hall
Access Study

Figure No.
B.1

Title
Recommended Access Plan
Entrance Turning Movements



V:\1137\active\113705560\drawing\401_predesign\sheet_files\dwg_20110329_mjb_firehall_autoturn.dwg
2011-03-31 10:28AM By: mbradley

March, 2011
113705560

ORIGINAL SHEET – ANSI B

Stantec

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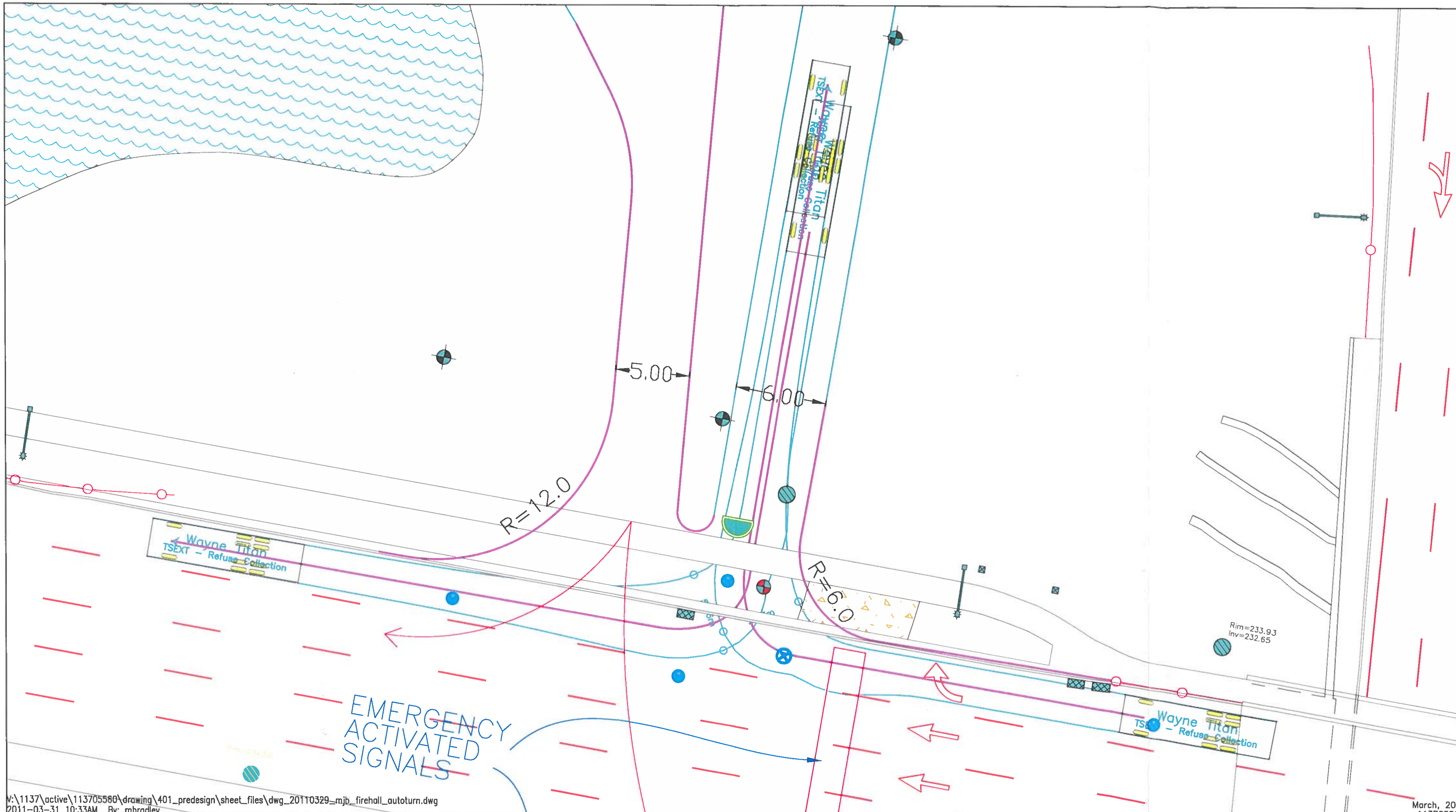
Fax. 204.453.9012
www.stantec.com

Client/Project
Shidco
Core Fire Hall
Access Study

Figure No.
B.2

Title
Recommended Access Plan
Exit Turning Movements



ORIGINAL SHEET – ANSI B

Stantec

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Client/Project

Shindico
Core Fire Hall
Access Study

Figure No.

B.3

Title

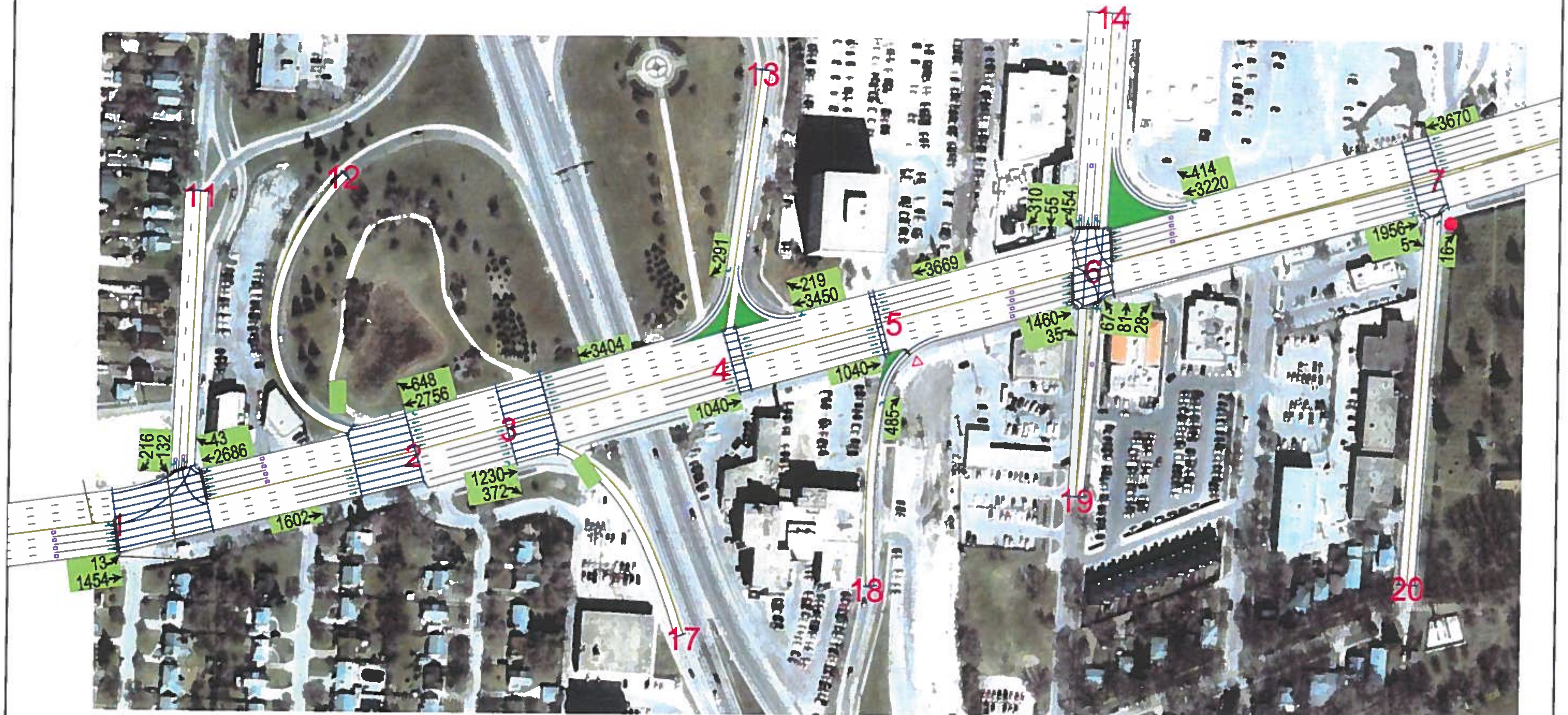
Recommended Access Plan
Service Vehicle Turning Movements

APPENDIX C

SYNCHRO ANALYSIS

Stantec

PM Peak Hour Existing
Volumes



V:\1137\miscellaneous\Firehall\Analysis\PM peak existing\PM Peak existing.syn

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰↑↑↑↑	↑↑↑↱		↰	↱
Volume (vph)	13	1440	2659	43	131	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	0.86	0.86	1.00	1.00
Frt			0.998			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	6479	6466	0	1772	1601
Flt Permitted		0.861			0.950	
Satd. Flow (perm)	0	5578	6466	0	1772	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			5			3
Link Speed (k/h)		60	60		50	
Link Distance (m)		243.4	143.7		161.2	
Travel Time (s)		14.6	8.6		11.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	101%	101%	101%	101%	101%	101%
Heavy Vehicles (%)	2%	2%	2%	2%	3%	2%
Adj. Flow (vph)	14	1515	2797	45	138	225
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1529	2842	0	138	225
Enter Blocked Intersection	Yes	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	L NA	R NA
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		-30.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm					Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Minimum Split (s)	20.0	20.0	20.0		20.0	20.0
Total Split (s)	85.0	85.0	85.0	0.0	35.0	35.0
Total Split (%)	70.8%	70.8%	70.8%	0.0%	29.2%	29.2%
Maximum Green (s)	81.0	81.0	81.0		31.0	31.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)		81.0	81.0		31.0	31.0
Actuated g/C Ratio		0.68	0.68		0.26	0.26
v/c Ratio		0.41	0.65		0.30	0.54
Control Delay		9.1	3.4		38.0	43.5
Queue Delay		0.0	0.0		0.0	0.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Total Delay		9.1	3.4		38.0	43.5
LOS		A	A		D	D
Approach Delay		9.1	3.4		41.4	
Approach LOS		A	A		D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 72 (60%), Referenced to phase 2:EBTL and 6:WBT, Start of Green	
Natural Cycle: 50	
Control Type: Pretimed	
Maximum v/c Ratio: 0.65	
Intersection Signal Delay: 8.1	Intersection LOS: A
Intersection Capacity Utilization 59.7%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Int

Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations		↑↑↑↑	↑↑↑↑	↱		
Volume (vph)	0	1571	2702	635	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	1.00	1.00
Frt				0.850		
Flt Protected						
Satd. Flow (prot)	0	6479	6479	1601	0	0
Flt Permitted						
Satd. Flow (perm)	0	6479	6479	1601	0	0
Link Speed (k/h)		60	60		48	
Link Distance (m)		143.7	46.8		175.9	
Travel Time (s)		8.6	2.8		13.2	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	102%	102%	102%	102%	102%	102%
Adj. Flow (vph)	0	1669	2871	675	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1669	2871	675	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			24	24	14
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 43.4% ICU Level of Service A
Analysis Period (min) 15

Lane Group	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Volume (vph)	1206	365	0	3337	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		46.0	0.0		0.0	0.0
Storage Lanes		1	0		0	0
Taper Length (m)		2.5	2.5		2.5	2.5
Lane Util. Factor	0.86	1.00	1.00	0.81	1.00	1.00
Frt		0.850				
Flt Protected						
Satd. Flow (prot)	6479	1601	0	7628	0	0
Flt Permitted						
Satd. Flow (perm)	6479	1601	0	7628	0	0
Link Speed (k/h)	60			60	48	
Link Distance (m)	46.8			104.2	134.6	
Travel Time (s)	2.8			6.3	10.1	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	102%	102%	102%	102%	102%	102%
Adj. Flow (vph)	1281	388	0	3546	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1281	388	0	3546	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 42.8%	ICU Level of Service A
Analysis Period (min) 15	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑↑	↑↑↑↱			↱
Volume (vph)	0	1020	3382	215	0	285
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	0.86	1.00	1.00
Frt			0.991			0.865
Flt Protected						
Satd. Flow (prot)	0	6479	6421	0	0	1629
Flt Permitted						
Satd. Flow (perm)	0	6479	6421	0	0	1629
Link Speed (k/h)		60	60		40	
Link Distance (m)		104.2	84.7		141.5	
Travel Time (s)		6.3	5.1		12.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	102%	102%	102%	102%	102%	102%
Adj. Flow (vph)	0	1084	3593	228	0	303
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1084	3821	0	0	303
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 78.3%	ICU Level of Service D
Analysis Period (min) 15	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑↑			↑↑↑↑		↱
Volume (vph)	1020	0	0	3597	0	475
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	1.00	1.00	0.86	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	6479	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	6479	0	1629
Link Speed (k/h)	60			60	40	
Link Distance (m)	84.7			97.5	127.1	
Travel Time (s)	5.1			5.9	11.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	102%	102%	102%	102%	102%	102%
Adj. Flow (vph)	1084	0	0	3822	0	505
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1084	0	0	3822	0	505
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 56.5% ICU Level of Service B
Analysis Period (min) 15

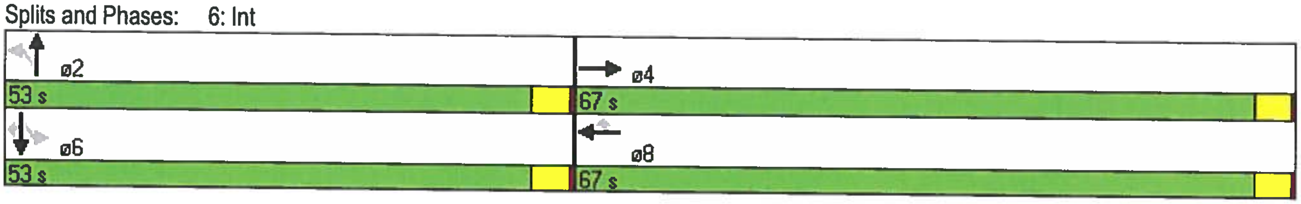
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1460	35	0	3220	414	67	81	28	454	55	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997				0.850		0.979				0.850
Flt Protected								0.981		0.950		
Satd. Flow (prot)	0	6460	0	0	6479	1601	0	1795	0	1789	1883	1601
Flt Permitted								0.872		0.616		
Satd. Flow (perm)	0	6460	0	0	6479	1601	0	1596	0	1160	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5				307		10				
Link Speed (k/h)		60			50			50			50	
Link Distance (m)		97.5			168.4			109.0			120.9	
Travel Time (s)		5.9			12.1			7.8			8.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	2%	2%	2%	2%	2%
Adj. Flow (vph)	0	1521	36	0	3354	431	70	84	29	473	57	323
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1557	0	0	3354	431	0	183	0	473	57	323
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	L NA	Left	R NA	L NA	Left	R NA
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type						Perm	Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases						8	2			6		6
Minimum Split (s)		20.0			20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	0.0	67.0	0.0	0.0	67.0	67.0	53.0	53.0	0.0	53.0	53.0	53.0
Total Split (%)	0.0%	55.8%	0.0%	0.0%	55.8%	55.8%	44.2%	44.2%	0.0%	44.2%	44.2%	44.2%
Maximum Green (s)		63.0			63.0	63.0	49.0	49.0		49.0	49.0	49.0
Yellow Time (s)		3.5			3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		0.5			0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		5.0			5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0			0	0	0	0		0	0	0
Act Effct Green (s)		63.0			63.0	63.0		49.0		49.0	49.0	49.0
Actuated g/C Ratio		0.52			0.52	0.52		0.41		0.41	0.41	0.41
v/c Ratio		0.46			0.99	0.44		0.28		1.00	0.07	0.49
Control Delay		17.1			40.8	6.2		23.8		77.1	22.1	29.6
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		17.1			40.8	6.2		23.8		77.1	22.1	29.6
LOS		B			D	A		C		E	C	C
Approach Delay		17.1			36.9			23.8			55.4	
Approach LOS		B			D			C			E	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 2 (2%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 65
Control Type: Pretimed
Maximum v/c Ratio: 1.00
Intersection Signal Delay: 34.2 Intersection LOS: C
Intersection Capacity Utilization 85.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 6: Int



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1937	5	0	3634	0	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	1.00	0.81	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	7628	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	7628	0	1629
Link Speed (k/h)	60			60	50	
Link Distance (m)	168.4			159.0	193.9	
Travel Time (s)	10.1			9.5	14.0	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	101%	101%	101%	101%	101%	101%
Adj. Flow (vph)	2038	5	0	3823	0	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	2043	0	0	3823	0	17
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	R NA
Median Width(m)	2.0			2.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary

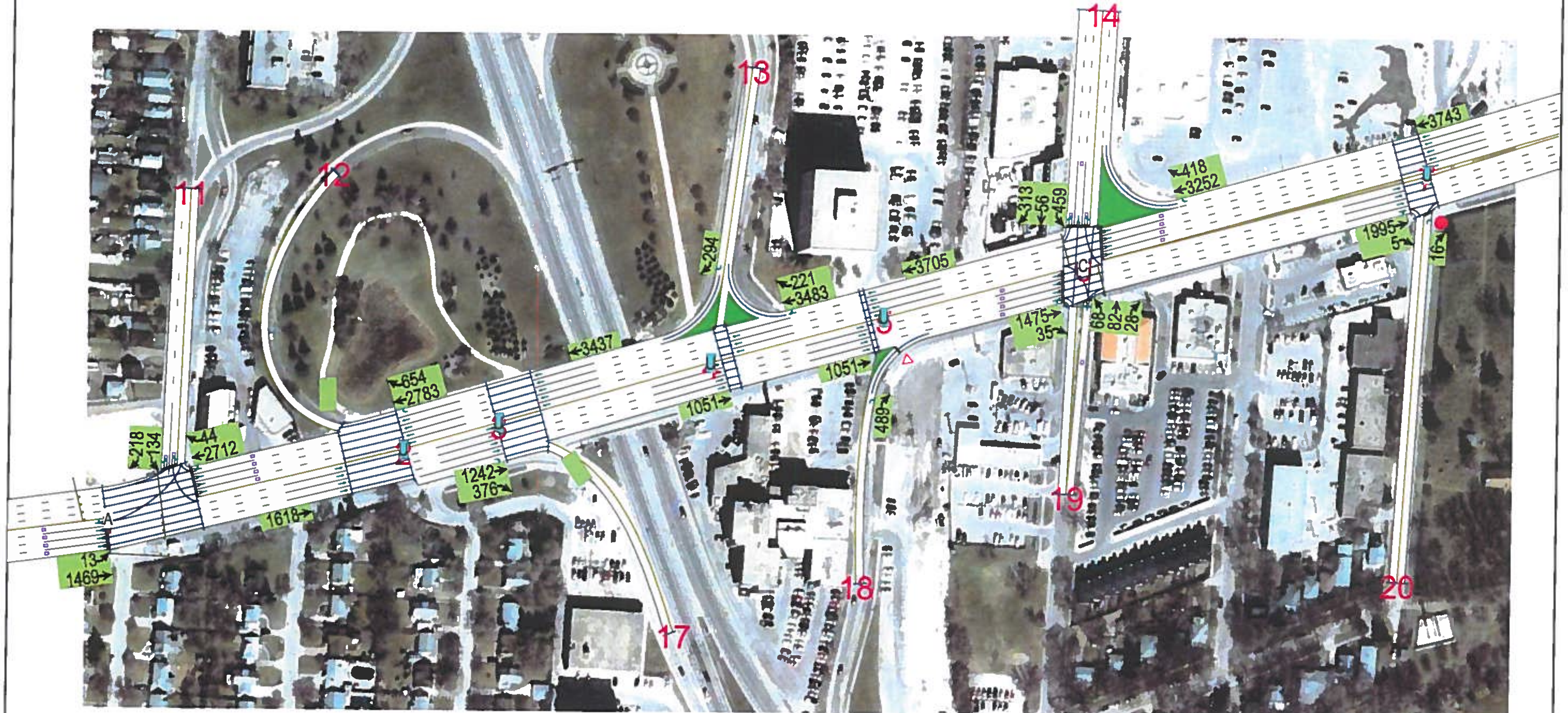
Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 45.9% ICU Level of Service A

Analysis Period (min) 15

PM Peak 2012 Pre-Development
Levels of Service



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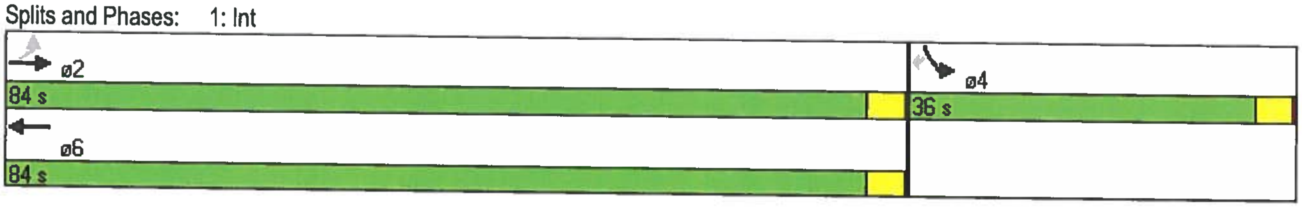
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	13	1440	2659	43	131	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	0.86	0.86	1.00	1.00
Frt			0.998			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	6479	6466	0	1772	1601
Flt Permitted		0.860			0.950	
Satd. Flow (perm)	0	5572	6466	0	1772	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			5			3
Link Speed (k/h)		60	60		50	
Link Distance (m)		243.4	143.7		161.2	
Travel Time (s)		14.6	8.6		11.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	2%	2%	2%	3%	2%
Adj. Flow (vph)	14	1530	2825	46	139	227
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1544	2871	0	139	227
Enter Blocked Intersection	Yes	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	L NA	R NA
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		-30.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm					Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Minimum Split (s)	20.0	20.0	20.0		20.0	20.0
Total Split (s)	84.0	84.0	84.0	0.0	36.0	36.0
Total Split (%)	70.0%	70.0%	70.0%	0.0%	30.0%	30.0%
Maximum Green (s)	80.0	80.0	80.0		32.0	32.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)		80.0	80.0		32.0	32.0
Actuated g/C Ratio		0.67	0.67		0.27	0.27
v/c Ratio		0.42	0.67		0.29	0.53
Control Delay		9.6	3.2		37.1	42.4
Queue Delay		0.0	0.0		0.0	0.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Total Delay		9.6	3.2		37.1	42.4
LOS		A	A		D	D
Approach Delay		9.6	3.2		40.4	
Approach LOS		A	A		D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 37 (31%), Referenced to phase 2:EBTL and 6:WBT, Start of Green	
Natural Cycle: 50	
Control Type: Pretimed	
Maximum v/c Ratio: 0.67	
Intersection Signal Delay: 8.1	Intersection LOS: A
Intersection Capacity Utilization 60.2%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Int



Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	0	1571	2702	635	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	1.00	1.00
Frt				0.850		
Flt Protected						
Satd. Flow (prot)	0	6479	6479	1601	0	0
Flt Permitted						
Satd. Flow (perm)	0	6479	6479	1601	0	0
Link Speed (k/h)		60	60		48	
Link Distance (m)		143.7	46.8		175.9	
Travel Time (s)		8.6	2.8		13.2	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	0	1686	2899	681	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1686	2899	681	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			24	24	14
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 43.8% ICU Level of Service A
Analysis Period (min) 15

Lane Group	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations						
Volume (vph)	1206	365	0	3337	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		46.0	0.0		0.0	0.0
Storage Lanes		1	0		0	0
Taper Length (m)		2.5	2.5		2.5	2.5
Lane Util. Factor	0.86	1.00	1.00	0.81	1.00	1.00
Frt		0.850				
Flt Protected						
Satd. Flow (prot)	6479	1601	0	7628	0	0
Flt Permitted						
Satd. Flow (perm)	6479	1601	0	7628	0	0
Link Speed (k/h)	60			60	48	
Link Distance (m)	46.8			104.2	134.6	
Travel Time (s)	2.8			6.3	10.1	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	1294	392	0	3580	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1294	392	0	3580	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 43.2%	ICU Level of Service A
Analysis Period (min) 15	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑↑	↑↑↑↱			↱
Volume (vph)	0	1020	3382	215	0	285
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	0.86	1.00	1.00
Frt			0.991			0.865
Flt Protected						
Satd. Flow (prot)	0	6479	6421	0	0	1629
Flt Permitted						
Satd. Flow (perm)	0	6479	6421	0	0	1629
Link Speed (k/h)		60	60		40	
Link Distance (m)		104.2	84.7		141.5	
Travel Time (s)		6.3	5.1		12.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	0	1094	3629	231	0	306
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1094	3860	0	0	306
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 79.0% ICU Level of Service D
Analysis Period (min) 15

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑↑			↑↑↑↑		↱
Volume (vph)	1020	0	0	3597	0	475
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	1.00	1.00	0.86	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	6479	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	6479	0	1629
Link Speed (k/h)	60			60	40	
Link Distance (m)	84.7			97.5	127.1	
Travel Time (s)	5.1			5.9	11.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	1094	0	0	3859	0	510
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1094	0	0	3859	0	510
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 57.0% ICU Level of Service B

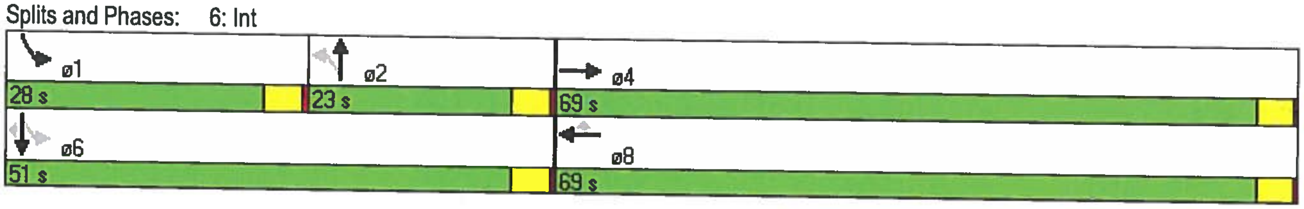
Analysis Period (min) 15

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1460	35	0	3220	414	67	81	28	454	55	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.996				0.850		0.979				0.850
Flt Protected								0.981		0.950		
Satd. Flow (prot)	0	6453	0	0	6479	1601	0	1795	0	1789	1883	1601
Flt Permitted								0.853		0.461		
Satd. Flow (perm)	0	6453	0	0	6479	1601	0	1561	0	868	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6				319		7				
Link Speed (k/h)		60			50			50			50	
Link Distance (m)		97.5			168.4			109.0			120.9	
Travel Time (s)		5.9			12.1			7.8			8.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	2%	2%	2%	2%	2%
Adj. Flow (vph)	0	1536	37	0	3388	436	70	85	29	478	58	326
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1573	0	0	3388	436	0	184	0	478	58	326
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	L NA	Left	R NA	L NA	Left	R NA
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type						Perm	Perm			pm+pt		Perm
Protected Phases		4			8			2		1	6	
Permitted Phases						8	2			6		6
Minimum Split (s)		20.0			20.0	20.0	20.0	20.0		8.0	20.0	20.0
Total Split (s)	0.0	69.0	0.0	0.0	69.0	69.0	23.0	23.0	0.0	28.0	51.0	51.0
Total Split (%)	0.0%	57.5%	0.0%	0.0%	57.5%	57.5%	19.2%	19.2%	0.0%	23.3%	42.5%	42.5%
Maximum Green (s)		65.0			65.0	65.0	19.0	19.0		24.0	47.0	47.0
Yellow Time (s)		3.5			3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		0.5			0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Walk Time (s)		5.0			5.0	5.0	5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0			0	0	0	0			0	0
Act Effct Green (s)		65.0			65.0	65.0		19.0		47.0	47.0	47.0
Actuated g/C Ratio		0.54			0.54	0.54		0.16		0.39	0.39	0.39
v/c Ratio		0.45			0.97	0.43		0.73		0.91	0.08	0.52
Control Delay		15.6			35.8	5.5		63.7		54.8	23.4	31.6
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		15.6			35.8	5.5		63.7		54.8	23.4	31.6
LOS		B			D	A		E		D	C	C
Approach Delay		15.6			32.3			63.7			43.9	
Approach LOS		B			C			E			D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection	
Natural Cycle: 90	
Control Type: Pretimed	
Maximum v/c Ratio: 0.97	
Intersection Signal Delay: 30.7	Intersection LOS: C
Intersection Capacity Utilization 86.3%	ICU Level of Service E
Analysis Period (min) 15	

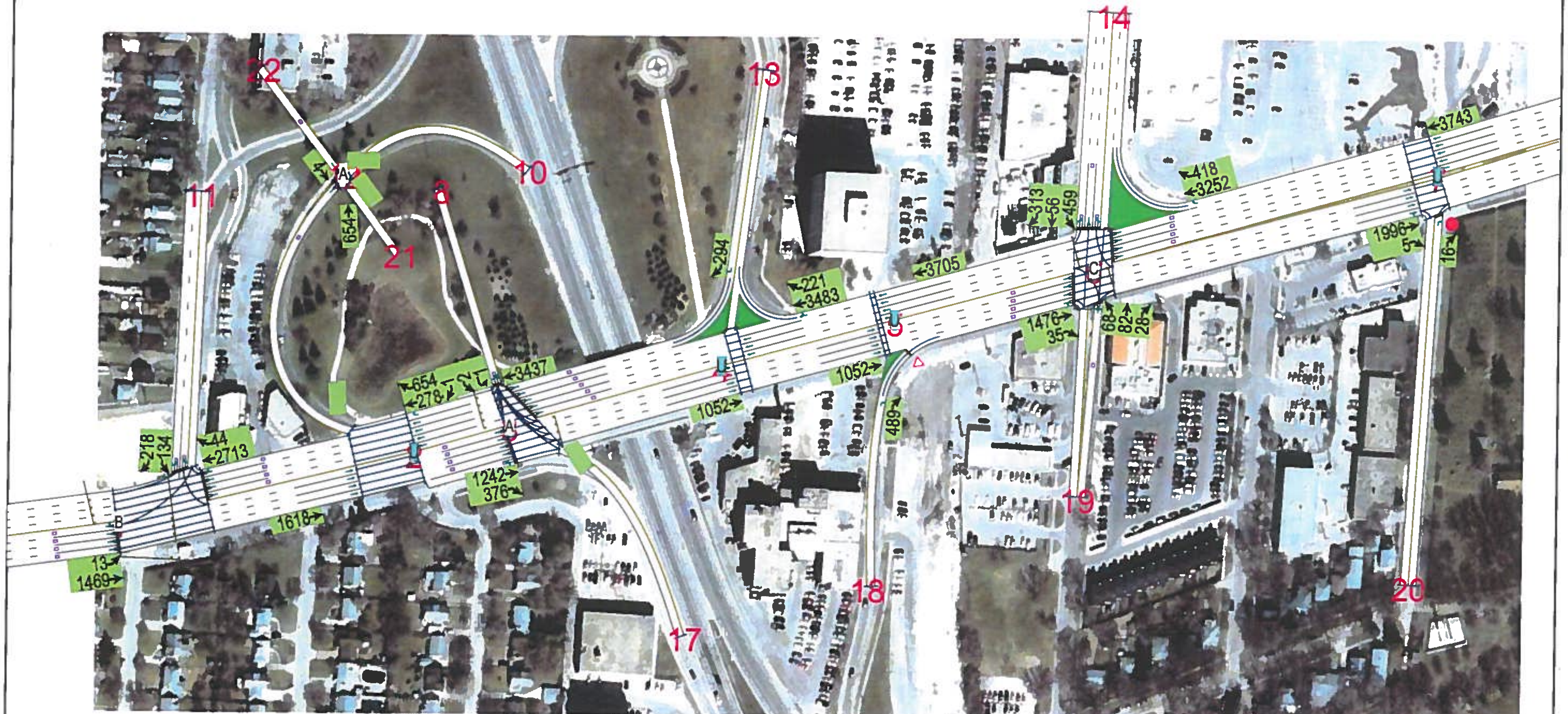
Splits and Phases: 6: Int



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1937	5	0	3634	0	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	1.00	0.81	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	7628	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	7628	0	1629
Link Speed (k/h)	60			60	50	
Link Distance (m)	168.4			159.0	193.9	
Travel Time (s)	10.1			9.5	14.0	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	2078	5	0	3899	0	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	2083	0	0	3899	0	17
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	R NA
Median Width(m)	2.0			2.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 46.7%		ICU Level of Service A
Analysis Period (min) 15		

PM Peak 2012 Post Development
Levels of Service



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Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	13	1440	2660	43	131	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	0.86	0.86	1.00	1.00
Frt			0.998			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	6479	6466	0	1772	1601
Flt Permitted		0.857			0.950	
Satd. Flow (perm)	0	5553	6466	0	1772	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			5			2
Link Speed (k/h)		60	60		50	
Link Distance (m)		243.4	143.7		161.2	
Travel Time (s)		14.6	8.6		11.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	102%	102%	102%	102%	102%	102%
Heavy Vehicles (%)	2%	2%	2%	2%	3%	2%
Adj. Flow (vph)	14	1530	2826	46	139	227
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1544	2872	0	139	227
Enter Blocked Intersection	Yes	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	L NA	R NA
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		-30.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm					Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Minimum Split (s)	24.0	24.0	24.0		24.0	24.0
Total Split (s)	83.0	83.0	83.0	0.0	37.0	37.0
Total Split (%)	69.2%	69.2%	69.2%	0.0%	30.8%	30.8%
Maximum Green (s)	78.0	78.0	78.0		32.0	32.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)		78.0	78.0		32.0	32.0
Actuated g/C Ratio		0.65	0.65		0.27	0.27
v/c Ratio		0.43	0.68		0.29	0.53
Control Delay		10.6	14.3		37.1	42.6
Queue Delay		0.0	0.8		0.0	0.0

Lanes, Volumes, Timings
1: Int

5/19/2011

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Total Delay		10.6	15.0		37.1	42.6
LOS		B	B		D	D
Approach Delay		10.6	15.0		40.5	
Approach LOS		B	B		D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 37 (31%), Referenced to phase 2:EBTL and 6:WBT, Start of Green	
Natural Cycle: 60	
Control Type: Pretimed	
Maximum v/c Ratio: 0.68	
Intersection Signal Delay: 15.6	Intersection LOS: B
Intersection Capacity Utilization 61.9%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Int

Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Volume (vph)	0	1571	2703	635	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	1.00	1.00
Frt				0.850		
Flt Protected						
Satd. Flow (prot)	0	6479	6479	1601	0	0
Flt Permitted						
Satd. Flow (perm)	0	6479	6479	1601	0	0
Link Speed (k/h)		60	60		48	
Link Distance (m)		143.7	46.8		175.9	
Travel Time (s)		8.6	2.8		13.2	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	0	1686	2900	681	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1686	2900	681	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			24	24	14
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 43.8%	ICU Level of Service A
Analysis Period (min) 15	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL2	SBL	SBR	NWL	NWR
Lane Configurations											
Volume (vph)	0	1206	365	0	3337	0	1	2	1	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		46.0	0.0		0.0		0.0	0.0	0.0	0.0
Storage Lanes	0		1	0		0		1	0	0	0
Taper Length (m)	2.5		2.5	2.5		2.5		2.5	2.5	2.5	2.5
Lane Util. Factor	1.00	0.86	1.00	1.00	0.81	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850					0.966			
Flt Protected								0.964			
Satd. Flow (prot)	0	6479	1601	0	7628	0	0	1754	0	0	0
Flt Permitted								0.964			
Satd. Flow (perm)	0	6479	1601	0	7628	0	0	1754	0	0	0
Right Turn on Red			No			Yes			Yes		
Satd. Flow (RTOR)								1			
Link Speed (k/h)		60			60			25		48	
Link Distance (m)		46.8			104.2			117.4		134.6	
Travel Time (s)		2.8			6.3			16.9		10.1	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	0	1294	392	0	3580	0	1	2	1	0	0
Shared Lane Traffic (%)											
Lane Group Flow (vph)	0	1294	392	0	3580	0	0	4	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Right
Median Width(m)		0.0			0.0			3.7		0.0	
Link Offset(m)		0.0			0.0			0.0		0.0	
Crosswalk Width(m)		1.6			1.6			1.6		1.6	
Two way Left Turn Lane											
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24	24	14	24	14
Turn Type			Perm				Perm				
Protected Phases		2			6			4			
Permitted Phases			2				4				
Minimum Split (s)		24.0	24.0		24.0		24.0	24.0			
Total Split (s)	0.0	872.0	872.0	0.0	872.0	0.0	28.0	28.0	0.0	0.0	0.0
Total Split (%)	0.0%	96.9%	96.9%	0.0%	96.9%	0.0%	3.1%	3.1%	0.0%	0.0%	0.0%
Maximum Green (s)		867.0	867.0		867.0		23.0	23.0			
Yellow Time (s)		4.0	4.0		4.0		4.0	4.0			
All-Red Time (s)		1.0	1.0		1.0		1.0	1.0			
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0
Lead/Lag											
Lead-Lag Optimize?											
Walk Time (s)		5.0	5.0		5.0		5.0	5.0			
Flash Dont Walk (s)		11.0	11.0		11.0		11.0	11.0			
Pedestrian Calls (#/hr)		0	0		0		0	0			
Act Effct Green (s)		867.0	867.0		867.0			23.0			
Actuated g/C Ratio		0.96	0.96		0.96			0.03			
v/c Ratio		0.21	0.25		0.49			0.09			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SBL2	SBL	SBR	NWL	NWR
Control Delay		0.8	1.2		1.4			350.8			
Queue Delay		1.8	6.4		1.7			0.0			
Total Delay		2.6	7.6		3.0			350.8			
LOS		A	A		A			F			
Approach Delay		3.7			3.0			350.8			
Approach LOS		A			A			F			

Intersection Summary	
Area Type: Other	
Cycle Length: 900	
Actuated Cycle Length: 900	
Offset: 870 (97%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Natural Cycle: 60	
Control Type: Pretimed	
Maximum v/c Ratio: 0.49	
Intersection Signal Delay: 3.5	Intersection LOS: A
Intersection Capacity Utilization 51.5%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 3: Int

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1021	3382	215	0	285
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	0.86	1.00	1.00
Frt			0.991			0.865
Flt Protected						
Satd. Flow (prot)	0	6479	6421	0	0	1629
Flt Permitted						
Satd. Flow (perm)	0	6479	6421	0	0	1629
Link Speed (k/h)		60	60		40	
Link Distance (m)		104.2	84.7		141.5	
Travel Time (s)		6.3	5.1		12.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	0	1095	3629	231	0	306
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1095	3860	0	0	306
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 79.0%	ICU Level of Service D
Analysis Period (min) 15	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑↑			↑↑↑↑		↱
Volume (vph)	1021	0	0	3597	0	475
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	1.00	1.00	0.86	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	6479	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	6479	0	1629
Link Speed (k/h)	60			60	40	
Link Distance (m)	84.7			97.5	127.1	
Travel Time (s)	5.1			5.9	11.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	1095	0	0	3859	0	510
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1095	0	0	3859	0	510
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Free	

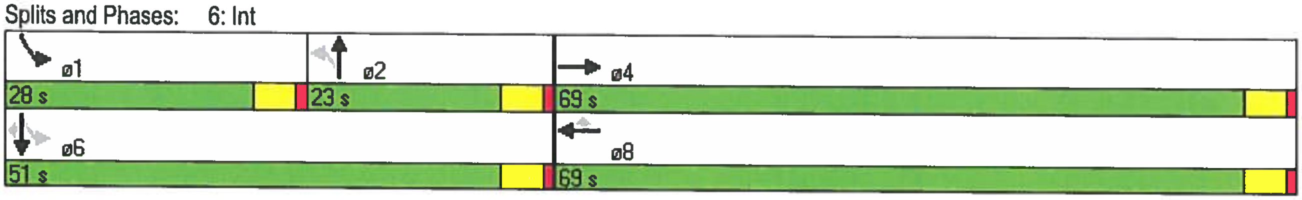
Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 57.0%	ICU Level of Service B
Analysis Period (min) 15	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↱			↑↑↑↑	↱		✣		↰	↑	↱
Volume (vph)	0	1461	35	0	3220	414	67	81	28	454	55	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.996				0.850		0.979				0.850
Flt Protected								0.981		0.950		
Satd. Flow (prot)	0	6453	0	0	6479	1601	0	1795	0	1789	1883	1601
Flt Permitted								0.850		0.459		
Satd. Flow (perm)	0	6453	0	0	6479	1601	0	1556	0	865	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6				313		7				
Link Speed (k/h)		60			50			50			50	
Link Distance (m)		97.5			168.4			109.0			120.9	
Travel Time (s)		5.9			12.1			7.8			8.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	2%	2%	2%	2%	2%
Adj. Flow (vph)	0	1537	37	0	3388	436	70	85	29	478	58	326
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1574	0	0	3388	436	0	184	0	478	58	326
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	L NA	Left	R NA	L NA	Left	R NA
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type						Perm	Perm			pm+pt		Perm
Protected Phases		4			8			2		1	6	
Permitted Phases						8	2			6		6
Minimum Split (s)		24.0			24.0	24.0	24.0	24.0		9.0	24.0	24.0
Total Split (s)	0.0	69.0	0.0	0.0	69.0	69.0	23.0	23.0	0.0	28.0	51.0	51.0
Total Split (%)	0.0%	57.5%	0.0%	0.0%	57.5%	57.5%	19.2%	19.2%	0.0%	23.3%	42.5%	42.5%
Maximum Green (s)		64.0			64.0	64.0	18.0	18.0		23.0	46.0	46.0
Yellow Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)		1.0			1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	4.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Walk Time (s)		5.0			5.0	5.0	5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0			0	0	0	0			0	0
Act Effct Green (s)		64.0			64.0	64.0		18.0		46.0	46.0	46.0
Actuated g/C Ratio		0.53			0.53	0.53		0.15		0.38	0.38	0.38
v/c Ratio		0.46			0.98	0.44		0.77		0.94	0.08	0.53
Control Delay		17.7			39.1	5.9		68.9		60.5	24.0	32.6
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		17.7			39.1	5.9		68.9		60.5	24.0	32.6
LOS		B			D	A		E		E	C	C
Approach Delay		17.7			35.3			68.9			47.5	
Approach LOS		B			D			E			D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection	
Natural Cycle: 90	
Control Type: Pretimed	
Maximum v/c Ratio: 0.98	
Intersection Signal Delay: 33.6	Intersection LOS: C
Intersection Capacity Utilization 88.8%	ICU Level of Service E
Analysis Period (min) 15	

Splits and Phases: 6: Int



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1938	5	0	3634	0	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	1.00	0.81	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	7628	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	7628	0	1629
Link Speed (k/h)	60			60	50	
Link Distance (m)	168.4			159.0	193.9	
Travel Time (s)	10.1			9.5	14.0	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	2079	5	0	3899	0	17
Shared Lane Traffic (%)						
Lane Group Flow (vph)	2084	0	0	3899	0	17
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	R NA
Median Width(m)	2.0			2.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 46.7%	ICU Level of Service A
Analysis Period (min) 15	

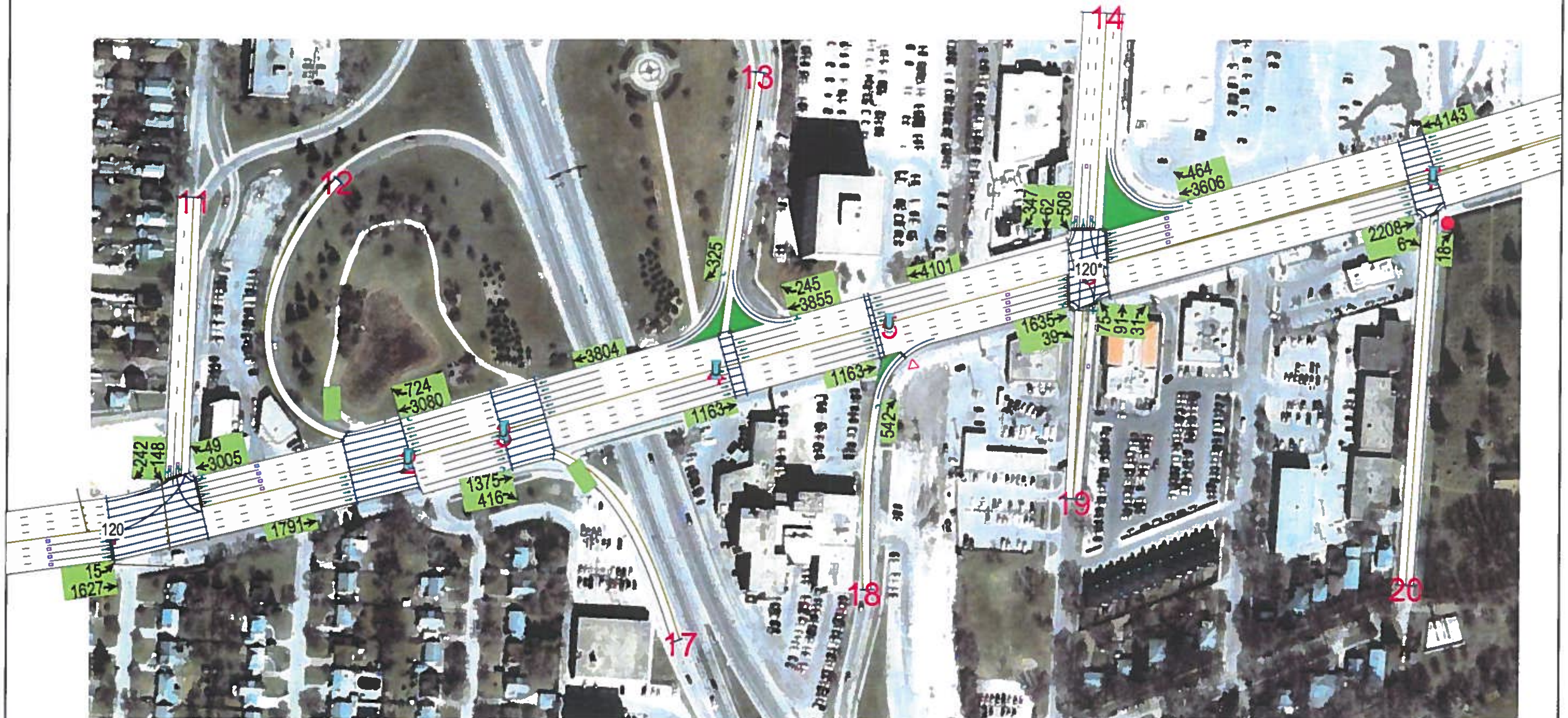
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations		↑						↑				
Volume (vph)	0	4	0	0	0	0	0	635	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt												
Flt Protected												
Satd. Flow (prot)	0	1883	0	0	0	0	0	1883	0	0	0	0
Flt Permitted												
Satd. Flow (perm)	0	1883	0	0	0	0	0	1883	0	0	0	0
Right Turn on Red	Yes		Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												
Link Speed (k/h)		25			48			40			48	
Link Distance (m)		63.6			46.5			175.9			100.2	
Travel Time (s)		9.2			3.5			15.8			7.5	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%	103%
Adj. Flow (vph)	0	4	0	0	0	0	0	681	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	4	0	0	0	0	0	681	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			0.0			0.0	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type												
Protected Phases		4										
Permitted Phases								2				
Minimum Split (s)		24.0						24.0				
Total Split (s)	0.0	32.0	0.0	0.0	0.0	0.0	0.0	868.0	0.0	0.0	0.0	0.0
Total Split (%)	0.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%	96.4%	0.0%	0.0%	0.0%	0.0%
Maximum Green (s)		27.0						863.0				
Yellow Time (s)		4.0						4.0				
All-Red Time (s)		1.0						1.0				
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	4.0	4.0	4.0	4.0	5.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		5.0						5.0				
Flash Dont Walk (s)		11.0						11.0				
Pedestrian Calls (#/hr)		0						0				
Act Effct Green (s)		27.0						863.0				
Actuated g/C Ratio		0.03						0.96				
v/c Ratio		0.07						0.38				
Control Delay		427.2						0.6				
Queue Delay		0.0						0.0				
Total Delay		427.2						0.6				

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
LOS		F						A				
Approach Delay		427.3						0.6				
Approach LOS		F						A				

Intersection Summary	
Area Type: Other	
Cycle Length: 900	
Actuated Cycle Length: 900	
Offset: 893 (99%), Referenced to phase 2:NET, Start of Green	
Natural Cycle: 55	
Control Type: Pretimed	
Maximum v/c Ratio: 0.38	
Intersection Signal Delay: 3.1	Intersection LOS: A
Intersection Capacity Utilization 46.1%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 12: Int

PM Peak 2022 Pre-Development
Cycle Lengths



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Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	13	1440	2659	43	131	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	0.86	0.86	1.00	1.00
Frt			0.998			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	6479	6466	0	1772	1601
Flt Permitted		0.848			0.950	
Satd. Flow (perm)	0	5494	6466	0	1772	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			5			1
Link Speed (k/h)		60	60		50	
Link Distance (m)		243.4	143.7		161.2	
Travel Time (s)		14.6	8.6		11.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	113%	113%	113%	113%	113%	113%
Heavy Vehicles (%)	2%	2%	2%	2%	3%	2%
Adj. Flow (vph)	15	1695	3130	51	154	252
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1710	3181	0	154	252
Enter Blocked Intersection	Yes	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	L NA	R NA
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		-30.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm					Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Minimum Split (s)	20.0	20.0	20.0		20.0	20.0
Total Split (s)	84.0	84.0	84.0	0.0	36.0	36.0
Total Split (%)	70.0%	70.0%	70.0%	0.0%	30.0%	30.0%
Maximum Green (s)	80.0	80.0	80.0		32.0	32.0
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)		80.0	80.0		32.0	32.0
Actuated g/C Ratio		0.67	0.67		0.27	0.27
v/c Ratio		0.47	0.74		0.33	0.59
Control Delay		10.2	3.2		37.7	44.7
Queue Delay		0.0	0.0		0.0	0.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Total Delay		10.2	3.2		37.7	44.7
LOS		B	A		D	D
Approach Delay		10.2	3.2		42.0	
Approach LOS		B	A		D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 36 (30%), Referenced to phase 2:EBTL and 6:WBT, Start of Green	
Natural Cycle: 55	
Control Type: Pretimed	
Maximum v/c Ratio: 0.74	
Intersection Signal Delay: 8.4	Intersection LOS: A
Intersection Capacity Utilization 66.0%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 1: Int

Lane Group	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations		↑↑↑↑	↑↑↑↑	↱		
Volume (vph)	0	1571	2702	635	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	1.00	1.00
Frt				0.850		
Flt Protected						
Satd. Flow (prot)	0	6479	6479	1601	0	0
Flt Permitted						
Satd. Flow (perm)	0	6479	6479	1601	0	0
Link Speed (k/h)		60	60		48	
Link Distance (m)		143.7	46.8		175.9	
Travel Time (s)		8.6	2.8		13.2	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	114%	114%	114%	114%	114%	114%
Adj. Flow (vph)	0	1866	3209	754	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1866	3209	754	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			24	24	14
Sign Control		Free	Free		Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 48.2%	ICU Level of Service A
Analysis Period (min) 15	

Lane Group	EBT	EBR	WBL	WBT	NWL	NWR
Lane Configurations	↑↑↑↑	↱		↑↑↑↑↑		
Volume (vph)	1206	365	0	3337	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		46.0	0.0		0.0	0.0
Storage Lanes		1	0		0	0
Taper Length (m)		2.5	2.5		2.5	2.5
Lane Util. Factor	0.86	1.00	1.00	0.81	1.00	1.00
Frt		0.850				
Flt Protected						
Satd. Flow (prot)	6479	1601	0	7628	0	0
Flt Permitted						
Satd. Flow (perm)	6479	1601	0	7628	0	0
Link Speed (k/h)	60			60	48	
Link Distance (m)	46.8			104.2	134.6	
Travel Time (s)	2.8			6.3	10.1	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	114%	114%	114%	114%	114%	114%
Adj. Flow (vph)	1432	433	0	3963	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1432	433	0	3963	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 47.4%	ICU Level of Service A
Analysis Period (min) 15	

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1020	3382	215	0	285
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	0.86	1.00	1.00
Frt			0.991			0.865
Flt Protected						
Satd. Flow (prot)	0	6479	6421	0	0	1629
Flt Permitted						
Satd. Flow (perm)	0	6479	6421	0	0	1629
Link Speed (k/h)		60	60		40	
Link Distance (m)		104.2	84.7		141.5	
Travel Time (s)		6.3	5.1		12.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	114%	114%	114%	114%	114%	114%
Adj. Flow (vph)	0	1211	4016	255	0	338
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1211	4271	0	0	338
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		0.0	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Free	

Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 86.7%	ICU Level of Service E
Analysis Period (min) 15	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑↑			↑↑↑↑		↱
Volume (vph)	1020	0	0	3597	0	475
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	1.00	1.00	0.86	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	6479	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	6479	0	1629
Link Speed (k/h)	60			60	40	
Link Distance (m)	84.7			97.5	127.1	
Travel Time (s)	5.1			5.9	11.4	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	114%	114%	114%	114%	114%	114%
Adj. Flow (vph)	1211	0	0	4271	0	564
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1211	0	0	4271	0	564
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Free	

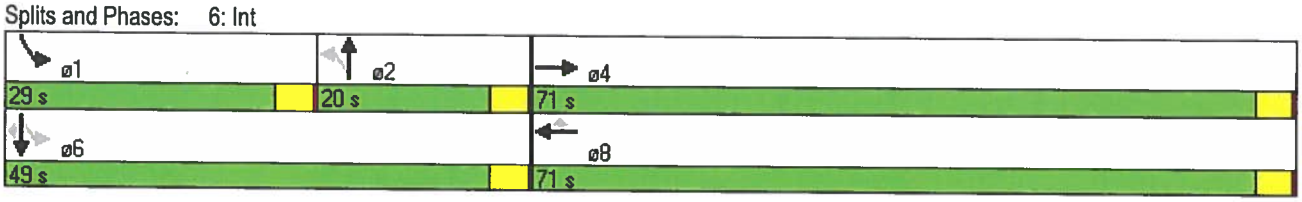
Intersection Summary	
Area Type: Other	
Control Type: Unsignalized	
Intersection Capacity Utilization 62.8%	ICU Level of Service B
Analysis Period (min) 15	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↱			↑↑↑↑	↱		✥		↰	↑	↱
Volume (vph)	0	1460	35	0	3220	414	67	81	28	454	55	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.996				0.850		0.978				0.850
Flt Protected								0.981		0.950		
Satd. Flow (prot)	0	6453	0	0	6479	1601	0	1794	0	1789	1883	1601
Flt Permitted								0.848		0.405		
Satd. Flow (perm)	0	6453	0	0	6479	1601	0	1550	0	763	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6				330		7				
Link Speed (k/h)		60			50			50			50	
Link Distance (m)		97.5			168.4			109.0			120.9	
Travel Time (s)		5.9			12.1			7.8			8.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	2%	2%	2%	2%	2%
Adj. Flow (vph)	0	1703	41	0	3757	483	78	94	33	530	64	362
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1744	0	0	3757	483	0	205	0	530	64	362
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	L NA	Left	R NA	L NA	Left	R NA
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type						Perm	Perm			pm+pt		Perm
Protected Phases		4			8			2		1	6	
Permitted Phases						8	2			6		6
Minimum Split (s)		20.0			20.0	20.0	20.0	20.0		8.0	20.0	20.0
Total Split (s)	0.0	71.0	0.0	0.0	71.0	71.0	20.0	20.0	0.0	29.0	49.0	49.0
Total Split (%)	0.0%	59.2%	0.0%	0.0%	59.2%	59.2%	16.7%	16.7%	0.0%	24.2%	40.8%	40.8%
Maximum Green (s)		67.0			67.0	67.0	16.0	16.0		25.0	45.0	45.0
Yellow Time (s)		3.5			3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		0.5			0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Walk Time (s)		5.0			5.0	5.0	5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0			0	0	0	0			0	0
Act Effct Green (s)		67.0			67.0	67.0		16.0		45.0	45.0	45.0
Actuated g/C Ratio		0.56			0.56	0.56		0.13		0.38	0.38	0.38
v/c Ratio		0.48			1.04	0.46		0.96		1.06	0.09	0.60
Control Delay		15.1			53.1	6.0		103.1		90.7	24.8	35.5
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		15.1			53.1	6.0		103.1		90.7	24.8	35.5
LOS		B			D	A		F		F	C	D
Approach Delay		15.1			47.7			103.1			65.4	
Approach LOS		B			D			F			E	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection			
Natural Cycle: 130			
Control Type: Pretimed			
Maximum v/c Ratio: 1.06			
Intersection Signal Delay: 43.7		Intersection LOS: D	
Intersection Capacity Utilization 101.3%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 6: Int

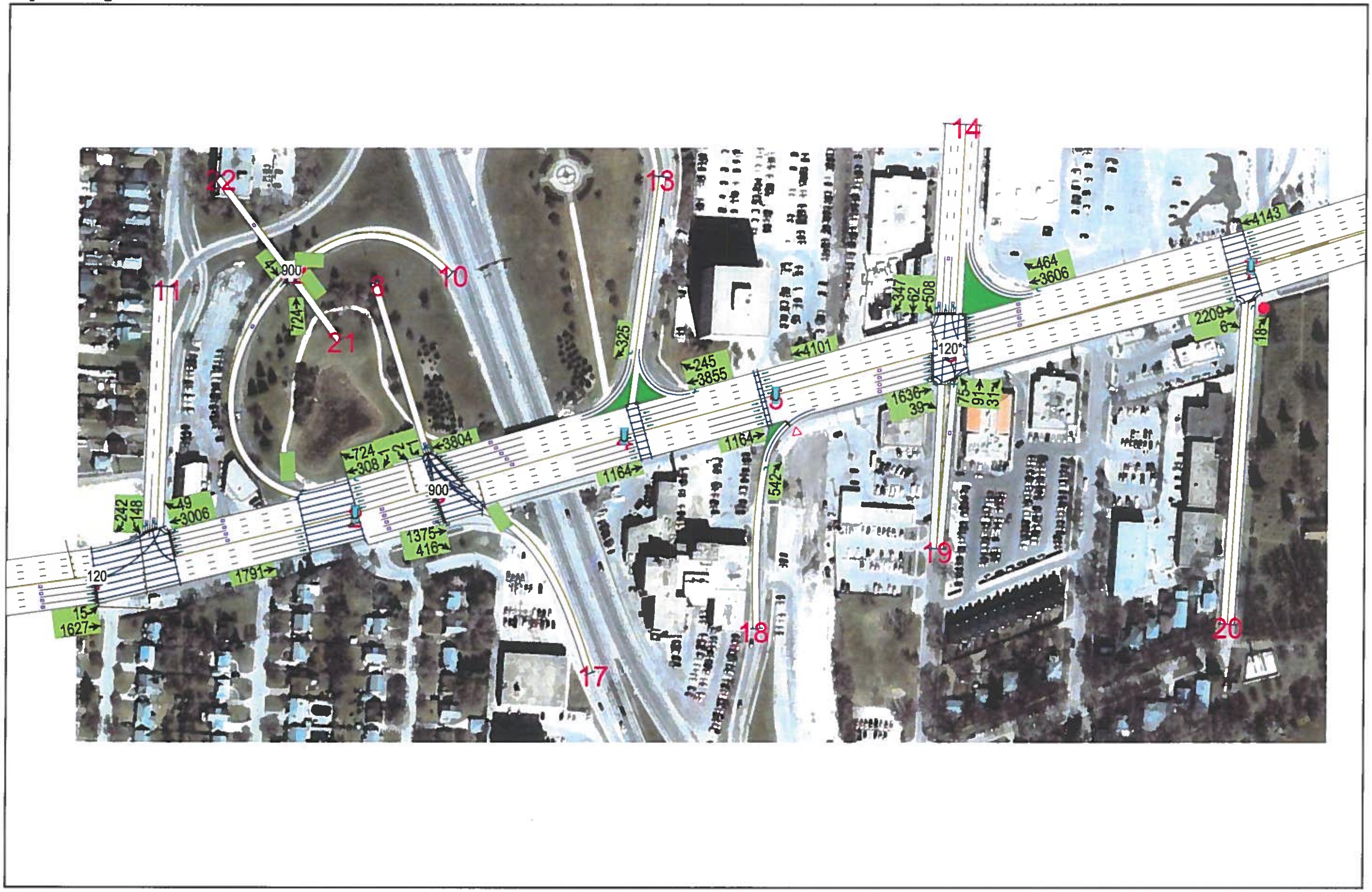


Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1937	5	0	3634	0	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	1.00	0.81	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	6479	0	0	7628	0	1629
Flt Permitted						
Satd. Flow (perm)	6479	0	0	7628	0	1629
Link Speed (k/h)	60			60	50	
Link Distance (m)	168.4			159.0	193.9	
Travel Time (s)	10.1			9.5	14.0	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	114%	114%	114%	114%	114%	114%
Adj. Flow (vph)	2300	6	0	4315	0	19
Shared Lane Traffic (%)						
Lane Group Flow (vph)	2306	0	0	4315	0	19
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	R NA
Median Width(m)	2.0			2.0	0.0	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 51.4% ICU Level of Service A
Analysis Period (min) 15

PM Peak 2022 Post Development
Cycle Lengths



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Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	13	1440	2660	43	131	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.86	0.86	0.86	0.86	1.00	1.00
Frt			0.998			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	6479	6466	0	1772	1601
Flt Permitted		0.845			0.950	
Satd. Flow (perm)	0	5475	6466	0	1772	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			5			1
Link Speed (k/h)		60	60		50	
Link Distance (m)		243.4	143.7		161.2	
Travel Time (s)		14.6	8.6		11.6	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	113%	113%	113%	113%	113%	113%
Heavy Vehicles (%)	2%	2%	2%	2%	3%	2%
Adj. Flow (vph)	15	1695	3131	51	154	252
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1710	3182	0	154	252
Enter Blocked Intersection	Yes	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	L NA	R NA
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		-30.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm					Perm
Protected Phases		2	6		4	
Permitted Phases	2					4
Minimum Split (s)	24.0	24.0	24.0		24.0	24.0
Total Split (s)	84.0	84.0	84.0	0.0	36.0	36.0
Total Split (%)	70.0%	70.0%	70.0%	0.0%	30.0%	30.0%
Maximum Green (s)	79.0	79.0	79.0		31.0	31.0
Yellow Time (s)	4.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	4.0	5.0	5.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0		5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)	0	0	0		0	0
Act Effct Green (s)		79.0	79.0		31.0	31.0
Actuated g/C Ratio		0.66	0.66		0.26	0.26
v/c Ratio		0.47	0.75		0.34	0.61
Control Delay		10.7	15.2		38.7	46.3
Queue Delay		0.0	1.7		0.0	0.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Total Delay		10.7	16.8		38.7	46.3
LOS		B	B		D	D
Approach Delay		10.7	16.8		43.4	
Approach LOS		B	B		D	

Intersection Summary	
Area Type: Other	
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 36 (30%), Referenced to phase 2:EBTL and 6:WBT, Start of Green	
Natural Cycle: 60	
Control Type: Pretimed	
Maximum v/c Ratio: 0.75	
Intersection Signal Delay: 16.9	Intersection LOS: B
Intersection Capacity Utilization 67.7%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 1: Int

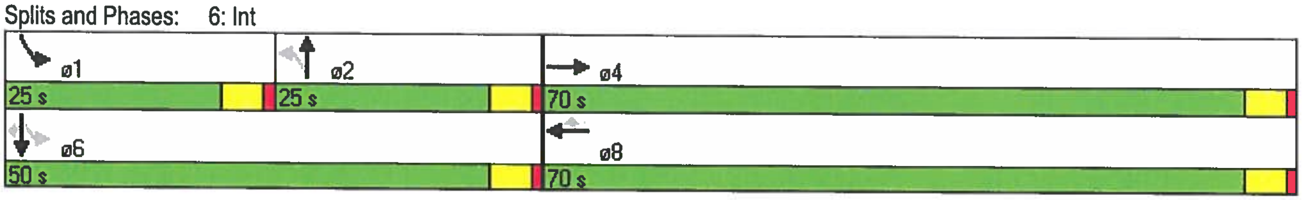
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↱			↑↑↑↑	↱		✥		↰	↑	↱
Volume (vph)	0	1461	35	0	3220	414	67	81	28	454	55	310
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	0.86	0.86	1.00	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.996				0.850		0.978				0.850
Flt Protected								0.981		0.950		
Satd. Flow (prot)	0	6453	0	0	6479	1601	0	1794	0	1789	1883	1601
Flt Permitted								0.848		0.458		
Satd. Flow (perm)	0	6453	0	0	6479	1601	0	1550	0	863	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6				318		7				
Link Speed (k/h)		60			50			50			50	
Link Distance (m)		97.5			168.4			109.0			120.9	
Travel Time (s)		5.9			12.1			7.8			8.7	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	2%	2%	2%	2%	2%
Adj. Flow (vph)	0	1704	41	0	3757	483	78	94	33	530	64	362
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1745	0	0	3757	483	0	205	0	530	64	362
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	L NA	Left	R NA	L NA	Left	R NA
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type						Perm	Perm			pm+pt		Perm
Protected Phases		4			8			2		1	6	
Permitted Phases						8	2			6		6
Minimum Split (s)		24.0			24.0	24.0	24.0	24.0		9.0	24.0	24.0
Total Split (s)	0.0	70.0	0.0	0.0	70.0	70.0	25.0	25.0	0.0	25.0	50.0	50.0
Total Split (%)	0.0%	58.3%	0.0%	0.0%	58.3%	58.3%	20.8%	20.8%	0.0%	20.8%	41.7%	41.7%
Maximum Green (s)		65.0			65.0	65.0	20.0	20.0		20.0	45.0	45.0
Yellow Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)		1.0			1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	5.0	4.0	4.0	5.0	5.0	5.0	5.0	4.0	5.0	5.0	5.0
Lead/Lag							Lag	Lag		Lead		
Lead-Lag Optimize?							Yes	Yes		Yes		
Walk Time (s)		5.0			5.0	5.0	5.0	5.0			5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0	11.0	11.0			11.0	11.0
Pedestrian Calls (#/hr)		0			0	0	0	0			0	0
Act Effct Green (s)		65.0			65.0	65.0		20.0		45.0	45.0	45.0
Actuated g/C Ratio		0.54			0.54	0.54		0.17		0.38	0.38	0.38
v/c Ratio		0.50			1.07	0.48		0.78		1.11	0.09	0.60
Control Delay		17.8			66.0	6.9		66.8		107.3	24.8	35.5
Queue Delay		0.0			0.0	0.0		0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		17.8			66.0	6.9		66.8		107.3	24.8	35.5
LOS		B			E	A		E		F	C	D
Approach Delay		17.8			59.2			66.8			74.6	
Approach LOS		B			E			E			E	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green, Master Intersection
Natural Cycle: 130
Control Type: Pretimed
Maximum v/c Ratio: 1.11
Intersection Signal Delay: 51.4 Intersection LOS: D
Intersection Capacity Utilization 103.8% ICU Level of Service G
Analysis Period (min) 15

Splits and Phases: 6: Int



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