January 26, 2018

City of Winnipeg – Zoning and Permits
Unit 31 - 30 Fort Street
Winnipeg, Manitoba
R3C 4X7

Attention: Mr. Martin Grady
City of Winnipeg Zoning Administrator

RE: Precinct G – Precinct Plan

Dear Mr. Grady,

Landmark Planning & Design Inc. is pleased to submit this application for the Precinct G Precinct Plan. Our Project Team has worked closely with various City of Winnipeg Departments (including Planning, Property and Development, Public Works, Water and Waste, and Parks) on this Plan for over two years. An informal circulation among these City departments (initiated in May 2017) led to valuable input that has been integrated into the Plan. Our process has included three rounds of meaningful public consultation and stakeholder engagement, including targeted meetings with those likely to be directly impacted by the future development of the Precinct. We have also worked closely with Precinct landowners throughout the planning process, and have achieved consensus on the direction and intent of the Plan. The Precinct Plan incorporates input and feedback from City departments, community stakeholders, and area landowners. The end result is a Plan that we feel will act as a solid foundation to guide growth and development in Precinct G over the coming decades.

Our submission includes four (4 copies) of each of these accompanying materials:

- Precinct G Precinct Plan and Figures
- Servicing Studies
- Natural Areas Assessment – Sub-Areas 2a and 2b
- Transportation Study (to follow)
- Consultation Report (to follow)
- Application Fee ($35,920)

If you have any questions or require additional information, please contact the undersigned at 204-453-8008. We thank you for your consideration in this matter, and we look forward to meeting with City of Winnipeg representatives on this file.

Yours truly,

Brendan Salakoh, MCIP, RPP
LANDMARK PLANNING & DESIGN INC

Landmark
Planning & Design Inc.

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Precinct G – Precinct Plan – Consultation Report Executive Summary

Landmark Planning and Design was retained to prepare a Precinct Plan for the New Community in northwest Winnipeg known as Precinct G. As part of the planning process, the project team undertook an extensive public consultation and stakeholder engagement process involving local residents, landowners, businesses, government agencies, the local school division, other stakeholders, and the general public. The objectives of this process were to communicate project information to stakeholders, provide regular updates on progress, seek input from stakeholders, work to address and mitigate potential concerns, and integrate feedback into the planning process.

The process included three rounds of public engagement over a 24-month period (December 2015 to December 2017). The objective of Round 1 was to communicate project information to stakeholders and receive their feedback relating to potential impacts, issues, or concerns that the project team could consider prior to drafting the Precinct Plan. The objective of Round 2 was to update stakeholders on the latest project information, including draft land-use concepts and road network concepts. The objective of Round 3 was to update stakeholders, present the draft Precinct Plan, and offer participants and additional opportunity to provide input.

The project team worked closely throughout the project with various City of Winnipeg Departments (including Planning, Property and Development, Public Works, Water and Waste, and Parks) on this Plan for over two years. An informal circulation among City departments (initiated in May 2017) led to valuable input that was also integrated into the Plan. The project team hosted targeted stakeholder meetings with those most likely to be directly impacted by the future development of the Precinct (e.g. those living adjacent to the Plan area, and those living along collector roads that connect to the Precinct Plan Area). The team also worked closely with Precinct landowners throughout the planning process and achieved reasonable consensus on the direction and intent of the Plan.

Approximately 150 landowners, stakeholders and residents attended various meetings and open houses over the two-year period. Notification methods included hand-delivered meeting invites to adjacent residents, email blasts to all those involved in the process, phone invites to select stakeholders, newspaper advertisements for open house events (Winnipeg Free Press and CanStar Weekly) and periodic updates to the project website.

The project team worked diligently over the course of the project to understand, consider, and address comments and concerns raised by the various stakeholder groups. Below is a chart outlining some of the key stakeholder comments/concerns, as well as the project team's response:

#	Issue Description	Response
1	Cut-through traffic through the existing Riverbend neighbourhood	A comprehensive transportation study was completed as part of the planning process. The preferred road network concept will serve to disperse traffic amongst several collectors and arterials, minimizing the impact on existing neighbourhoods.

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#	Issue Description	Response
2	Existing traffic on Murray Avenue	The Plan anticipates the possible future closing of the Murray Avenue crossing of the rail line, once the Chief Peguis Trail is extended to McPhillips Street. Also, the dispersion of traffic will reduce the relative impact on Murray Avenue.
3	Desire for the Chief Peguis Trail to be built prior to development	While the landowners do not control the construction of the CPT (as it is an expressway), developments like Precinct G will help create a sense of urgency for this critical piece of transportation infrastructure.
4	Desire to see parks and greenspace in the area	Parks and greenspace (for both passive and active recreational uses) will be dispersed through the community (at least one in each sub-area and a large park overall), as per the policies of the Plan. Park locations will be determined at the subdivision stage.
5	Provision of schools	The project team met with the School Division and Public Schools Finance Board. At least one K-8 school is required in the area, and policies in the Plan address school siting criteria.
6	Development timeline	The development timeline will depend on various factors, including market demand, infrastructure investment, population growth and landowner interest in development. The Plan assumes that the majority of development will take place over a 25-year time horizon.
7	Provision of Active Transportation (AT)	An active transportation (AT) and pathway network has been a key component of the Plan. Policies ensure connectivity both internally and to the larger AT network outside of Precinct G.
8	Preservation of high-quality natural areas	A natural areas assessment was undertaken for a portion of the lands in Precinct G, and policies encourage the preservation of high-quality natural areas through land dedication.
9	Project communications	The project team committed to following up with stakeholders and the general public throughout the planning process. Not only was a master stakeholder list developed to ensure participants were notified in subsequent rounds, but all display materials were made available through the Landmark Planning website.

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#	Issue Description	Response
10	Property values	Research indicates that existing property values are likely to increase as a result of new development.
11	Loss of privacy and views	There are policies in place to ensure appropriate transitions between differing housing densities. Lands adjacent to existing development have been designated for lower density (e.g. single-family) development.
12	How will construction traffic be addressed?	A construction staging plan will be required at a later stage of the development process.

The Precinct Plan incorporates input and feedback from City departments, community stakeholders, area landowners, and the general public. The comprehensive engagement process is considered thorough for a project of this scale and nature.

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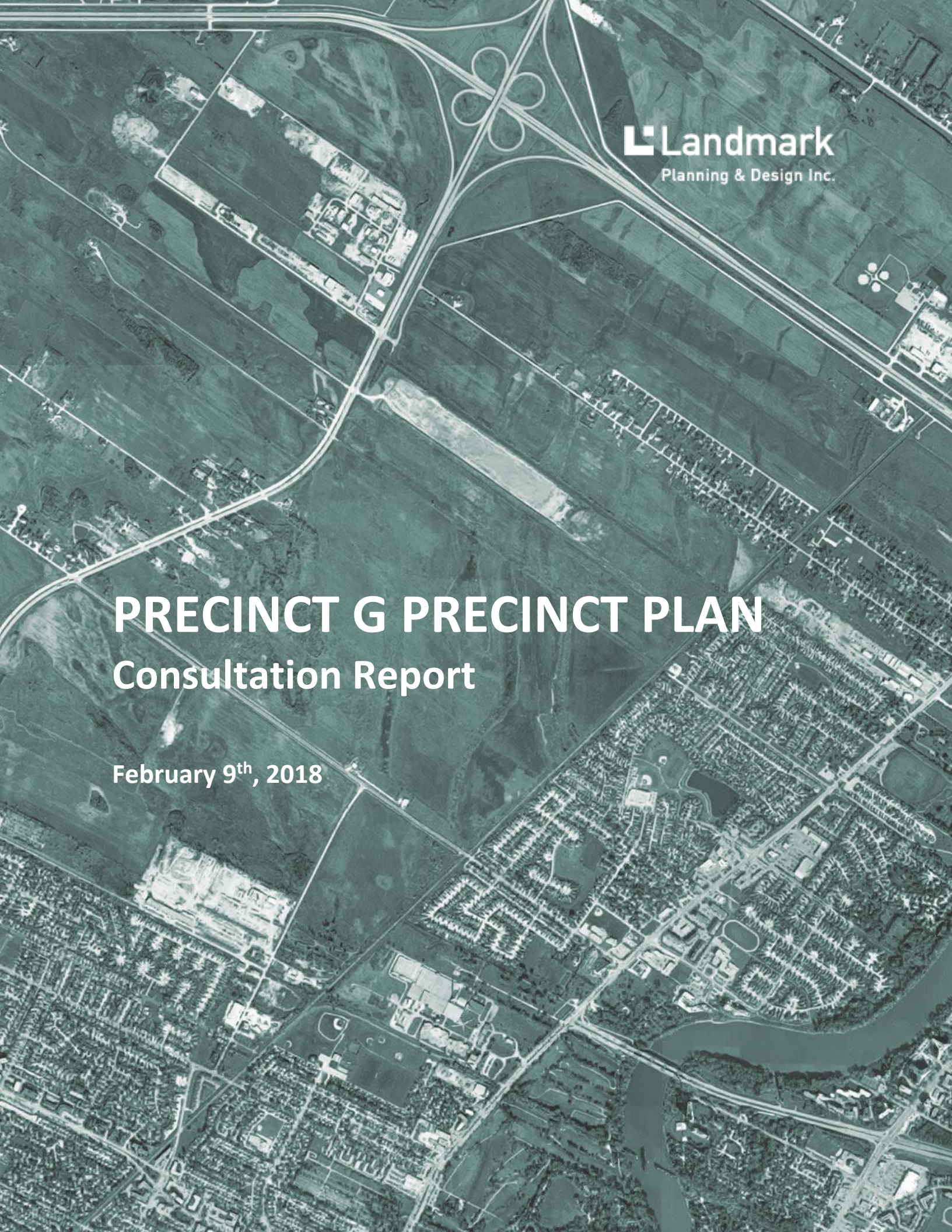

Landmark
Planning & Design Inc.

PRECINCT G PRECINCT PLAN
Consultation Report

February 9th, 2018

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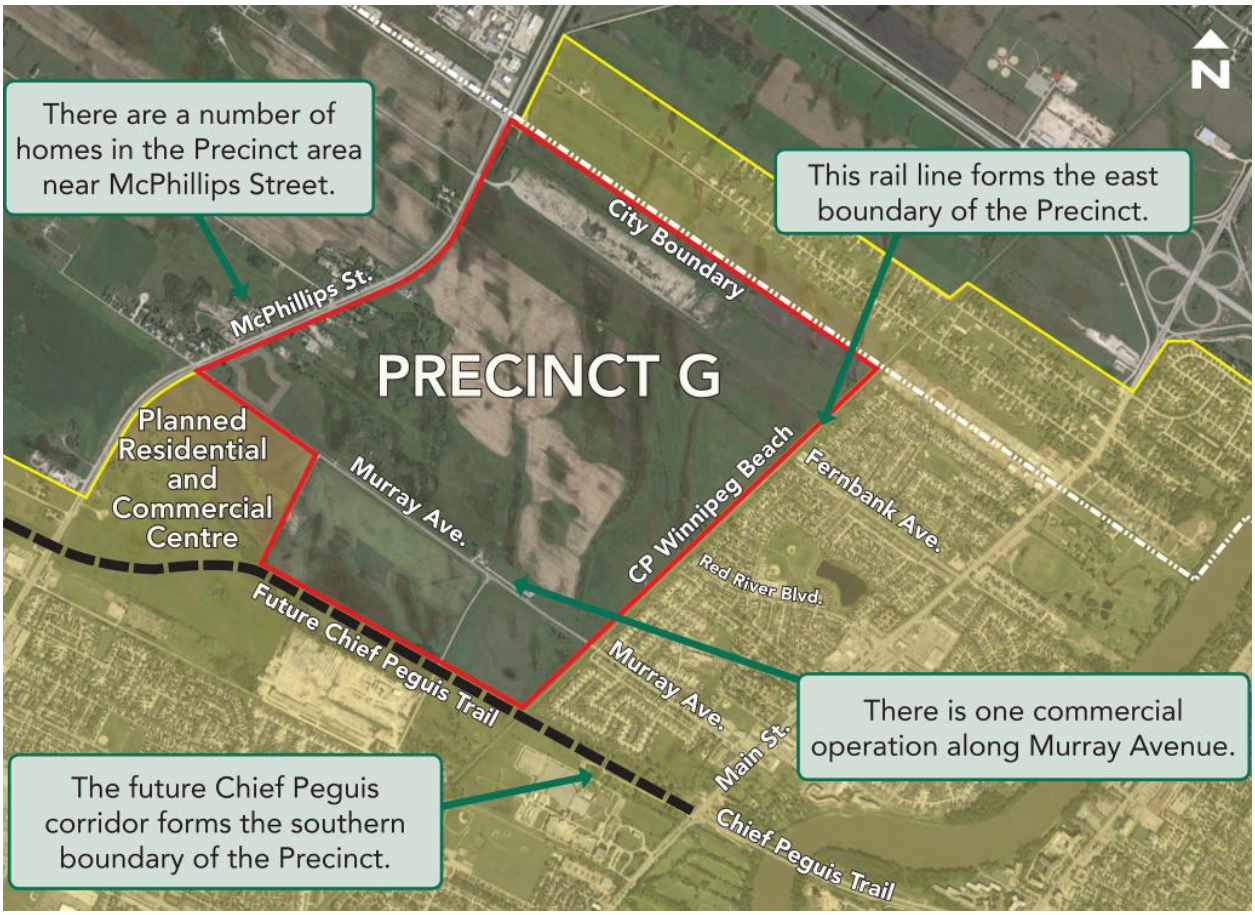
1 Introduction

Landmark Planning and Design was retained to prepare a land use plan (Precinct Plan) for an 800-acre area in north Winnipeg, identified in *OurWinnipeg* as Precinct "G" (see ***Figure 1***). The planning process addressed land use, transportation and servicing for the area and resulted in a Precinct Plan that will guide development within the new neighbourhood.

An extensive, 24-month consultation and engagement process with local residents, landowners, businesses, government agencies, the local school division, and the general public was undertaken. The objectives of this process were to communicate project information to residents, landowners, and interested parties, provide regular updates on progress, seek input from stakeholders, and work to mitigate potential concerns.

Figure 1 – Precinct G Area



1.1 Process

The public consultation process included three rounds, each with different objectives.

Round 1 (December 2015 to June 2016)

The objective of Round 1 was to communicate project information to stakeholders and receive their feedback, relating to potential impacts, issues, or concerns that the project team could consider prior to drafting the Precinct Plan. The Project Team:

- Identified potential stakeholders and interested parties in the project area;
- Met with study area landowners to review project parameters and understand landowner concerns and questions;
- Met with internal and external stakeholders to review project parameters and understand stakeholder concerns and questions; and,
- Hosted a public open house to introduce the project, review project parameters and understand public concerns and questions.

Round 2 (July 2016 to January 2017)

The objective of Round 2 was to update stakeholders on the latest project information, including draft land-use and road network concepts. Stakeholders understood how Round 1 input was considered and addressed. The Project Team:

- Hosted follow-up landowner meetings to present draft land-use and road network concepts, and receive input;
- Hosted follow-up stakeholder meetings to present draft land-use and road network concepts, and receive input; and,
- Held a second public open house to present draft land-use and road network concepts and receive input.

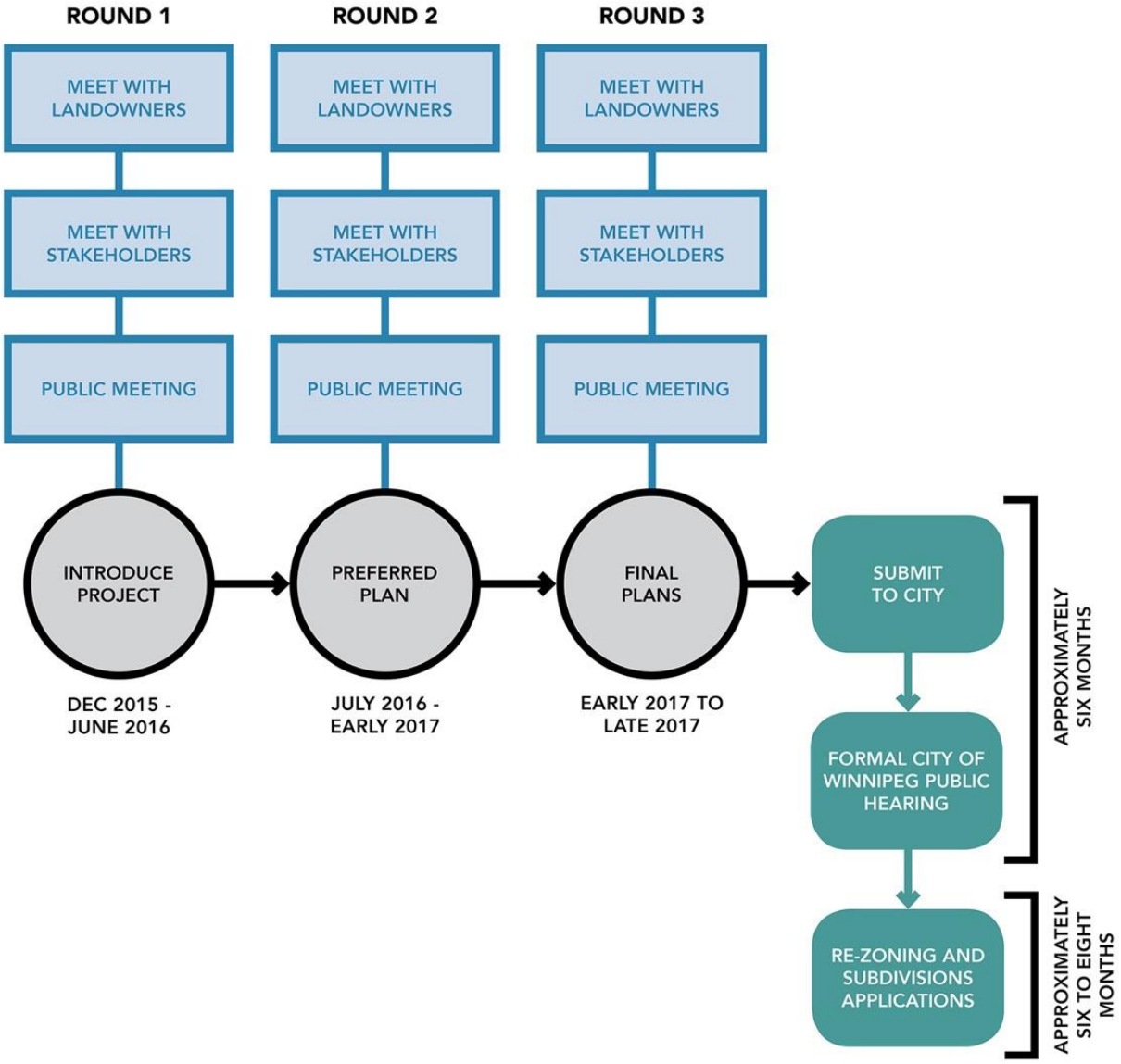
Round 3 (February 2017 to December 2017)

The objective of Round 3 was to update stakeholders, present the draft Precinct Plan and Figures, and offer stakeholders and the public an additional opportunity to provide input. The Project Team:

- Hosted follow-up landowner meetings to present the draft Plan and Figures, and receive input;
- Hosted follow-up stakeholder meetings to present the draft Plan and Figures, and receive input; and,
- Held a third public open house to present the draft Plan and Figures concepts and receive input.

The following sections outline the major tasks undertaken as part of the consultation process.

Figure 2 – Meeting Process



2 Landowner Meetings (Round 1)

2.1 Format and Purpose

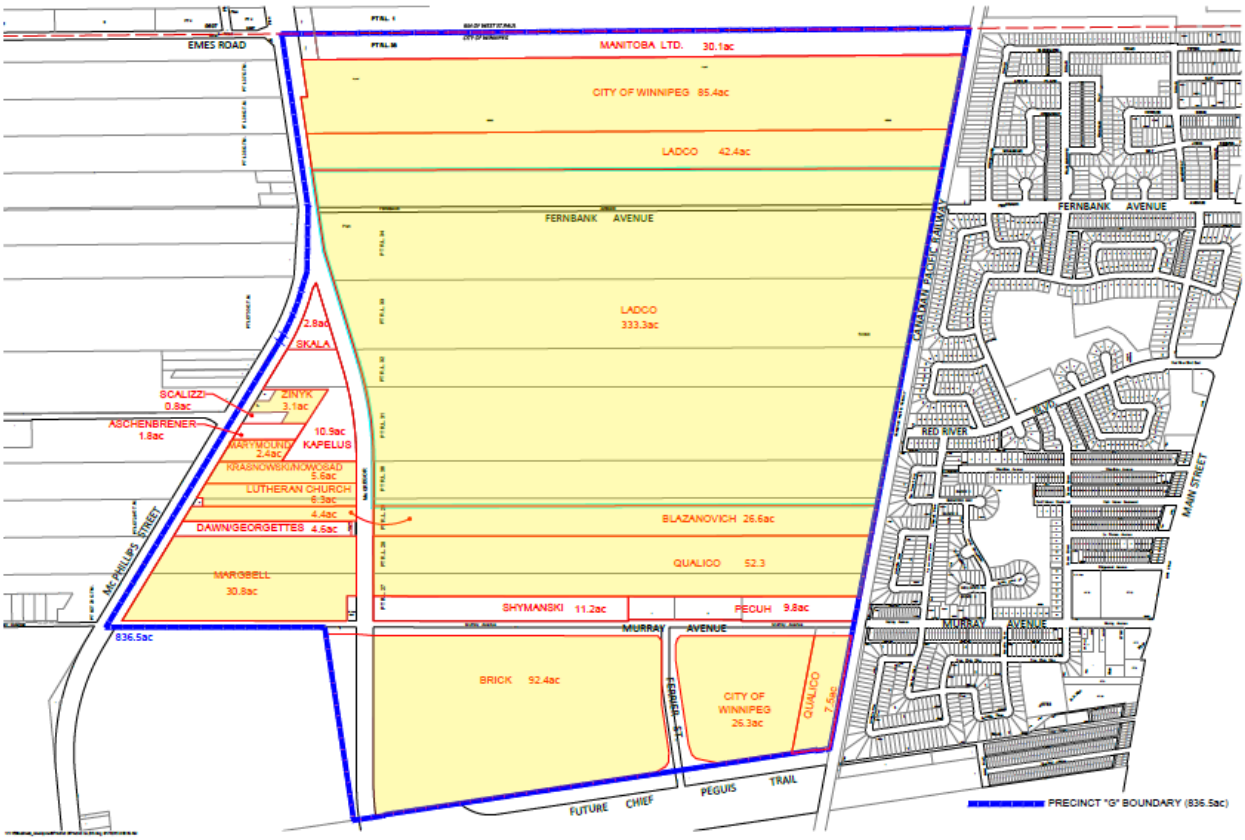
A landowner meeting was held on December 14, 2015 at the Red River Community Centre, 293 Murray Avenue. The meeting was carried out to review project parameters and understand landowner concerns and issues. Landowner meeting minutes are included in **Appendix A**.

2.2 Notification and Attendance

There are approximately 20 landowners within the boundaries of Precinct G. Invitation letters were mailed to the majority of landowners, while others received an invitation via email (if email address was available).

Sixteen participants attended the landowner meeting. Sample notification materials are provided in **Appendix B**. **Figure 3** highlights (in yellow) the properties of landowners who participated in the meeting on December 14, 2015. The vast majority of Precinct G landowners have participated in the planning process.

Figure 3 – Landowner Participation



2.3 Participant Information

Landowners were asked to complete a comment sheet at the conclusion the meeting. Of the 6 respondents, 56% indicated their interest in the project to be specific to landownership, 11% indicated it was because they reside in the area, and another 11% indicated their interest was related to business ownership. Twenty-two percent of participants indicated "other" as a reason for their interest in the project, but did not elaborate.

2.4 Understanding the Need for a Precinct Plan

Participants were asked if they generally understood the reasons a Precinct Plan is required for this area. All respondent (100%) stated that they understood the need for a Precinct Plan to be developed for Precinct G.

2.5 Intent to Participate in the Precinct Plan Process

Participants were asked whether they intended to participate in the Precinct Plan process. All participants (100%) indicated that they intended to participate in the process.

2.6 Specific Information about the Precinct Plan or the Precinct Plan Process

When participants were asked if there was any further information that the project team could provide about the Precinct Plan or the Precinct Plan process, one (1) participant indicated that they would like information specific to their property. Four (4) did not have any questions or comments.

2.7 Other Comments

Participants were asked to provide any other comments or questions they had regarding the Precinct Plan Process. The following comments were provided:

- Would like access to be provided east of Sub-Area 5, to the "old" proposed extension of McGregor Avenue (x2).

2.8 Meeting Effectiveness

When asked if they found the information session helpful, five (5) participants indicated "yes" and only 1 participant indicated the information was "somewhat" helpful.

3 Adjacent and Collector Road Resident Meetings (Round 1)

3.1 Format and Purpose

The project team decided that due to potential traffic impacts, the residents along the three collector streets that may connect to Precinct G (Murray Avenue, Red River Boulevard and Fernbank Avenue) be consulted. The project team also reached out to all property owners directly adjacent to Precinct G (i.e. those along the CPR Winnipeg Beach rail line). Meetings for these collector street homeowners and adjacent homeowners were held on May 3 and 4, 2016 at the Red River Community Centre, 293 Murray Avenue. Four meeting sessions were offered over the two-day period. The meetings were carried out to review project parameters and understand resident concerns and issues. Meeting minutes are included in **Appendix A**.

3.2 Notification and Attendance

Approximately 225 letters were hand delivered to residents along Murray Avenue, Red River Boulevard and Fernbank Avenue, as well as those directly adjacent to the Precinct. Twenty-eight participants attended one of the 4 information sessions offered on May 3 and May 4, 2016. Copies of the notification materials are provided in **Appendix B**.

3.3 Participant Information

Participants were asked to complete a comment sheet at the conclusion the meeting. A sample comment sheet is provided in **Appendix C**. Of the 19 respondents, 26% (5) indicated residing on Murray Avenue, 26% (5) resided on Red River Boulevard, 21% (4) resided on Fernbank Avenue, and 26% (5) indicated they lived on a street flanking one of the collector roads.

3.4 Understanding the Need for a Precinct Plan

Participants were asked if they generally understood the reasons a Precinct Plan is required for this area. Eighteen respondents (95%) stated that they understood the need, while 1 respondent (5%) indicated that they “somewhat” understood the need.

3.5 Understanding the Planning Process

When asked if they generally understood the steps of the planning process, 84% (16) of respondents indicated “yes” they understood the process, and 16% (3) indicated they “somewhat” understood the process.

3.6 Information/Opinions Provided to the Study Team

Participants were asked what type of issues/concerns the Project Team should consider as they begin to prepare the Precinct Plan. Most of the comments focused on the road networks and traffic impacts. A few comments were offered on active transportation, green space, as well as property values. A sampling of the most common themes are highlighted below.

Road Networks/Traffic

- Ensure the road network is planned properly from the outset.
- Concerns regarding increased traffic on collector roads in Riverbend.
- Need connections to regional arteries (e.g. Chief Peguis Trail and McPhillips Street).

Active Transportation/Green Space

- Include functional pedestrian routes in the plan.
- Would like to see more information on active transportation.
- Would like to see more green space.

Property Implication

- How will development affect taxes and new home values?

Several concerns, comments, and questions came up during the landowner meetings themselves. The following is a high-level summary of those:

Process

- What is the process timeline?
- How much influence does participant input have on the process?
- Will the City of Winnipeg be taking note and addressing resident concerns?

Transportation

- When will Chief Peguis Trail extend west?
- Will there be traffic lights installed on the collector roads?
- Why does traffic from the new development need to cut through existing neighborhoods?
- Will Ferrier Street be extended to the City Boundary?
- Will the right-of-way for McGregor Street be utilized?
- Will existing collectors be widened?
- How many rail crossings will be allowed?

Land Use

- What is the plan for schools in this area?
- Will Ivan's Autobody be allowed to continue operating?
- Will there be a fire hall in study area?
- How many additional new homes/residents are anticipated in Precinct G?
- Will there be Manitoba Housing in the proposed development area?
- Will there be an allocation for greenspace in Precinct G?

Active Transportation

- Are sidewalks, bike paths, and trails considered in the precinct planning process?

Construction

- How will construction traffic be addressed?
- What is the construction timeline?

Other

- Is there a need for more development in the City of Winnipeg?
- Will residents in the existing neighborhoods be subject to an LID?
- Is this a done deal?

3.7 Meeting Effectiveness

Fourteen respondents (78%) found the information session helpful while the remaining 4 respondents (22%) found the session "somewhat" helpful.

Comments included:

- Very informative.
- Well presented.
- Friendly team members.
- Gained a better understanding of the Precinct Plan process and how development would proceed.
- Feels as if this is a done deal. If not, prove it; listen to the residents' concerns.

4 Stakeholder Meetings (Round 1)

4.1 Format and Purpose

A series of stakeholder meetings were carried out to discuss key project parameters with identified stakeholders, and to understand stakeholder concerns and address them where possible. Meetings were held with the following groups and organizations:

- City of Winnipeg – Public Works
- City of Winnipeg – Water and Waste
- City of Winnipeg – Parks and City Naturalist
- City of Winnipeg – Transit
- City of Winnipeg – Fire Paramedic
- City of Winnipeg – Planning, Property and Development
- City of Winnipeg – Community Services
- CP Rail
- Manitoba Hydro
- RM of West St. Paul
- Ivan's Autobody
- Seven Oaks School Division

4.2 Participant Feedback/Input

At each of the stakeholder meetings, project representatives informed participants of the proposed project parameters. Participants shared input regarding their respective interests and concerns. The following notes summarize key discussion points from various stakeholders (see **Appendix A** for detailed meeting minutes):

City of Winnipeg – Public Works Department

The Public Works Department shared their long-term vision for roadways in and around the study area.

City of Winnipeg – Public Works – Snow Dump Operations

Public Works indicated that there are no short or long-term plans to relocate the McPhillips Snow Dump as it is the largest in the city. Public Works representatives noted a potential liability risk if residents attempt to utilize the snow dump as a tobogganing hill. This concern could be mitigated with appropriate fencing.

City of Winnipeg – Water and Waste Water Department

City of Winnipeg representatives noted that there are no major constraints that would impede servicing the study area with water. There is a sufficiently sized feeder-main on Murray Avenue, along with a number of other connection points to the east (Fernbank Avenue and Red River Boulevard) that would

serve as the primary servicing points. Fire protection and domestic needs could be addressed as well. However, further study will be required at the subdivision stage.

It was discussed that an interceptor sewer would run along Fernbank Avenue to Main Street (the Fernbank Interceptor Sewer). This interceptor sewer would service most of Precinct G, as well as land west of Precinct G (Precinct D). The southern portion of Precinct G could potentially be serviced by a new sewer line routed straight south to the interceptor in the Chief Peguis Trail right-of-way. The Fernbank Interceptor should be planned with consideration for servicing areas to the west of Precinct G (Precinct D and possibly beyond).

City of Winnipeg Water and Waste Department – Solid Waste Services

There is a closed landfill in the northeast quadrant of Precinct G. The once active landfill operated for nine years and was decommissioned in 1974. It is relatively small in size, was capped, and has a good vegetative covering. There are monitoring wells on and around the site (primarily on the east side) and more monitoring wells will be installed in the near future to further monitor water quality and gas migration.

There is a 90-meter control zone around the site that restricts development. It is possible that the control zone could be reduced, although this would require further study. The Parks and Solid Waste departments will work with the study team to incorporate the closed landfill into the planned area. Potential future uses include a passive park or dog park. It is also possible that the control zone may be used as park space.

City of Winnipeg – Community Services

Further investigation into the capacity of the Garden City Community Centre and the Vince Leah Community Centre will need to be undertaken before it can be determined if a community centre is required in Precinct G. The current trend in community centre development is to construct multiplex-style campuses that can accommodate schools, libraries and recreations facilities.

City of Winnipeg – Community Services – Naturalist Services

There is a grade 'A' natural area, as determined by City of Winnipeg officials, located in the Chief Peguis Trail right-of-way, which includes an aspen forest and prairie grasslands. The City of Winnipeg Public Works Department is considering purchasing land to allow the Chief Peguis Trail extension to swing north and avoid the natural area.

Natural area policies will be included in the Precinct Plan in order to protect high quality natural areas. Developers, in consultation with the City of Winnipeg, could include natural areas as public reserve in the design of their developments.

City of Winnipeg – Community Services – Urban Design (Parks)

Representatives of the City of Winnipeg Urban Design Division indicated that consideration should be given to include four or five parks within the study area. Required land dedication will be calculated at a later stage. It is estimated that approximately 58 acres of dedication will be required.

City of Winnipeg – Winnipeg Transit

Winnipeg Transit indicated their desire to keep bus service on collector roads and for bus routes to be accessible within 400 meters of most users. Phasing will be important. It was recommended that a park-and-ride be explored during the early stages of planning. Transit will work with the developer and can review draft plans during the planning process as well as at the rezoning and subdivision stage.

City of Winnipeg – Fire Paramedic Services

WFPS noted that it was unlikely a new station would be required in Precinct G; it is directly adjacent to the City boundary (which would limit its reach in terms of radius). It was also noted that the City is currently looking to retain a consultant to do a fire response-time study, which may look at potential new station locations (e.g. where service times are weakest). Station No. 16 (1001 McGregor) would likely serve as the primary station for Precinct G. A connection to the south would be important to allow access. If Ferrier Street served as that connection, it should be paved for its entire length.

CP Rail

New crossings can be accommodated if it is demonstrated that the crossing is required in lieu of other more viable options. Installation of any new crossings would be carried out by CP then charged back to the initiator. Railway setbacks will follow Federation of Canadian Municipalities (FCM) guidelines. The Precinct Plan should consider including policies that identify the relevant FCM guidelines.

RM of West St. Paul

A north-south roadway connecting the study area and the RM of West St. Paul was discussed. Representatives of West St. Paul were indifferent to such a connection.

Municipal representatives confirmed that the right-of-way of the boundary road between the City of Winnipeg and the RM of West St. Paul is the responsibility of both jurisdictions. The most northerly landowner in Area 1 has potential access off the boundary road.

Ivan's Autobody

The owner of Ivan's Autobody briefly described the nature of the business, Ivan's Autobody, at 811 Murray Avenue. It operates on approximately 10 acres of land and is zoned Agricultural. There are currently two buildings located on the property that are connected by an internal roadway. One building operates primarily as an autobody and repair shop and the other as a paint shop. The business owner communicated his intentions to expand the operation in the immediate future. The expansion would include a 10,000 (+/-) square foot building, for which design work has been completed. The Project Team noted that Ferrier Street might eventually be extended north as a possible connector for development in Area 3. This would impact the future expansion of Ivan's Autobody.

Seven Oaks School Division (SOSD)

SOSD indicated they would require at least one K-8 school within Precinct G. A 10-acre site is required unless the school is located adjacent to a park (a 5-acre park next to a 5-acre school site is acceptable). SOSD indicated that all three high schools in the division are at capacity and that they will be seeking a

fourth high school site somewhere in north Winnipeg. A minimum 16-acre site is required for a high school.

Manitoba Hydro
In order to determine hydro servicing requirements for a new development, Manitoba Hydro considers the total number of acres minus land loss (parks, schools, roads, etc.) and then makes a comparison to other developments with similar characteristics

5 Public Open House (Round 1)

5.1 Format and Purpose

A public open house was held on Thursday, May 4, 2016 at the Red River Community Centre, 293 Murray Avenue. A series of information boards (see **Appendix D**) were displayed around the room, outlining the project purpose, process, timeline, and other important information. Project representatives were available to answer questions, address concerns, and receive input from attendees. Participants were asked to sign-in at the registration table, and to fill out a written response form prior to leaving the open house. For those not able to attend, the information boards were posted online. A sample comment sheet is provided in **Appendix C**.

5.2 Notification and Attendance

The Public Open House was advertised in the Saturday, April 23, 2016 edition of the Winnipeg Free Press. Copies of notification materials are provided in **Appendix B**. Twenty-four people signed in at the Public Open House. The moderate attendance at the open house is likely due (in part) to the extensive participation of stakeholders and landowners at previous meetings.

5.3 Public Open House Participants

Of the 12 respondents who completed a comment sheet, 5 (45%) indicated that they resided between Main Street and the CP Rail Line and 6 (55%) indicated they resided in an area “other” than those listed on the comment sheet.

5.4 Understanding the Need for a Precinct Plan

When respondents were asked if they understood the need for a Precinct Plan, all respondents (100%) indicated they understood the initiative.

Comments included:

- Understand the reason but do not agree that we need more homes to take away from the beauty of the open field.

- It would have been helpful to have a graphic representation or an example of what the plan would include; perhaps the last/most recent precinct plan.

5.5 Understanding the Planning Process

When asked if they generally understood the steps of the planning process, 45% (5) of respondents indicated "yes" they understood the process and 55% (6) indicated they "somewhat" understood the process.

Comments included:

- Have a better understanding now.
- Beginning to learn the process.

5.6 Information/Opinions Provided to the Study Team

Participants were asked what information or opinions they would like to offer the study team as they begin to prepare the Precinct Plan. The majority of comments provided by respondents were specific to either road networks and traffic implications or land use options.

Comments included:

Road Networks/Traffic

- Concerns about cut-through traffic, particularly along Murray Avenue and Carsdale Drive.
- Need for the Chief Peguis Trail extension.

Land Use

- How many homes will be built in Precinct G?
- Is expropriation required?
- Concern about higher densities adjacent to existing development.

5.7 Public Open House Effectiveness

Four (36%) participants indicated that they found the open house helpful, while 7 (64%) indicated that they found the open house "somewhat helpful". No participants indicated that the open house was not helpful. Respondents noted that there was a good overview of the planning concept, but that they were looking forward to more detail in future meetings.

6 Resident and Landowner Meetings (Round 2)

6.1 Format and Purpose

A landowner meeting was held on July 11, 2016 followed by three meetings on October 4 and 5, 2016. All meetings were held at the Red River Community Centre, 293 Murray Avenue. These meetings were for area landowners, adjacent residents, and residents living along the collector streets leading into Precinct G. The purpose of these meetings was to provide residents and landowners with a project update, introduce the road network and land-use concepts, and explain how earlier feedback was considered or addressed by the project team. Meeting minutes are included in **Appendix A**.

6.2 Notification and Attendance

Invitations were hand-delivered to all residents directly adjacent to Precinct G, as well as those in Riverbend living on Murray Avenue, Red River Boulevard, or Fernbank Avenue. Notices were also sent via registered mail to all landowners within the Precinct.

Five participants attended the landowners' meeting on July 11, 2016. The meetings held on October 4 and October 5 were well-attended (37 participants). Copies of the notification materials are provided in **Appendix B**.

6.3 Participant Information

Participants were asked to complete a comment sheet at the conclusion of each meeting. A sample of the Comment Sheet is provided in **Appendix C**. Of the 19 respondents, 16% (3) indicated that they resided within Precinct G, 64% (12) indicated that they resided along a collector street leading into Precinct G and 21% (4) noted residing somewhere other than the areas identified on the comment sheet. A total of 8 (44%) of respondents had attended a previous meeting and 10 (56%) had not.

6.4 Understanding the Need for a Precinct Plan

Participants were asked if they generally understood the reasons a Precinct Plan is required for this area. Sixteen respondents (89%) indicated that they understood the need for a plan to be prepared for this area, and 2 respondents (11%) indicated that they "somewhat" understood the need.

Comments included:

- Growth in Winnipeg must be done in a planned/integrated way to ensure proper use and connections to existing areas.

6.5 Understanding the Planning Process

When asked if they generally understood the steps of the planning process, 83% (15) of respondents indicated "yes" they understood the process and 17% (3) indicated they "somewhat" understood the process.

6.6 Opinions on Road Concepts

When participants were asked to share their opinion about the proposed road concepts, 47% (9) indicated that they "liked" the road concepts, another 47% (9) indicated that they were "unsure" about the road concepts and 5% (1) participant indicated that they "disliked" the concepts. Comments generally centred on the following themes:

- The need to mitigate cut-through traffic to the extent possible.
- The need for the Chief Peguis Trail to be extended to McPhillips Street.
- Like the concept of a fused grid.

6.7 Opinions on Land Use Concepts

Seventy-five percent (12) of participants indicated that they "liked" the proposed land use concepts, 19% (3) indicated they were "unsure" about the concepts and 6% (1) indicated that they did not like the concepts. Comments generally centered on the following themes:

- The land use concepts seemed to be balanced and well-thought out.
- Want additional detail on higher density areas, particularly adjacent to existing development.

6.8 Opinions on Lake and Trail Concepts

The majority of participants (76%) indicated that they "liked" the proposed lake and trail concepts and the remaining 24% indicated they were "unsure" about the concepts. Comments included:

- The more lakes and connected trails the better.
- Greenspace is excellent.
- Would like to see more detailed plans concerning green space and connectivity.

6.9 Information/Opinions Provided to the Study Team

Participants were asked what information or opinions they would like to offer the study team as they begin to prepare the Precinct Plan. The following comments were offered:

- Would like the Chief Peguis Trail to be extended.
- Would like to see a dog park, and the preservation of some natural areas.
- Like the idea of roundabouts.
- Would like more details about construction traffic.

Several comments, questions, and concerns came up during the landowner and adjacent residents' meetings themselves. The following is a summary of those comments questions and concerns:

Process

- When will development begin, and is it a done deal?
- How will the costs of development be shared?

- How can local residents stay informed?
- What tools do residents have to share their concerns?

Transportation/Servicing

- What would bus routes look like?
- Would collector roads have sidewalks on both sides?
- Will roundabouts be utilized in the new development?
- Will Murray Avenue, west of the CP Rail Line, be a four-lane street?
- How will drainage from the snow dump be addressed?
- Will there be traffic calming measures built in existing neighborhoods?

Land Use

- Will there be greenspace, parks pace and natural areas?
- Will there be a school in the area?
- What are the plans for the snow dump?

Active Transportation

- How will future active transportation corridors connect to existing communities?
- When will an active transportation corridor be installed along the CP Rail Line?
- When planning future communities, is it standard practice to include pathways?

Other

- What is the projected population for Precinct G?
- What community in the city is comparable to what is proposed for Precinct G?

6.10 Information Session Effectiveness

When participants were asked if they found the information session helpful, all participants (100%) indicated “yes”.

Comments included:

- Well done.
- Great Information.
- Useful meeting; thank you.

7 Stakeholder Meetings (Round 2)

7.1 Format and Purpose

A series of stakeholder meetings were carried out between July 2016 and January 2017, including meetings with:

- City of Winnipeg – Public Works
- City of Winnipeg – Parks and City Naturalist
- City of Winnipeg – Transit
- City of Winnipeg – Planning, Property and Development
- Public Schools Finance Board
- Seven Oaks School Division

7.2 Participant Feedback/Input

At each of the stakeholder meetings, project representatives provided stakeholders with a project update. Participants shared information concerning their respective interests and concerns. The following notes summarize key discussion points from various stakeholders (see **Appendix A** for detailed meeting minutes):

Public Schools Finance Board (PSFB)

A meeting with the PSFB was held to understand potential issues and opportunities, particularly as it related to school sites. A few key points that emerged included:

- A high school site is not necessary for Precinct G (there is land set aside for a high school in Precinct D).
- Childcare spaces should be considered on-site.
- New elementary school capacity should be in the 600 to 800 student range.
- The PSFB estimates approximately 0.6 students per household (K to 12) in this quadrant of the city. This translates into approximately 1280 students from K to 8 at full build-out.
- School sites should be 8 to 12 acres in size, or if co-located with City parks, then 6 to 8 acres in size.
- When the time comes, need to work with PSFB and SOSD on purchase prices of school site land.

City of Winnipeg – Public Works

The project team met with the City of Winnipeg Public Works department to give a project update and review road network concepts. The project team expressed a preference for the direct connection concept. Public Works noted several points for the project team to consider:

- Concern about the current alignment of Murray Avenue (e.g. substandard intersection at Main Street; cannot be widened east of rail line).
- Whether CP will object to additional crossings of the Winnipeg Beach rail line.

- Project team should consider connection to West St. Paul.
- Staging of road network (e.g. consider Chief Peguis Trail extension timeline).
- Need for external intersection analysis.
- Consider City is working on a sidewalk policy.
- Consider active transportation connections, particularly to parks and schools.

City of Winnipeg – Planning, Property and Development

The project team met with the City of Winnipeg Planning, Property, and Development Department to provide and update on the planning process and understand potential issues and opportunities. Key topics included:

- An overview of preferred road network.
- A discussion as to whether the City would build a major interceptor along Fernbank Avenue, as had been shown in previous City plans and budgets.
- The City provided an outline of what they would like included in the Precinct Plan, including a draft table of contents.

City of Winnipeg – Parks and City Naturalist

The project team met with the City of Winnipeg Parks Department and the City Naturalist to discuss environmental concerns and greenspace. Key points from these discussions are listed below:

City Naturalist:

- Overview of natural area habitat assessments (4 areas).
- Discussion of wetlands, and whether they are artificial due to the snow dump drainage.
- City would like to meet with Native Plant Solutions to discuss the findings of their Natural Areas Assessment for sub-areas 2a and 2b.
- Preservation of "Grade A" habitat where feasible and reasonable.

Parks:

- Small parks (2-acres or less) are difficult to maintain; parks of five acres or larger are preferred
- The closed landfill might eventually transition to park space; buffers should be considered
- Approximately 55 to 60 acres of dedication are required
- There should be greenspace within approximately 400 m from most residences
- Parks should be connected by pathways

City of Winnipeg – Water and Waste Department

The Water and Waste Department indicated that since the previous meeting (February 6, 2016), it had been decided that the wastewater services for Precinct G could be entirely accommodated south through the Chief Peguis Trail interceptor, rather than through the previously planned Fernbank Avenue interceptor. Representatives indicated that this previous plan was only a concept and that their latest calculations support the proposed alternative. With this new concept, all lands to the West of McPhillips,

including all of Precinct D, would be accommodated through this interceptor. Local sewers would tie all areas, including some in Precinct G, to the interceptor sewer.

City of Winnipeg – Transit

The project team met with Transit to present the road network concepts and understand issues and opportunities from Transit's perspective. The vast majority of Precinct G would be within the 400 m catchment (residences to Transit stops). Key points included:

- Park and ride opportunities should be discussed in the future.
- Transit noted that the preferred road network concept would likely be serviceable by Transit, due to its direct connection pattern.
- Need to understand travel patterns (e.g. crosstown).
- Need to consider bus stop location (e.g. community focal points) and integrating transit with pedestrian and cycling facilities.
- Ideally, transit routes would follow collector streets.

City of Winnipeg – Fire Paramedic Service (WFPS)

The project team met with the WFPS to give an overview of the project, and to understand what types of issues the project team should be considering relating to emergency services. It was noted that Precinct G could potentially be served by five fire halls, including stations 6, 7, 16, 17 and 24. It is unlikely that a new fire station would be requested in Precinct G. The WFPS asked that the team consider road widths and turning radii (to accommodate fire trucks), water supply/pressure, and more than one access point to developments. A connection to the south would be important, as station 16 (on McGregor) would likely be the primary station for servicing Precinct G.

8 Public Open House (Round 2)

8.1 Format and Purpose

A public open house session was held on Wednesday, October 5, 2016 at the Red River Community Centre (from 7:00 PM to 9:00 PM). A series of information boards (see **Appendix D**) were displayed, outlining the project purpose, process, timeline, and other important information. Project representatives were available to answer questions, address concerns, and receive input from attendees. Participants were asked to sign-in at the registration table, and to fill out a written response form prior to leaving the open house (see **Appendix C**). For those not able to attend, the information boards were posted online.

8.2 Notification and Attendance

The Public Open House was advertised in the September 26, 2016 edition of the *Winnipeg Free Press*, as well as the September 21 and September 28, 2016 editions of the *Times* (CanStar Weekly). Copies of notification materials are provided in **Appendix B**. Forty-two people signed in at the public open house, 18 of whom completed a comment sheet. The moderate attendance at the open house is likely due (in part) to the extensive participation of stakeholders and landowners at previous, targeted meetings.

8.3 Public Open House Participants

Half (50%) of respondents indicated that they resided in the area adjacent to Precinct G between Main Street and the CP Rail Line (the Riverbend neighbourhood). One person (6%) indicated that they were from West St. Paul and the remaining 8 (44%) respondents indicated that they resided somewhere “other” than the areas indicated on the comment sheet. Seventy-eight percent of respondents indicated they had not attended a previous project meeting. Four respondents (22%) had attended a past meeting.

8.4 Understanding the Need for a Precinct Plan

Participants were asked if they generally understood the reasons why a Precinct Plan is required for this area. Fifteen respondents (83%) indicated that they understood the need for a Plan to be prepared for this area, and 3 respondents (17%) indicated that they “somewhat” understood the need.

8.5 Understanding the Planning Process

When asked if they generally understood the steps of the planning process, 78% (14) of respondents indicated “yes” they understood the process and 22% (4) indicated they “somewhat” understood the process.

8.6 Opinions on the Road Network Concepts

When participants were asked to share their opinion about the proposed road concepts, 69% (11) indicated that they “liked” the road concepts, 25% (4) indicated that they were “unsure” about the road

concepts and 6% (1) participant indicated that they “disliked” the concepts. Residents noted their support for concepts that would minimize cut-through traffic within the existing neighbourhood.

8.7 Opinions on Land Use Concepts

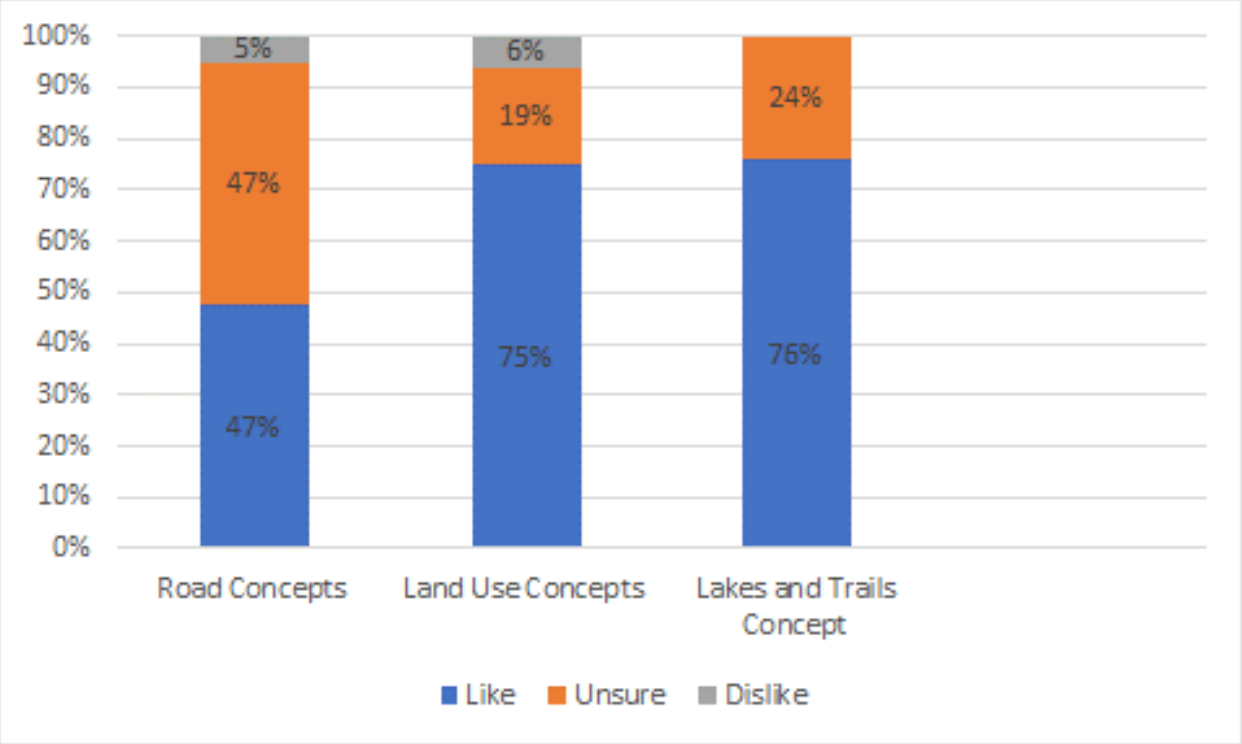
Just over half of participants (65%) indicated that they “liked” the land use concepts whereas the 24% were “unsure” about the concepts and 12% “disliked” the concepts. Residents noted that they would like to see more greenspace (including small parks and play areas).

8.8 Opinions on Lake and Trail Concepts

The majority of participants (76%) indicated that they “liked” the proposed lake and trail concepts. One participant (6%) indicated that they “disliked” the concepts and the remaining 18% indicated they were “unsure” about the concepts. Most comments were supportive of the combination of lakes, green space, and trails; others noted their concerns about geese and mosquitoes.

Figure 3 illustrates participant responses regarding Road Concepts, Land Use Concepts, and Lake and Trail Concepts, as per the comment sheets.

Figure 3 – Road, Land Use and Lake and Trail Concepts



8.9 Information/Opinions Provided to the Study Team

Participants were asked what information or opinions they would like to offer the study team as they begin to prepare the Precinct Plan; the following comments were offered:

Process

- Growth is inevitable; having a plan is good.
- Would like to see plans move ahead more quickly; need this new development now.
- Continue to keep the public informed.
- Good to involve the existing community members in planning.

Land Use

- Include all levels of housing from low income to elite.
- More commercial development is needed.
- Is a Personal Care Home feasible in the proposed planning concepts?

Servicing

- Will the Hydro sub-station on Fernbank Avenue increase in size due to the proposed development?

Natural Areas

- There is wildlife coexisting in this area; it is sad that it will be displaced.
- Preserve urban forest/grasslands.
- Find a way to beautify the CPR line - adjacent greenspace would be a good start.

Concerns

- What is the purpose of a consultation process if the area is already being proposed for housing.
- Looks like another development with an intent to maximize developer profit and not consider the quality of life of citizens (lack of sidewalks, loss of urban forest, not enough park areas, and poor quality green spaces).

8.10 Information Session Effectiveness

When participants were asked if they found the information session helpful, all participants (100%) indicated “yes”.

Comments included:

- The facilitators were very friendly and helpful.
- Staff on hand had a good concept of the plans.
- Thank you.
- Hope decisions have not already been made and that I am not wasting my time on this survey.

9 Resident and Landowner Meetings (Round 3)

9.1 Format and Purpose

Two resident and landowner meetings were held on November 30, 2017 at the Red River Community Centre. These meetings were intended for area landowners, adjacent residents, and residents living along the collector streets leading into Precinct G. The purpose of these meetings was to provide residents and landowners with a project update, introduce them to the preferred road network and land-use concepts, and explain how earlier feedback was considered or addressed by the project team. Meeting minutes are included in **Appendix A**.

9.2 11.2 Notification and Attendance

Invitations were hand-delivered to all residents directly adjacent to Precinct G, as well as those in Riverbend living on either Murray Avenue, Red River Boulevard, or Fernbank Avenue. Notices were also sent via email to previous meeting participants who provided a valid email address for project updates.

Two meeting sessions were conducted on November 30, 2017 at the Red River Community Centre, 293 Murray Avenue. Seven participants attended the meetings overall. Copies of the notification materials are provided in **Appendix B**.

9.3 11.3 Participant Information

Participants were asked to complete a comment sheet (see **Appendix C**) at the conclusion of each meeting. All of the respondents (7) indicated that they resided adjacent to Precinct G, between Main Street and the CP Rail Line. The majority of respondents (86%) indicated that they had not attended a previous project meeting. One respondent (14%) had attended a past meeting.

9.4 11.4 Understanding the Need for a Precinct Plan

Participants were asked if they generally understood the reasons a Precinct Plan is required for this area. Four respondents (67%) indicated that they understood the need for a plan to be prepared for this area, and 2 respondents (33%) indicated that they “somewhat” understood the need.

Comments included:

- Would like to see an updated traffic count.
- Would like to see locations of parkland dedication.

9.5 Understanding the Planning Process

When asked if they generally understood the steps of the planning process, 83% (5) of respondents indicated “yes” they understood the process and 17% (1) indicated they “somewhat” understood the process.

Comments included:

- Understand steps very well; lots of bad experiences.

9.6 Opinions on Road Network Concepts

When participants were asked to share their opinion about the proposed road network concepts, one (1) indicated that they "liked" the road concepts, two (2) indicated that they were "unsure" about the road concepts and three (3) participants indicated that they "disliked" the concepts.

Comments included:

- Concerns that cut-through traffic would increase along Murray Avenue.
- Dispersing traffic along several collectors will lessen the burden on Murray Avenue.

9.7 Opinions on Land Use Concepts

Two participants indicated that they "liked" the proposed land use concepts, while another two indicated they were "unsure" about the concepts. One respondent indicated that they did not like the concepts.

Comments included:

- As long as the additional traffic is properly distributed, there are no concerns with the land use concepts.
- Would like to take some more time to look at the plans.
- Need conditions in the plan that limit future traffic on Murray Avenue.
- Where are the parks going to be located?

9.8 Information/Opinions Provided to the Study Team

Participants were asked what information or comments they would like to offer the study team as they work to finalize the Precinct Plan; the following comments were offered:

- Overall, I wish the land would remain as is, but I understand and accept that it will be developed at some point.
- Satisfied that cut-through traffic will be mitigated to some extent.
- Interested in seeing traffic count numbers.
- Concerned about traffic on Murray Avenue.

Several concerns, comments, and questions came up during the landowner meetings themselves. The following is a summary of those concerns:

Transportation

- Will collector roads be built as proposed?
- Will there be more roads than are shown on the concept drawings?

- Why does Red River Boulevard not continue through to McPhillips Street?
- What streets would potentially connect to the future extension of the Chief Peguis Trail?
- Where will construction traffic be routed?
- Will Murray Avenue west of the rail line (to McPhillips Street) be twinned?
- Did the project team utilize current data for the traffic analysis?

Land Use

- Will there be an Emergency Services Station in Precinct G?
- How does 800 acres translate in terms of residents?

9.9 Information Session Effectiveness

When participants were asked if they found the information session helpful, four (4) participants indicated "yes" and only one (1) indicated "no".

Comments included:

- Had not attended previous meetings. Everything was well explained, and questions were answered clearly.
- First chance to see the latest version of the plan.
- Didn't know this project was taking place until I received an invitation and read about it online.

10 Public Open House (Round 3)

10.1 Format and Purpose

A public open house session was held on Thursday November 30, 2017 at the Red River Community Centre (7:00 PM to 9:00 PM). A series of information boards (see **Appendix D**) were displayed around the room, outlining the project purpose, process, timeline, updates, and other important information. Project representatives were available to answer questions, address concerns, and receive input from attendees. Participants were asked to sign in at the registration table, and to fill out a written response form prior to leaving the open house. For those not able to attend, the information boards were posted online (as they had been for the previous two rounds of consultation).

10.2 Notification and Attendance

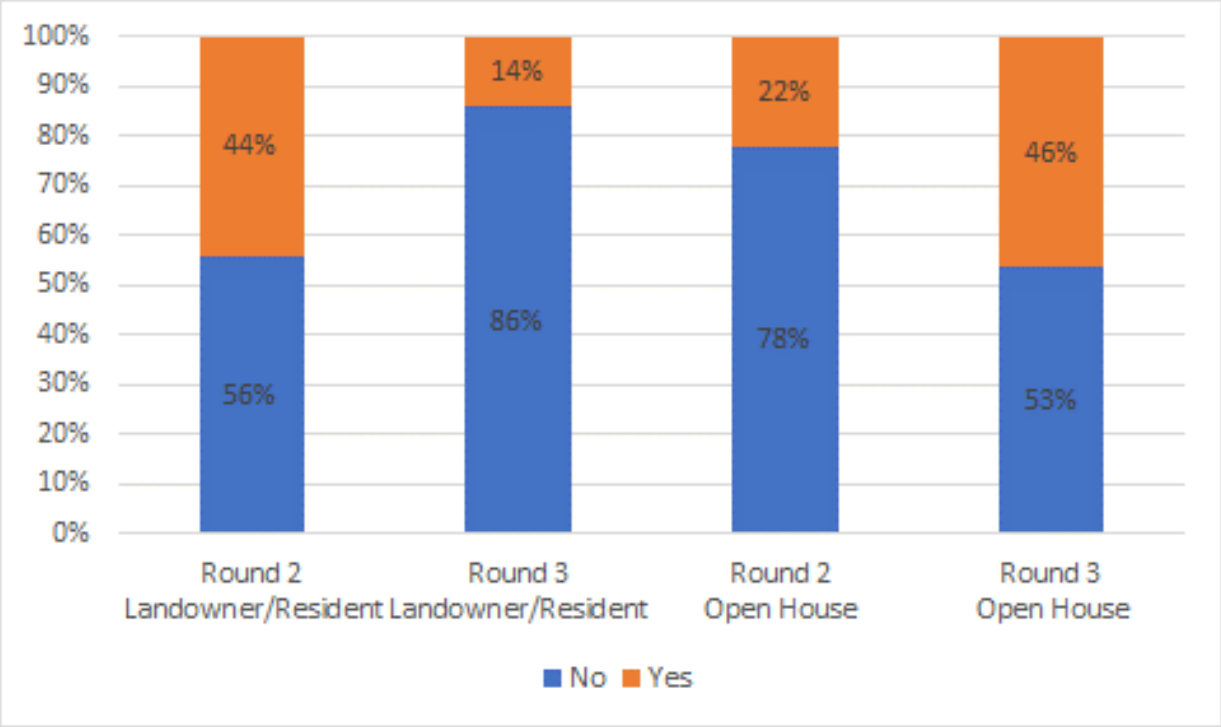
The Public Open House was advertised in the November 25, 2017 edition of the *Winnipeg Free Press* and the November 22, 2017 edition of the *The Times* (CanStar Weekly). Copies of notification materials are provided in **Appendix B**. Approximately 41 people signed in at the public open house, 19 of whom completed a comment sheet. The moderate attendance was likely due (in part) to the extensive participation of stakeholders and landowners at previous meetings.

10.3 Public Open House Participants

Twelve (67%) respondents indicated that they resided in the area adjacent to Precinct G, between Main Street and the CP Rail Line. Five respondents (28%) indicated that they lived within Precinct G, and one person (6%) indicated that they resided somewhere "other" than the areas indicated on the comment sheet. Approximately half (47%) of respondents indicated they had attended a previous project meeting. The remaining 53% percent of respondents had not attended a previous meeting.

Figure 4 illustrates past participant attendance at landowner/resident meetings and the public open houses held during Rounds 2 and 3. More than half of the participants at each meeting indicated that they had not attended a previous project meeting.

Figure 4 – Participation in Previous Meetings



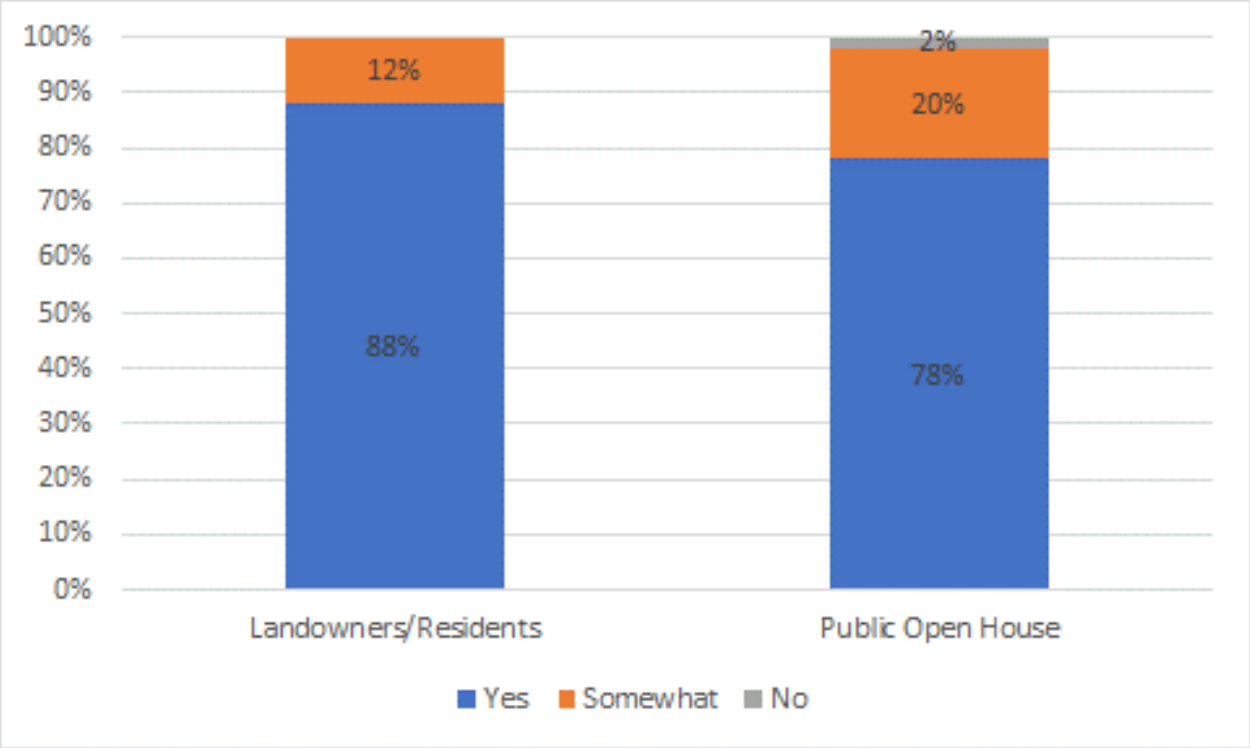
10.4 Understanding the Need for a Precinct Plan

Participants were asked if they generally understood the reasons a Precinct Plan is required for this area. Eleven respondents (58%) indicated that they understood the need for a Plan to be prepared for this area, seven respondents (37%) indicated that they "somewhat" understood the need, and only one participant (5%) did not understand the initiative. Comments and questions centred on:

- Traffic (including cut-through traffic, traffic counts, and other traffic impacts).
- When will the Chief Peguis Trail extension move forward?
- Desire for a dog park.
- The desire to continue to be informed as the project proceeds.

Figure 5 illustrates the overall understanding respondents had regarding the need for a Precinct Plan to be established (all three rounds of public consultation).

Figure 5 – Understanding the Need for a Precinct Plan (Rounds 1, 2, and 3)



10.5 Understanding the Planning Process

When asked if they generally understood the steps of the planning process, 63% (12) of respondents indicated "yes" they understood the process, while 37% (7) indicated they "somewhat" understood the process. Comments included:

- The project team clearly explained where the development would begin and answered all my questions.
- Will the general public have input during the subdivision process?
- Concerns about construction impacts (e.g. construction traffic).
- A lot of the process seems to be hidden from the affected residents.
- Planners present at the meeting don't care.
- Appears a preferred concept has already been identified.

10.6 Opinions on Road Concepts

When participants were asked to share their opinion about the proposed road concepts, 16% (3) indicated that they "liked" the road concepts, 26% (5) indicated that they were "unsure" about the road concepts and 58% (11) participant indicated that they "disliked" the concepts. Comments included:

- Would like to see the Chief Peguis Trail extension completed prior to development
- Concern about increase of traffic on Murray Avenue
- Would like additional connections to McPhillips Street
- Concern about increased traffic in general
- Would like additional cycling and pedestrian infrastructure

10.7 Opinions on Land Use Concepts

Twenty-four percent of participants (4) indicated that they "liked" the land use concepts, 41% (7) indicated they were "unsure" about the concepts and 35% (6) participants "disliked" the concepts. Comments included:

- Good mix of uses.
- Prefer to see existing fields, rather than new homes.
- Would like low density housing adjacent to existing homes.
- Concerns about traffic.
- Would like to see greenspace and a dog park.

10.8 Information/Opinions Provided to the Study Team

Participants were asked what information or opinions they would like to offer the study team as they begin to prepare the Precinct Plan. A sample of the comments include:

- Chief Peguis Trail needs to be built prior to development.
- Concerned about cut-through traffic (particularly along Murray Avenue).
- Cut off Murray Avenue at the rail line; extend Red River Boulevard to McPhillips instead.
- Would like more detailed information.
- Would like to see updated traffic counts.
- Would like to see increased notification.
- When would development take place?
- Would like to know how construction traffic will be addressed.
- Would like to see a dog park, as well as other green space and open space.
- Traffic congestion and volumes will negatively affect existing residents.
- I understand the need for the development.
- Who will be responsible for the cost of all the upgrades that need to be done.

10.9 Information Session Effectiveness

When participants were asked if they found the information session helpful, 79% (15) indicated "yes", 5% (1) indicated "somewhat" and 16% (3) indicated "no".

Comments included:

- Staff were very good at answering questions and explaining layouts on the presentation boards.
- Very helpful; will continue to attend future information sessions.
- The process of development was explained well.
- The project team has been approachable and helpful at the various meetings; much appreciated.
- Received clarification.
- Concepts do not address impacts to the existing areas.
- The boards could be more detailed.

11 Consultation Summary

The public consultation process was both thorough and adequate for a project of this scale and nature. Participants who attended a landowner or collector road meeting, or the public open house session generally understood the need for a Precinct Plan for Precinct G and had a moderate understanding of the planning process.

Key concerns included the implications new development would have on traffic, specifically regarding volume, speed and safety on collector roads leading into Precinct G. Other concerns centred around future road networks and the need for Chief Peguis Trail to be extended. Land use issues raised centred on the types of homes that would be built adjacent to existing homes. Some participants noted the importance of well-planned active transportation routes. Participants were generally satisfied that their concerns were understood and would be addressed as the study moved forward.

The project team worked diligently over the course of the project to understand, consider, and address comments and concerns raised by the various stakeholder groups. Below is a chart outlining some of the key stakeholder comments/concerns, as well as the project team's response:

#	ISSUE DESCRIPTION	RESPONSE
1	Cut-through traffic through the existing Riverbend neighbourhood	A comprehensive transportation study was completed as part of the planning process. The preferred road network concept will serve to disperse traffic amongst several collector and arterial roads, minimizing the impact on existing neighbourhoods.
2	Existing traffic on Murray Avenue	The Plan anticipates the possible future closing of the Murray Avenue crossing of the rail line, once the Chief Peguis Trail is extended to McPhillips Street. This dispersion of traffic will reduce the relative impact on Murray Avenue, while policies

#	ISSUE DESCRIPTION	RESPONSE
		allow for the future closure of Murray Avenue (subject to additional rail crossings being established).
3	Desire for the Chief Peguis Trail (CPT) to be built prior to development	While the landowners/developers do not control the construction of the CPT (as it is an expressway which the City of Winnipeg controls the timing for construction), developments like Precinct G will help create a sense of urgency for this critical piece of transportation infrastructure.
4	Desire to see parks and greenspace in the area	Parks and greenspace (for both passive and active recreational uses) will be dispersed through the community (at least one in each sub-area and a large park overall), as per the policies of the Plan. Park locations will be determined at the subdivision stage.
5	Provision of schools	The project team met with the School Division and Public Schools Finance Board. At least one K-8 school is required in the area, and policies in the Plan address school siting criteria.
6	Development timeline	The development timeline will depend on various factors, including market demand, infrastructure investment, population growth and landowner interest in development. The Plan assumes that the majority of development will take place over a 25-year time horizon.
7	Provision of Active Transportation (AT)	An active transportation (AT) and pathway network has been a key component of the Plan. Policies ensure connectivity both internally and to the larger AT network outside of Precinct G.
8	Preservation of high-quality natural areas	A natural areas assessment was undertaken for a portion of the lands in Precinct G, and policies encourage the preservation of high-quality natural areas through land dedication.
9	Project communications	The project team committed to following up with stakeholders and the general public throughout the planning process. Not only was a master stakeholder list developed to ensure participants were notified in subsequent rounds, but information materials were made available through the project website.
10	Property values	Research indicates that existing property values are likely to increase as a result of new development.

#	ISSUE DESCRIPTION	RESPONSE
11	Loss of privacy and views	There are policies in place to ensure appropriate transitions between differing housing densities. Lands adjacent to existing development have been designated for lower density (e.g. single-family) development.
12	How will construction traffic be addressed?	A construction staging plan will be required at a later stage of the development process.

The Precinct Plan incorporates input and feedback from City departments, community stakeholders, area landowners, and the general public. The comprehensive engagement process is considered thorough for a project of this scale and nature.

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G - Collector Road Residents

Date of Meeting: May 3, 2016

Time: 4:00PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 10 Local Residents Adjacent to a Collector Roads
Noah Yauk, City of Winnipeg
Donovan Toews, Landmark Planning and Design Inc.
Brendan Salakoh, Landmark Planning and Design Inc.
Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. Where is the north boundary of Precinct G? A. The north boundary for Precinct G is the City boundary which is generally located at Emes Road. Q. Does Landmark Planning and Design own land in Precinct G? A. No, Landmark Planning and Design has been engaged by Ladco, a major landowner in Precinct G but is essentially working for all landowners through public meetings to ensure that all interests are considered during the precinct planning process.	

	Q. Can the CP rail line act as a hard boundary so that new development in Precinct G would only have access via McPhillips Street. A. A traffic study will need to be undertaken however it is very unlikely that this is a feasible solution for the potential increase in traffic on the collector roads. Roadways should to be a network that offer connectivity to surrounding neighborhoods. Q. Is this a done deal? A. There will be a neighborhood in Precinct G and there will need to be a street network but there are still many factors that need to be finalized. Q. Why does traffic from the new development need to cut through existing neighborhoods? A. There are several reason including connectivity, emergency vehicle response and the fact that transit will work effectively. Q. Why are water mains linked to access points? A. For practical reasons water mains are almost always located in the same alignment as the roadway. They need to be accessible. Q. Do people want connectivity? Most of neighborhoods want to be self-contained. A. Q. Why does Red River Boulevard narrow at the easterly end; will the City be expropriating land to improve this street? A. No, there are no plans for expropriation. The width of the street is based on traffic volumes; high volume areas will be wider than low volume areas. Q. Have you met with the school division? A. Yes, the project team has met with the school division. They have indicated a need for an elementary school in Precinct G as well as a potential requirement for a high school. The school division prefers to see schools located on collector roads which enables proper access. Q. How will Red River Boulevard connect to McPhillips Street? A. Street patterns have not been established at this time. Q. How many additional new homes/residents are anticipated in Precinct G? A. The number of residents and homes in this area will depend on zoning and the allocation of single-family and multi-family designations. A rough estimation of 4000 units or 10,000 residents could be anticipated. Q. Will the existing collector roads be made lager? A. Murray Avenue will not be increased in size; Fernbank Street and Red River Boulevard have been designed as collector roads. Q. Which street will be most affected by the development? A. The more connections there are, the more disburse the traffic will be. Q. How much influence does our input have on the process? A. The study teams main goal is to have good communication that identifies concerns and to try and mitigated those concerns when possible. Q. What is the process timeline? A. We anticipate the Precinct Plan to be complete by Spring of 2017. Once the Precinct Plan has been adopted, landowners can then move forward with	

	subdivision and rezoning applications. Processing those applications may take another 6-12 months. Construction will follow after that. Q. Will the City of Winnipeg be taking note and addressing resident concerns? A. A thorough public engagement process will be undertaken where the study team will identify and address the concerns of all those that have an interest in the project. Q. How will the implications of connectivity provide a safe environment for children and pedestrians? A. There are traffic calming measures that can be implemented to slow traffic. Q. Will Ferrier Street be extended to the City Boundary? A. This option will be evaluated during the traffic study.	
4.	**Next Steps** A thorough consultation and planning process will continue to be undertaken with the stakeholders, local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
Recorded By: Brenda Tesarski		
Date: May 3, 2016		

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G - Collector Road Residents

Date of Meeting: May 3, 2016

Time: 7:00PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 11 Local Residents Adjacent to a Collector Road
Noah Yauk, City of Winnipeg
Donovan Toews, Landmark Planning and Design Inc.
Brendan Salakoh, Landmark Planning and Design Inc.
Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. Will the right-of-way for McGregor Street be utilized? A. Yes, however to what extend will depend on the road network design. Q. Will the intersection at Murray Avenue and McPhillips Street be closed? A. It is unlikely that this intersection will be closed as Murray Avenue is a collector road. Q. Will there be Manitoba Housing in the proposed development area? A. When a precinct plan is established, it addresses the form of tenure not the type of tenure. Specifically, the precinct plan will describe zoning as single-	

	family, multi-family, commercial, etc. and not as condominium or Manitoba Housing. Q. Will there be a fire hall in study area? A. A fire hall would not be identified in the plan at this level; the plan would indicate where a fire hall could be located with regards to zoning but not that one must be included. The Winnipeg Fire Department is on our list of Stakeholder to speak with for this project. Q. How much greenspace will be allocated in the precinct plan? A. Typically, there is a 10% allocation to greenspace. Q. What is the timeline for development? A. It is anticipated that the plan will be submitted to Councils for their consideration in January 2017. The adoption process by Council is expected to take approximately 6 months. Once a plan has been adopted, landowners can proceed with subdivision and rezoning applications. These approvals can take several months. Groundbreaking will probably not be underway until Spring 2018. Q. When will Chief Peguis Trail extend west? A. The study team is unaware of when this project will move forward however it is included in the City of Winnipeg's 5-year capital plan. The Public Works Department has completed the functional design and they have held a Public Open House regarding the extension. Q. Will residents in the existing neighborhoods be subject to an LID? A. No, development costs will not be charged as an LID to existing neighborhoods. Q. Is there development happening south of Murray Avenue? A. Yes, a precinct plan has been adopted and subdivision/rezoning applications have been submitted. Q. What will happen to the commercial/industrial operations (Ivan's Autobody) currently existing in Precinct G when a plan is established? A. Communication with the landowner will ensure that their interests are considered when preparing the plan. It is beneficial to have this type of use located on a collector road. Q. Are sidewalks and trails considered in the precinct planning process. A. Yes, policies will be established to describe what is required. Q. Will there be bike paths? A. Yes, consideration will be given to active transportation. Q. Will there be a dog park? A. A dog park is undetermined at this time. Q. Will Fernbank Avenue need to be widened. A. It is possible that Fernbank Avenue will need to be widened; it will be considered during the traffic study analysis. Q. Will there be a splash pad? A. A splash pad is undetermined at this time.	

4.	**Next Steps** A thorough consultation and planning process will continue to be undertaken with the stakeholders, local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded By: Brenda Tesarski
		Date: May 3, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G - Collector Road Residents

Date of Meeting: May 4, 2016

Time: 1:30PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 3 Local Residents Adjacent to a Collector Roads

Donovan Toews, Landmark Planning and Design Inc.

Brendan Salakoh, Landmark Planning and Design Inc.

Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	Introductions and Project Overview BS provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	Project Background Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	Question and Answer Q. Will there be an allocation for greenspace in Precinct G? A. Yes, per the Winnipeg Charter Act and the Planning Act a minimum of 10% of qualifying land must be dedicated toward greenspace. Eight percent of which is land dedication and 2% cash for improvements. Q. Is this considered a significantly large piece of developable land in the City of Winnipeg. A. The land area itself is large but keep in mind that we are not developing the land at this point, only creating the plan. Q. What is the potential number of new homes in Precinct G.	

	A. The number of potential residents and homes in this area will depend on the zoning and the allocation of single-family and multi-family designations. A rough estimation of 4000 units or 10,000 residents could be anticipated. Q. What is the requirement for schools in this area? A. The school division has indicated a need for an elementary school (K-8) as well as a potential requirement for a high school. Q. Will a community centre be required? A. Meetings with the City of Winnipeg's Community Service Department were held. The department will undertake a study to determine if a community centre will be required. Q. Will Ivan's Autobody be allowed to continue operating? A. Communications with the landowner will ensure their interest are considered when preparing the plan. It is beneficial to have this type of use located on a collector road. Q. When Chief Pequis Trail is extended how will it be accessed from Precinct G? A. Ferrier Street will be the access onto Chief Peguis Trail. Q. Will there be traffic lights installed at the intersection of Murray Street and Main Street? A. The traffic study will address the intersections of all three collector roads at Main Street. This analysis will determine if a light is required. Q. Will there be a fire hall in study area? A. A fire hall would not be identified in the plan at this level; the plan would indicate where a fire hall could be located with regards to zoning but not that one must be included. The Winnipeg Fire Department is on our list of Stakeholder to speak with for this project. Q. How will construction traffic be addressed? A. This issue is not addressed in the precinct plan. During the development phase the developer or someone they have assigned will be responsible for construction traffic.	
4.	Next Steps A thorough consultation and planning process will continue to be undertaken with the stakeholders, local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded By: Brenda Tesarski
		Date: May 4, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G - Collector Road Residents

Date of Meeting: May 4, 2016

Time: 3:30PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 2 Local Residents Adjacent to a Collector Road
Donovan Toews, Landmark Planning and Design Inc.
Brendan Salakoh, Landmark Planning and Design Inc.
Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. Could construction start next summer (2017)? A. No, the process is timely and will be undertaken thoroughly using good planning practices and good public engagement procedures. Q. Is there a need for more development in the City of Winnipeg? A. This issue is considered when preparing the precinct plan. Q. How will the existing schools be impacted? A. The school division has indicated a need for an additional elementary school (K-8) as well as a potential requirement for a high school. Q. Would a school be constructed in the existing neighborhoods? A. No, the existing neighborhoods are already built up.	

	Q. What is the general feeling towards the new development? A. In the preliminary stages of the public engagement process people are typically not happy. There is always an aversion to change. Q. Will there be bus routes on the collector roads? A. There are ongoing conversations with Winnipeg Transit. Bus routes are almost always located on collector roads. Winnipeg Transit has indicated that the vast majority of homes must be within 400 meters of a bus route. Q. Will there be traffic lights installed on the collector roads? A. If traffic lights are installed it would probably only be at the intersection of collector and arterial roads when warranted. It is more likely that roundabouts would be installed. Q. How many rail crossings will be allowed? A. CP Rail does not have the authority to disallow rail crossings but can object if they are not necessary. Typically, they are agreeable to crossings where existing streets are located. Q. What is the construction timeline? A. It is anticipated that the precinct plan will be submitted to Councils for their consideration in January 2017. The adoption process by Council is expected to take approximately 6 months. Once a plan has been adopted, landowners can proceed with subdivision and rezoning applications. These approvals can take several months. Groundbreaking will probably not be underway until Spring 2018. Q. How will construction traffic be addressed? A. This issue is not addressed in the precinct plan. During the development phase the developer or someone they have assigned will be responsible for construction traffic.	
4.	**Next Steps** A thorough consultation and planning process will continue to be undertaken with the stakeholders, local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded By: Brenda Tesarski
		Date: May 4, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G - Super Tac (Public Works and Transit)

Date of Meeting: January 21, 2016

Time: 9:30AM

Location: City of Winnipeg – 40 Fort Street

In Attendance: James Platt (JP), City of Winnipeg – Planning, Property and Development
David Patman (DP), City of Winnipeg – Transit
Cindy Desjardine (CD), City of Winnipeg – Public Works
Luis Escobar (LE), City of Winnipeg – Public Works
Scott Suderman (SS), City of Winnipeg – Public Works
Steven Florko (SF), Stantec Consulting
Mike Carruthers (MC), Ladco Company Ltd.
Tyler Smith (TS), Ladco Company Ltd.
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** JP opened the meeting with: • Introduction of the study team and meeting participants • Purpose of the meeting • DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	

3.	**General Discussion** There was general discussion on the following topics: **Precinct G Boundaries** DT described the boundaries of Precinct G. It was identified that there is a potential for the boundaries of Precincts F and G to be realigned. Regardless of any boundary line changes, the planning process will not change. **CP Rail Line** At a recent meeting, CP indicated that the CP Winnipeg Beach Rail Line will continue functioning into the foreseeable future. They identified a potential for increased activity on this line if changes to an alternative CP line to the west proceeds. In both scenarios train volumes are minimal (i.e. 7-10 trains per week). Three collector roads within the study area, Murray Avenue, Fernbank Avenue and Red River Boulevard intersect with the CP Rail Line. CP indicated that they cannot prevent crossings at the collector streets and that they would work with the developer to ensure that standards are met. **Roadways and Active Transportation** Public Works shared their long-term vision for roadways in and around the study area which included: • Ferrier Street north of Chief Peguis Trail is planned as a two-lane roadway with roundabouts in the short term and will progress to a four-lane roadway as the need arises. There is a possibility that this roadway will be moved slightly east in the future and has been proposed by Public Works to connect to Chief Peguis Trail. This recommendation would need to go to Council for approval. The Public Works Department will share drawings for the planned Ferrier Street. • In the long term, McPhillips Street is envisioned as a six-lane urban street with a bike path and lowered speed limit (60km/hr). • Would like the Murray/McPhillips intersection to become a 90-degree intersection, however there are issues with the homes on the west side of McPhillips. • An interchange is anticipated at the junction of Main Street and Chief Peguis Trail. Public Works shared their preferences for roadwork and active transportation in Precinct G. This included: • Roundabouts to be installed at the intersection of collector roads. • A three-meter wide cycling path in addition to a sidewalk along Murray Avenue and Fernbank Avenue is preferred. • A minimum of one east-west cycling facility connecting to Main Street; potentially along Fernbank Avenue is expected. • A grid spacing of 400 meters is desired for cycling pathways (deter mid-block crossings for active transportation). The Public Works Department will need to comment on the road connections between the City of Winnipeg and the RM of West St. Paul. It was recommended that a discussion with the RM of West St. Paul and the developer (Lombard North) of lands in the municipality adjacent to Precinct G	PW to provide Ferrier Street drawings

	be undertaken to determine what their intent is and the best solution for roadways in this area. Public Works noted that they would be open to traffic signals at McPhillips Street and the boundary road. There is a potential to have diamond lanes on Main Street and McPhillips. **Transit** Transit indicated their desire to keep bus service on collector roads and for routes to be accessible within 400 meters of most users. Phasing will be important. Transit will work with the developer and can review draft plans during the design process. It was recommended that the option for a park-and-ride be explored during the early stages of planning as it is easier to designate a location while the land is being developed. It was suggested that the existing snow dump could be utilized for this purpose or that other large parking areas such as schools and community centers be explored as potential park-and-ride locations. Park-and-Rides should be accessible to both vehicular traffic and cycling traffic. **Traffic Study** A traffic study is being undertaken for the study area. It was recommended that the following factors be taken into consideration during the study: • Analysis of the roadways connecting to Main Street and McPhillips street including Fernbank Avenue, Murray Avenue and Red River Boulevard. • Analysis of the Murray Avenue and Ferrier Avenue intersection. • Analysis of McPhillips Street and Leila Avenue intersection (background information only). • Consideration of historical growth rate data. Public Works is to provide this information to Stantec. • CP Rail crossing volumes. • Consideration of future resident destinations (city or rural commuters). • The potential for a park-and-ride location and diamond lanes on Main Street and McPhillips Street.	PW to provide growth rate.
4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded by: Brenda Tesarski
		Date: Jan 21, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – "Super TAC" (Snow Operations)

Date of Meeting: February 5, 2016

Time: 3:00PM

Location: Public Works Department – 1155 Pacific Avenue

In Attendance: Jim Berezowsky (JB), City of Winnipeg – Public Works Department
Jean-Luc Lambert (JL), City of Winnipeg – Public Works Department
James Platt (JP), City of Winnipeg – Planning, Property and Development
Noah Yauk (NY), City of Winnipeg – Planning, Property and Development
Mike Carruthers (MC), Ladco Company Ltd.
Tyler Smith (TS), Ladco Company Ltd.
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** JP opened the meeting with: • Introduction of the study team and meeting participants • Purpose of the meeting • DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	

3.	**General Discussion** There was general discussion on the following topics: **Use and Operation** The City of Winnipeg currently operates three snow dumps within the City limits, one on McPhillips Street, one on Wilkes Avenue and one at the south-end treatment plant. They also utilize two other small sites, one on Chester Street and one on Bangor Avenue. The McPhillips Street snow dump has the largest capacity of all the sites and is the most efficient. It operates 24 hours a day, seven days a week during the winter months. There are no short or long-term plans to relocate this site. There are plans to remove a couple of feet from the floor of the snow dump to increase its capacity. Typically, the only complaints received about the snow dump relate to noise. Specifically, the slamming of truck tailgates when they have finished dumping a load. Lighting has not been an issue. **Drainage** The snow dump drains east to the CP rail line, into the LDS at the backend of Fernbank Avenue. There is a drainage issue on the north end of the site which is attributed to low lying area. **Development Implications on the Snow Dump** There are concerns that if the closed landfill is developed into a park then public access to snow dump could become an issue. There is a potential liability risk if people try and utilize the snow dump as a tobogganing hill. Fencing would be required. **North-South Boundary** The streets maintenance division is not supportive of a north-south roadway connecting Precinct G with West St. Paul through the snow dump site. The implications of a roadway include decreased storage area and potential for unwanted public access. Decreased storage area could result an increased surcharge for businesses and communities to haul the snow to other sites.	JB will arrange tour of snow dump in the spring COW to provide complainant name to DT
4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded by: Brenda Tesarski
		Date: Feb 5, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – "Super TAC" (Water and Waste Department)

Date of Meeting: February 5, 2016

Time: 1:30PM

Location: Water and Waste Department – 1199 Pacific Avenue

In Attendance: Andrew McMillan (AM), City of Winnipeg – Water and Waste Department
Swarna Jayakody (SJ), City of Winnipeg – Water and Waste Department
Marek Gajda (MG), City of Winnipeg – Water and Waste Department
Andree Kirouac (AK), City of Winnipeg – Water and Waste Department
James Platt (JP), City of Winnipeg – Planning, Property and Development
Noah Yauk (NY), City of Winnipeg – Planning, Property and Development
Len Chambers (LC), Stantec
Dan Mages (DM), Stantec
Mike Carruthers (MC), Ladco Company Ltd.
Tyler Smith (TS), Ladco Company Ltd.
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** JP opened the meeting with: • Introduction of the study team and meeting participants • Purpose of the meeting • DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	

2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**General Discussion** There was general discussion on the following topics: **Water** City of Winnipeg representatives noted that there are no major constraints that would impede servicing the study area with water. There is a sufficient sized feeder-main on Murray Avenue along with a number of other connection points to the east (Fernbank, Red River) that would serve as the primary servicing points. Fire protection and domestic needs can be met with no concerns. Further study will be required. **Sanitary Sewer** The planned route for a future sewer interceptor in the study area is to run along Fernbank Avenue to Main Street (the Fernbank Interceptor Sewer). This interceptor sewer will service most of Precinct G and additional land west of Precinct G into Precinct D. AM asked if going south was an option. There is potential for portions of the southern area of the precinct to be serviced by a new sewer line routed straight south to the interceptor south of the Chief Peguis Trail. Ladco referred to the City Capital Budget (2015) and Interceptor Sewer Planning Maps, and would plan to utilize the planned Fernbank Avenue interceptor. The Fernbank Avenue interceptor should be planned to include long term requirements with consideration to surrounding areas to the west (Precinct D and possibly beyond). A sewer analysis will be undertaken by Stantec/City of Winnipeg to identify total area to be serviced by the Fernbank Interceptor (including land west of McPhillips). The study team will prepare subdivision designs and servicing options which will be brought back to the Water and Waste Department for comment. **Land Drainage** The Precinct will be serviced by two land drainage districts. The south portion of the Precinct (south of Murray Ave) will be serviced by the existing LDS sewer in Murray at CPR Winnipeg Beach Rail Line. Representatives of the Water and Waste Department do not believe that this connection is large enough to handle additional drainage, other than a small portion of frontage on Murray Ave. WWD will confirm with DM specific quantities. Land north of Murray Ave frontage will be serviced by the outfall in the middle of the Precinct, flowing east through the Riverbend community to the Red River.	

	In keeping with the City of Winnipeg's term drainage concept for the area, a series of lakes in Area 2 will extend west and branch to the north and south to service future land to the west of McPhillips. Internally, areas 3 and 4 will each require their own lakes and would drain into the LDS in Area 2. Area 5 (and limited frontage on the north side of Murray Ave) has an LDS that is already planned and separate from Areas 1-4.	WWD to provide flow rates to DM
4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded by: Brenda Tesarski
		Date: Feb 5, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G - Super Tac (Parks and Solid Waste)

Date of Meeting: January 21, 2016

Time: 10:30AM

Location: City of Winnipeg – 40 Fort Street

In Attendance: James Platt (JP), City of Winnipeg – Planning, Property and Development
Donna Beaton (DB), City of Winnipeg – Parks
Chris Kozak (CK), City of Winnipeg – Solid Waste
Becky Raddatz (BR), City of Winnipeg – Solid Waste
Tyler Smith (TS), Ladco Company Ltd.
Mike Carruthers (MC), Ladco Company Ltd.
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** JP opened the meeting with: • Introduction of the study team and meeting participants • Purpose of the meeting DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	

3.	**General Discussion** There was general discussion on the following topics: **Precinct G Boundaries** DT described the boundaries of Precinct G. It was identified that there is a potential for the boundaries of Precincts F and G to be realigned. Regardless of any boundary line changes, the planning process will not change. **Parks** During the planning stages consideration should be given to include four or five parks within the study area. It is roughly estimated that 58 acres of dedication will be required. (to be calculated at a later date) Discussions should be undertaken with Community Services Department to determine if land for a community center will be required in the study area as part of land dedication. **Natural Areas** There are some treed areas in the south west portion of the study area in the vicinity of the McGreggor Street right-of-way. The right-of way will follow an existing sewer line. It was recommended that the matter of the treed areas be directed to Rodney Penner (RP) for comment and verification if further study is warranted and if so to what extent. Since the treed areas are not entirely located on Ladco Lands, if a study is required, Ladco would only have access to the area within their boundaries. **Decommissioned Landfill** The landfill operated for nine years and was decommissioned in 1974. The decommissioned landfill is relatively small in size, has a good cap and a good vegetative covering. There are monitoring wells on and around the site (primarily on the east side) and more wells will be installed in the near future to further monitor water quality and gas mitigation. There is a 90-meter control zone around the site that restricts development. There is potential to reduce the size of the control zone however this would require two to five years of study data. It is often easier to employ gas mitigation measures. Standard control zones for solid waste are 15, 45 and 90 meters. It may be possible to reduce the control zone given certain measures or studies are undertaken. Further discussion will be required to define study requirements. Parks and Solid Waste will work with the study team to incorporate the decommissioned landfill into the planned area. Possible uses included a passive park or dog park. There is potential that if the control zone is used as parklands that the developer may receive partial credit for dedication. The site may or may not be fenced depending on future uses of the site. **Snow Dump** The snow dump is operated by the Public Works Department. Solid Waste will provide contact information for the Public Works Street Supervisor.	JP to setup meeting with C.S. JP to set up meeting with RP JP to set up meeting.

4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
Recorded by: Brenda Tesarski		
Date: Jan 21, 2016		

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – "Super TAC" (Community Services)

Date of Meeting: March 15, 2016

Time: 9:00AM

Location: City of Winnipeg – 40 Fort Street

In Attendance: Peter deGraaf (PdG), City of Winnipeg – Community Services
James Houldsworth (JH), City of Winnipeg – Community Services
Rick Walker (RW), City of Winnipeg – Library Services
Shauna Prociuk (SP), City of Winnipeg – Urban Design Division
Donna Beaton (DB), City of Winnipeg – Urban Design Division
James Platt (JP), City of Winnipeg – Planning, Property and Development
Noah Yauk (NY), City of Winnipeg – Planning, Property and Development
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** JP opened the meeting with: • Introduction of the study team and meeting participants Purpose of the meeting • DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	

3.	**General Discussion** There was general discussion on the following topics: **Green Space and Dedication** DB recapped discussions from a meeting previously held on January 21, 2016. (see notes) **Community Centre** A budget to has been allocated for a Master Recreation Plan for Winnipeg, and is currently being considered by the City of Winnipeg Council. Further investigation into the capacity of the Garden City Community Centre and the Vince Leah Community Centre will need to be undertaken before it can be determined if a community centre is required in Precinct G. The current trend in community centre development is to construct multiplexes that can accommodate schools, libraries and recreations facilities. **Libraries** There may be a need for a library within Precinct G however there are several variables that need to be considered. There is potential to close the West Kildonan Library and establish a new library further north however the Mynarski Ward councillor, Councillor Eadie is not in favour of this option. If this plan was to move forward it is anticipated that a new library would operate out of a leased facility. A library could lease space in a high school but not in an elementary school.	PdG to investigate into existing CC capacity NY to obtain projected population for Precinct F
4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
	Recorded by: Brenda Tesarski	
	Date: March 15, 2016	

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – "Super TAC" (Naturalist Services)

Date of Meeting: February 5, 2016

Time: 3:00PM

Location: Public Works Department – 1155 Pacific Avenue

In Attendance: Rodney Penner (RP), City of Winnipeg – Naturalist Services
Donna Beaton (DB), City of Winnipeg – Urban Design Division
James Platt (JP), City of Winnipeg – Planning, Property and Development
Noah Yauk (NY), City of Winnipeg – Planning, Property and Development
Mike Carruthers (MC), Ladco Company Ltd.
Tyler Smith (TS), Ladco Company Ltd.
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** JP opened the meeting with: • Introduction of the study team and meeting participants • Purpose of the meeting DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	

3.	**General Discussion** There was general discussion on the following topics: **Natural Areas North of Murray Ave** RP noted that there is a grade 'A' natural area located south of Area 5 in the Chief Peguis Trail right-of-way which includes an aspen forest, wetlands and prairie grasslands. The City of Winnipeg Streets Department is considering purchasing some land in Area 5 to allow Chief Peguis Trail to swing north and avoid the natural area. RP also indicated that Areas 2, 3 and 4 have a small amount of natural area. This assessment was completed in 1995 and its accuracy is questionable and should be revisited. **Objective** When asked how to address the natural areas under the policies of the Precinct Plan, RP noted that the objective is to protect the most diverse species and the most representative to the natural history of Winnipeg. **Assessments** Ladco has indicated that they will have Native Plant Solutions assess the natural area located on their property. There may be an opportunity to partner with Qualico as part of the natural area is encompassed on their land. Assessments will be done in the spring/summer. A habitat assessment should also be undertaken and should include amphibians. Natural area policies will be included in the Precinct Plan and developers should attempt to include natural areas in the design of the development to be included as public reserve. **Closed Landfill** DB indicated that it is possible that the closed landfill could be utilized as a dog park. Shauna Trudeau is conducting a cross section assessment to determine the feasibility of this use.	DB/RP to provide map of natural areas to study team Ladco to undertake natural area study City to advise on dog park feasibility
4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
	Recorded by: Brenda Tesarski	
	Date: Feb 5, 2016	

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Winnipeg Fire Paramedic Service (WFPS)

Date of Meeting: June 13, 2016

Time: 1:00 PM

Location: 185 King Street, Winnipeg, MB

In Attendance: Mark Reshaur, Assistant Chief, Fire and EMS, Prevention and Public Education – Winnipeg Fire Paramedic Service

Tom Wallace, Deputy Chief, Support Services – Winnipeg Fire Paramedic Service

Brendan Salakoh, Planner, Landmark Planning and Design Inc.

Item	Description	Action by
1.	**Introductions and Project Overview** BS introduced the project, and gave an overview of the open house slides. BS asked what types of issues the project team should be considering as it develops Plan for Precinct G.	
2.	**General Notes** It was noted that Precinct G could potentially be served by five (5) fire halls: • No. 6 Station 603 Redwood Avenue • No. 7 Station 10 Allan Blye Drive • No. 16 Station 1001 McGregor Street • No. 17 Station 1501 Church Avenue • No. 24 Station 1665 Rothesay Street The WFPS noted several items that they thought the project team should consider during the planning process, including: • Road widths and turning radii to accommodate fire trucks; • Water supply and water pressure; and, • More than one access point to developments. BS noted that these concerns would likely not be addressed at the Precinct planning stage, but that high level policies could be included (e.g. that fire/paramedic buildings are appropriate land uses in Precinct G, including in residential areas). WFPS noted that it was unlikely a new station would be requested in Precinct G, due to the fact that it is directly adjacent to the City boundary (which would limit its reach in terms of radius). It was also noted that the City is currently looking to retain a consultant to do a fire response-time study, which may look at potential new station locations (e.g. where service times are weakest).	

	WFPS noted that there are currently high-level discussions regarding the potential of a residential sprinkler system by-law, which would require new homes to have sprinkler systems. This would allow firefighters more time to respond to a call, as the sprinkler system would presumably help suppress the fire for longer. It was noted that a connection to the south would be important, as Station No. 16 (1001 McGregor) would likely serve as the primary station for Precinct G. If Ferrier served as that connection, it should be paved for its entire length (as trucks cannot travel as fast on gravel roads). Upon looking at Google Street View, it seems as though Ferrier is paved for its entire length. TW noted that Don Franchuk might also be interested in attending future meetings.	
3.	**Next Steps** BS noted that Landmark will keep lines of communication open over the course of the project, and notify the WFPS during the next round of public engagement.	Landmark to add WFPS to the Master Stakeholder List. Invite the WFPS to future stakeholder meetings.
		Recorded by: Brendan Salakoh
		Date: June 13, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G Stakeholder Meeting (CP Rail)

Date of Meeting: December 2, 2015

Time: 9:30 p.m.

Location: CP Office – Logan Avenue and Arlington Street

In Attendance: Bob Kurylko, P. Eng (Stantec) (BK)
Mike Carruthers (Ladco) (MC)
Tyler Smith (Ladco) (TS)
Noah Yauk (City of Winnipeg) (NY)
James Platt (City of Winnipeg) (JP)
Aleshia Perry (CP Rail) (AP)
Donovan Toews (Landmark) (DT)

Item	Description	Action By
1.	**Introductions and Project Overview** DT introduced the project and provided background explaining the reasons for the Precinct Plan. The purpose of the meeting was to share the scope of work for plan preparation and to discuss existing and proposed rail crossings and to gain feedback on same.	
2.	**Project Content** DT/DS/BW provided an overview of the project, including the need for new crossings. Topics included: • Purpose of meeting • OurWinnipeg • Precinct Plans (Complete Communities) • Sample Precinct Plans • Precinct G Boundaries • Precinct Planning Process • Precinct Sub-Areas for planning purposes • Next Steps	

3.	**Rail Crossing Overview** A summary is as follows: 1. .Existing crossing at Murray Avenue. 2. New Crossing at Fernbank. 3. New Crossing at Red River Boulevard AP indicated that CP would work with landowners to review proposed plans and accommodate any new crossing if it can be demonstrated that the crossing is required in lieu of other more viable options. AP will review existing crossings to ensure they meet CP crossing standards.	
4.	**Other Matters** AP advised that a section of the CPR Arborg subdivision may be re-routed north of the City of Winnipeg and tie into the CP Glenboro subdivision. Both routes are fairly low volume (+- 7 trains per week). AP advised how to pursue whistle cessation for this section of track, which includes a 3rd Party study to determine if the line can be operated safely without whistles (e.g. slow enough, good site lines, etc.). Additional insurance may be required (i.e. City added to CP's policy). CP website offers further information. Transport Canada is not involved in this process. AP advised that installation of any new crossings would be carried out by CP then charged back to the initiator. AP asked whether the Land Development Branch circulates rezoning/subdivision files to CP. Railway setbacks may follow FCM guidelines. The Plan should consider including policies that identify the relevant FCM guidelines.	Stantec to investigate Noah Yauk to advise
4.	**Next Steps** The planning process with continue over the next year and a half. Meetings will be held with landowners, stakeholders and the general public to provide project parameters and receive feedback from those with an interest in the project.	
		Recorded By: Donovan Toews
		Date: December 2, 2015

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Landowner Meeting (Pecuh)

Date of Meeting: February 24, 2016

Time: 12:00PM

Location: 2419 Main Street – Browns Social House

In Attendance: Brent Olynyk, RM of West St. Paul - CAO

Dave Romanow, RM of West St. Paul – Director of Infrastructure

Donovan Toews (DT), Landmark Planning and Design Inc.

Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**General Discussion** **North-South Roadway** There was discussion on whether a north-south roadway connecting the study area and the RM of West St. Paul would be necessary. Representatives of West St. Paul are indifferent on the matter. **Boundary Road** Municipal representatives indicated that the right-of-way for the boundary road between the City of Winnipeg and the RM of West St. Paul is a shared boundary road. The most northerly landowner in Area 1 could gain access from the boundary road.	Study team to work with Stantec to determine requirement of north-south road

4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
Recorded by: Brenda Tesarski		
Date: Feb 24, 2016		

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Landowner Meeting (Pecuh)

Date of Meeting: February 24, 2016

Time: 10:00AM

Location: 811 Murray Avenue – Ivan's Autobody

In Attendance: Ivan Pecuh, Landowner
Igor Pecuh, Landowner
Donovan Toews (DT), Landmark Planning and Design Inc.
Brenda Tesarski (BT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G project, including: • Reason for the project being undertaken • Project process • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**General Discussion** **Existing Operation** Mr. Ivan Pecuh briefly described the nature of his business, Ivan's Autobody, at 811 Murray Avenue. It is a family run business that operates on approximately 10 acres of land. Five acres is under title to the business and five acres of land is in the name of Igor Pecuh. Mr. Ivan Pecuh noted that the land is currently zoned Agricultural. There are currently two buildings located on the property that are connected by an internal roadway. One building primarily operates as an autobody and repair shop and the other a paint shop.	

	Future Plans Mr. Ivan Pecuh communicated his desire to expand his operation in the immediate future. His customer base has grown, and Manitoba Public Insurance has implemented stricter health and safety regulations for the industry. The family is planning an addition 10,000 (+/-) square foot building with an innovative design to meet regulations and to be visually pleasing. Discussion with Pecuh indicated that design work has been undertaken for the proposed expansion. DT identified the requirement for a Precinct Plan before any expansion to the premises would likely be permitted by the City of Winnipeg. **Ferrier Street** DT noted that there is potential for Ferrier Street to continue north as a possible connector for development in Area 4 (as described by the study team). Should Ferrier Street extend, a right-of-way through Pecuh's property would be required. This will have an implication on the future expansion of Ivan's Autobody. **Future Meeting** In order to address the future needs and wishes of Ivan's Autobody in the Precinct Plan, DT has advised Ivan to revisit his business intent in light of the information provided. It was agreed that we will meet again once it becomes clearer what the required roadways would be within the Precinct (likely mid-April).	Ivan Pecuh to consider sharing design proposal with study team
4.	**Next Steps** A thorough consultation and planning process will be undertaken with project stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners.	
		Recorded by: Brenda Tesarski
		Date: Feb 24, 2016

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Seven Oaks School Division

Date of Meeting: October 27, 2015

Time: 1:30 p.m.

Location: 830 Powers Street

In Attendance: Wayne Shimizu, Seven Oaks School Division, Secretary Treasurer

Brian O'Leary, Seven Oaks School Division, Superintendent

Donovan Toews, Landmark Planning and Design Inc.

Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided a brief introduction of the project: • The project scope is to prepare a Precinct Plan for Precinct G as outlined in Our Winnipeg – Complete Communities prior to any development taking place. • The planning process will take approximately 12-16 months to complete. • The study team will engage many stakeholders during this process including landowners, City departments, School Division, and nearby residents among others. • Ladco is Landmark's client however Landmark will be preparing the precinct plan on behalf of all landowners within the precinct and the plan will become a regulatory document 'owned' by the City of Winnipeg. • The study team committed to working with the School Division through the course of the project to try and satisfy the needs of the School Division to the greatest extent possible.	
3.	**General Notes** • DT indicated the boundaries of the Precinct may be adjusted (to move the boundary to the north of Murray Avenue. • SOSD indicated they will be requiring a K-8 school site south of Murray Avenue and will likely also require one north of Murray Avenue (within Precinct G). A 10-acre site is required unless the school is located adjacent to a park (5-acre park plus 5-acre site is acceptable). • SOSD indicated that all three high schools within the division are full and that they will be seeking a fourth high school site somewhere in north Winnipeg, possibly within Precinct G.	

	• A minimum 16-acre site is required for a high school site.	
4.	**Next Steps** The planning process will continue over the next year and a half. Meetings will be held with landowners, stakeholders and the general public to provide project parameters and receive feedback from those with an interest in the project. The SOSD and Landmark agreed to keep each other apprised with relevant information over this period.	
		Recorded By: Brenda Tesarski
		Date: October 27, 2015

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G (Manitoba Hydro)

Date of Meeting: Dec 10, 2015

Time: 10:00AM

Location: Landmark Planning and Design Inc. (298 Waterfront Drive)

In Attendance: Wally Rzeszutek, Manitoba Hydro
Angelo Colatruglio, Manitoba Hydro
Mike Carruthers, Ladco Company Ltd.
Donovan Toews, Landmark Planning and Design Inc.
Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**General Discussion** There was general discussion on the following topics: **Precinct G Boundaries** DT described the boundaries of Precinct G and identified City of Winnipeg representatives, James Platt and Noah Yauk, as having responsibility for land use planning in the study area. **Manitoba Hydro's Applications to Density** In order to determine hydro servicing requirements for a new development, Manitoba Hydro considers the total number of acres minus land loss (parks,	

	schools, roads, etc.) and then compares to other developments with similar characteristics. **Project Timing** There are two stages to this project; the first is the adoption of a Precinct Plan by the City of Winnipeg and the second is the development stage which will include a rezoning and subdivision application submitted for lands held by Lacdo Company Ltd. or any other landowners within the Precinct. It is anticipated that the first stage of the project will take approximately one year, followed by subdivision and rezoning applications which can be expected to take an additional year to complete. Servicing of Ladco Lands is expected to begin in early 2018 with housing starts commencing in the fall of 2018. Buildout for Ladco's 400 acres of land within Precinct G is predicted to be 15-25 years. **Fernbank Avenue Hydro Station** The land owned by Manitoba Hydro on Fernbank Avenue which houses a Hydro Station was purchased in the 1960's prior to the area being developed. Fernbank Avenue is currently a two-lane street. If there is a requirement for Fernbank Avenue to be widened in the future in order to accommodate another one to two traffic lanes, it is unlikely that Manitoba Hydro will be willing to sell a portion of their land in order to meet this need. It was noted that Manitoba Hydro has a difficult time acquiring land and will most likely need to expand this station in the future. The Hydro Station at this location accommodates a 66KV line and a 12KV line underbuilt.	
4.	**Next Steps** A thorough consultation and planning process will be undertaken with the stakeholders. Meetings will take place with local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined, and land use and street layout options will be prepared. The study team will also begin to assess the cost sharing options between area landowners. The study team will keep Manitoba Hydro informed.	
		Recorded By: Brenda Tesarski
		Date: December 10, 2015

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Area 3 Residents

Date of Meeting: July 11, 2016

Time: 4:00PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: Peter Kostiuk
Don Edel
Marvin Zindler
Anne Zinyk
Randy Javonicki
Donovan Toews, Landmark Planning and Design Inc.
Brendan Salakoh, Landmark Planning and Design Inc.
Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for this area and will result in a Precinct Plan that will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. Why propose a curve in Red River Boulevard when connecting to Balgona Road? A. Road standards require intersections to be at a 90-degree angle, and the curve will accommodate this.	

	Q. When will the residents begin to see development happening? A. It is anticipated that building construction would begin in 2018 if the plan was approved. Q. Will there be an allotment of green space in Precinct G? A. Yes however green space is not addressed in the Precinct Plan; dedication is dealt with during the development stage. Q. Will there be enough children in Precinct G to support a school? A. Yes, a K-8 school (or possibly 2) will be required but not a high school. Q. How will Area 3 be developed? A. Development will depend on what landowners would like to do, how much land they have and if they are working with other land owners in the area. Q. How will cost sharing for infrastructure within the Precinct work? A. Policies will be included in the Precinct Plan to share the cost of development amongst all the land owners. Costs will likely be based on acreage. Q. How much land is required in order to be considered a developer? A. This classification is not based on the amount of land a person has but on what they are proposing to do. Q. After the Precinct Plan is adopted, does the developer have to respect the plan with regards to zoning? A. Yes, they would need to adhere to the plan or they would need to ask to amend the plan, which is a lengthy process. Q. What type of zoning is anticipated for the churches land? A. The Church's land will probably be designated as 'single-family'. Q. How will existing access on McPhillips Street be effected? A. This will be determined by the City of Winnipeg and how they decide to deal with McPhillips Street in the future, but may involve the creation of a service road.	
4.	**Next Steps** A thorough consultation and planning process will continue to be undertaken with the stakeholders, local residents, landowners, businesses, government agencies, the local school division and the general public. Servicing options will be determined and land use and street layout options will be prepared. The study team will also begin to draft cost sharing policies among area landowners.	
Recorded By: Brenda Tesarski		
Date: July 11, 2016		

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Collector Road Residents

Date of Meeting: October 4, 2016

Time: 3:00PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 6 Local Residents Adjacent to a Collector Road

Donovan Toews, Landmark Planning and Design Inc.

Brendan Salakoh, Landmark Planning and Design Inc.

Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public is being undertaken. The Precinct Plan will address land use, transportation and servicing for this area and will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. When will an active transportation corridor be installed along the CP Rail Line? A. The desire for an active transportation corridor is long term planning (40, 50, 60 years). The precinct plan will identify a corridor as a future possibility should the rail line cease to operate. Q. What are the regulations concerning transit when planning future developments? A. There is policy that establishes bus stops within 400 meters of most residential units.	

	Q. When planning future communities, is it standard practice to include pathways? A. It is good planning practice to connect all communities. Q. Would the modified grid road design presented equate to less new traffic on Red River Boulevard? A. Yes. Q. What is the anticipated timing for the Chief Peguis Trail extension? A. The study team is not actively involved in this project however it has been reported that the conceptual stages of the project have been completed and the project has now moved into the functional design stage. Q. Will sidewalks be added to both sides of the existing portion of Red River Boulevard? A. No, there is a service road therefore no sidewalks would be installed. Q. Are collector roads required to have sidewalks on both sides? A. Yes, this is now standard practice for collector roads. Q. What development is starting at McPhillips Street and progressing east? A. Precinct F is developing in this area. There is a lot of commercial and multi-family residential planned for this area which will allow the development southof Murray Avenue to proceed west to east. Q. How can local residents stay informed? A. The study team has a project website that can be accessed for project updates. Additionally, an email notification list has been prepared of those wanting to be kept informed and who have provided an email address. Regular updates will be sent out via email. Q. How is traffic being monitored/addressed? A. Traffic is a significant concern for the City, Province and surrounding municipalities. Together, all entities are working towards a solution. Some of the traffic issues for this area are being addressed through the Chief Peguis Trail study. Q. Are there any designated “Frog Plains” within Precinct G? A. There are no designated frog plain areas or any other official preservation areas noted. Native Plant Solutions is currently conducting a thorough investigation of the area and the study team is working with City Naturalists. Q. What is the projected population for Precinct G? A. The projected population is approximately 8000 people. Q. How many bus stops will be on Red River Boulevard? A. As a collector road, Red River Boulevard will be utilized as a bus route. It is likely that stops will be created along the existing portion of the street. The location and frequency of stops will be determined during the development process. Q. Are there policies for roundabouts? A. There are no policies that require roundabouts to be installed. The preference would be to use roundabouts where feasible as they can handle larger traffic volumes more efficiently than signalized intersections.	

4.	**Next Steps** The study team is currently writing a first draft of the Precinct Plan. Following this round of consultation meetings and the public open houses, the study team will make revisions to the draft plans and complete another round of consultations.	
Recorded By: Brenda Tesarski		
Date: October 4, 2016		

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Collector Road Residents

Date of Meeting: October 4, 2016

Time: 7:00PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 23 Local Residents Adjacent to a Collector Road
Donovan Toews, Landmark Planning and Design Inc.
Brendan Salakoh, Landmark Planning and Design Inc.
Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public is being undertaken. The Precinct Plan will address land use, transportation and servicing for this area and will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. Will the existing Murray Avenue be a four-lane street? A. Murray Avenue will be defined as a four-lane roadway in the Precinct Plan but the timing of the upgrade is unknown. Q. How do we express our concerns about the impacts of traffic in the existing neighborhoods? A. When planning the new area, the study team does its best to minimize the impacts to existing residential areas. They will try more than one street configuration and select one that creates the best outcome from several perspectives. Q. Will Murray Avenue, west of the CP Rail Line, be a four-lane street?	

	A. It is likely that this section of Murray Avenue will be a two-lane street possibly with roundabouts at the major intersections. Q. What is the projected population for Precinct G? A. The projected population is approximately 8000 people (800 acres x 4 units per acre x 2.5 persons per unit = 8000). Q. Have developers indicated when they would like to start developing? A. Once the Precinct Plan has been adopted by Council, development applications can be submitted. If everything goes as planned this could happen as early as next summer (2017). Q. Is there any intention to upgrade the existing infrastructure? A. The City of Winnipeg may require developers to pay for offsite improvements. Q. What are the plans for the CP Rail Line? A. There is no indication that CP plans to abandon this rail line. Q. Will there be an off-leash dog park located at the closed landfill site? A. Discussions with the City of Winnipeg Parks Department and Public Works Department will determine if this is feasible. Q. Is there a pre-existing development that would compare to what is being considered for Precinct G? A. South Pointe, a Ladco Project, is an example of what is being considered for this area. Q. Are front drive lots or back-lane lots being proposed? A. Front drives are only permitted on collector roads if there are frontage roads. Q. When is the extension of Chief Peguis Trail expected to move forward? A. The study team is not actively involved in this project however it has been reported that the conceptual stages of the project have been completed and the project has now moved into the functional design stage. Q. Will there be connections to Chief Peguis Trail? A. The only connections to Chief Peguis Trail will be Main Street, Ferrier Road and McPhillips Street. Q. Is the development of Precinct G a done deal? A. The precinct areas will be planned, and the City is going to develop; however everything is subject to a process (ie. development applications). Q. Can residents speak with their Councillors regarding concerns about development? A. Yes. Q. Can development in Precinct G be put on hold until the extension of Chief Peguis Trail is complete? A. The current task is to write a Precinct Plan for Precinct G. Individuals may contact their City Councillor to discuss development timing. The Precinct Plan will include a road staging plan to limit what can be developed before the Chief Peguis Trail connection is made.	

	Q. Will the "wet lands" in Precinct G be preserved? A. Native Plant Solutions is undertaking a thorough investigation of the area and will note which areas would be candidates for preservation. Q. Which street network concept is preferred? A. The "modified grid" concept is the preferred option. Q. What are the plans for the snow dump? A. There is no indication that the City is changing the current use of the snow dump. Q. Will roundabouts be utilized in the new development? A. Yes, it is likely there will be roundabouts located at the major collector road intersections. Q. How will drainage from the snow dump be addressed? A. The City has a drainage plan in place. Q. Will residents be notified when development applications are submitted? A. When a development application is made, the City of Winnipeg Charter Act requires advertising in a local paper and information to be posted on the property for a specific period of time before the public hearing. Q. What will happen to Ivan's Autobody Shop? A. The operation will be considered an existing, non-conforming use. Q. When will construction start? A. Construction is a few years away.	
4.	**Next Steps** The study team is currently of writing a first draft of the Precinct Plan. Following this round of consultation meetings and the public open houses, the study team will make revisions to the draft plans and complete another round of consultations.	
Recorded By: Brenda Tesarski		
Date: Oct 4, 2016		

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – Collector Road Residents

Date of Meeting: October 5, 2016

Time: 3:00PM

Location: Red River Community Centre – 293 Murray Avenue

In Attendance: 8 Local Residents (Adjacent to a Nearby Collector Road)

Donovan Toews, Landmark Planning and Design Inc.

Brendan Salakoh, Landmark Planning and Design Inc.

Brenda Tesarski, Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** BS provided an overview of the Precinct G Project, including: • Introduction of the study team • Reason for the project being undertaken • Project process • Purpose of the meeting • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a land development plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public is being undertaken. The Precinct Plan will address land use, transportation and servicing for this area and will guide development within the new neighbourhood.	
3.	**Question and Answer** Q. How far away from the existing rail line will homes need to be constructed? A. There are regulations and guidelines that specify the minimum distance a home can be constructed from a rail line; this condition would be addressed in the subdivision/rezoning application. Q. Will there be a school located in Precinct F? A. Yes, a K-8 school site has been identified in Precinct F. Q. Will the road network be constructed first to ensure traffic moves efficiently?	

	A. The road network will be established in phases; existing roads would be used in the interim, and policies will be provided in the Precinct Plan to limit the amount of construction prior to a connection to CPT. Q. Who is responsible for cleaning up construction garbage along the rail line? A. This issue is not dealt with at this level of planning. Q. What is "low density" housing? A. This refers to single family homes, two family homes and possibly townhouses on collector roads. Q. Is there a preservation area in Precinct G? A. Native Plant Solutions is undertaking a thorough investigation of the area and will note which areas would be candidates for preservation. Q. How will future AT connect to existing communities? A. Future AT will tie into sidewalks along collector streets. Q. What is the anticipated timing for the Chief Peguis Trail extension? A. The study team is not actively involved in this project however it has been reported that the conceptual stages of the project have been completed and the project has now moved into the functional design stage. Q. Will Red River Boulevard be a bus route? A. Bus routes are established on collector roads; Red River Boulevard is a collector road. There is policy to have bus stops within 400 meters of most residential units. Winnipeg Transit will determine bus routes and the location of bus stops. Q. What type of traffic signalization would be at the intersections of collector roads and the CP Rail Line? A. There is a formula that determines traffic signalization requirements at these intersections. The CP Rail Line is a low volume rail line; the requirement may be to have flashing lights. Q. Can developers negotiate specific types of zoning in Precinct G? A. When developing a community, it is essential to consider the present and the future and what is best for everyone overall. Planners aim to follow good planning practices that are insightful, comprehensive and strategic and are not influenced by developer profitability. Q. How will Ivan's Autobody Shop be addressed? A. The operation will be considered an existing, non-conforming use. Q. What are the plans for the snow dump. A. There is no indication that the City is changing the current use of the snow dump? Q. How much land does a school require? A. A school site requires 10 acres of land unless it is located by a park; if this is the case then only 5 or 6 acres of land are required. Q. Will a high school be required in Precinct G? A. No.	

4.	**General Discussion** Participants at the meeting raised concerns about the potential traffic impacts of new developments in Precinct G. There was general discussion on the following topics: • Potential impact to existing road network • Increased traffic volume in existing communities • Traffic calming measures in existing neighborhoods • School drop off zones • AT connectivity • Purpose of collector roads in a community	
5.	**Next Steps** The study team is currently writing a first draft of the Precinct Plan. Following this round of consultation meetings and the public open houses, the study team will make revisions to the draft plans and complete another round of consultations.	
Recorded By: Brenda Tesarski		
Date: Oct 5, 2016		

MEETING MINUTES

Landmark Planning & Design Inc.

Project: Precinct G

Meeting: Public Schools Finance Board

Date: November 10, 2016 (10:00 AM)

Location: Public Schools Finance Board, 258 Portage Avenue

Purpose

- To update the Public Schools Finance Board (PSFB) on the development of the Precinct G Precinct Plan, particularly as it relates to potential school sites.
- To understand potential issues and opportunities from the PSFB's perspective.

Attendance

Rick Dedi	Public Schools Finance Board – Executive Director
Konrad Erickson	Public Schools Finance Board – Senior Project Leader
James Platt	City of Winnipeg – PP&D
Michael Carruthers	Ladco
Tyler Smith	Ladco
Donovan Toews	Landmark Planning & Design
Brendan Salakoh	Landmark Planning & Design

Item	Description	Action
1.	**Project Update** DT introduced the project and outlined the Precinct G land-use and roadway concepts, as well as the content, timing and process for preparation of the Precinct Plan.	
2.	**Notes** RD asked whether the Precinct Plan would address schools. DT noted that policies would be incorporated that support effective siting of schools, but that actual placement of school sites does not occur at the Precinct Plan stage. KE asked whether Seven Oaks School Division (SOSD) bought land for a school in adjacent Precinct F. DT noted that he was unsure whether or not land was purchased, but that a school site had been identified in the northeast corner of Precinct F in its Precinct Plan (which is non-statutory). It was noted that the SOSD has a school site secured in Precinct E (for a K to 4 immersion school), but that the school division may sell or trade that site.	

Item	Description	Action
	Regarding high schools, it was noted that SOSD has purchased a high school site in Precinct D (west of McPhillips Street). It was also noted that the Winnipeg School Division is also contemplating a new high school in northwest Winnipeg. RD noted that the PSFB usually requires new schools to include childcare spaces. He added that these daycares can either be attached to new schools, or built as stand-alone buildings on school property. KE noted that the preferred capacity for new elementary schools is in the 600 to 800 student range. Recently, schools built in new communities in northwest Winnipeg have been at capacity (or over-capacity) the day they open. The PSFB noted that their rule of thumb for estimating the number of potential students in a new community is 0.6 students per household (K to 12) and therefore, 0.4 students per household for students in grades K to 8. Assuming a full build-out of 3200 homes in Precinct G, that would indicate roughly 1280 students from K to 8, or about two new schools. MC asked how the PSFB student projections account for community demographic cycling (i.e. when the community inevitably ages, translating into fewer students per household). RD responded that that the PSFB must consider building for the peaks in enrolment. KE added that portables can be used as a stop-gap solution, and that the SOSD currently has approximately 35 portables in operation. It was noted the planning for schools on a precinct by precinct basis is difficult, and that looking at an entire quadrant of the city would allow for a better understanding of future needs. RD noted the possibility of partnering with the City of Winnipeg's Parks and Recreation department on school sites. JP noted that policies to address co-location (of school division land and city parks) could be incorporated into the Precinct Plan. KE noted that the PSFB's ideal school site area (for K to 8) would be 8 to 12 acres. If co-located with a city park, then 6 to 8 acres would suffice. He listed reasons for the increased area requirements, including: Increased school footprints; • Increased gym sizes; • Inclusion of daycares, and the preference for a separate daycare drop-off zone; • Larger parent drop-off zones for the school; • Increased parking requirements; and, • Increased greenspace. RD noted that in the later school site planning stages, there will need to be discussions with the developers and school division on land purchase prices (for schools). PSFB noted that Ladco's current system has worked well in the past (i.e. Lacdo typically charges a school division the market rate for raw land plus the cost of servicing that land). DT noted that the final draft of the Precinct Plan will be circulated to the PSFB.	PSFB to confirm location of SOSD land in Precinct D. Landmark to circulate final draft Precinct Plan to the PSFB

Recorded by Brendan Salakoh, November 10, 2016.

MEETING MINUTES

Landmark Planning & Design Inc.

Project: Precinct G

Meeting: City of Winnipeg – Public Works

Date: October 27, 2016 (10:00 AM)

Location: City of Winnipeg Public Works, 1155 Pacific Avenue (Transportation Boardroom)

Purpose

- To update the City of Winnipeg Public Works department on the development of the Precinct G Precinct Plan, particularly as it relates to the road and active transportation networks.
- To understand potential issues and opportunities from a Public Works perspective.

Attendance

Cindy Desjardine	Public Works
Stephanie Whitehouse	Public Works (AT)
Noah Yauk	PP&D
Bob Kurylko	Stantec
Steven Florko	Stantec
Mike Carruthers	Ladco
Tyler Smith	Ladco
Donovan Toews	Landmark Planning & Design
Brendan Salakoh	Landmark Planning & Design

Notes:

Item	Description	Action
1.	**Project Update** DT provided a project update and outlined the Precinct G open house materials.	
2.	Notes – **Road Network** DT and BK provided a detailed overview of the road network concepts. DT noted the advantages of concept two (direct connection concept), including: • It would funnel traffic to the west and south (mitigating cut-through traffic through existing neighbourhoods to the east); • It would provide direct connections to destinations (e.g. the commercial centre or the future Chief Peguis Trail extension), following desire lines; and,	

Item	Description	Action
	• It would provide a long-term connection between Precinct D and Chief Peguis Trail extension). CD expressed concerns with the current alignment of Murray Avenue (a direct east-west connection between McPhillips and Main). BK noted that it is currently built, so there is little that can be done. CD asked whether CP would permit additional crossings of the Winnipeg Beach rail line. DT noted that CP Rail has no issue with the two additional crossings (Fernbank Avenue and Red River Boulevard), and that they do not have the authority to prohibit them if they are demonstrated to be required by the City. CD asked whether a road connection to the RM of West St. Paul was considered. DT noted that both the City of Winnipeg and RM of West St. Paul have stated that the connection is unnecessary. BK added that Stantec will be working on a transportation master plan for West St. Paul, which might include a policy to protect a right-of-way for a future connection between the City and RM. CD suggested that Transit may want a connection to West St. Paul for future service extensions. BK noted that most collector-collector intersections would be served by roundabouts. BK noted that due to volumes, a closer look would need to be taken at the intersection of Ferrier and Murray. CD asked to see the transportation study. BK noted that they will finalize the study shortly and forward it to Public Works. CD asked whether the study considered a staged approach to the road network, based on the Chief Peguis Trail extension timeline. BK noted that staging has been considered to some extent. MC added that the likely sequence of connections to existing major streets would be to the east (to Main Street), to the west (to McPhillips Street), and then finally to the south (to the Chief Peguis Trail extension). He added that depending on construction access, a connection to McPhillips might actually be needed during phase 1 of development. BK added that there may be a need to look more closely at intersection improvements at Main Street and Fernbank Avenue. There was some discussion as to the final routing of the Chief Peguis Trail extension (i.e. whether or not it would bend north around a natural area). CD noted she would confirm the alignment with Scott Suderman, adding that it will ultimately be a council decision. There was some discussion regarding the challenges with Murray Avenue, including: • The fact that the intersection at Main Street is substandard; • The fact that Murray cannot be feasibly widened between the CP Winnipeg Beach rail line and Main Street; and, • The fact that the intersection of Murray and McPhillips is at a substandard angle.	Stantec to forward the transportation study to Public Works once finalized. Landmark to meet with Stantec to discuss staging options. CD to follow-up with Scott Suderman on CPT extension alignment.

Item	Description	Action
	CD added that there might be options to limit traffic on Murray, including: • Altering the intersection at Main Street into a right-in, right-out only; • Cutting off Murray at the CP Winnipeg Beach rail line; or, • T-ing off Murray at McPhillips. CD noted that she will want to see external intersection analysis (e.g. Main and Murray, Main and Fernbank) as part of the transportation study to see if upgrades are needed. She also added that there would be a need to assess whether there are any right-of-way constraints to these upgrades. Stantec noted they would forward the road network concepts to Public Works. **Notes – Active Transportation (AT)** SW noted that the City is currently working on a policy for sidewalks in new neighbourhoods. SW offered to forward the project team the latest AT mapping for the area. It was noted that CP's rail rationalization study is currently on hold. The study was to explore consolidating the CP Winnipeg Beach and CP Arborg rail lines. In the long term, the CP Winnipeg Beach line (adjacent to Precinct G) might become surplus, in which case it would be a prime candidate for becoming part of the AT network. **Notes – Schools** In regards to schools, it was noted that the Seven Oaks School Division has expressed the need for at least one (and possibly two) elementary school sites in Precinct G. MC added that the school division has purchased land for a high school in Precinct D (west of McPhillips). SW noted the importance of connecting school sites via active transportation pathways. DT noted that this would be written into the plan as policy, but that school siting does not take place at the Precinct planning level.	Stantec to forward road network concepts to Public Works. SW to forward AT shape files. Landmark to follow-up with Seven Oaks School Division on precise location of High School Site.

Recorded by Brendan Salakoh, October 27, 2016.

MEETING MINUTES

Landmark Planning & Design Inc.

Project: Precinct G

Meeting: City of Winnipeg

Date: June 21, 2016

Location: Landmark Planning & Design, 298 Waterfront Drive, Winnipeg, MB

Purpose

- To provide a project update to the City of Winnipeg
- To understand potential issues and opportunities

Attendance

Michael Carruthers	Ladco
Tyler Smith	Ladco
James Platt	City of Winnipeg
Noah Yauk	City of Winnipeg
Donovan Toews	Landmark Planning & Design
Brendan Salakoh	Landmark Planning & Design

Notes:

Item	Description	Action
1.	**Project Update** DT gave a project update.	
2.	**Notes** In terms of roads, it was noted that Public Works has recently altered the alignment of the Chief Peguis Trail (to swing north near Ferrier, presumably to protect a forested area). It was noted that potential intersections along McPhillips would be at least 400 m apart, as per City policy. MC added that roundabouts would be the preferred option for the intersection of collector roads in Precinct G. DT noted that the traffic study produced by Stantec is still in draft form, and that the two traffic models (grid and curvilinear) have differing impacts on traffic flow. There was consensus among participants that the curvilinear model was the preferred model for a variety of reasons, including: • cost, • length, • future maintenance, • traffic flow, and • developable land.	DT to contact Stantec to find out status of draft report. JP to set up a meeting with Public Works and Winnipeg Transit (re: road concepts).

Item	Description	Action
	It was noted that neighbourhood nodes (e.g. multifamily, institutional, or neighbourhood commercial) would likely be located at the intersection of two collectors or a collector and an arterial. It was noted that the road concepts could be put forward to Public Works and Winnipeg Transit for comment. It was noted that an open house is taking place on June 30 at the Red River Community Centre (re: Chief Peguis Trail extension and City of Winnipeg antenna). NY noted that after advertising the proposed emergency services antenna, he only received 1 or 2 comments. DT noted that Qualico sent an official objection to the City. NY noted that it is difficult to get all departments on the same page regarding the location of the antenna. DT asked whether the land beneath the antenna could be used as a dog park. It was noted that the project team will be meeting with the Seven Oaks School Division at 10 AM on June 29th to discuss school site needs in the area. It is anticipated that at least one K-8 school will be warranted for the area. It was noted that the Public Schools Amendment Act (Community Use of Schools) is unclear in its requirements of developers, which has led to 'one-off' negotiations for individual school sites. Ladco noted that they have undertaken development planning for Precinct G under certain assumptions and assurances from the City of Winnipeg (specifically from the Water and Waste Department) regarding servicing. This includes the understanding that a major regional interceptor along Fernbank Avenue is being planned by the City of Winnipeg to service Precinct G and future development in the northwest (City of Winnipeg regional wastewater servicing map and City of Winnipeg Capital Budgets 2011-2015). However, it appears that the status of this interceptor sewer is not clear from discussions with the Water and Waste Department. The Interceptor was pushed out of the 2016 Capital Budget and the Department suggests that it may not be needed. In the absence of a regional interceptor, Ladco could build a local/lateral sewer system along Fernbank Avenue, sized for their development only. However, this would hurt the City long term, as the pipes would not be sized to service other new communities to the west in the long-term. This would be a last resort. Ladco intends to follow-up with the City on this item. BS gave an overview of his meeting with the Winnipeg Fire Paramedic Service. JP gave an outline of what the City would like to see in the Precinct Plan. He noted that background and engineering should be included as appendices, rather than as components of the Plan itself. He also noted that the administration section can be minimal and that the city would provide boilerplate material for this section. In terms of mapping, he noted that property lines should be kept off of the maps, and that mapping should be very high level.	City (JP) to consider whether programming space as a dog park is feasible. MC to follow-up with City on interceptor issue. BS to forward WFPS minutes to team. JP to send a draft table of contents to BS.

Recorded by Brendan Salakoh, June 21, 2016.

MEETING MINUTES

Landmark Planning & Design Inc.

Project:	Precinct G
Meeting:	City of Winnipeg – Parks and Natural Areas
Date:	October 24, 2016 (1:30 PM)
Location:	City of Winnipeg, 30 Fort Street (PP&D Boardroom)

Purpose

- To update the City of Winnipeg on the development of the Precinct G Precinct Plan, particularly as it relates to parks and natural areas.
- To understand potential issues and opportunities from a parks and natural areas perspective

Attendance

James Platt	PP&D
Noah Yauk	PP&D
Laura Rempel	PP&D
Donna Beaton	PP&D (Parks)
James Houldsworth	Parks
Ian Legge	PP&D
Rodney Penner	Public Works (Parks)
Tyler Smith	Ladco
Donovan Toews	Landmark Planning & Design
Brendan Salakoh	Landmark Planning & Design

Notes:

Item	Description	Action
1.	**Project Update** DT provided a project update and outlined the Precinct G land-use concepts and road network concepts.	
2.	**Notes - Natural Areas:** RP gave an overview of the City's four natural area habitat assessments within and near Precinct G. He outlined an area of "Grade A" quality habitat (within Precinct G Sub-Area 3, City reference 345A) which has a mix of 'aspen forest' and 'wetland'. He noted that this assessment was completed in 1995, and may not be accurate due to the lack of precise geographic coordinates at the time of assessment. He also outlined some habitat in the southeast corner of Precinct G (City reference 552B and	

Item	Description	Action
	553B); these areas are tied historically/ecologically to the 'frog plains' to the east. This land is largely in the CP rail right-of-way, specifically in the ditch that runs alongside the rail line. He also identified lands near the Chief Peguis Trail extension right-of-way as natural area 627B. DT and TS noted that based on historical aerial photography, the "wetlands" in Precinct G were in fact farmland as recently as 1988. It was suggested that perhaps drainage patterns from the snow dump had artificially raised water levels on private land in the recent past. DT asked whether the City had plans to alter the drainage of these lands (as the drainage is currently flowing onto private lands from City lands), and that if the drainage pattern was corrected, whether the condition of this wet land would return to its earlier farmed condition. DT noted that the project team is working with Native Plant Solutions on an ecological study of Precinct G, the results of which should soon be available. RP noted that he would like to see the results of this study, which could help supplement the City's limited ecological inventory of the area. He added he would also like to meet with NPS to discuss their findings. RP noted that the City would like to see some of the "Grade A" habitat (345 A) as well as a portion of the existing wetlands (south of the snow dump) preserved where feasible and reasonable. He added that failing to conserve these wet areas could become an issue both internally and with residents. DT asked whether creating habitat (e.g. through engineered, naturalized wetlands) would be well received by the department, as was done in Ridgewood. RP responded that in some cases, it might work (e.g. engineered wetlands can serve as habitat for some waterfowl). However, in other cases, engineered wetlands may not work well (e.g. as frog habitat, because frogs require shallow water and ephemeral landscapes). DT noted that two local residents have expressed an interest in the environmental issues in Precinct G. RP asked that he be kept in the loop regarding those discussions, while DB suggested a meeting with these stakeholders (as well as DB and RP) might be helpful. DB noted that it would be helpful to superimpose the proposed road network concept onto the natural areas map. TS noted that a sewer pipe runs north-south along the McGregor right-of-way, cutting through the Grade A lands in Precinct G. **Parks** In terms of parks, DT noted that the project team is writing policies that encourage small parks in each Precinct sub-area and a larger park to service the entire Precinct (e.g. the closed landfill). DB added that the City has recently expressed a preference for larger local parks (i.e. around 5 acres) that can accommodate a wide variety of passive and active uses; small parks (i.e. those of 2 acres or less) are costlier to maintain. DB added that based on City calculations of gross area, approximately 55 to 60 acres of parkland would be required in Precinct G. She noted the City's preference for a park within 400 m of most residences. DB added	Landmark to set up meeting with City and NPS. Landmark will query NPS to see if they can modify designs to create better frog habitat (ephemeral areas). Landmark to keep RP in the loop regarding discussions with the two local residents. Landmark to superimpose road network onto natural areas map.

Item	Description	Action
	that she suspects the closed landfill could eventually serve as a passive park, or potentially even a dog park (although there might be challenges with erecting fencing and other amenities due to the restrictions and remediation requirements on closed landfills). It was also noted that West St. Paul should be kept apprised of plans for the landfill, particularly if it eventually becomes a park (as the RM may want to consider a connection to it). DB added that should the closed landfill become a park, buffer zones for residential development might be considered due to the landfill's height (and the potential privacy concerns the height could generate), and a substantial pedestrian connection be provided at the subdivision stage. DT noted the neighbourhood would be interconnected through a series of pathways, some of which would run along the naturalized retention ponds. He added that policies would encourage pathways along both the Chief Peguis Trail extension and the CP rail line (should it ever be abandoned by the railway). DT noted that Seven Oaks School Division expressed a need for at least one (but possibly two) elementary school sites in Precinct G; no high school sites are required in Precinct G. DB added that a few acres in Precinct G might be needed to accommodate a proposed school site in Precinct F. DB asked who she should contact in regards to Precinct F, and DT suggested Paul Moroz (Daytona Homes). **Other Planning Considerations** JP noted that a developer in West St. Paul, just north of Precinct G, was planning a residential development adjacent to the City boundary. He added that West St. Paul has a secondary plan in place for those lands, and that the developer may propose using the parcel of land immediately south of West St. Paul (in the City of Winnipeg, north of the snow dump and closed landfill) as a retention pond. DB to noted she would review the Ridgewood South Precinct Plan and see if similar park policies would work for Precinct G. DT asked whether a decision had been made whether to alter the alignment of the Chief Peguis Trail to avoid an area of ecological significance (City reference 627B). RP noted that he was not sure whether or not a final decision had been made on the alignment, and JP added that it likely must still be approved by council. Latest drawings suggest the alignment has been changed. DB asked whether Ferrier would connect to the Chief Peguis Trail extension. DT noted that it would.	Landmark to provide DB with Paul Moroz contact information. P to speak with Becky Raddatz in regards to whether or not the strip could be used for water retention. DB to review Ridgewood South policies.

Recorded by Brendan Salakoh, October 24, 2016.

RECORD OF MEETING

Landmark Planning & Design Inc.

Title: Precinct G – "Super TAC" (Water and Waste Department)

Date of Meeting: June 16, 2016

Time: 1:30PM

Location: Water and Waste Department – 1199 Pacific Avenue

In Attendance: Andrew McMillan (AM), City of Winnipeg – Water and Waste Department
Swarna Jayakody (SJ), City of Winnipeg – Water and Waste Department
Marek Gajda (MG), City of Winnipeg – Water and Waste Department
Andree Kirouac (AK), City of Winnipeg – Water and Waste Department
Duane Griffin (DG), City of Winnnipeg – Water and Waste Department
James Platt (JP), City of Winnipeg – Planning, Property and Development
Dan Mages (DM), Stantec
Mike Carruthers (MC), Ladco Company Ltd.
Tyler Smith (TS), Ladco Company Ltd.
Donovan Toews (DT), Landmark Planning and Design Inc.

Item	Description	Action By
1.	**Introductions and Project Overview** DT provided a recap of the Precinct G project, including: • Reason for the project being undertaken • Project process • Precinct Sub-Areas • Next steps	
2.	**Project Background** Landmark Planning and Design was retained to prepare a precinct plan for an 800-acre area in north Winnipeg which is identified in OurWinnipeg as Precinct "G". An extensive consultation process with local residents, landowners, businesses, government agencies, the local school division and the general public will be undertaken. The planning process will address land use, transportation and servicing for the area and will result in a Precinct Plan that will guide development within the new neighbourhood.	

3.	**General Discussion** There was discussion on the following topics: **Water** **Sanitary Sewer** W&W indicated that since the previous meeting February 6, 2016, they have decided that the wastewater services for Precinct G can be entirely accommodated south through the Chief Peguis Trail interceptor, rather than through the previously planned Fernbank interceptor. Representatives indicated that this previous plan was only a concept and that their latest calculations support the current alternative. With this new concept, all lands to the West of McPhillips, including all of Precinct D, would be accommodated through this interceptor. Local sewers would tie in all areas, including Precinct G, to the interceptor. **Land Drainage**	WWD to provide flow rates to DM
4.	**Next Steps**	
		Recorded by: Donovan Toews
		Date: June 16, 2016

MEETING MINUTES

Landmark Planning & Design Inc.

Project: Precinct G

Meeting: Winnipeg Transit

Date: October 4, 2016

Location: Winnipeg Transit, 421 Osborne Street

Purpose

- To present the road network concepts for Precinct G to Winnipeg Transit
- To understand potential issues and opportunities from Winnipeg Transit's perspective.

Attendance

David Patman	Winnipeg Transit
Mike Carruthers	Ladco
Tyler Smith	Ladco
Bob Kurylko	Stantec
Steve Florko	Stantec
Donovan Toews	Landmark Planning & Design
Brendan Salakoh	Landmark Planning & Design

Notes:

Item	Description	Action
1.	**Project Update** DT provided a project update and outlined the two road network concepts.	
2.	**Notes** SF presented 250m and 400m transit catchment maps for each of the two road network concepts. The entire Precinct is well within the 400m catchment (i.e. all lands are within 400m of a collector) for both road network concepts, and is effectively also within the 250 m catchment. BK noted that Concept 2 (direct connections concept) is preferred over Concept 1 (traditional grid concept). He noted that Concept 2 would be most effective at dispersing traffic, while limiting the funneling of traffic through the existing neighbourhoods. In terms of transit, he noted that eventually buses could connect to the future Chief Peguis Trail extension via Ferrier. BK noted that the 4-laning of collectors could be deferred by utilizing roundabouts. DP suggested that the team should review the road network concepts with Public Works (Cindy Desjardine). BK noted that there may be future park and ride opportunities in Precinct G (including on City owned land near the intersection of Murray Avenue and Ferrier Street, and at the snow dump site). DP added that park and ride locations are typically in the 400 to 500 stall range (up to 10 acres), but can	Landmark and Stantec to arrange a meeting with Public Works.

Item	Description	Action
	go as high as 1000 stalls. He noted that a problem with current park and ride locations is that they are leased (generally at the edges of existing commercial parking lots) and therefore there are rarely opportunities for expansion. He noted that Transit would like to own their own park and rides, and integrate them with City facilities (e.g. a recreation complex, library, etc.). There was some discussion around park and rides in Calgary, and how as land values increase, higher intensity uses are sought for the sites (e.g. housing, parkades, etc.). MC noted that there might be opportunities to review land leases with Transit for park and rides. DP noted that Transit generally prefers grid-type layouts, as they tend to facilitate Transit's bus routing. Curvilinear networks can be challenging, particularly when buses need to make left turns on busy collectors. However, he noted that Concept 2 would likely be serviceable since it is more like a grid than a curvilinear pattern. DP noted the need to understand travel patterns, noting that not all residents would be heading towards the downtown. Rather, they might be travelling to Polo Park, Centreport, the Airport, etc. He added that Transit is looking closely at adding future crosstown transit corridors. DP asked that the project team include transit policies in the Precinct Plan, including: • Integrating transit with pedestrian and cycling facilities; and, • Placement of transit stops at community focal points. DP gave an overview of the existing transit routes in the area. He noted that ideally, transit would travel down collectors (past multifamily developments). DP suggested that the project team meet with Alex Regiec of Winnipeg Transit to discuss bus routing in more depth.	Landmark to include transit policies in draft Precinct Plan. Landmark to arrange meeting with Alex Regiec.

Recorded by Brendan Salakoh, October 4, 2016.

Landmark
Planning & Design Inc.

December 1, 2015
[Landowner Address]

Dear [Landowner Name],

We are writing to invite you to attend a meeting of landowners with holdings in the area of Winnipeg referred to as 'Precinct G' as outlined on the attached sketch. These boundaries have been established by the City of Winnipeg in a regulatory document called *OurWinnipeg – Complete Communities*. Undeveloped and un-serviced areas such as Precinct G, require a thorough consultation and planning process to be undertaken before the City of Winnipeg will consider the future for such lands. The objective of this process is to create a long term plan and vision that will set the overall framework for future growth and development.

Ladco Company Limited (Ladco), a local, family owned business, is a landowner within Precinct G and has taken the initiative of introducing a process to prepare a Precinct Plan for consideration by the City of Winnipeg. Ladco recognizes that all landowners within the plan area should have a stake in future growth of the community. With that, we are seeking the participation of landowners in the very early stages of this planning process.

Landmark Planning & Design will be leading this process and invite you to participate in an initial meeting. We will introduce the planning process, timeline and anticipated steps. We also would like to discuss a variety of ideas along with addressing any comments and concerns that you may have. Additional meetings will follow over the next 12-16 months.

If you would like to attend this meeting, please RSVP to Brenda Tesarski (204-453-8008). Further meetings will be scheduled with other project stakeholders and members of the general public throughout the duration of this process.

We look forward to seeing you on December 14 at 7PM at the Red River Community Centre (293 Murray Avenue).

If you are unable to attend, or would like additional information, please feel free to contact me at your convenience.

Sincerely,

Donovan Toews, MCIP

298 Waterfront Drive
Winnipeg, MB R3B 0G5
Tel: 204.453.8008
landmkpd@mts.ne

Landmark
Planning & Design Inc.

January 5, 2016

[Landowner Address]

Dear [Landowner],

We are writing to advise you that a landowner meeting was held on December 14, 2015 for a project we are undertaking in the area of Winnipeg referred to as 'Precinct G' as outlined on the attached sketch. We understand that you were unable to attend.

During the meeting we introduced the project planning process, timeline, anticipated steps and addressed any comments or concerns that participants had. Additional meetings will follow over the next 12-16 months.

Please contact our office at 204-453-8008 if you would like additional information on the project.

Sincerely,

Donovan Toews, MCIP
Principal

298 Waterfront Drive
Winnipeg, MB R3B 0G5
Tel: 204.453.8008
landmkpd@mts.ne

Landmark
Planning & Design Inc.

April 21, 2016

Dear Resident,

We are writing to invite you to attend a meeting to discuss future plans for a +/- 800 acre area in north Winnipeg known as Precinct G.

OurWinnipeg, the City's Development plan, requires that new communities be established through a formalized planning process. The Precinct G Precinct Plan will help guide the orderly, efficient and sustainable development of these lands. A Precinct Plan typically includes policies on such matters as sewer, water and land drainage services, roads, land use types and densities, development cost sharing, recreation facilities, schools and other important planning considerations.

Community consultation and public input play an important role in creating an effective plan. Please consider attending one of the following 90-minute information sessions at the Red River Community Centre, 293 Murray Avenue:

Tuesday, May 3, 2016	**4:00PM**
Tuesday, May 3, 2016	**7:00PM**
Wednesday, May 4, 2016	**1:30PM**
Wednesday, May 4, 2016	**3:30PM**

Due to limited seating capacity, please RSVP to Landmark Planning and Design at 204-453-8008 or info@landmarkplanning.ca to confirm your attendance. This is a special meeting for residents living directly adjacent to collector roads that will service the planned area.

A Public Open House will follow these invited meetings on Wednesday May 4, 2016 from 7:00PM to 9:00PM at the Red River Community Centre. The Open House is open for anyone with an interest in the project. Residents unable to attend one of the information sessions noted above are welcome to attend the Public Open House. Other stakeholder and public meetings will be held in the weeks and months to follow.

Sincerely,

Donovan Toews, MCIP MCP
Principal

Precinct G – Precinct Plan
PUBLIC OPEN HOUSE

You are invited to attend a public open house to discuss future plans for a +/- 800 acre area in north Winnipeg known as Precinct G.

OurWinnipeg, the City's development plan, requires that new communities be established through a formalized planning process.

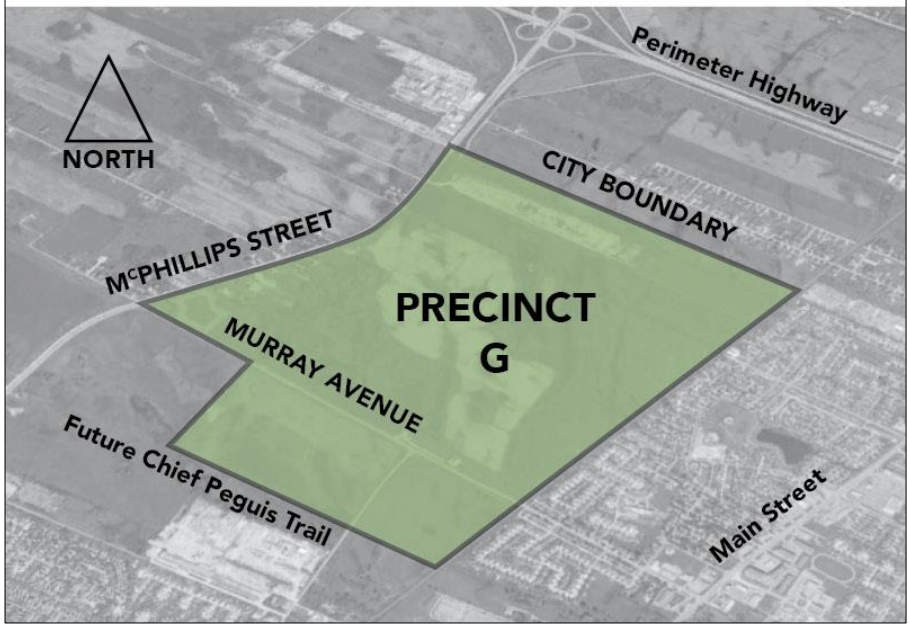
The Precinct G Precinct Plan will help guide the orderly, efficient and sustainable development of these lands.

A *Precinct Plan* typically includes policies on such matters as sewer, water and land drainage services, roads, land use types and densities, development cost sharing, recreation facilities, schools and other important planning considerations.

Community consultation and public input are important components of making this plan a success. This is the first of a series of public meetings to take place over the next 18 months.

Wednesday May 4, 2016
Drop-in Anytime: 7:00 – 9:00 PM
Red River Community Centre, Gymnasium
293 Murray Avenue

For more information please contact:
Landmark Planning and Design Inc.
204-453-8008 or info@landmarkplanning.ca



Landmark
Planning & Design Inc.

June 30, 2016

[Landowner Address]

Dear [Landowner],

We are writing to invite you to attend a second meeting of landowners with holdings in the area of Winnipeg referred to as Precinct G, as outlined on the attached map. More specifically, your lands fall within the area highlighted as *Area 3*. Precinct G has been designated as a future *New Community* under Winnipeg's development plan, *Our Winnipeg*. Undeveloped and unserviced areas such as Precinct G require a thorough consultation and precinct planning process to be undertaken before the City of Winnipeg will consider any development of such lands. The objective of this process is to create a long term plan and vision that will set the overall framework for future growth and development.

Ladco Company Limited (Ladco), a local, family-owned business, is a major landowner within Precinct G and has taken the initiative of preparing a Precinct Plan for consideration by the City of Winnipeg. Ladco recognizes that all landowners within the plan area should have a stake in future growth of the community.

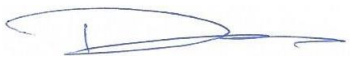
As you may be aware, Landmark Planning & Design has been retained to lead this planning process, and invites you to participate in this follow-up meeting. We will re-introduce the planning process, timeline, and anticipated next steps. We will also seek your input into the progress to date.

If you would like to attend this meeting, please RSVP to Brenda Tesarski (204-453-8008 or info@landmarkplanning.ca). Further meetings will be scheduled with landowners, project stakeholders, and members of the general public throughout the duration of this process.

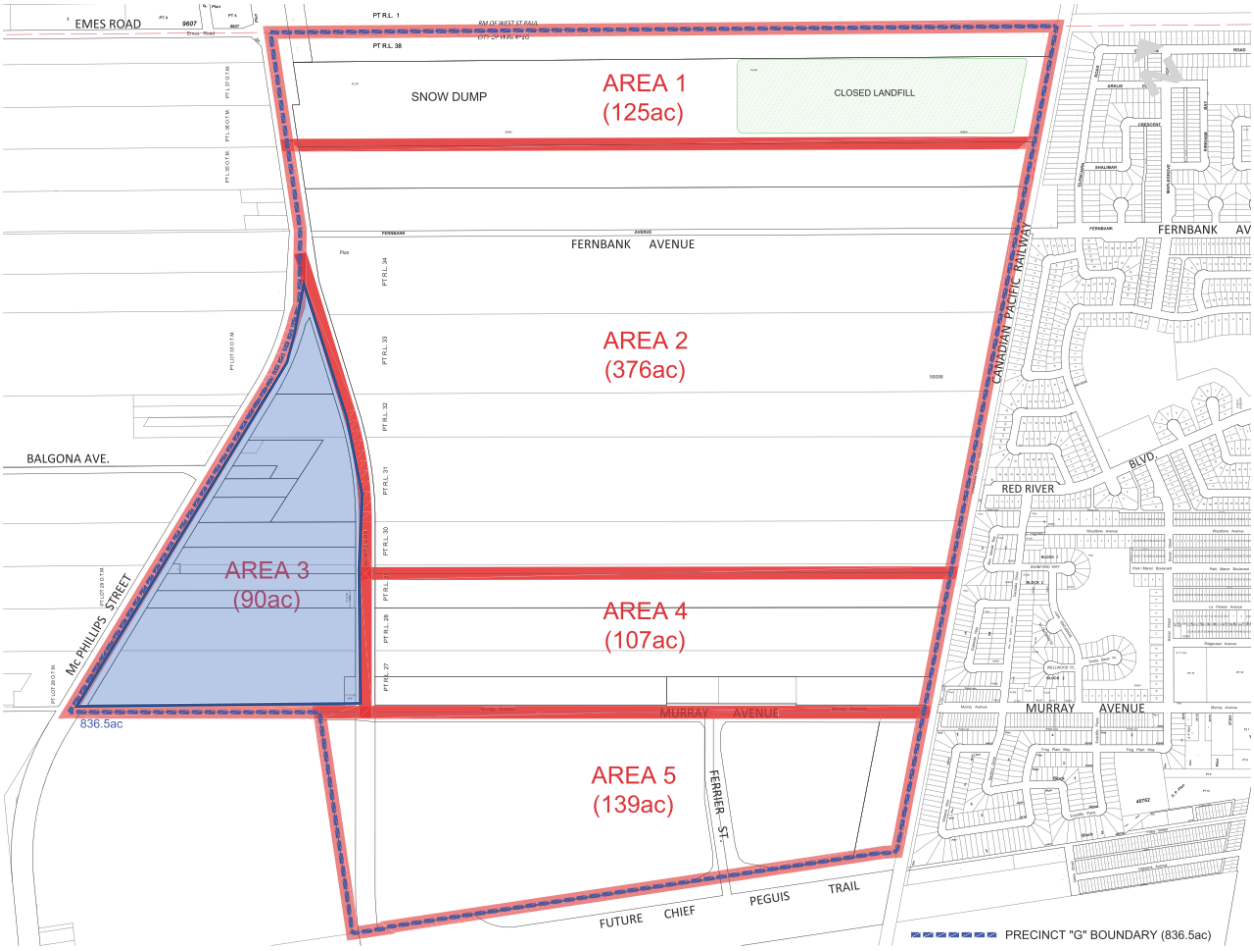
We look forward to seeing you on Monday July 11, 2016 at 4:00PM at the Red River Community Centre (293 Murray Avenue).

If you are unable to attend, or would like additional information, please feel free to contact me at your convenience.

Sincerely,



Donovan Toews, MCIP



Map of Precinct G Sub-Areas (Area 3 highlighted in blue)

Landmark
Planning & Design Inc.

September 20, 2016

Dear Resident,

We are writing to invite you to attend a project update meeting to discuss future plans for an +/- 800-acre area in north Winnipeg known as Precinct G.

OurWinnipeg, the City's Development plan, requires that new communities be established through a formalized planning process. The Precinct G Precinct Plan will help guide the orderly, efficient and sustainable development of these lands. A Precinct Plan typically includes policies on such matters as sewer, water and land drainage services, roads, land use types and densities, development cost sharing, recreation facilities, schools and other important planning considerations.

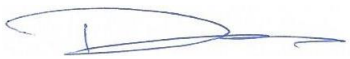
Community consultation and public input play an important role in creating an effective plan. Please consider attending one of the following 90-minute information sessions at the Red River Community Centre, 293 Murray Avenue:

Tuesday October 4, 2016	**3:00PM**
Tuesday October 4, 2016	**7:00PM**
Wednesday October 5, 2016	**3:00PM**

Due to limited seating capacity, please RSVP to Landmark Planning and Design at 204-453-8008 or info@landmarkplanning.ca to confirm your attendance. This is a special meeting for residents living directly adjacent to collector roads that will service the planned area or directly adjacent to the east boundary of Precinct G.

A Public Open House will follow these invited meetings on Wednesday October 5, 2016 from 7:00PM to 9:00PM at the Red River Community Centre. The Open House is open for anyone with an interest in the project. Residents unable to attend one of the information sessions noted above are welcome to attend the Public Open House. Other stakeholder and public meetings will be held in the weeks and months to follow.

Sincerely,



Donovan Toews, MCIP MCP
Principal

Precinct G – Precinct Plan
PUBLIC OPEN HOUSE

You are invited to attend a public open house to discuss future plans for a +/- 800 acre area in north Winnipeg known as Precinct G.

OurWinnipeg, the City's development plan, requires that new communities be established through a formalized planning process.

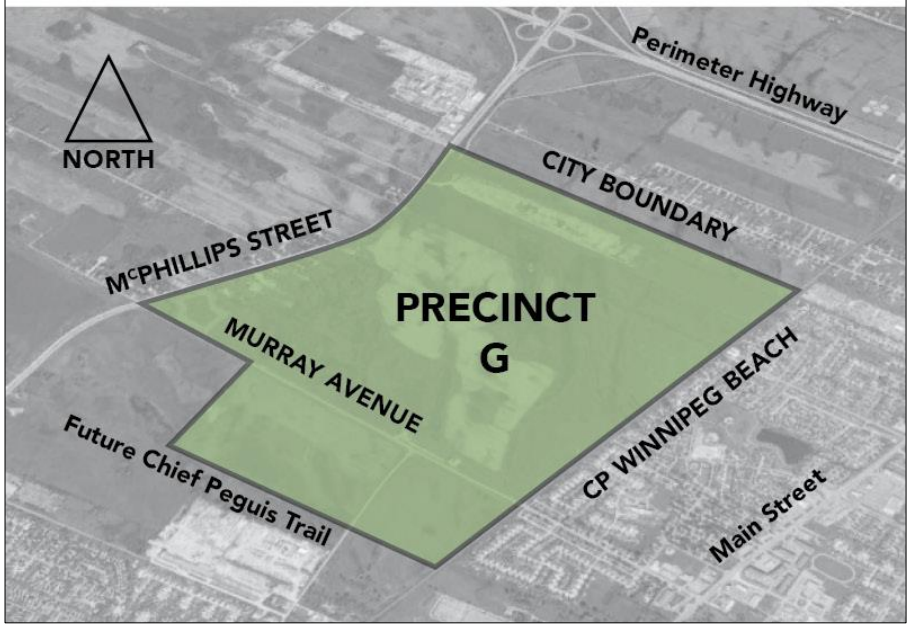
The Precinct G Precinct Plan will help guide the orderly, efficient and sustainable development of these lands.

A *Precinct Plan* typically includes policies on such matters as sewer, water and land drainage services, roads, land use types and densities, development cost sharing, recreation facilities, schools and other important planning considerations.

Community consultation and public input are important components of making this plan a success.

Wednesday October 5, 2016
Drop-in Anytime: 7:00 – 9:00 PM
Red River Community Centre, Gymnasium
293 Murray Avenue

For more information please contact:
Landmark Planning and Design Inc.
204-453-8008 or info@landmarkplanning.ca



Landmark
Planning & Design Inc.

November 16, 2017

Dear Resident,

We are writing to invite you to attend a meeting for residents that live directly adjacent to an area of Winnipeg referred to as 'Precinct G' as outlined on the reverse of this letter. The precinct boundaries were established by the City of Winnipeg in a regulatory document called *OurWinnipeg – Complete Communities*. Undeveloped and un-serviced areas such as Precinct G require a thorough consultation and planning process to be undertaken before the City of Winnipeg will consider development on such lands. The objective of this process is to create a long-term plan and vision that will set the overall framework for future neighbourhood development.

Landmark Planning & Design has been leading the planning and consultation process for this project. Previous meetings have been held which you may or may not have been able to attend. During those meetings the project team introduced the planning process, timeline and anticipated next steps. Over the course of the past several months, the team has worked to address the feedback received at previous meetings. A draft Precinct Plan has now been prepared. You are invited to participate in a meeting to review the draft document and provide input prior to it being officially submitted to the City of Winnipeg for consideration. Please consider attending one of the following 90-minute information sessions being held at the **Red River Community Centre**, 293 Murray Avenue:

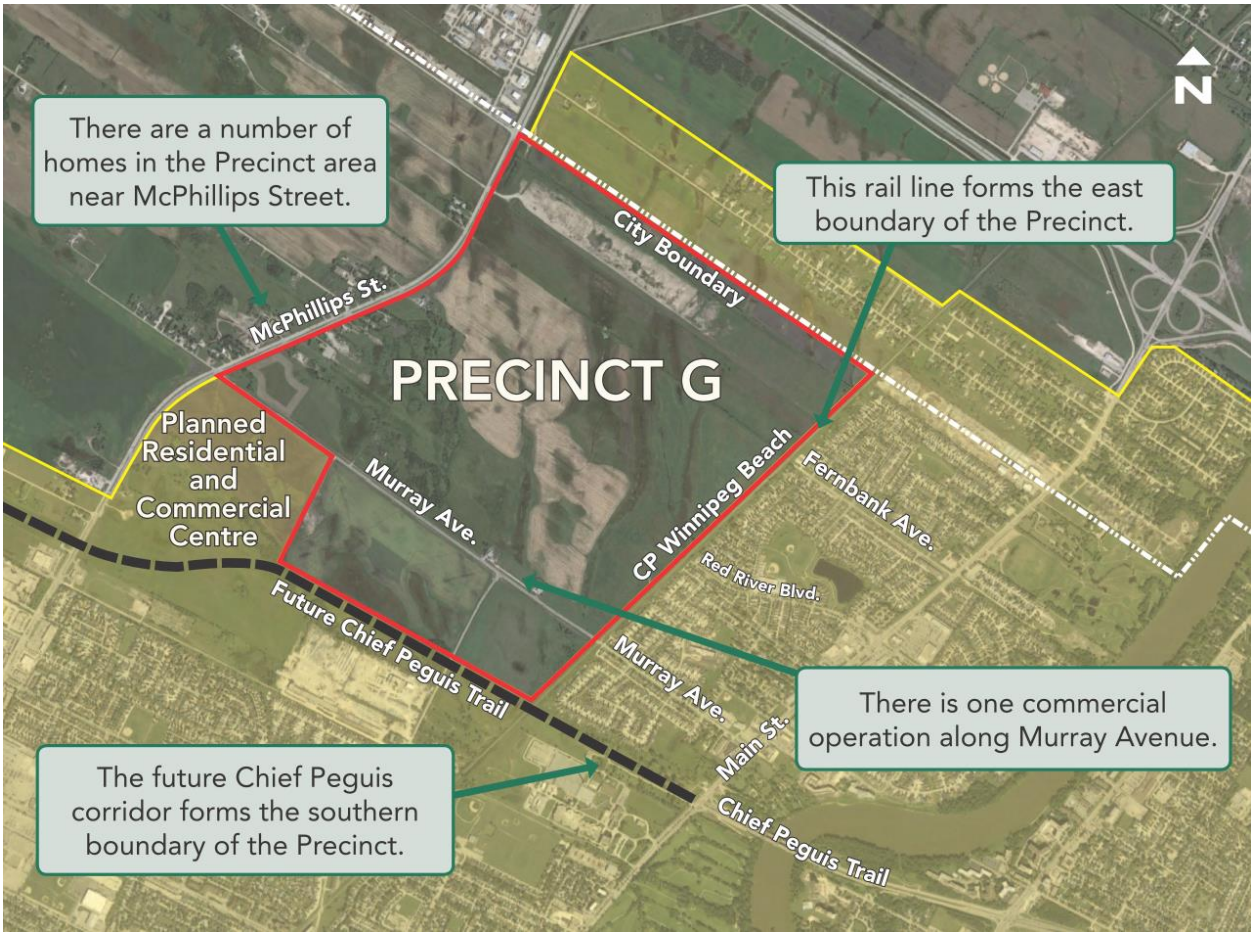
Thursday, November 30, 2017	**1:00 PM**
Thursday, November 30, 2017	**3:30 PM**

If you would like to attend one of these meetings, please RSVP to Brenda Tesarski at info@landmarkplanning.ca or 204-453-8008.

A Public Open House will follow these resident information sessions on Thursday, November 30, 2017 from 7:00PM to 9:00PM at the Red River Community Centre. The Open House is open to anyone with an interest in the project. Residents unable to attend one of the information sessions noted above are welcome to attend the Public Open House.

Sincerely,

Donovan Toews, RPP, MCIP



Map of Precinct G

Precinct G – Precinct Plan
PUBLIC OPEN HOUSE

You are invited to attend a public open house to discuss future plans for a +/- 800 acre area in north Winnipeg known as Precinct G. This is the third and final round of public engagement before submitting this plan for review by the City of Winnipeg.

OurWinnipeg, the City's development plan, requires that new communities be established through a formalized planning process.

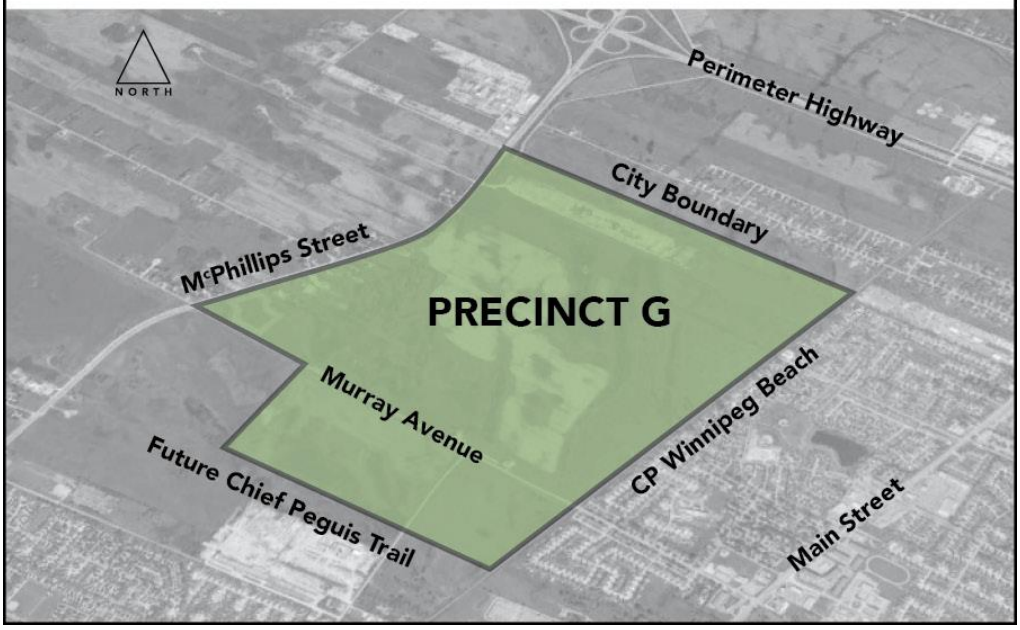
The Precinct G Precinct Plan will help guide the orderly, efficient and sustainable development of these lands.

A *Precinct Plan* typically includes policies on such matters as sewer, water and land drainage services, roads, land use types and densities, development cost sharing, recreation facilities, schools and other important planning considerations.

Community consultation and public input are important components of making this plan a success. Please join us:

Thursday November 30, 2017
Drop-in Anytime: 7:00 – 9:00 PM
Red River Community Centre, Gymnasium
293 Murray Avenue

For more information please contact:
Landmark Planning and Design Inc.
204-453-8008 or info@landmarkplanning.ca



LANDOWNER INFORMATION SHEET

Precinct G

If you need additional space please use the reverse side of this page.

1. **Select the option that best suits you. Please check all that apply:**
   - ☐ I reside within the study area
   - ☐ I own land within the study area
   - ☐ I own a business within the study area
   - ☐ Other: _____

2. **Do you generally understand the reasons a Precinct Plan is required for this area?**
   - ☐ Yes ☐ No

   Comments: _____

3. **Do you intend to participate in the Precinct Plan process?**
   - ☐ Yes ☐ No

   Comments: _____

4. **Is there any specific information you would like regarding the Precinct Plan or the precinct plan process?**
   - ☐ Yes ☐ No

   Comments: _____

5. **Please provide any other comments or questions you may have:**

6. **Did you find this information session helpful?**
   - ☐ Yes ☐ No ☐ Somewhat

   Comments: _____

Landmark Planning & Design Inc.

PUBLIC OPEN HOUSE COMMENT SHEET

Precinct G

Please review the Open House materials and provide us with your comments or questions.
Your input will be carefully considered during the planning process.

If you need additional space please use the reverse side of this page.

1. **I live:**
   - ☐ Within the Precinct G boundaries
   - ☐ Between the CPR Rail line and Main Street
   - ☐ In West St. Paul
   - ☐ Other: _____

2. **I understand the reason why a Precinct Plan is required:**
   ☐ Yes ☐ No ☐ Somewhat

   Please explain your answer, including what information you might find helpful: _____

3. **Do you generally understand the steps of the planning process that is now beginning?**
   ☐ Yes ☐ No ☐ Somewhat

   Please explain: _____

4. **What information or opinion would you like to offer the study team as they begin to prepare the Precinct Plan?**

5. **Did you find this information session helpful?**
   ☐ Yes ☐ No ☐ Somewhat

   Please explain: _____

If you would like to be added to a notification list for future meetings please include your email (please print clearly): _____

Landmark
Planning & Design Inc.

PRECICNT G COMMENT SHEET

Please review the display materials and provide us with your comments or questions.
Your input will be carefully considered during the planning process.

If you need additional space please use the reverse side of this page.

1. **I live:**
   - ☐ Within the Precinct G boundaries
   - ☐ Between the CPR Rail line and Main Street
   - ☐ In West St. Paul
   - ☐ Other: _____

2. **Have you attended a meeting in the past?**
   - ☐ Yes ☐ No

3. **I understand the reason why a Precinct Plan is required:**
   - ☐ Yes ☐ No ☐ Somewhat

   Please explain your answer, including what information you might find helpful: _____

4. **Do you generally understand the steps of the planning process?**
   - ☐ Yes ☐ No ☐ Somewhat

   Please explain: _____

5. **What are your thoughts on the road network concepts for Precinct G?**
   - ☐ Like ☐ Dislike ☐ Unsure

   Please explain: _____

6. **What are your thoughts on the land-use concepts for Precinct G?**
   - ☐ Like ☐ Dislike ☐ Unsure

   Please explain: _____

Landmark Planning & Design Inc.

7. What are your thoughts on the lake system and trail concepts for Precinct G?

☐ Like ☐ Dislike ☐ Unsure

Please explain:_____

8. What information or opinion would you like to offer the study team on the draft Precinct Plan?

9. Did you find the information session helpful?

☐ Yes ☐ No

Please explain:_____

If you would like to be added to a notification list for future meetings please include your email (please print clearly):_____

Additional comments:

Landmark Planning & Design Inc.

PRECINCT G COMMENT SHEET

Please review the display materials and provide us with your comments or questions.
Your input will be carefully considered during the planning process.

If you need additional space please use the reverse side of this page.

1. **I live:**
   - ☐ Within the Precinct G boundaries
   - ☐ Between the CPR Rail line and Main Street
   - ☐ In West St. Paul
   - ☐ Other: _____

2. **Have you attended a meeting in the past?**
   - ☐ Yes ☐ No

3. **I understand the reasons why a Precinct Plan is required:**
   - ☐ Yes ☐ No ☐ Somewhat

   Please explain your answer, including what information you might find helpful: _____

4. **Do you generally understand the steps of the planning process?**
   - ☐ Yes ☐ No ☐ Somewhat

   Please explain: _____

5. **What are your thoughts on the road network concepts for Precinct G?**
   - ☐ Like ☐ Dislike ☐ Unsure

   Please explain: _____

6. **What are your thoughts on the land-use concepts for Precinct G?**
   - ☐ Like ☐ Dislike ☐ Unsure

   Please explain: _____

Landmark Planning & Design Inc.

7. What other information or opinion would you like to offer the study team on the draft Precinct Plan?

8. Did you find the information session helpful?

☐ Yes ☐ No

Please explain:

If you would like to be added to a notification list for future meetings please include your email (please print clearly):

Additional comments:

Landmark Planning & Design Inc.

Welcome

PRECINCT G
PUBLIC MEETINGS
May 3-4, 2016

Welcome to the Precinct G public meeting.

Please feel free to browse the display boards. Members from the project team (wearing name tags) are available to answer any questions you may have.

Your feedback is important to us. Please fill out a comment sheet before leaving.

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What is a Precinct Plan?

The City of Winnipeg is expected to grow by nearly 200,000 people over the next two decades. To accommodate this growth in an orderly and sustainable fashion, our new communities must be planned in a way that anticipates long-term needs.

A Precinct Plan is a document created to guide the development of new communities. It includes policies and maps that illustrate and define how the new community will grow in terms of major infrastructure, land-use, and recreation spaces. It acts as the foundation upon which the new community (Precinct G) will eventually grow.

The Precinct Plan for Precinct G must consider the following:

- Existing land ownership and lot patterns
- Existing and future roads
- Future land drainage, water and sanitary sewers
- Residential, commercial, recreation and other land uses
- Demographics and market conditions
- Appropriate densities
- Transportation requirements
- Public engagement and consultation



Above: Royalwood Neighbourhood - constructed wetland

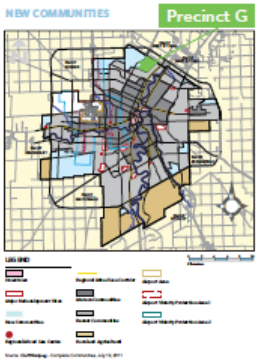
Landmark

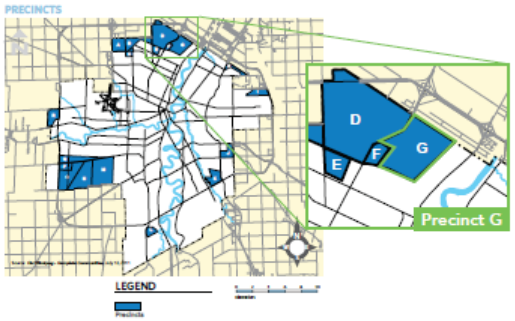
2

OurWinnipeg Planning Context

New Communities (or "Precincts") are described in Winnipeg's municipal development plan (OurWinnipeg) as large, undeveloped land areas identified for future urban development that are not currently serviced by a full range of municipal services (sewer, water, etc.).

Each Precinct area identified in the graphic below requires the preparation of a Precinct Plan. Precinct G is approximately 800 acres.

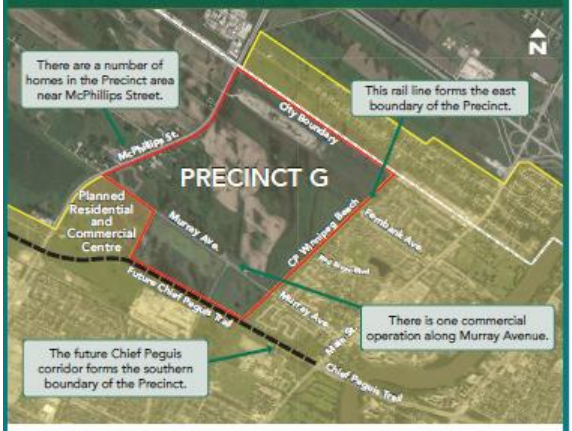




Landmark

3

Context Map

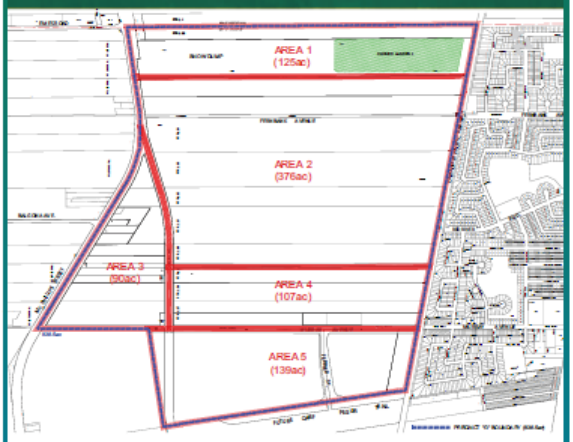


- The Precinct G area is located within the northwest quadrant of Winnipeg, north of the planned Chief Peguis Trail extension (dashed black line).
- The area is north and west of residential neighbourhoods (shown in yellow) with a mixed variety of housing types.
- There are well-established commercial areas to the east along Main Street, south along McPhillips Street and a planned commercial centre to the southwest of Precinct G.

Landmark

4

Precinct G Sub-Areas



- Precinct G has been divided into five sub-areas based on a combination of factors including street network, land ownership, land drainage, and potential land uses.
- These areas are useful for talking about the Precinct during the planning process and for making references to specific areas within the Precinct Plan document that will be prepared.
- There are approximately 20 property owners within the Precinct.

Landmark Stantec 5

Infrastructure
(Sewer, Water, and Land Drainage)



- Services are at the boundary of Precinct G. Extensions of these services will be required as part of the normal process of developing land within City of Winnipeg.
- The drawing above illustrates the location of services.
- The City of Winnipeg requires water run-off to be retained in retention ponds before it can be slowly released into the underground pipe drainage system.

Landmark Stantec 6

Roads



- This figure illustrates 8 access points for the lands within Precinct G.
- The Precinct planning process will include the preparation of road layouts within the Precinct that will include connections to these access points.
- A detailed traffic study will be prepared over the next months to determine what the anticipated roadway requirements will be and the potential effects on the existing local and collector roads such as Fernbank Avenue, Red River Boulevard, and Murray Avenue.

Landmark Stantec 7

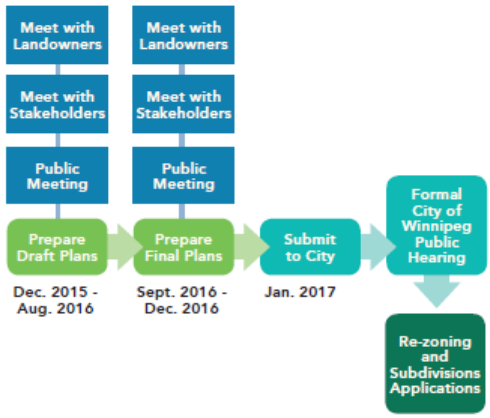
Land Uses



- The specific land uses have not been determined at this early stage of the planning process
- There will be a mix of uses which may include single-family homes, multi-family homes, parks, local-scale commercial, mixed-use buildings, or educational, etc.
- At the next public meeting, a road and land use concept will be presented

Landmark 8

Planning Process



Next Steps:

- Determine sewer, water, and land drainage servicing options
- Prepare land use and street layout concept
- Begin to assess cost-sharing options between area landowners
- Further meetings with landowners and other stakeholders

Landmark

9

Thank You

Next Steps:

- Review comments and feedback
- Initiate traffic and servicing studies
- Prepare initial draft neighbourhood plans
- Review information with project stakeholders and local area residents
- Review draft feedback
- Prepare a second draft for initial consideration by City departments

Thank you for participating in today's Open House. Please feel free to fill out a comment form before you leave.

If you have any further questions, or would like to provide further feedback, please contact us at:

Landmark Planning & Design
204-453-8008 or info@landmarkplanning.ca

Landmark

10



WELCOME

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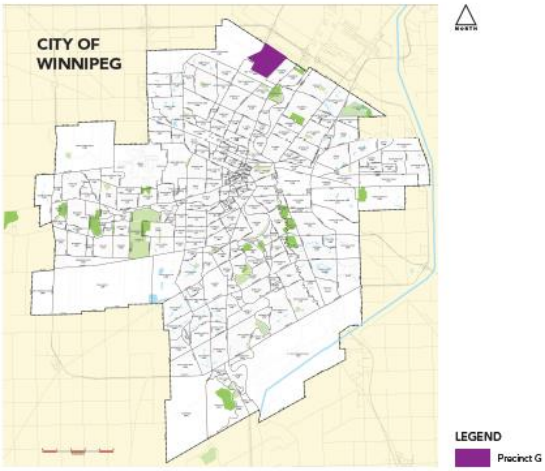

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2

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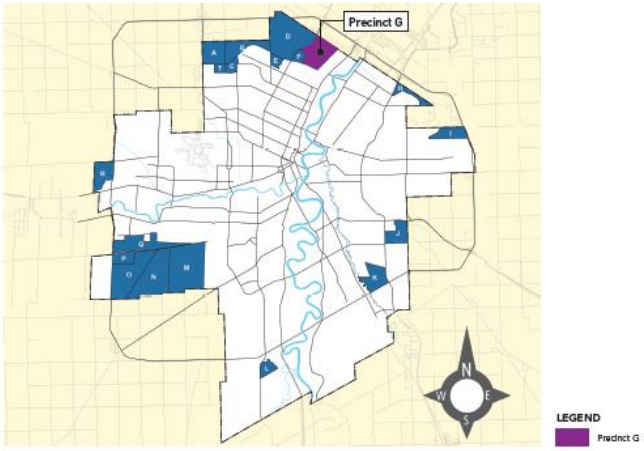

3

WHAT IS A PRECINCT PLAN?

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- A Precinct Plan is a **document created to guide the development of new communities**. It includes policies and maps that illustrate and define how the new community will grow in terms of major infrastructure, land-use, and recreation spaces. It acts as the foundation upon which the new community (Precinct G) will eventually grow.
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  - Residential, commercial, recreation and other land uses
  - Demographics and market conditions
  - Appropriate densities
  - Transportation requirements
  - Public engagement and consultation

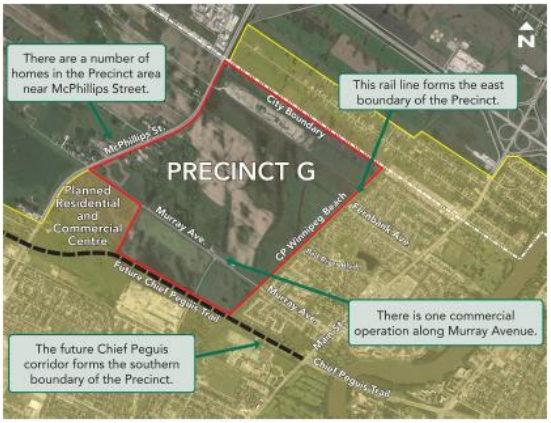


Constructed wetlands, Royalwood and Sage Creek neighbourhoods
Image sources: Ladco (top), 2015 Digital Globe (middle), Quadco (bottom)

4

CONTEXT MAP

- The Precinct G area is located within the northwest quadrant of Winnipeg, north of the planned Chief Peguis Trail extension (dashed black line).
- The area is north and west of residential neighbourhoods (shown in yellow) with a mixed variety of housing types.
- There are well-established commercial areas to the east along Main Street, south along McPhillips Street and a planned commercial centre to the southwest of Precinct G.



5

SUB-AREAS

- Precinct G has been divided into five sub-areas based on a combination of factors including street network, land ownership, land drainage, and potential land uses.
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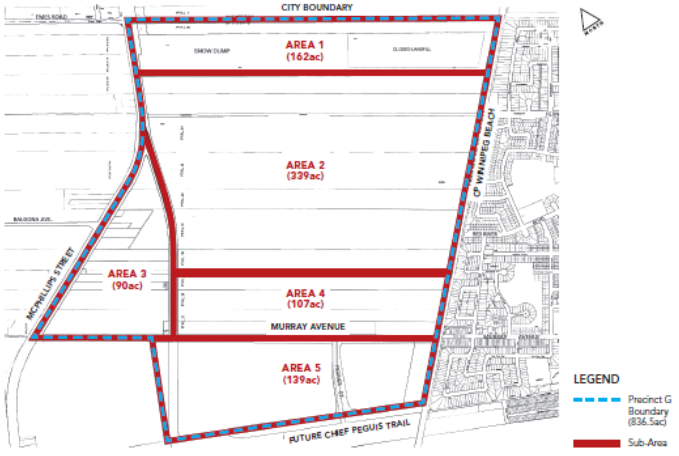
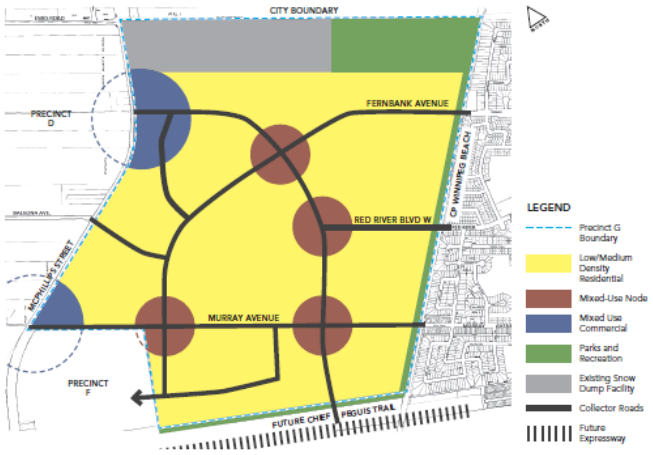
- There are approximately 20 property owners within the Precinct.



6

LAND USE CONCEPT

- This plan illustrates the potential land uses in the new neighbourhood.
- Precinct G will be a vibrant suburban community, connected by an integrated network of pathways, parks, and open spaces.
- Due to its strategic location in northwest Winnipeg, it will provide residents with opportunities to live, work and play.



- There will be a range of housing options and recreational amenities, plus community services, shopping and employment opportunities nearby.
- Neighbourhood nodes will include spaces for multiple-family housing, neighbourhood commercial, and other important community features.

7

TRANSPORTATION STUDY

- A Transportation Study is underway to evaluate the effectiveness of each road network concept.
- A carefully planned transportation system will provide a safe and efficient street network for area residents and users.
- Transit service will be available within a five minute walk of most residences.
- The neighbourhood will have pedestrian and cycling pathways throughout the community.





Image source: www.landco.mb.ca

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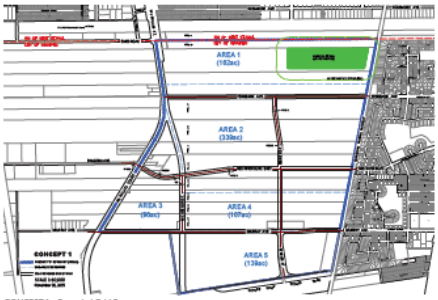
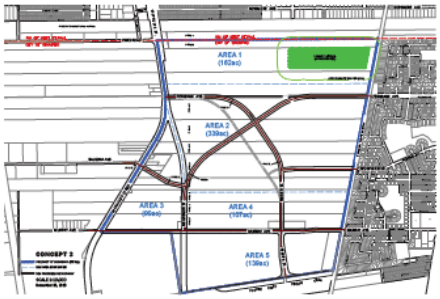
8

STREET NETWORK CONCEPTS

- Two street network concepts have been developed.
- Each concept must make connections to the existing adjacent streets; these streets were designed to service Precinct G lands.
- Each concept is being evaluated based on a number of factors including:
  - How well would traffic flow within the neighbourhood in each concept?
  - How well does the concept provide for good roadway and pathway connections to other adjacent neighbourhoods and commercial centres?
  - What land use opportunities are enabled in each concept?
  - How efficient and costly is each concept?
  - How is transit service accommodated in each concept?
- At this stage of the analysis, there is a preference for Concept 2.



CONCEPT 1 - Extended Grid Pattern



CONCEPT 2 - Curvilinear/Direct Connection Pattern

9

ACTIVE TRANSPORTATION

- Precinct G will develop as a pedestrian and cyclist-friendly community.
- The walking and cycling network will promote connectivity both within the community, and to external nodes and centres.
- The figure below is an <u>early concept</u> showing how pathways could connect different parts of the Precinct.

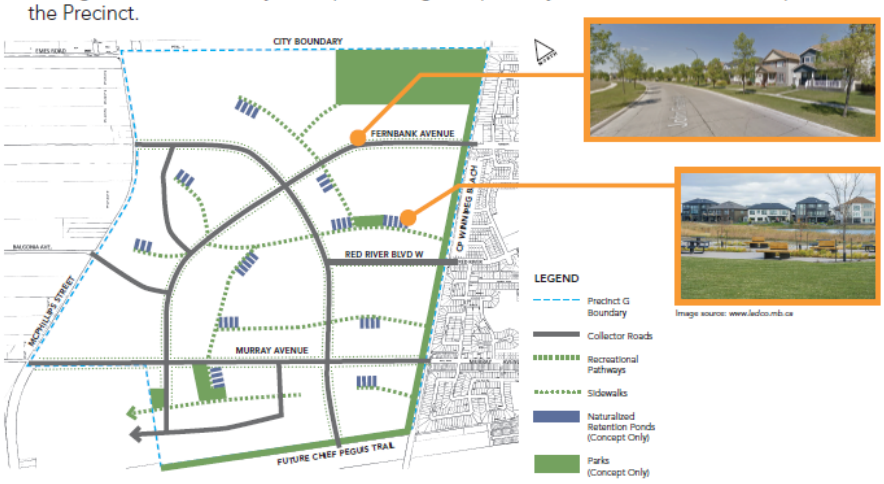
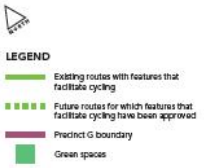


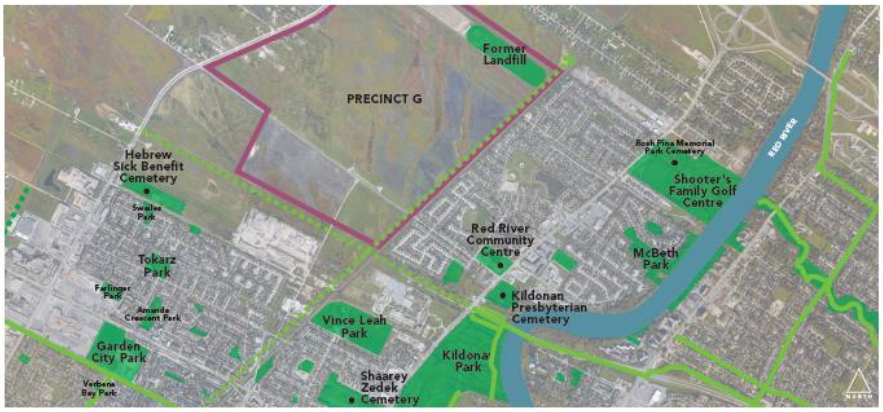
Image source: www.ledco.mb.ca

10

COMMUNITY AMENITIES AND RECREATION

- There are many parks and recreational opportunities within close proximity to Precinct G.
- These amenities will complement the parks and trails planned for the new community.
- The former landfill will likely become a formalized passive park and will be connected to the community by pathways.

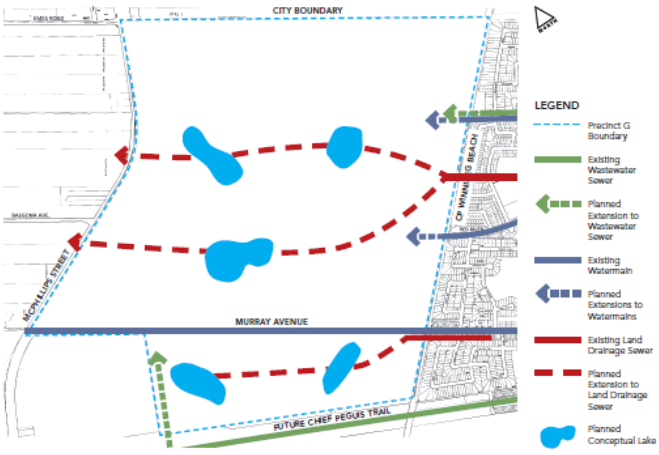




11

INFRASTRUCTURE CONCEPTS

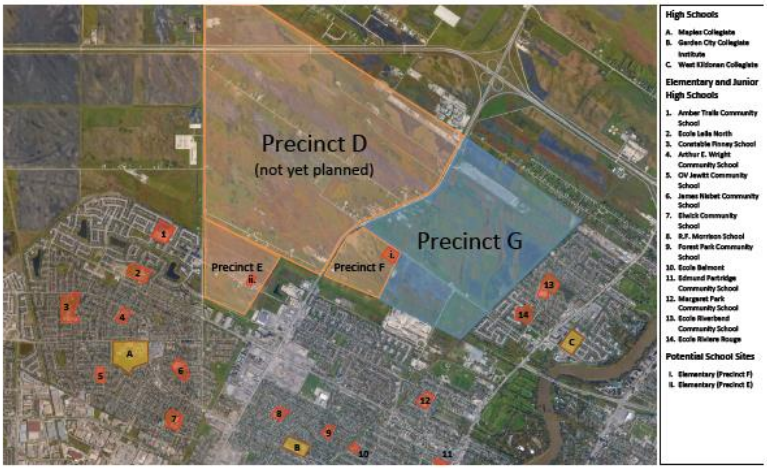
- Development within Precinct G will be fully serviced with piped municipal infrastructure (water, sanitary sewer, and stormwater) as well as shallow utilities (gas, electrical, telecommunications).
- This plan illustrates the conceptual servicing locations for the precinct.



12

SCHOOLS

- The Seven Oaks School Division has indicated a need for one or possibly two new K-8 schools in the area.
- The map below illustrates the existing local schools in northwest Winnipeg.
- As lands are being subdivided within Precinct G, the School Division can request that land be set aside for schools.



13

PUBLIC CONSULTATION AND STAKEHOLDER ENGAGEMENT

- Public consultation and stakeholder engagement are crucial to the success of any planning project. The project team has arranged and hosted a variety of stakeholder meetings over the past year, in order to receive input into draft policies and maps. A few of these meetings include:
  - City of Winnipeg Departments
    - Planning, Property & Development
    - Public Works
    - Water & Waste
    - Transit
  - Nearby Residents and Business Owners
  - Local Landowners
  - Major Landowners
  - Seven Oaks School Division
  - Emergency Services
  - Others

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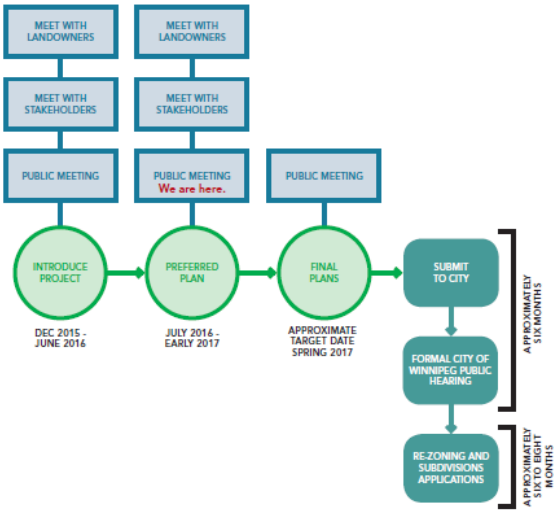
14

PUBLIC CONSULTATION AND STAKEHOLDER ENGAGEMENT

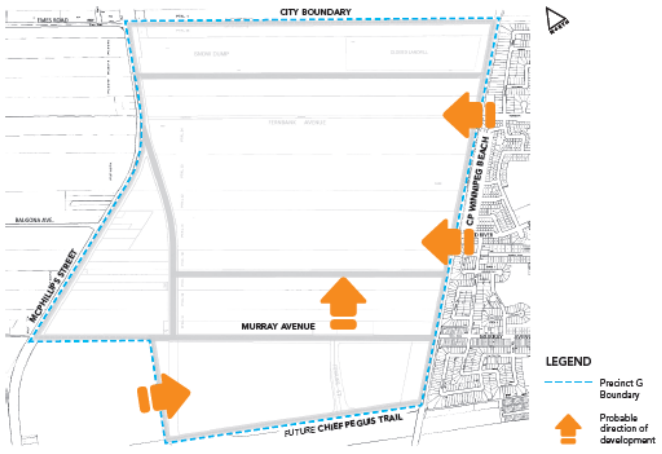
- The Project Team is currently in the early stages of writing the Precinct Plan. The plan incorporates:
  - Feedback from stakeholders and the public
  - Recommendations from the infrastructure and transportation reports
  - Input from various City of Winnipeg departments
- Following these public open houses, the project team will make revisions to the draft plans and complete another round of consultation.



15

PHASING AND NEXT STEPS

- If the Precinct Plan is approved by City Council, individual landowners would be free to apply to have their land rezoned and subdivided.
- City Planners will review these applications against the new Precinct Plan.
- Only applications that are consistent with the Plan's policies and maps will be considered for approval. This process ensures that development is orderly, efficient, and sustainable.
- Phasing will depend on a variety of factors, including location of existing infrastruture, market demand, population growth, and landowner interest in development.
- It is likely that the majority of development will take place over a 15 to 25 year time horizon.



16

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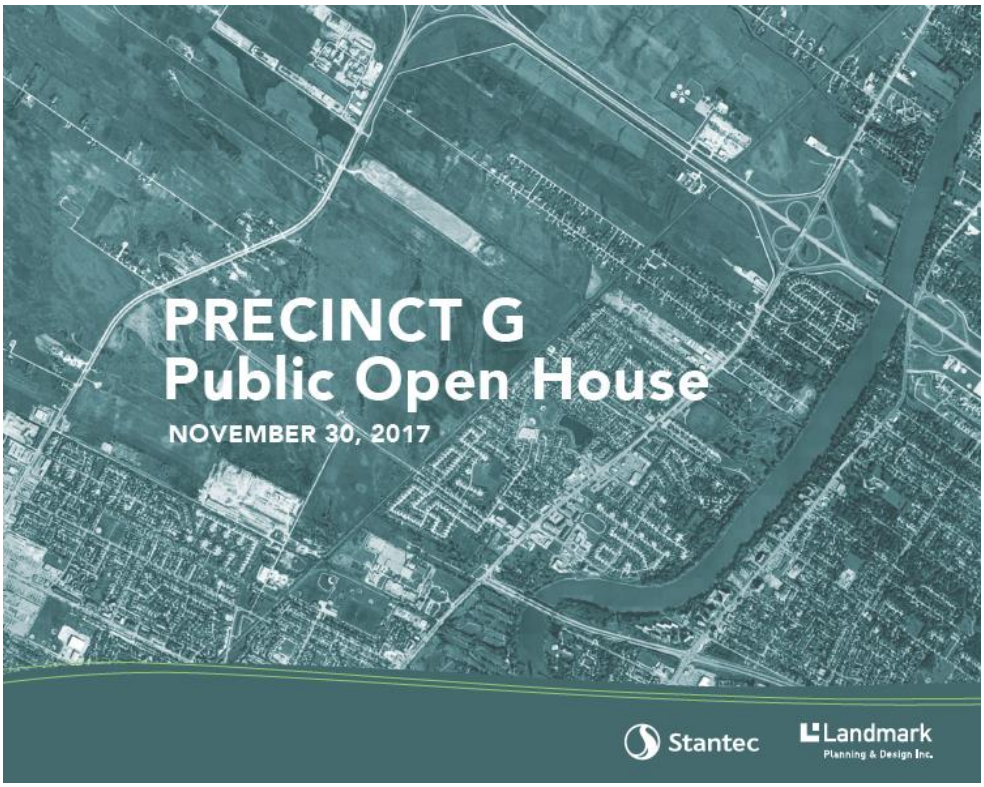
17



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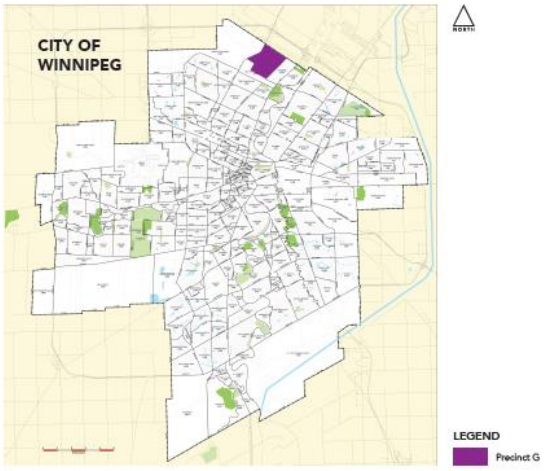

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2

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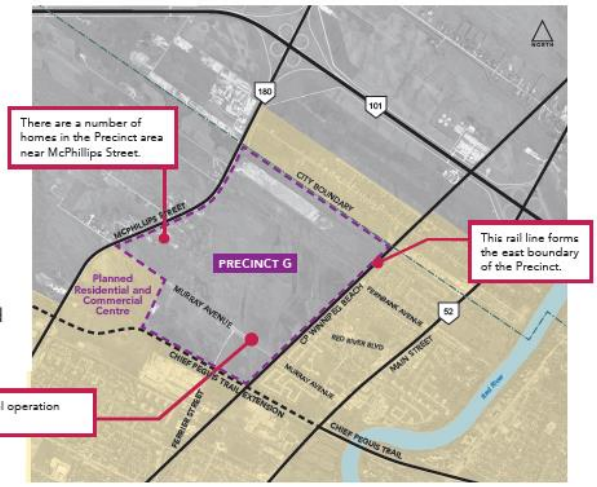

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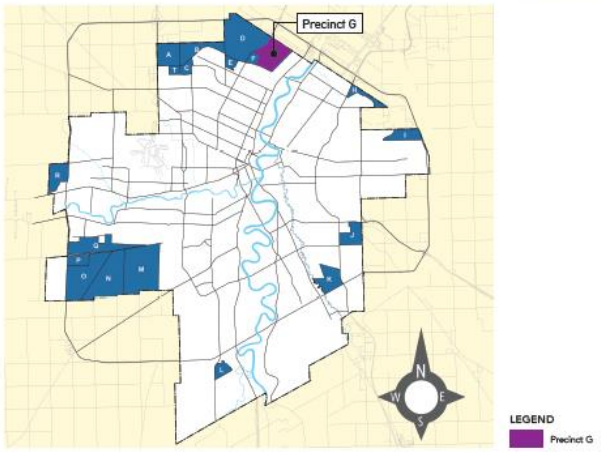

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4

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SUB-AREAS

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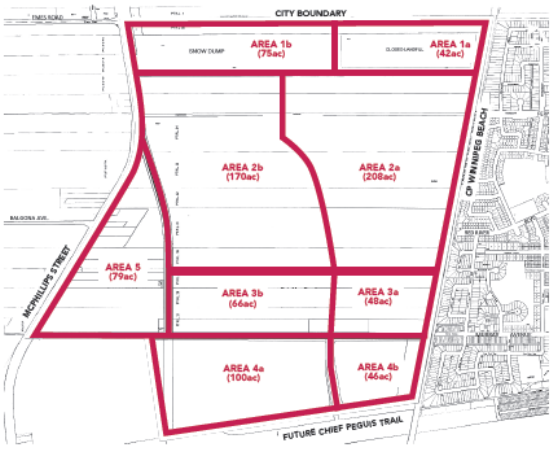
- There are approximately 20 property owners within the Precinct.
- The precinct is approximately 800 acres in size.



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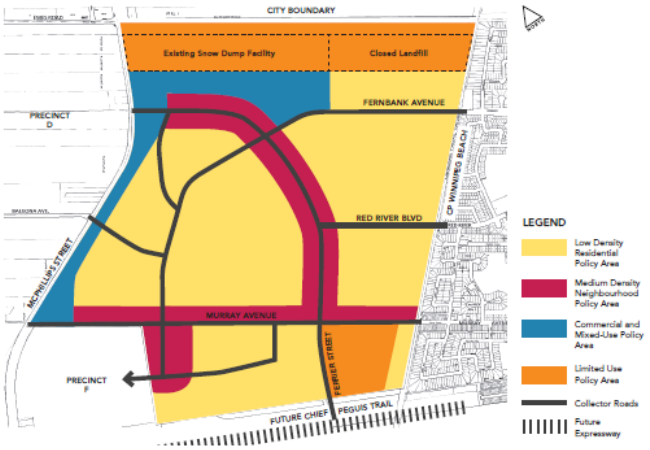
6

LAND USE CONCEPT

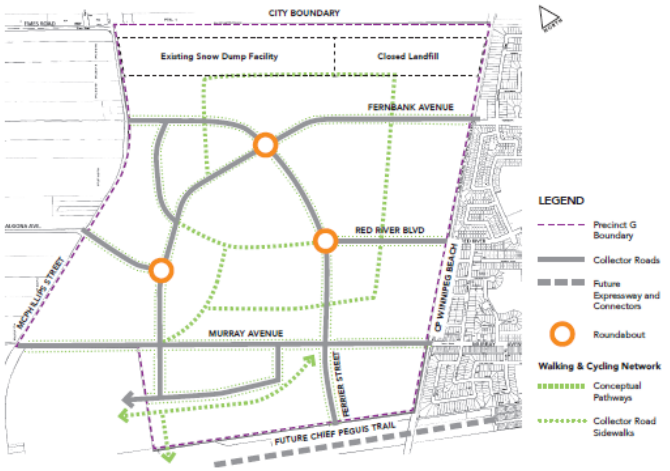
- This plan illustrates the potential land uses in the new neighbourhood.
- Precinct G will be connected by an integrated network of pathways, parks, and open spaces (not shown).
- The Precinct will provide residents with opportunities to live, work, and play.
- There will be a range of housing options and recreational amenities, plus community services, shopping and employment opportunities nearby.



7

TRANSPORTATION NETWORK

- A Transportation Study was undertaken to evaluate the effectiveness of potential road network concepts.
- The Transportation Network was developed in consideration of various factors, including:
  - Traffic flow
  - Connectivity
  - Land use opportunities
  - Efficiency
  - Cost
  - Transit service
  - Impact on existing residents
  - Input from Public Works



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ACTIVE TRANSPORTATION

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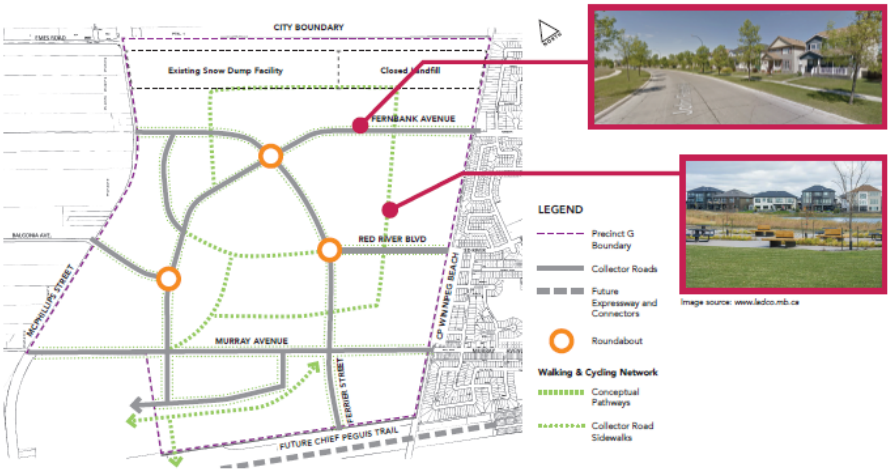
- Transit service can be accommodated within a five minute walk of most residences.



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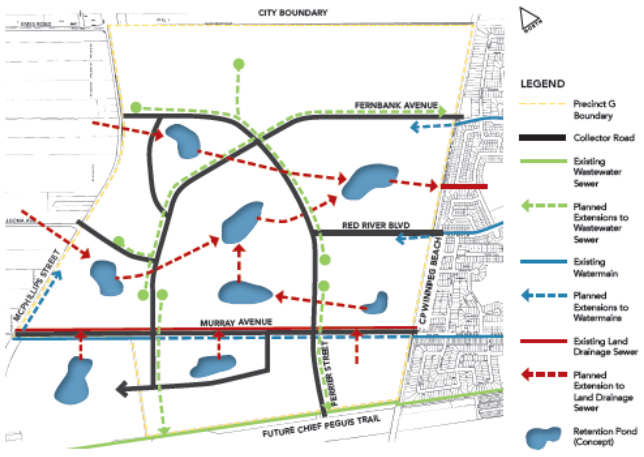

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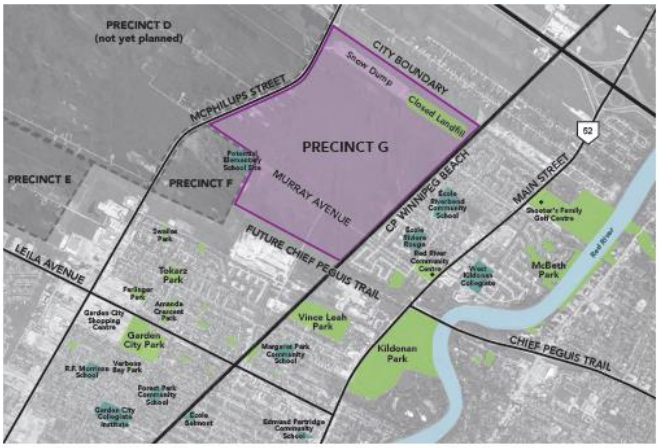
10

LOCAL PARKS AND RECREATION

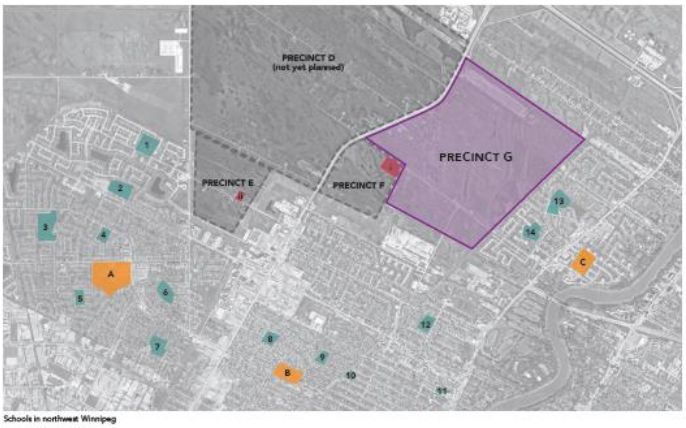
- There are many parks and recreational opportunities within close proximity to Precinct G.
- These amenities will complement the parks and trails planned for the new community.
- The Closed Landfill may become a formalized passive park and would be connected to the community by pathways.
- Each sub-area will have a small park, while the Precinct will have at least one large park.



11

SCHOOLS

- This map illustrates the existing local schools in northwest Winnipeg.
- The Seven Oaks School Division has indicated a need for up to two new K-8 schools in the Precinct.
- As lands are being subdivided within Precinct G, the School Division can request that land be set aside for schools.
- The Plan includes policies to ensure that appropriate school sites can be accommodated within the Precinct.



Schools in northwest Winnipeg

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PUBLIC CONSULTATION AND STAKEHOLDER ENGAGEMENT

- Public engagement is important for the success of any planning project. The project team has arranged and hosted a series of stakeholder meetings over the past 18 months, in order to receive input into draft policies and maps. These meetings include:
  - City of Winnipeg Departments
    - Planning, Property & Development
    - Public Works
    - Water & Waste
    - Transit
  - Nearby Residents and Business Owners
  - Local Landowners
  - CP Rail
  - Manitoba Hydro
  - Seven Oaks School Division
  - Emergency Services
  - Others

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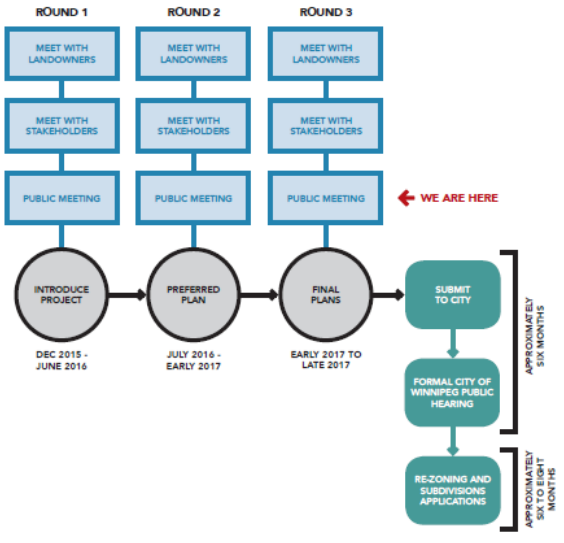
PUBLIC ENGAGEMENT

- The Project Team has hosted three rounds of public engagement, which took place in May 2016, October 2016, and November 2017.
- The Project Team is currently in the final stages of writing the Precinct Plan before submitting it to the City of Winnipeg.
- The Plan has incorporated:
  - Feedback from stakeholders and the public
  - Recommendations from professional engineering reports (regarding servicing, infrastructure and transportation); and
  - Input from City of Winnipeg departments
- Following this third round of public engagement, the project team will finalize the draft plan and submit it to the City of Winnipeg prior to the end of the year.



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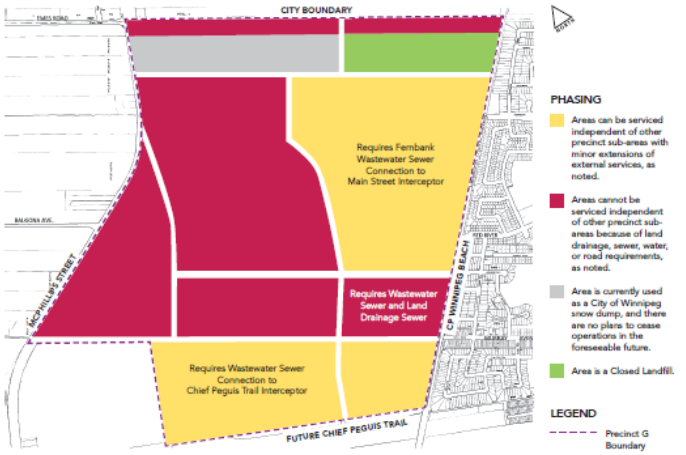
PHASING AND NEXT STEPS

- If the Precinct Plan is approved by City Council, individual landowners would be free to apply to have their land rezoned and subdivided.
- City Planners will review these applications against the new Precinct Plan.
- Only applications that are consistent with the Plan's policies and maps will be considered for approval. This process ensures that development is orderly, efficient, and sustainable.
- Phasing is based on a variety of factors, including location of existing infrastructure, market demand, population growth, and landowner interest in development.
- It is likely that the majority of development will take place over the next 15 to 25 years.



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THANK YOU

- Thank you for participating in tonight's Public Open House. Please feel free to fill out a comment sheet before you leave.
- If you have any further questions, or would like to provide additional feedback, please contact us at:

Landmark Planning & Design
204-453-8008 or
info@landmarkplanning.ca

Stantec Landmark Planning & Design Inc.

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Aurora at North Point
Municipal Servicing Report



Stantec

Prepared for:
Daytona Land

Prepared by:
Stantec Consulting Ltd.

APEGM
Certificate of Authorization
Stantec Consulting Ltd.
No. 1301

File: 116809401

May 26, 2016

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APPENDIX B – Detailed Rational Design Spreadsheet

APPENDIX C – Servicing Criteria Sheets

1.0 Introduction

This brief has been prepared for submission to the City of Winnipeg as a requirement of their development review and subsequent approval on behalf of the developer, Daytona Land. The brief covers the design criteria and parameters utilized for the water, wastewater and land drainage systems. The required Servicing Criteria Forms are also included in this brief.

The proposed development encompasses approximately 46.856 Hectares and is bounded:

- on the north by the Murray Road Right of Way;
- on the east by future development lands 710 m east of McPhillips Road Right of Way;
- on the south by Future Chief Peguis Trail Right of Way; and
- on the west by McPhillips Road.

The development will be constructed in multiple phases based on demand.

2.0 Water

The subdivision water service area including the required pipe sizing and available fire flows are shown in Figure 1.0 and Figure 2.0. The external feedpoints will be located at:

- the intersection of McPhillips Street and Future Chief Peguis Trail off a 250 mm watermain.
- the intersection of McPhillips Street and Murray Road off the 400 mm offtake from the feedmain.

The Subdivision will be responsible for installing the 250 mm watermain on McPhillips street from the south limit of Chief Peguis Trail to Murray Avenue. They will also install the 300 mm watermain on Murray Avenue from McPhillips Street to the first proposed intersection east of McPhillips Street.

The systems performance was analyzed under various operating conditions using EPA NET 2.0, a computer simulation program produced by the Environmental Protection Agency (EPA).

For our analysis, the City of Winnipeg's Water and Waste Department provided us with simulated conditions at the above feedpoints. The simulated feedpoint pressures used were 400 kPa (58.0 psi) and 409 kPa (59.3 psi) and are representative of peak hour demand conditions in the distribution system.

The following design criteria and assumptions were used in the analysis of the watermains:

1. Hazen-Williams coefficient of friction ("C" value) was assumed to be 120 for watermains with diameters of 200 mm or smaller and 130 for diameters larger than 200 mm.

2. Population based on the following;
   - 3.05 persons per single family dwelling unit.
   - 2.30 persons per multi family dwelling unit.

3. The number of dwelling units served by each node was calculated based on:
   - the single family lotting plan where shown.
   - 12.29 dwelling units per hectare (single family) where not shown.
   - 74.13 dwelling units per hectare (multi family)

4. The average daily per capita consumption used was 225 L + 10%.

5. The assumed average daily consumption for commercial is 16,800 l/day/ha

6. The maximum day demand used was 1.6 x average day rate.

7. The peak hour multiplier used was 2.5.

8. Minimum design fire flows to be provided with maximum day demand on the system to be 100 l/s (single family) and 200 l/s (multifamily) and 250 l/s for commercial or greater based on FUS method.

9. For analysis purposes, the watermains were assumed to be at a constant elevation considering the subdivision's ground elevations vary slightly. The watermain system was tied into feedpoint nodes where simulated hydrant flow test data was provided by the City of Winnipeg.

10. Hydrant losses were accounted for by calculating available fire flows using 25 psi as opposed to 20 psi.

Based on the above conditions, the proposed watermain system can meet the required operating criteria of:

- A minimum pressure of 207 kPa (30 psi) under maximum hour consumption.
- The minimum fire flow specified above at 140 kPa (20 psi) with maximum day consumption.

The available fire flows at various locations throughout the development are demonstrated in Figure 1.0 and Figure 2.0.

We are providing a 300 mm watermain stub for future development to the east on Murray Road with the assumption they will also connect to existing watermains to the east to achieve their required fire flows. We are also providing a 300 mm watermain stub to the north on McPhillips Street for future development north of Aurora at North Point.

We are providing adequate fire flow protection within the right-of-ways around the multi-family and commercial sites. It will be the responsibility of the design engineer for the sites to design an internal watermain system to provide adequate fire protection within the site.

Below are the average water demand calculations for the entire development:
- Single Family = 15.77 Ha x 12.29 units/Ha x 3.05 ppu x 225 L/c/day + 10% = 146,305 L/day
- Multi Family = 3.39 Ha x 74.13 units/Ha x 2.30 ppu x 225 L/c/day + 10% = 143,053 L/day
- Commercial = 18.60 Ha x 16,800 l/day/Ha = 312,480 l/day
- **Total = 601,838L/day**

3.0 Wastewater

The proposed development is located in Area 5 of the North End Interceptor Sewer District. Its wastewater sewer system is designed to flow through proposed internal wastewater sewers then flow into the existing 1500 mm Interceptor Sewer in the future Chief Peguis Trail Right of Way and eventually to the existing North End Pollution Control Centre. A 450 mm stub exists off the existing 1500 mm Interceptor within the Chief Peguis right of way which will be utilized by the land to the east of this development. Two options are being considered that will be decided upon in the future. One option is for all of the land to the east to connect to the 450 mm stub and the other is for approximately half of the land to the east to connect to the 450 mm stub and the other half to connect at a new connection point to minimize the depth of sewers. The second option is the preferred option.

The contributing wastewater area and proposed pipe sizing are shown on Figure 3.0.

The design criteria and assumptions for the wastewater sewer system are:

1. Peak Design Flow = domestic sewage x peaking factor plus extraneous flow.
   The extraneous flows include groundwater infiltration and manhole cover inflow.

2. Domestic Sewage (Residential)
   Average Flow: 270 L/capita/day
   Peaking Factor: Harman's = 1 + 14/(4+(p/1000)^0.5))
   Population/dwelling = 3.05 persons (single family)
   = 2.30 persons (multi family)
   Dwelling Density = as per lotting plan where shown
   = 12.29 dwellings per Hectare (single family) (where lotting not shown)
   = 74.13 dwellings per Hectare (multi family)

3. Peak Commercial Flow: 28,100 L/hectare/day

4. Extraneous Flow
   a) Groundwater Infiltration: 2200 L/hectare/day
   b) Manhole Infiltration: 12 L/min/MH
   Manhole Spacing: 1.6 Manholes/hectare

5. Pipe selection was based on full flow pipe with Manning's N = 0.013 and minimum velocity of 0.60 m/sec. Adequate pipe cover and slope will be illustrated on the detailed design drawings.

The wastewater sewer system design for this subdivision for peak design flows is presented in Appendix A. The table shows that pipe sizes presented are sufficient to handle flows produced within this development.

4.0 Land Drainage

4.1 BACKGROUND

Aurora at North Point is a residential/commercial development in the West Kildonan Drainage Area in Northwest Winnipeg and is comprised of approximately 46.856 ha. The proposed development area is bounded:

- To the north by Murray Road Right of Way;
- To the east by future development lands approximately 710m east of McPhillips Street Right of Way;
- To the south by future Chief Peguis Trail Right of Way;
- And, to the west by McPhillips Street Right of Way;

The proposed development will contain a 1.784 ha naturalized retention pond to store and attenuate runoff from the development, Murray Avenue plus 20m north (from McPhillips Street to future McGregor Street) and McPhillips Street (from Murray Avenue to the existing urban road cross section high point approximately 300 m south of the proposed road connection to McPhillips Street). The proposed development and retention pond catchment is illustrated in Figure 5.0. Approximately 46.856 ha from within the development along with 3.709 ha from McPhillips Street and 3.495 ha from Murray Avenue will drain to the proposed retention pond. The total catchment area for the Aurora at North Point Subdivision retention pond will be 54.06 ha.

The proposed pond will drain through an interconnecting pipe to a Manhole complete with a 250mm flow restricting orifice that will be set and at elevation of 228.00 which will control the normal water level of the ponds. It will be located on Murray Avenue, west of the C.P.R. right-of-way. The flow restricting orifice manhole will include a weir wall within that will be set at the maximum 2010 storm event hydraulic grade line elevation at the weir manhole which will allow over flow in the case of a blockage. This manhole will then be interconnected with a Gate Chamber and then connected to the existing land drainage sewer on Murray Avenue that flows east to the Red River. An additional 250mm pipe will be installed at an elevation of 229.900 m (which is above the max high water level) to interconnect the flow restricting manhole and the Gate Chamber for the purposes of pumping down ponds while the Gate Chamber is in the closed position during a flood. The proposed interconnecting pipe on Murray Avenue will be designed to handle runoff from the Aurora at North Point Pond, the Future Pond #1 and Future Development Area #2 south of Murray Avenue.

Based on initial discussions with WWD, the normal water level specified for the retention ponds were 229.25, corresponding to the 700 year Flood Protection Water Level associated with the

Expanded Floodway. This differed from the proposed normal water level of 228.00. Due to the costs associated with fill placement and increased pipe sizes over the extents of the subdivision, it was requested that the option of a gate chamber be considered to protect the Aurora at North Point Subdivision and future development areas on the south side of Murray Avenue from high river levels instead of setting the normal water level at 229.25.

The following sections of this report demonstrate that the pond system can collect and store all major storm events when the Gate Chamber is closed during a major flood event. To help relieve the system with the gate chamber is closed, there is a 250 mm overflow/interconnecting pipe between the weir manhole and gate chamber where temporary pumping can take place to reduce the water level in the pond.

When the river level is above the normal water level of 228.00 the gate chamber will need to be operated and placed in the closed position. If a storm event occurs during this time when the gate chamber is closed pumping will be required to draw down the pond levels.

4.2 MODEL

4.2.1 Design Criteria

The following design criteria and assumptions were followed during the modeling analysis of the proposed drainage system.

4.2.1.1 Rainfall

The drainage system was analyzed using design storm hyetographs discretized into 5 minute time steps. The intensity equations are presented in Table 2.0.

Table 2.0 – Rainfall Intensity

Storm	Type	Intensity (mm/hr)
5 yr Return Period MacLaren 1974	Chicago Distribution	$i_5 = \frac{1199}{(t+8)^{0.828}}$
25 yr Return Period MacLaren 1974	Chicago Distribution	$i_{25} = \frac{1842}{(t+9)^{0.842}}$
100 yr Return Period Acres 1978	Chicago Distribution	$i_{100} = \frac{2318}{(t+8)^{0.856}}$
Historic Bernie Wolfe 2010	Observed Event	Variable

5 yr Spring Return Period MacLaren	Chicago Distriubtion	$i_5 = \frac{329}{(t+2.7)^{0.8}}$

4.2.1.2 Runoff

Runoff for this analysis was generated by hydrograph method which utilized a Horton infiltration model, and SWMM routing method. The total area of each subcatchment was divided into a pervious and an impervious runoff surface. The runoff parameters for the sub catchments are shown in Table 3.0 below.

Table 3.0 – Runoff Parameters

Sub Catchment	Slope (m/m)	% Impervious	Depression Storage	
			Imperv (mm)	Pervious (mm)
Aurora at North Point	0.5%	61	2.5	6
Future Development	0.5%	50	2.5	6

- Horton infiltration Parameters for Pervious Surfaces
    - fo = 75 mm/hr
    - fc = 3 mm/hr
    - a = 4.14 hr^{-1}

4.2.1.3 Retention Pond

The specific City of Winnipeg criteria guidelines applicable to the Retention Lake are as follows:

- Pond to be of naturalized design.
- 1.20 m lake rise for a 25 year storm (maximum).
- Freeboard Elevation 0.60 m above High Water Level (HWL).
- 7:1 side slopes above normal water level and extending 3.0 m horizontally into the water, and 4:1 side slopes below water.
- 2.5 m minimum water depth.
- Maximum pond drawdown times:
    - 48 hours for the 5 year storm

- 120 hours for the 100 year storm

The stage storage parameters for each retention pond used to model the Murray area Subdivision system are shown in Table 5.0 below.

Table 5.0 – Retention Pond Normal Water Level Areas

Retention Pond	Level	Elevation (m)	Area (m^2)	Volume (m^3)
Aurora at North Point	Bottom	225.50	9,013	0
	NWL	228.00	17,837	32,422
	Top 7:1	229.84	28,914	75,433
Pond #1	Bottom	225.50	16,249	0
	NWL	228.00	23,014	48,187
	Top 7:1	229.84	31,717	98,539

4.2.1.4 Allowable Discharge

The peak allowable discharge rate from this development has been set at 1.00 L/s/ha (as per information provided by the City of Winnipeg). Based on the total catchment areas (totaling 120.19 ha) for the Murray Subdivision and future development on the south side of Murray Avenue, the peak allowable discharge is 0.120 m^3/s.

4.2.1.5 Red River Tailwater Condition

Tailwater conditions for this model were initially analyzed with the Red River having a constant tailwater condition at the elevation of 224.801 for the 5 year, 25 year, 100 year and 2010 design storms.

As per the City of Winnipeg Land Drainage Branch request, the following storms were modeled using the specified tailwater conditions below;

5 Year Spring Storm	Tailwater = 227.410 (50 yr river level)
5 Year Summer Storm	Tailwater = 224.750 (5 yr river level)
May 2010 Design Storm	Tailwater = 226.610 (25 yr May river level)

4.2.2 Modelling Results

Detailed plots of the Aurora at North Point and Future Pond Levels are provided in Figures 6.0 and 6.1. The total system discharge through the orifice is provided in Figure 7.0. The Pond #1 discharge, Future Development Area #2 and Aurora at North Point Pond discharge to the interconnecting pipe on Murray Avenue are provided in Figures 8.0, 8.1 and 8.2.

The High Water Levels and Active Storage Volume for Aurora at North Point Pond and Future Pond #1 for the 5 year, 25 year, 100 year and 2010 design storm are shown in Table 6.0 and 6.1 below.

Table 6.0 – High Water Levels and Active Storage Volume: Aurora at North Point

Storm	**High Water Level Elevation** (m)	**Rise** (m)	**Active Storage Volume (NWL to HWL)** (m^3)
5 Year	228.744	0.744	14,891
25 Year	229.146	1.146	24,298
100 Year	229.428	1.428	31,483
2010 Design Storm	229.766	1.766	40,743

Table 6.1 – High Water Levels and Active Storage Volume: Pond #1

Storm	**High Water Level Elevation** (m)	**Rise** (m)	**Active Storage Volume (NWL to HWL)** (m^3)
5 Year	228.592	0.592	14,420
25 Year	228.934	0.934	23,483
100 Year	229.180	1.180	30,344
2010 Design Storm	229.599	1.599	42,703

As per the City of Winnipeg request, below are the High Water Level, Pond Rise and Active Storage Volume for the City of Winnipeg requested storms with the following Red River tailwater conditions. The results are presented in Table 6.2 and 6.3 below;

- 5 year spring storm with 50 yr Red River tailwater condition of 227.410
- 5 year summer storm with 5 yr Red River tailwater condition of 224.750
- May 2010 storm with 25 yr May Red River tailwater condition of 226.610

Table 6.2 – High Water Levels and Active Storage Volume (City Requested Storm Events): Aurora at North Point Pond

Storm	**High Water Level Elevation** (m)	**Rise** (m)	**Active Storage Volume (NWL to HWL)** (m^3)
5 Year Spring Storm (50 yr TW)	228.192	0.192	3,538
5 Year Summer Storm (5 yr TW)	228.744	0.744	14,927
May 2010 Storm (25 yr May TW)	229.766	1.766	40,743

Table 6.3 – High Water Levels and Active Storage Volume (City Requested Storm Events): Pond #1

Storm	**High Water Level Elevation** (m)	**Rise** (m)	**Active Storage Volume (NWL to HWL)** (m^3)
5 Year Spring Storm (50 yr TW)	228.162	0.162	3,794
5 Year Summer Storm (5 yr TW)	228.592	0.592	14,458
May 2010 Storm (25 yr May TW)	229.599	1.599	42,703

The total system discharge through the flow restricting orifice to the existing land drainage sewer on Murray Avenue is shown in Table 7.0 Below.

Table 7.0 – Total System Discharges through the flow restricting orifice to the existing land drainage sewer on Murray Ave.

Storm	**Max Discharage** (m^3/s)
5 Year	0.067
25 Year	0.091
100 Year	0.105
2010 Design Storm	0.119
5 Year Spring w/ 50 yr tailwater condition	0.018
5 Year Summer w/ 5 yr tailwater condition	0.067
May 2010 Storm w/ 25 yr May tailwater condition	0.120

The discharge to the existing Murray Avenue LDS system is less than the allowable 1 L/S/ha (0.120 m^3/s), and there is no negative impact on the existing system.

The discharges to the interconnecting pipe for the Aurora at North Point Pond, Future Pond #1 and Future Development Area #2 that are located on the south side of Murray Avenue are shown in Table 8.0 below.

Table 8.0 – Aurora at North Point Pond, Pond #1 and Future Development Area #2: Max Discharge to System

Storm	Max Discharge Aurora at North Point Pond (m^3/s)	Max Discharge Pond #1 (m^3/s)	Max Discharge Future Development Area #2 (m^3/s)
5 Year	0.102	0.027	0.054
25 Year	0.120	0.035	0.054
100 Year	0.129	0.039	0.065
2010 Design Storm	0.114	0.046	0.049
5 Year Spring w/ tailwater condition	0.051	0.009	0.012
5 Year Summer w/ tailwater condition	0.102	0.027	0.054
May 2010 Storm w/ tailwater condition	0.114	0.046	0.061

Future Development Area #2 has been identified by Water and Waste as the long term planned location for the wastewater treatment plant expansion. It will be the responsibility of the design engineer for this area to control the discharge rates from this area to the Murray Avenue Land Drainage Sewer as per the rates listed in Table 8.0.

4.2.3 Conclusion

As can been seen in Table 6.0, the greatest rise in the Aurora at North Point Pond is seen during the 2010 Design Storm. The maximum calculated High Water Level (HWL) is 229.766. The minimum basement floor elevation for walkout lots in the Aurora at North Point Subdivision will be set at 230.366, providing a freeboard of 0.60m

Due to tailwater conditions and allowable discharge rates, drawdown times exceed the design criteria of 48 hours for a 5 year storm and 120 hours for a 100 year storm. At 48 hours during a 5 year storm the Murray Subdivision pond will be 0.494 m above Normal Water Level. At 120 hours during a 100 year storm the Murray Subdivision pond will be 0.739 m above the Normal Water Level. These extended drawdown times may result in some grass die back if inappropriate species are planted around the pond verge.

The peak discharge of 0.120 m^3/s from the Proposed Development and Future Development to the existing land drainage sewer on Murray Avenue is equal to the allowable rate of 0.120 m^3/s which meets the City of Winnipeg allowable discharge of 1 L/s/ha.

It will be the responsibility of the design engineer for the future development on the south side of Murray Avenue to provide revised High Water Levels for the future pond and update discharge rates based on how the land develops.

4.3 LAND DRAINAGE SEWERS

This section details the design criteria, parameters, and assumptions used in the design of the land drainage sewers. The piped system was designed using the Rational Design method and was based on the following criteria:

- 5 year storm intensity equation I (mm/hr) = $1199/(t+8)^{0.828}$ ---> (MacLaren 1974).
- Pipe friction factor (Manning's n): 0.013 (Concrete and PVC).
- Minimum full flow velocity: 0.90 m/s.
- Maximum full flow velocity: 3.05 m/s.
- The 1:5 year return frequency was used for the design of the storm sewer system.
- Tailwater Condition at the Lake = 228.45 m (0.45m above NWL)

Runoff Design Criteria

The rational design method was used to estimate rainfall runoff to be handled by the piped system:

$Q = (1/360)\ CiA$

Where:

Q = runoff (CMS)

C = runoff coefficient

i = rainfall intensity (mm/hr)

A = area (hectares)

The drainage catchments include single family residential (C=0.5), multi-family residential (C=0.6), Commercial (C=0.6) and park (C=0.20).

System Design Criteria

Figure 4.0 shows the land drainage sewers and the detailed sub-catchment areas for the Aurora at North Point Subdivision.

Daytona Land will be installing all the required interconnecting land drainage sewers on Murray Avenue and within the development. During a storm event, runoff flow through a flow-restricting orifice that will be located on Murray Avenue, west of the CPR right-of-way and into the existing land drainage sewer system to the Red River.

Land Drainage
May 26, 2016

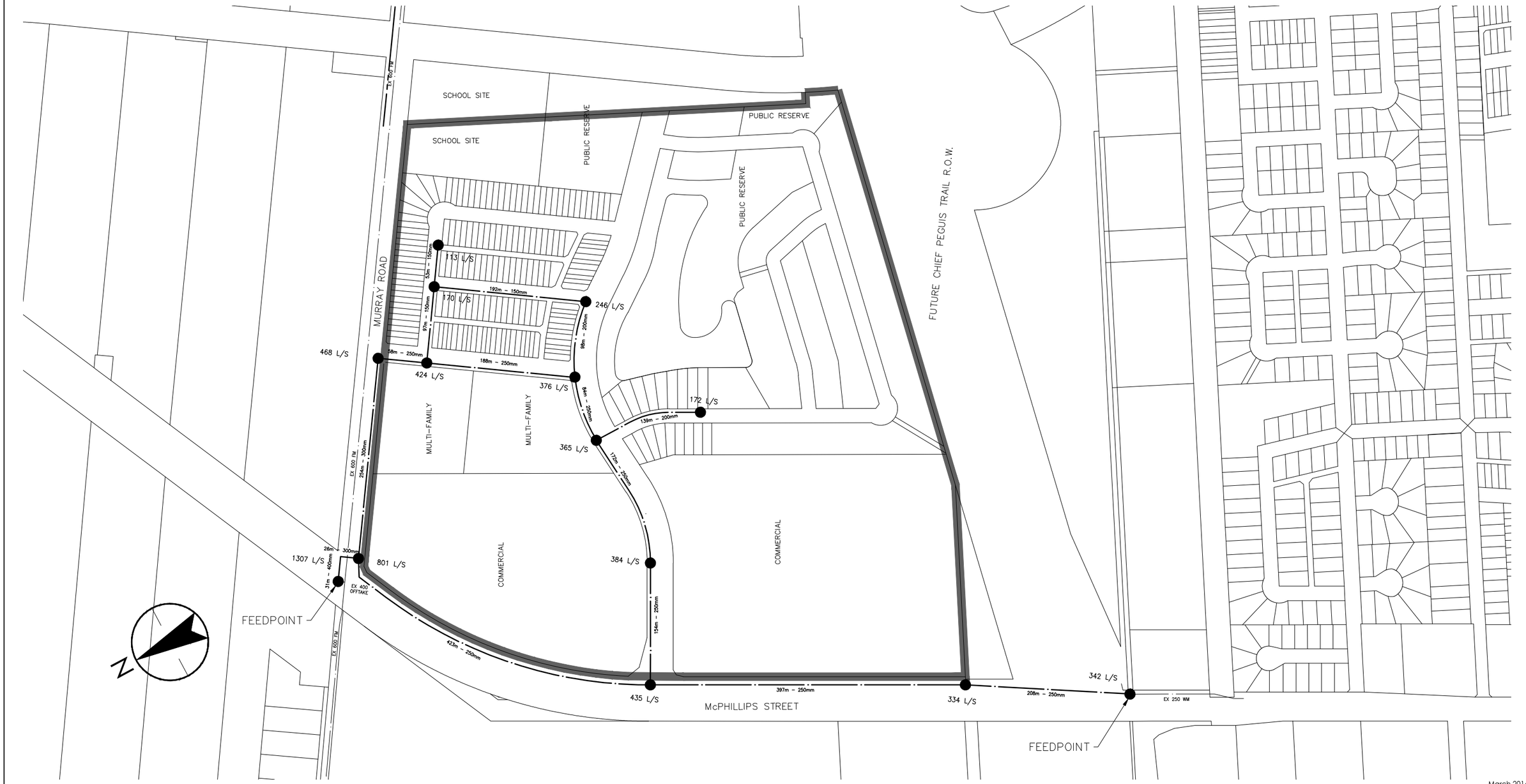
The land drainage sewers in this subdivision were designed as surcharged pipe systems to accommodate the calculated runoffs. The surcharge level of the system was designed to be at a minimum of 0.15m below the proposed gutter elevations. The Manning's Equation with an N = 0.013 for concrete or PVC pipe was used to determine pipe sizes and hydraulic losses within the system. At the outfalls to the lakes, the hydraulic grade line was assumed to be 0.45 m above the NWL elevation to ensure that the pipes could discharge the peak flows as the lake rose during the storm event.

Preliminary sizing has been provided for land drainage sewers on McPhillips St, a portion on Murray Ave and the outfall to Pond #1. These pipe sizes will have to be reviewed and possibly resized by the future design engineer that will be installing them.

The land drainage sewer on Murray Avenue adjacent to the Future Development Area #2 is sized to handle the Murray Avenue Street Catchments and can accept the peak flows from the Future Development Area #2.

Appendix B contains the Detailed Rational Method Design spreadsheets for each of the outfalls to the retention lake.

FIGURES



March 2016
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Legend

PROPOSED WATERMAIN

EXISTING WATERMAIN

NODE

100 L/S — AVAILABLE FIRE FLOW

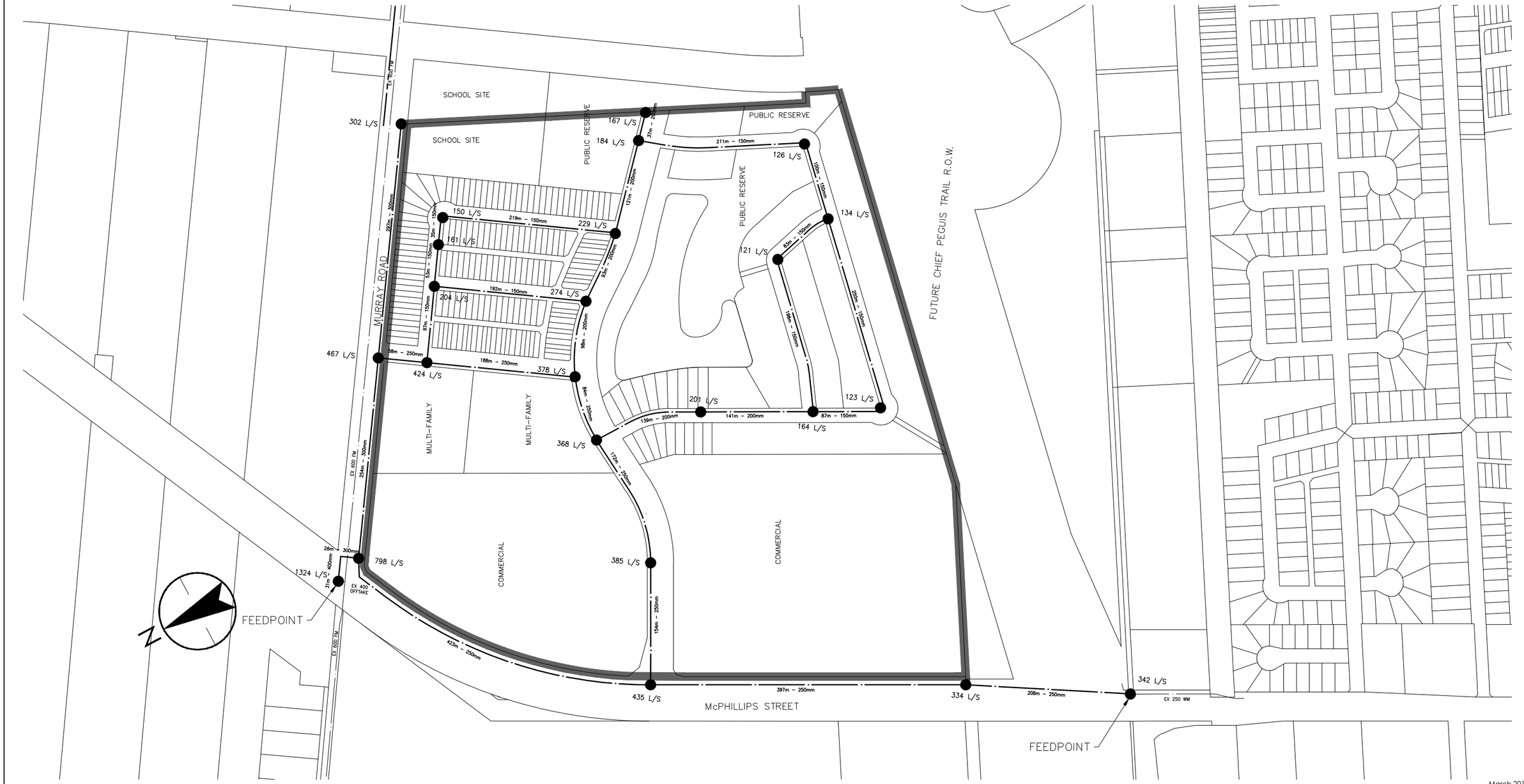
Notes

SERVICE AREA (46.856 ha)

Client/Project
DAYTONA LAND
AURORA
AT NORTH POINT

Figure No.
1.0

Title
WATERMAIN - PHASE 1 & 2
AVAILABLE FIRE FLOW AND PIPE SIZING



ORIGINAL SHEET - ISO 11x17 - v14.06

March 2016
116809401

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Legend

PROPOSED WATERMAIN

EXISTING WATERMAIN

NODE

100 L/S — AVAILABLE FIRE FLOW

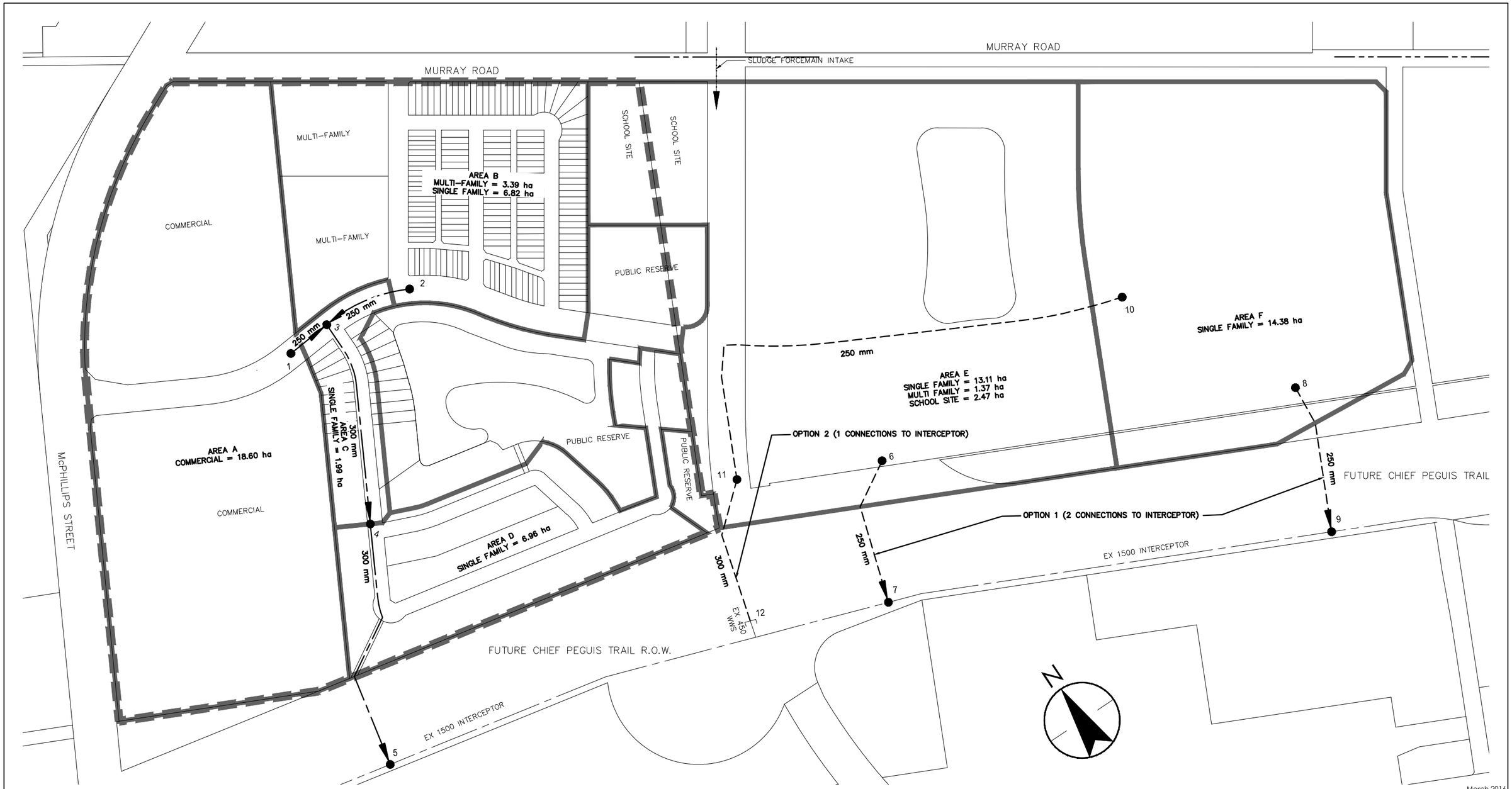
Notes

SERVICE AREA (46.856 ha)

Client/Project
DAYTONA LAND
AURORA
AT NORTH POINT

Figure No.
2.0

Title
WATERMAIN - ULTIMATE SYSTEM
AVAILABLE FIRE FLOW AND PIPE SIZING



March 2016
116809401

ORIGINAL SHEET - ISO 11x17 - v14.06

V:\1168\active\116809401\0300_drawing\0301_sketches\09401_catchments_mar2816.dwg FIG3_WWS
2016/05/10 8:44 AM By: Devisser, Kyle

Stantec

Stantec Consulting Ltd.
Suite 500, 311 Portage Avenue
Winnipeg MB Canada R3B 2B9
Tel. 204.489.5900 Fax. 204.453.9012
www.stantec.com

Legend

- WASTEWATER SEWER CATCHMENTS
- PROPOSED WASTEWATER SEWER
- EXISTING INTERCEPTOR
- FUTURE WASTEWATER SEWER

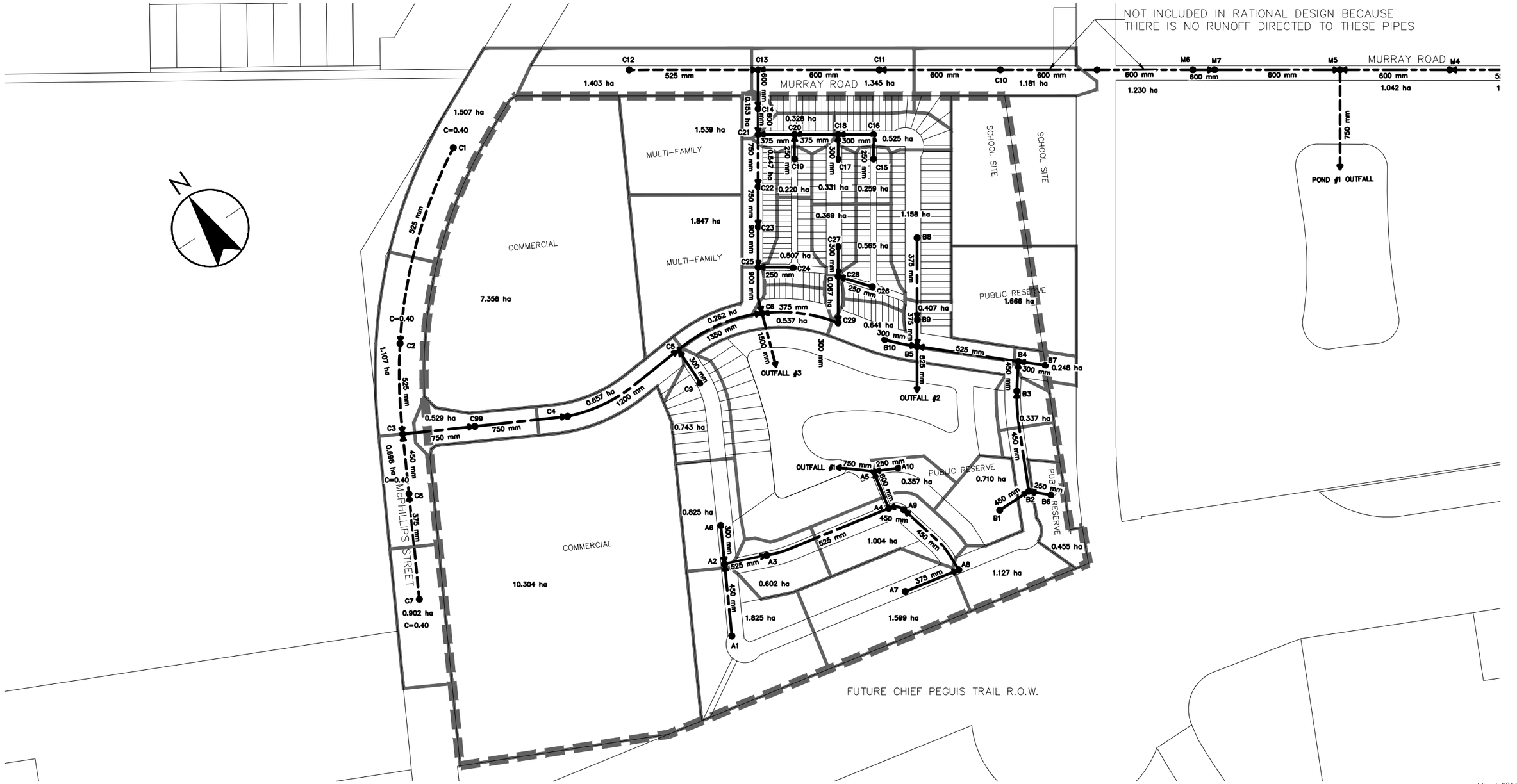
Notes

- SLUDGE FORCEMAIN INLET
- PROPOSED DEVELOPMENT BOUNDARY (DASZ 40/2015) 46.856 ha

Client/Project
DAYTONA LAND
AURORA
AT NORTH POINT

Figure No.
3.0

Title
WASTEWATER SEWER
PIPE SIZING AND CATCHMENTS



ORIGINAL SHEET - ISO 11x17 - v14.06

March 2016
116809401

V:\1168\active\116809401\0300_drawing\0301_sketches\09401_catchments_mar2816.dwg FIG4_LDS
2016/05/26 2:15 PM By: Devisser, Kyle

Stantec

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Legend

- CATCHMENT AREAS
- PROPOSED LAND DRAINAGE SEWER
- FUTURE LAND DRAINAGE SEWER/INTERCONNECTING PIPE (SIZING TO BE CONFIRMED BY DESIGN ENGINEER IN THE FUTURE)
- PROPOSED INTERCONNECTING PIPE

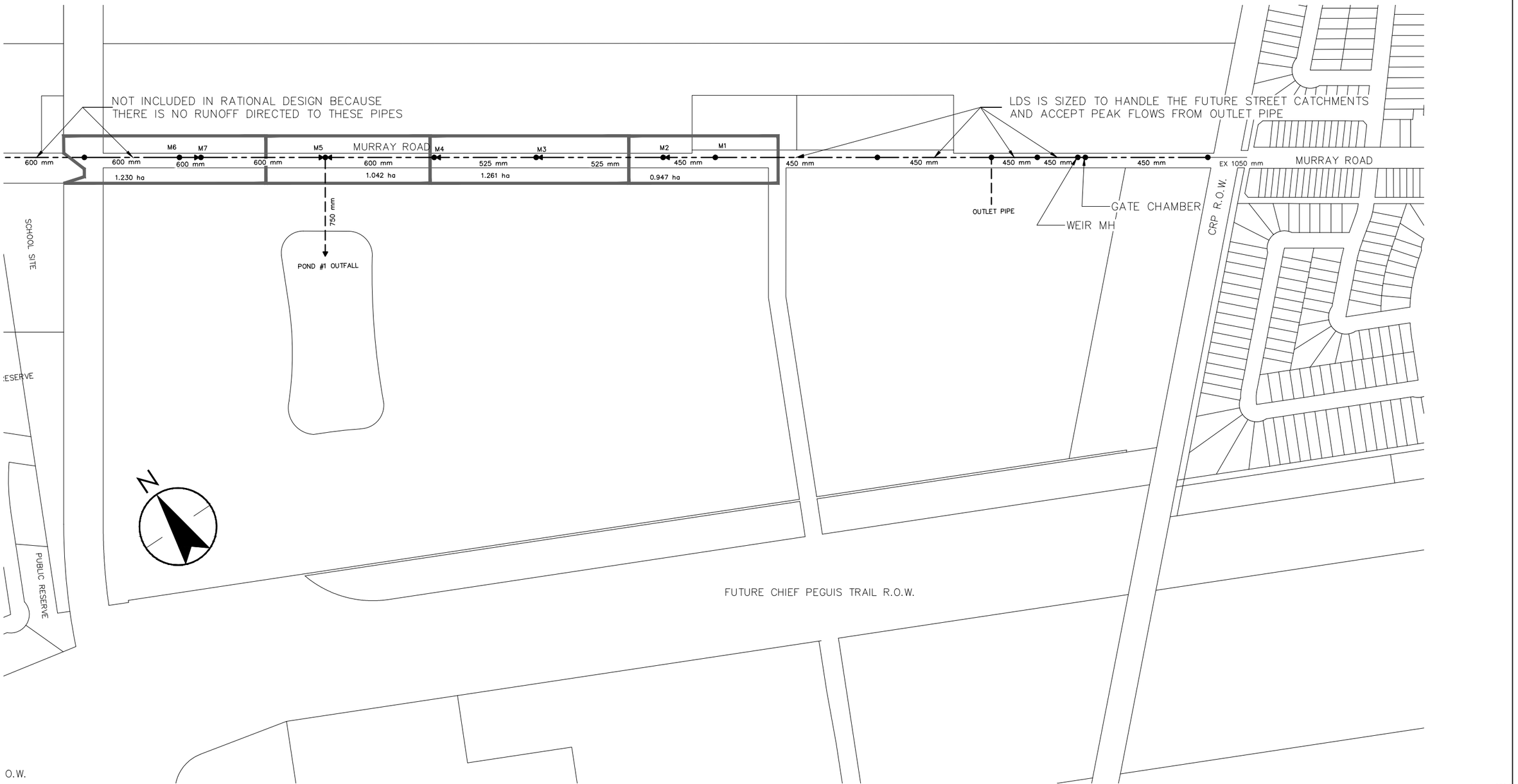
Notes

- PROPOSED DEVELOPMENT BOUNDARY (DASZ 40/2015) 46.856 ha

Client/Project
DAYTONA LAND
AURORA
AT NORTH POINT

Figure No.
4.0

Title
LAND DRAINAGE SEWER
PIPE SIZING AND CATCHMENTS



V:\1\168\active\116809401\0300_drawing\0301_sketches\09401_catchments_mar2816.dwg FIG4.1_MurrayLDS
2016/05/10 8:56 AM By: Denisser, Kyle

ORIGINAL SHEET - ISO 11x17 - v14.06

March 2016
116809401

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Legend

- CATCHMENT AREAS
- PROPOSED LAND DRAINAGE SEWER
- FUTURE LAND DRAINAGE SEWER/INTERCONNECTING PIPE (SIZING TO BE CONFIRMED BY DESIGN ENGINEER IN THE FUTURE)

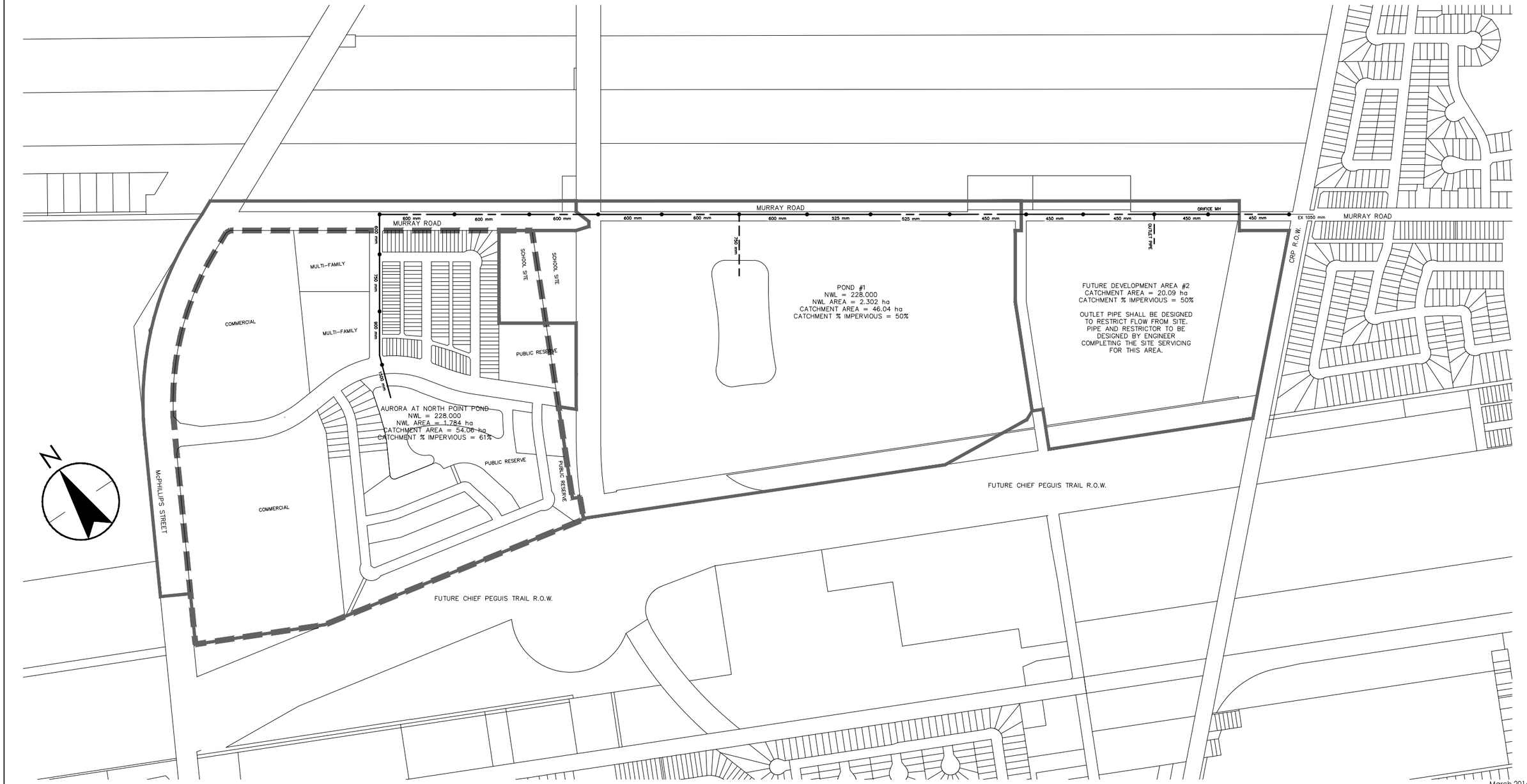
Notes

- PROPOSED INTERCONNECTING PIPE
- EXISTING LAND DRAINAGE SEWER

Client/Project
DAYTONA LAND
AURORA
AT NORTH POINT

Figure No.
4.1

Title
MURRAY AVENUE - LAND DRAINAGE SEWER PIPE SIZING AND CATCHMENTS



ORIGINAL SHEET - ISO 11x17 - v14.06

March 2016
116809401

V:\1168\active\116809401\0300_drawing\0301_sketches\09401_catchments_mar2816.dwg FIG5_POND
2016/05/10 8:56 AM By: Derksen, Kyle

Stantec

Stantec Consulting Ltd.
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www.stantec.com

Legend

- POND CATCHMENTS
- PROPOSED INTERCONNECTING PIPE
- EXISTING LAND DRAINAGE SEWER
- FUTURE INTERCONNECTING PIPE (SIZING TO BE CONFIRMED BY DESIGN ENGINEER IN THE FUTURE)

Notes

- PROPOSED DEVELOPMENT BOUNDARY (DASZ 40/2015) 46.856 ha

Client/Project
DAYTONA LAND
AURORA
AT NORTH POINT

Figure No.
5.0

Title
RETENTION POND CATCHMENTS AND INTERCONNECTING PIPE SIZING

Figure 6.0 - Aurora at North Point Pond Rises

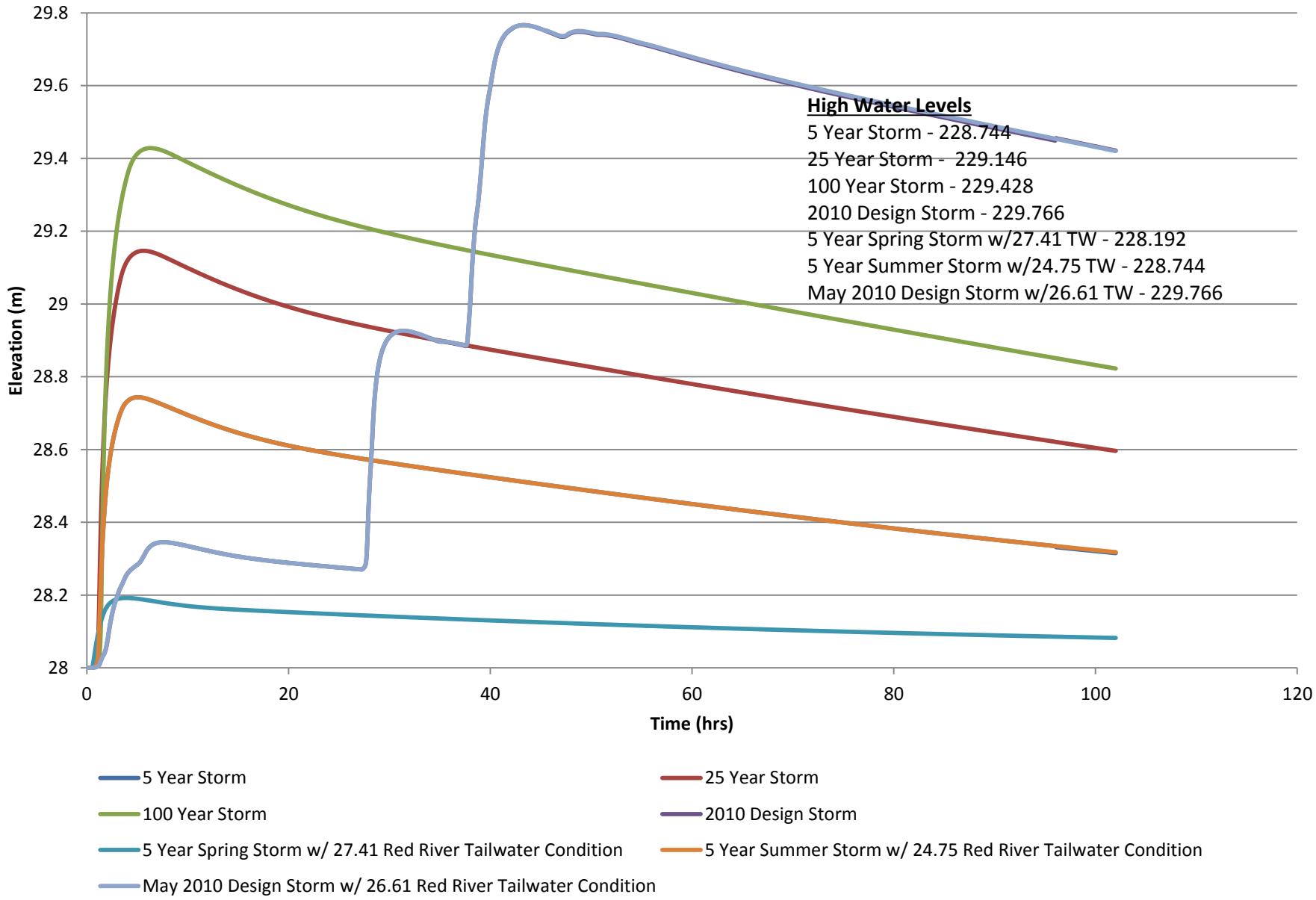


Figure 6.1 - Future Pond #1 Rises

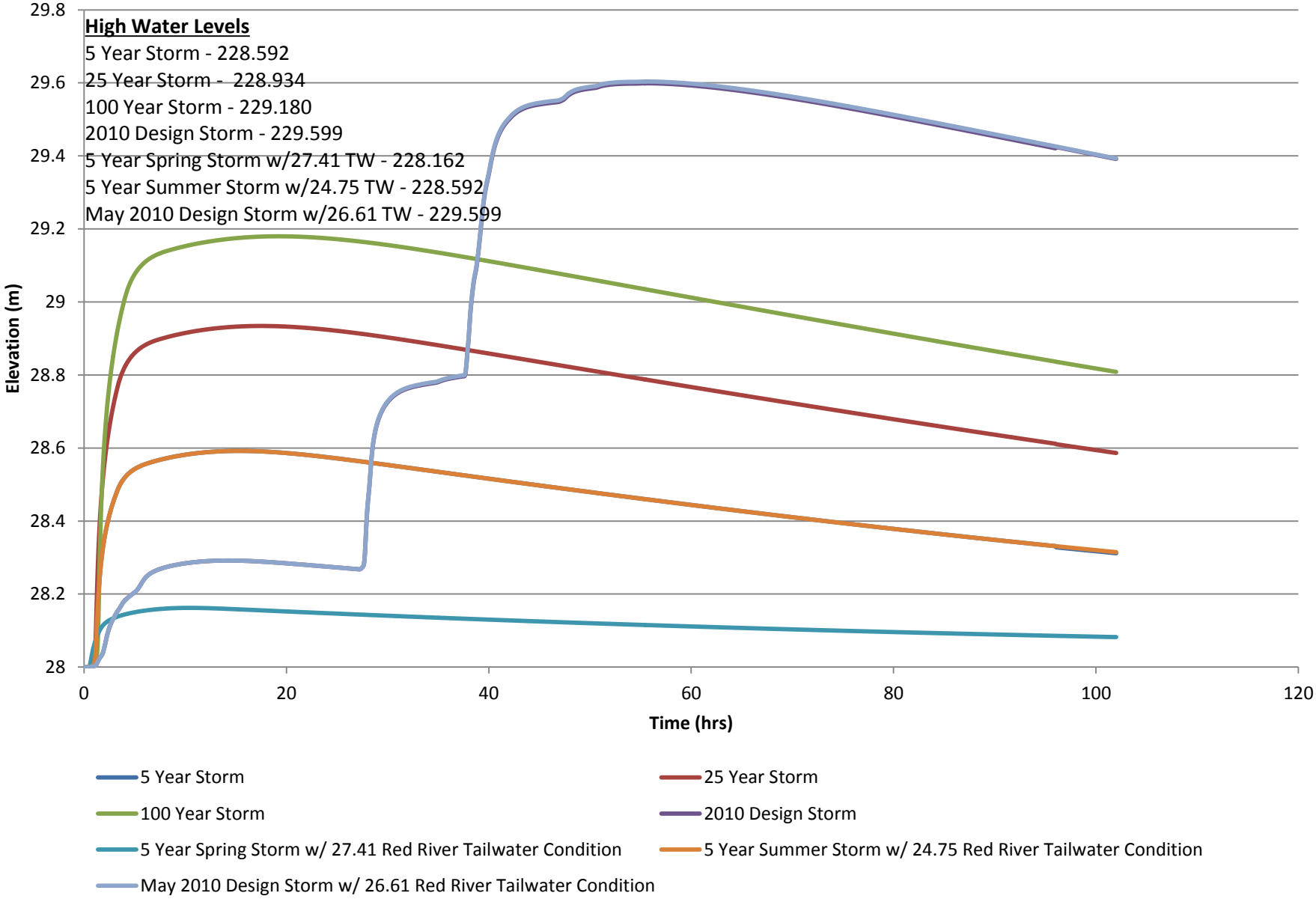


Figure 7.0 - Total System Discharge Through Orifice Manhole to Existing Murray Avenue Land Drainage Sewer

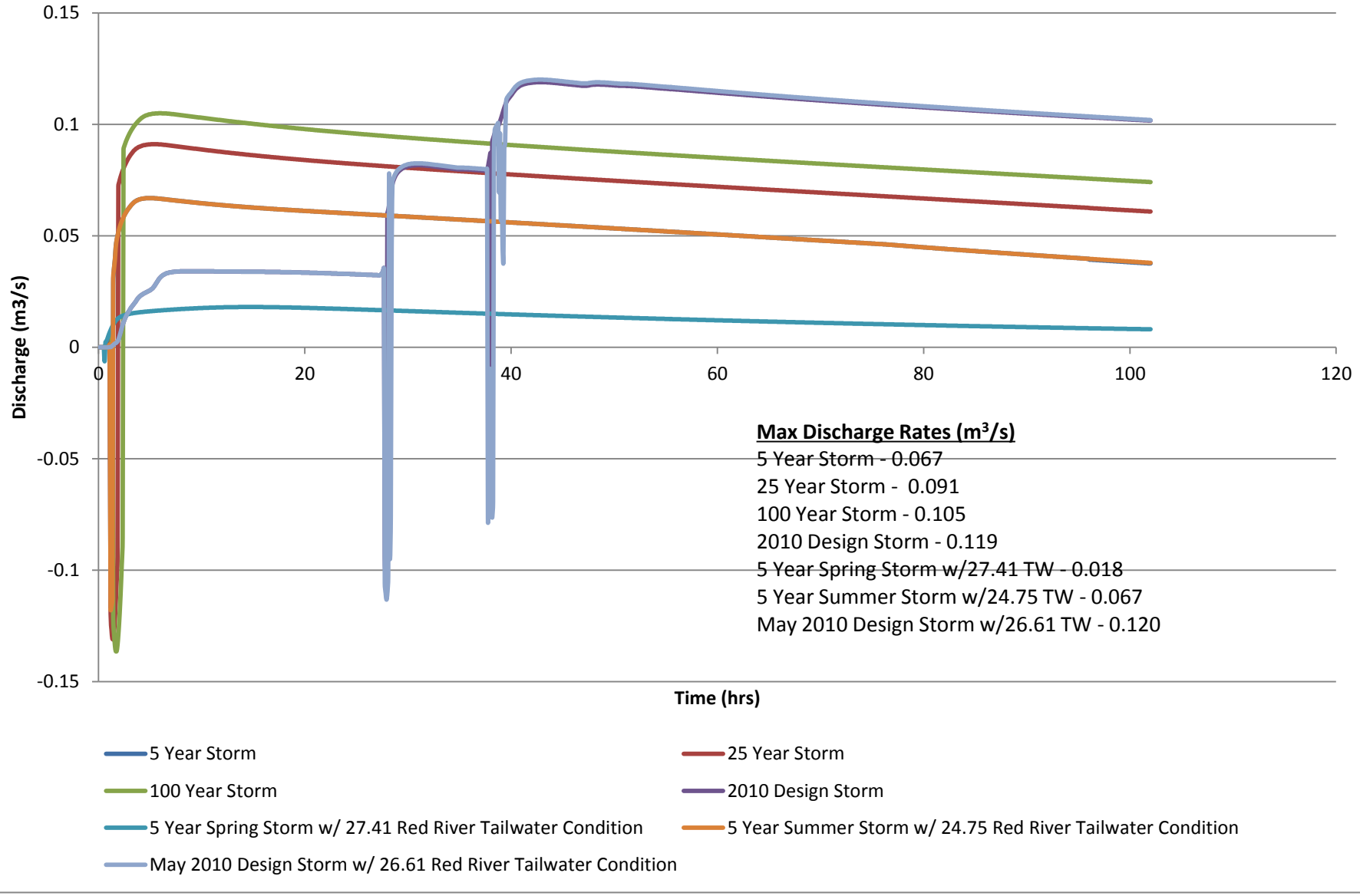


Figure 8.0 - Pond #1 Discharge to Proposed Murray Avenue Interconnecting Pipe

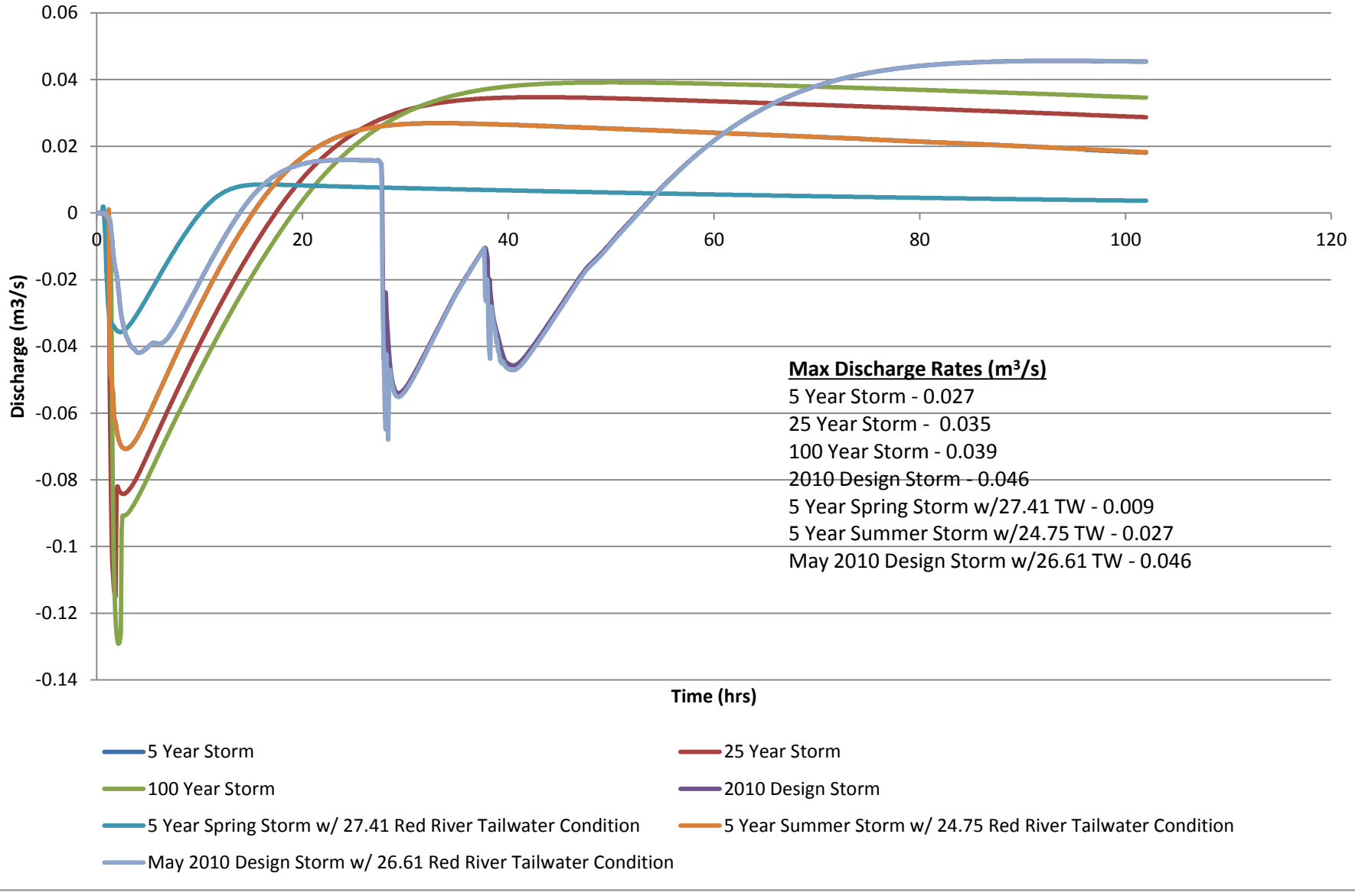


Figure 8.1 - Future Development Area #2
Discharge to Proposed Murray Avenue Interconnecting Pipe

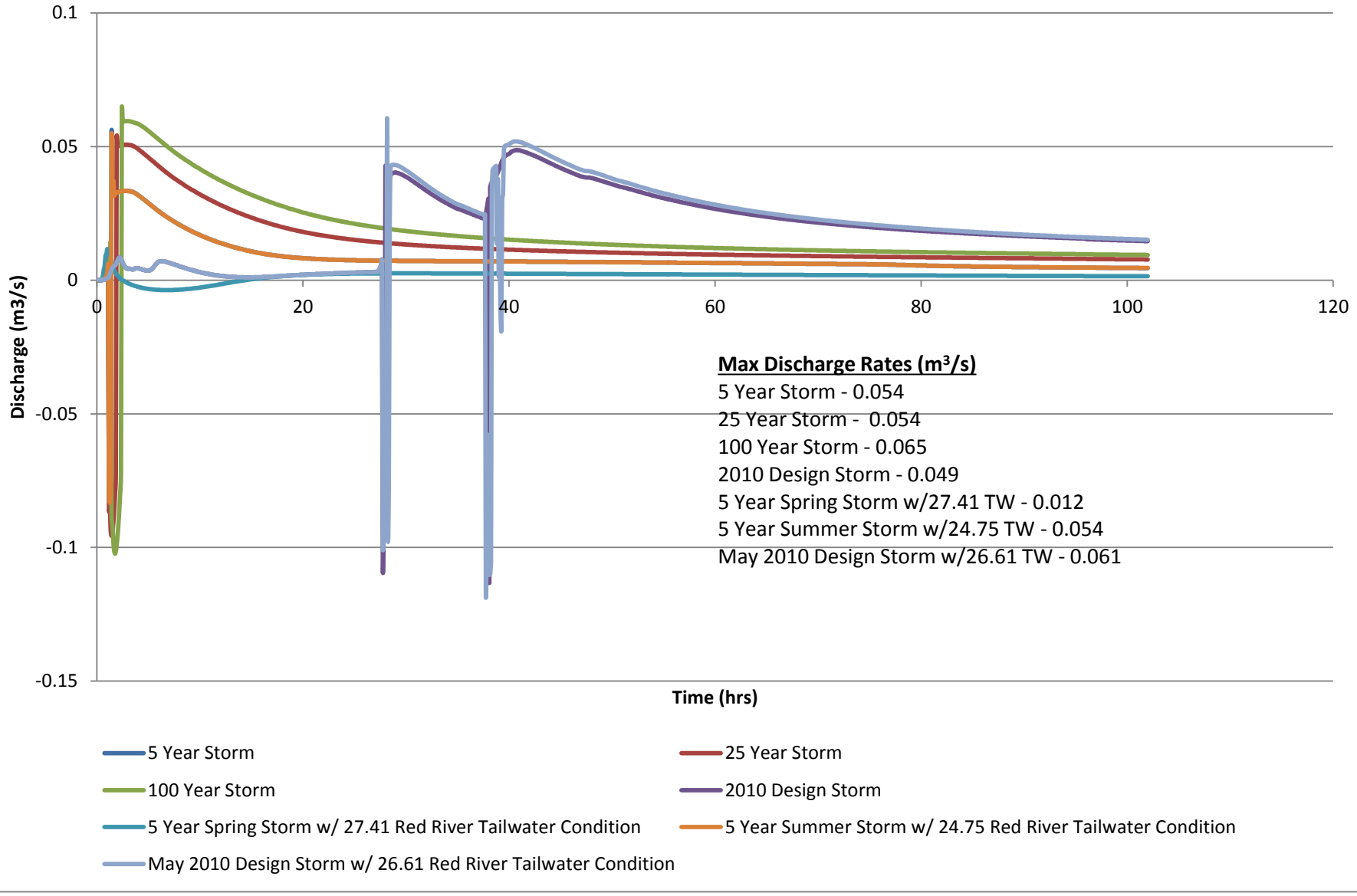
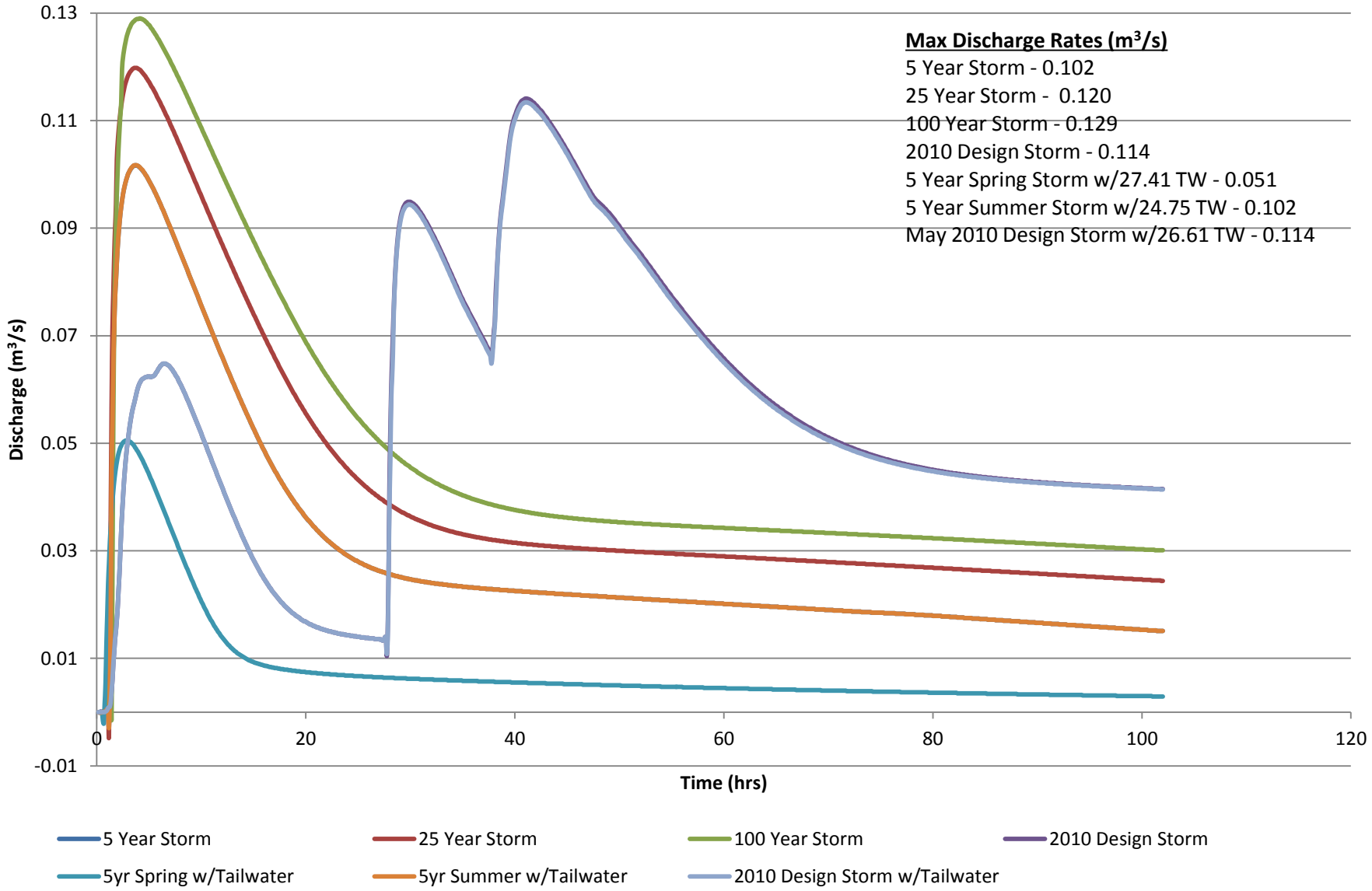


Figure 8.2 - Aurora at North Point
Discharge to Proposed Murray Avenue Interconnecting Pipe



APPENDIX A

Sanitary Sewer
Design Spreadsheet

WASTEWATER SEWER DESIGN SHEET **DESCRIPTION:** **Peak Sanitary Sewer Flow Calculations**

OWNER DAYTONA LAND
SUBDIV. NAME Aurora at North Point

Area No.	M.H. From	M.H. To	No. of SF Dwelling Units	No. of MF Dwelling Units	Incremental SF Area (ha)	Incremental MF Area (ha)	Cumulative SF Area (ha)	Cumulative MF Area (ha)	Incremental SF Population (Persons)	Incremental MF Population (Persons)	Incremental Total Population (Persons)	Cumulative Population (Persons)	Peaking Factor M	Peak Res Flow (l/s)	Incremental Com. Area (Ha)	Cumulative Com. Area (Ha)	Incremental Ind. Area (Ha)	Cumulative Ind. Area (Ha)	Cumulative Total Area (Ha)	Ground Water Infiltration (l/s)	Manhole Inflow (l/s)	Peak Com. Flow (l/s)	Cum Com. Flow (l/s)	Peak Ind. Flow (l/s)	Cum Ind. Flow (l/s)	Peak Design Flow (l/s)	Proposed Sewer					
																											Dia. (mm)	Slope %	Crit. Slope %	Des.Slope %	Capacity Q. (l/s)	Velocity (m/s)
AURORA AT NORTH POINT																															
A	**1**	**3**	**0**	**0**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0**	**0**	**0**	**0**	**4.500**	**0.00**	**18.6000**	**18.6000**	**0.0000**	**0.0000**	**18.6000**	**0.47**	**5.95**	**6.05**	**6.05**	**0.00**	**0.00**	**12.47**	**250**	**0.25%**	**1.43%**	**0.25%**	**29.73**	**0.61**
B	**2**	**3**	**158**	**251**	**6.8200**	**3.3900**	**6.8200**	**3.3900**	**482**	**578**	**1060**	**1060**	**3.784**	**12.53**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**10.2100**	**0.26**	**3.27**	**0.00**	**0.00**	**0.00**	**0.00**	**16.06**	**250**	**0.25%**	**1.43%**	**0.25%**	**29.73**	**0.61**
C	**3**	**4**	**40**	**0**	**1.9900**	**0.0000**	**8.8100**	**3.3900**	**122**	**0**	**122**	**1182**	**3.752**	**13.86**	**0.0000**	**18.6000**	**0.0000**	**0.0000**	**30.8000**	**0.78**	**9.86**	**0.00**	**6.05**	**0.00**	**0.00**	**30.54**	**300**	**0.21%**	**1.34%**	**0.21%**	**44.31**	**0.63**
D	**4**	**5**	**86**	**0**	**6.9600**	**0.0000**	**15.7700**	**3.3900**	**261**	**0**	**261**	**1443**	**3.692**	**16.64**	**0.0000**	**18.6000**	**0.0000**	**0.0000**	**37.7600**	**0.96**	**12.08**	**0.00**	**6.05**	**0.00**	**0.00**	**35.73**	**300**	**0.21%**	**1.34%**	**0.21%**	**44.31**	**0.63**
FUTURE DEVELOPMENT OPTION 1 (2 CONNECTIONS TO INTERCEPTOR)																															
E	**6**	**7**	**246**	**102**	**13.1100**	**1.3700**	**13.1100**	**1.3700**	**750**	**234**	**984**	**984**	**3.805**	**11.70**	**0.0000**	**0.0000**	**2.4700**	**2.4700**	**16.9500**	**0.43**	**5.42**	**0.00**	**0.00**	**1.07**	**1.07**	**18.63**	**250**	**0.25%**	**1.43%**	**0.25%**	**29.73**	**0.61**
F	**8**	**9**	**280**	**0**	**14.3800**	**0.0000**	**14.3800**	**0.0000**	**854**	**0**	**854**	**854**	**3.843**	**10.26**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**14.3800**	**0.37**	**4.60**	**0.00**	**0.00**	**0.00**	**0.00**	**15.22**	**250**	**0.25%**	**1.43%**	**0.25%**	**29.73**	**0.61**
FUTURE DEVELOPMENT OPTION 2 (1 CONNECTIONS TO INTERCEPTOR)																															
F	**10**	**11**	**280**	**0**	**14.3800**	**0.0000**	**14.3800**	**0.0000**	**854**	**0**	**854**	**854**	**3.843**	**10.26**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**14.3800**	**0.37**	**4.60**	**0.00**	**0.00**	**0.00**	**0.00**	**15.22**	**250**	**0.25%**	**1.43%**	**0.25%**	**29.73**	**0.61**
E	**11**	**12**	**246**	**102**	**13.1100**	**1.3700**	**27.4900**	**27.4900**	**750**	**234**	**984**	**1838**	**3.614**	**20.76**	**0.0000**	**0.0000**	**2.4700**	**2.4700**	**57.4500**	**1.46**	**18.38**	**0.00**	**0.00**	**1.07**	**1.07**	**41.68**	**300**	**0.21%**	**1.34%**	**0.21%**	**44.31**	**0.63**

Notes:

Single Family
3.05 Persons per Unit (Single Family)
12.29 Dwellings per Hectare (Single Family)
2.3 Persons per Unit (Multi Family)
74.13 Dwellings per Hectare (Multi Family)

Design Flow Factor, F = 0.003125 l/sec/person
60 I. Gal/person/day = 270 l/person/day
Harmon Factor Pf=1+(14/(4+(p)^.5) P = thousands of persons
2<=Pf<=4.5

Infiltration Factor, FI = 2200 l/Ha/day
Manhole Inflow 12 l/MH/min
Manhole Quantity 1.6 MH/Ha

Peak Commerical Flow			28100	L/day/Ha	0.325 L/sec/Ha
Peak Industrial Flow			37600	L/day/Ha	0.435 L/sec/Ha

Calculated By : K.DeVisser
Checked By : D. Mages
Date: 24-Mar-16
File: 116809401

APPENDIX B

Detailed Rational Design Spreadsheets

Aurora at North Point - Outfall #1

SPREADSHEET FOR SEWER DESIGN BY RATIONAL METHOD

Date: 18-Feb-16

Design By: KD

$I=1199/(t+8)^{.828}$ (MacLaren 1974) N = 0.013 Design S= 0.0076716

From	To	Area ha	"c"	A x c	Accum A x c	Time Conc	" I " mm/hr	" Q " m^3/sec	Pipe Diam (mm	Target Hyd Drop	Design Hyd Drop	v m/sec	L metres	Time min.	Top of Water High (m)	Low TARGET (m)	Low DESIGN	Ground Elev. @ U/S MH m	Actual HGL @ U/S MH m	Actual HGL @ D/S MH m	HGL Depth Below Gutter m	Minimum Pipe Slope %	" Q-full " m^3/sec	Q-des / Q-full
A1	**A2**	**1.825**	**0.5**	**0.91**	**0.91**	**15.0000**	**89.39**	**0.227**	**450**	**0.64**	**0.53**	**1.43**	**83.1**	**0.97**	**231.30**	**230.66**	**230.77**	**231.30**	**231.12**	**230.59**	**0.18**	**0.26**	**0.0263**	**8.62**
A6	A2	0.825	0.5	0.41	0.41	15.0000	89.39	0.103	300	0.34	0.50	1.45	44.4	0.51	231.50	231.16	231.00	231.50	231.09	230.59	0.41	0.45	0.0068	15.00
A2	**A3**	**0.000**	**0.5**	**0.00**	**1.33**	**15.9715**	**86.38**	**0.318**	**525**	**0.38**	**0.27**	**1.47**	**49.5**	**0.56**	**230.66**	**230.28**	**230.50**	**231.80**	**230.59**	**230.32**	**1.21**	**0.23**	**0.0458**	**6.94**
A3	**A4**	**0.602**	**0.5**	**0.30**	**1.63**	**16.5328**	**84.74**	**0.383**	**525**	**1.15**	**1.19**	**1.77**	**150.0**	**1.41**	**230.28**	**229.13**	**229.31**	**231.50**	**230.32**	**229.13**	**1.18**	**0.23**	**0.0458**	**8.36**
A7	A8	1.599	0.5	0.80	0.80	15.0000	89.39	0.199	375	0.51	0.85	1.80	66.4	0.62	231.30	230.79	230.45	231.30	230.63	229.78	0.67	0.34	0.0145	13.70
A8	A9	0.000	0.5	0.00	0.80	15.6152	87.45	0.194	450	0.72	0.44	1.22	94.2	1.28	230.79	230.07	230.01	231.80	229.78	229.34	2.02	0.26	0.0263	7.39
A9	A4	1.004	0.5	0.50	1.30	16.8999	83.70	0.303	450	0.14	0.21	1.90	18.5	0.16	230.07	229.93	229.80	231.10	229.34	229.13	1.76	0.26	0.0263	11.51
A4	**A5**	**0.000**	**0.5**	**0.00**	**2.93**	**17.9457**	**80.90**	**0.658**	**600**	**0.35**	**0.53**	**2.33**	**46.0**	**0.33**	**229.13**	**228.78**	**228.78**	**231.30**	**229.13**	**228.60**	**2.17**	**0.18**	**0.0692**	**9.52**
A10	A5	0.357	0.2	0.07	0.07	15.0000	89.39	0.018	250	0.22	0.03	0.36	28.5	1.31	230.50	230.28	230.47	230.50	228.63	228.60	1.87	0.56	0.0037	4.82
A5	**END**	**0.000**	**0.5**	**0.00**	**3.00**	**18.2749**	**80.06**	**0.667**	**750**	**0.33**	**0.15**	**1.51**	**42.9**	**0.47**	**228.78**	**228.45**	**228.63**	**230.50**	**228.60**	**228.45**	**1.90**	**0.13**	**0.1435**	**4.65**
												SUM L =	**371.5**					Lower Critical HGL by		0.18				

Target = T.O.W. (228.00+0.45=228.45)

Note: Rows are coloured to assist in differentiate between branches off the critical path

Aurora at North Point - Outfall #2
SPREADSHEET FOR SEWER DESIGN BY RATIONAL METHOD

Date: 26-May-16
Design By: KD

I=1199/(t+8)$^{.828}$ (MacLaren 1974) N = 0.013 Design S= 0.00598053

From	To	Area ha	"c"	A x c	Accum A x c	Time Conc	" I " mm/hr	" Q " m^3/sec	Pipe Diam (mm)	Target Hyd Drop	Design Hyd Drop	v m/sec	L metres	Time min.	Top of Water High (m)	Low TARGET (m)	Low DESIGN	Ground Elev. @ U/S MH m	Actual HGL @ U/S MH m	Actual HGL @ D/S MH m	HGL Depth Below Gutter m	Minimum Pipe Slope %	" Q-full " m^3/sec	Q-des / Q-full
B1	**B2**	**0.710**	**0.2**	**0.14**	**0.14**	**15.0000**	**89.39**	**0.035**	**450**	**0.24**	**0.01**	**0.22**	**39.9**	**3.00**	**230.60**	**230.36**	**230.59**	**230.60**	**230.39**	**230.38**	**0.21**	**0.26**	**0.0263**	**1.34**
B6	B2	0.455	0.2	0.09	0.09	15.0000	89.39	0.023	250	0.15	0.04	0.46	25.6	0.93	231.00	230.85	230.96	231.00	230.42	230.38	0.58	0.56	0.0037	6.15
B2	**B3**	**1.127**	**0.5**	**0.56**	**0.80**	**17.9974**	**80.76**	**0.179**	**450**	**0.69**	**0.46**	**1.12**	**115.8**	**1.72**	**230.36**	**229.67**	**230.14**	**230.80**	**230.38**	**229.93**	**0.42**	**0.26**	**0.0263**	**6.80**
B3	**B4**	**0.337**	**0.5**	**0.17**	**0.97**	**19.7138**	**76.60**	**0.205**	**450**	**0.20**	**0.18**	**1.29**	**34.2**	**0.44**	**229.67**	**229.46**	**229.96**	**231.40**	**229.93**	**229.75**	**1.47**	**0.26**	**0.0263**	**7.81**
B7	B4	0.248	0.5	0.12	0.12	15.0000	89.39	0.031	300	0.19	0.03	0.44	31.2	1.19	231.00	230.81	230.97	231.00	229.78	229.75	1.22	0.45	0.0068	4.51
B4	**B5**	**1.666**	**0.2**	**0.33**	**1.42**	**20.1549**	**75.60**	**0.299**	**525**	**0.70**	**0.57**	**1.38**	**117.5**	**1.42**	**229.46**	**228.76**	**229.39**	**231.75**	**229.75**	**229.18**	**2.00**	**0.23**	**0.0458**	**6.52**
B8	B9	1.158	0.5	0.58	0.58	15.0000	89.39	0.144	375	0.56	0.63	1.30	94.1	1.20	231.00	230.44	230.37	231.00	230.16	229.53	0.84	0.34	0.0145	9.92
B9	B5	0.407	0.5	0.20	0.78	16.2039	85.69	0.186	375	0.18	0.34	1.69	30.5	0.30	230.44	230.25	230.02	230.34	229.53	229.18	0.81	0.34	0.0145	12.85
B10	B5	0.641	0.5	0.32	0.32	15.0000	89.39	0.080	300	0.23	0.26	1.13	38.0	0.56	230.40	230.17	230.14	230.40	229.44	229.18	0.96	0.45	0.0068	11.65
B5	**END**	**0.000**	**0.5**	**0.00**	**2.53**	**21.5732**	**72.59**	**0.510**	**525**	**0.31**	**0.73**	**2.35**	**52.1**	**0.37**	**228.76**	**228.45**	**228.66**	**230.60**	**229.18**	**228.45**	**1.42**	**0.23**	**0.0458**	**11.12**
												SUM L =	**359.5**					Lower Critical HGL by		0.21				

Target = T.O.W. (228.00+0.45=228.45)

Note: Rows are coloured to assist in differentiate between branches off the critical path

Aurora at North Point - Outfall #3
SPREADSHEET FOR SEWER DESIGN BY RATIONAL METHOD

Date: 8-Apr-16
Design By: KD

I=1199/(t+8)$^{.828}$ (MacLaren 1974) N = 0.013 Design S= 0.00312353

From	To	Area ha	"c"	A x c	Accum A x c	Time Conc	" I " mm/hr	" Q " m^3/sec	Pipe Diam (mm)	Target Hyd Drop	Design Hyd Drop	v m/sec	L metres	Time min.	Top of Water High (m)	Low TARGET (m)	Low DESIGN	Ground Elev. @ U/S MH m	Actual HGL @ U/S MH m	Actual HGL @ D/S MH m	HGL Depth Below Gutter m	Minimum Pipe Slope %	" Q-full " m^3/sec	Q-des / Q-full
C1	**C2**	**1.507**	**0.4**	**0.60**	**0.60**	**10.0000**	**109.50**	**0.183**	**525**	**0.73**	**0.43**	**0.85**	**234.4**	**4.61**	**231.10**	**230.37**	**230.67**	**231.10**	**230.83**	**230.40**	**0.27**	**0.23**	**0.0458**	**4.00**
C2	**C3**	**1.107**	**0.4**	**0.44**	**1.05**	**14.6088**	**90.66**	**0.264**	**525**	**0.33**	**0.39**	**1.22**	**104.1**	**1.43**	**230.37**	**230.04**	**230.28**	**231.10**	**230.40**	**230.01**	**0.70**	**0.23**	**0.0458**	**5.75**
C7	C8	0.902	0.4	0.36	0.36	10.0000	109.50	0.110	375	0.38	0.48	0.99	121.5	2.04	231.10	230.72	230.62	231.10	230.76	230.28	0.34	0.34	0.0145	7.57
C8	C3	0.698	0.4	0.28	0.64	12.0364	100.20	0.178	450	0.22	0.27	1.12	69.0	1.03	230.72	230.50	230.35	231.10	230.28	230.01	0.82	0.26	0.0263	6.78
C3	**C99**	**0.000**	**0.6**	**0.00**	**1.69**	**16.0339**	**86.19**	**0.404**	**750**	**0.26**	**0.11**	**0.91**	**83.2**	**1.52**	**230.04**	**229.78**	**230.17**	**231.30**	**230.01**	**229.90**	**1.29**	**0.13**	**0.1435**	**2.81**
C99	**C4**	**0.529**	**0.6**	**0.32**	**2.00**	**17.5508**	**81.93**	**0.456**	**750**	**0.33**	**0.18**	**1.03**	**107.0**	**1.73**	**229.78**	**229.45**	**229.99**	**231.00**	**229.90**	**229.72**	**1.10**	**0.13**	**0.1435**	**3.18**
C4	**C5**	**18.319**	**0.6**	**10.99**	**12.99**	**19.2777**	**77.61**	**2.804**	**1200**	**0.47**	**0.78**	**2.48**	**150.0**	**1.01**	**229.45**	**228.98**	**229.22**	**231.20**	**229.72**	**228.95**	**1.48**	**0.07**	**0.6902**	**4.06**
C9	C5	0.743	0.5	0.37	0.37	15.0000	89.39	0.092	300	0.14	0.41	1.31	45.5	0.58	231.60	231.46	231.19	231.60	229.36	228.95	2.24	0.45	0.0068	13.50
C5	**C6**	**0.000**	**0.5**	**0.00**	**13.37**	**20.2862**	**75.31**	**2.798**	**1350**	**0.33**	**0.29**	**1.96**	**106.5**	**0.91**	**228.98**	**228.65**	**228.92**	**232.00**	**228.95**	**228.65**	**3.05**	**0.06**	**1.0235**	**2.73**
C10	C11	1.181	0.5	0.59	0.59	15.0000	89.39	0.147	600	0.43	0.08	0.52	139.0	4.46	230.40	229.97	230.32	230.40	230.12	230.04	0.28	0.18	0.0692	2.12
C11	C13	1.345	0.5	0.67	1.26	19.4640	77.18	0.271	600	0.43	0.27	0.96	139.0	2.42	229.97	229.53	230.05	230.50	230.04	229.77	0.46	0.18	0.0692	3.92
C12	C13	1.403	0.5	0.70	0.70	15.0000	89.39	0.174	525	0.46	0.24	0.81	148.0	3.06	230.50	230.04	230.26	230.50	230.02	229.77	0.48	0.23	0.0458	3.80
C13	C14	0.000	0.5	0.00	1.96	21.8813	71.97	0.393	600	0.14	0.18	1.39	44.7	0.54	229.53	229.39	229.87	231.25	229.77	229.59	1.48	0.18	0.0692	5.68
C14	C21	0.153	0.5	0.08	2.04	22.4172	70.92	0.402	600	0.09	0.13	1.42	29.5	0.35	229.39	229.30	229.74	230.95	229.59	229.46	1.36	0.18	0.0692	5.82
C15	C16	0.259	0.5	0.13	0.13	15.0000	89.39	0.032	250	0.09	0.08	0.66	28.2	0.72	231.20	231.11	231.12	231.20	230.73	230.65	0.47	0.56	0.0037	8.75
C16	C18	0.525	0.5	0.26	0.39	15.7169	87.14	0.095	300	0.13	0.39	1.34	40.6	0.50	231.11	230.99	230.73	231.20	230.65	230.26	0.55	0.45	0.0068	13.89
C17	C18	0.331	0.5	0.17	0.17	15.0000	89.39	0.041	300	0.09	0.05	0.58	28.5	0.82	231.20	231.11	231.15	231.20	230.31	230.26	0.89	0.45	0.0068	6.02
C18	C20	0.000	0.5	0.00	0.56	16.2206	85.64	0.133	375	0.16	0.29	1.20	50.1	0.69	230.99	230.83	230.44	231.50	230.26	229.97	1.24	0.34	0.0145	9.15
C19	C20	0.220	0.5	0.11	0.11	15.0000	89.39	0.027	250	0.09	0.06	0.56	28.1	0.84	231.20	231.11	231.14	231.20	230.03	229.97	1.17	0.56	0.0037	7.43
C20	C21	0.328	0.5	0.16	0.83	16.9155	83.66	0.193	375	0.13	0.51	1.75	41.8	0.40	230.83	230.70	229.93	231.00	229.97	229.46	1.03	0.34	0.0145	13.33
C21	C22	1.539	0.6	0.92	3.80	22.7627	70.26	0.741	750	0.19	0.27	1.68	59.8	0.59	229.30	229.11	229.47	231.30	229.46	229.20	1.84	0.13	0.1435	5.17
C22	C23	0.547	0.5	0.27	4.07	23.3566	69.15	0.782	750	0.14	0.23	1.77	46.2	0.43	229.11	228.97	229.25	230.90	229.20	228.97	1.70	0.13	0.1435	5.45
C23	C25	1.847	0.6	1.11	5.18	23.7914	68.37	0.984	900	0.14	0.14	1.55	46.3	0.50	228.97	228.82	229.11	231.20	228.97	228.83	2.23	0.1	0.2610	3.77
C24	C25	0.507	0.5	0.25	0.25	15.0000	89.39	0.063	250	0.13	0.45	1.28	40.3	0.52	231.00	230.87	230.55	231.00	229.28	228.83	1.72	0.56	0.0037	17.13
C25	C6	0.262	0.5	0.13	5.56	24.2903	67.49	1.044	900	0.17	0.18	1.64	53.4	0.54	228.82	228.66	228.93	230.50	228.83	228.65	1.67	0.1	0.2610	4.00
C26	C28	0.565	0.5	0.28	0.28	15.0000	89.39	0.070	250	0.13	0.57	1.43	40.9	0.48	231.00	230.87	230.43	231.00	230.55	229.98	0.45	0.56	0.0037	19.09
C27	C28	0.369	0.5	0.18	0.18	15.0000	89.39	0.046	300	0.11	0.08	0.65	34.0	0.87	231.20	231.09	231.12	231.20	230.05	229.98	1.15	0.45	0.0068	6.71
C28	C29	0.087	0.5	0.04	0.51	15.4767	87.88	0.125	300	0.17	0.89	1.76	53.4	0.50	230.87	230.71	229.54	230.80	229.98	229.09	0.82	0.45	0.0068	18.25
C29	C6	0.000	0.5	0.00	0.51	15.9811	86.35	0.123	375	0.28	0.43	1.11	88.9	1.34	230.71	230.43	229.11	231.10	229.09	228.65	2.01	0.34	0.0145	8.45
C6	**END**	**0.537**	**0.5**	**0.27**	**19.71**	**21.1941**	**73.37**	**4.020**	**1500**	**0.20**	**0.20**	**2.27**	**63.2**	**0.46**	**228.65**	**228.45**	**228.72**	**230.50**	**228.65**	**228.45**	**1.85**	**0.06**	**1.5600**	**2.58**
												SUM L =	**848.4**					Lower Critical HGL by		0.27				

Target = T.O.W. (228.00+0.45=228.45)

Note: Rows are coloured to assist in differentiate between branches off the critical path
Shading designates that pipe sizing is preliminary and should be confirmed by designing engineer in the future

Murray Avenue Pond # 1 - Outfall
SPREADSHEET FOR SEWER DESIGN BY RATIONAL METHOD

Date: 28-Mar-16
Design By: KD

I=1199/(t+8)$^{.828}$ (MacLaren 1974) N = 0.013 Design S= 0.00362703

From	To	Area ha	"c"	A x c	Accum A x c	Time Conc	" I " mm/hr	" Q " m^3/sec	Pipe Diam (mm)	Target Hyd Drop	Design Hyd Drop	v m/sec	L metres	Time min.	Top of Water High (m)	Low TARGET (m)	Low DESIGN	Ground Elev. @ U/S MH m	Actual HGL @ U/S MH m	Actual HGL @ D/S MH m	HGL Depth Below Gutter m	Minimum Pipe Slope %	" Q-full " m^3/sec	Q-des / Q-full
M1	**M2**	**0.947**	**0.5**	**0.47**	**0.47**	**15.0000**	**89.39**	**0.118**	**450**	**0.22**	**0.10**	**0.74**	**60.3**	**1.36**	**230.50**	**230.28**	**230.40**	**230.50**	**229.28**	**229.18**	**1.22**	**0.26**	**0.0263**	**4.47**
M2	**M3**	**0.000**	**0.5**	**0.00**	**0.47**	**16.3585**	**85.24**	**0.112**	**525**	**0.53**	**0.10**	**0.52**	**146.9**	**4.72**	**230.28**	**229.75**	**230.30**	**230.87**	**229.18**	**229.08**	**1.69**	**0.23**	**0.0458**	**2.45**
M3	**M4**	**1.261**	**0.5**	**0.63**	**1.10**	**21.0822**	**73.60**	**0.226**	**525**	**0.43**	**0.33**	**1.04**	**118.0**	**1.88**	**229.75**	**229.32**	**229.97**	**230.40**	**229.08**	**228.75**	**1.32**	**0.23**	**0.0458**	**4.93**
M4	**M5**	**0.000**	**0.5**	**0.00**	**1.10**	**22.9669**	**69.87**	**0.214**	**600**	**0.46**	**0.15**	**0.76**	**126.0**	**2.77**	**229.32**	**228.86**	**229.82**	**230.72**	**228.75**	**228.60**	**1.97**	**0.18**	**0.0692**	**3.10**
M6	M7	1.230	0.5	0.62	0.62	15.0000	89.39	0.153	600	0.09	0.02	0.54	24.9	0.77	230.40	230.31	230.38	230.40	228.70	228.69	1.70	0.18	0.0692	2.21
M7	M5	0.000	0.5	0.00	0.62	15.7678	86.99	0.149	600	0.52	0.08	0.53	143.9	4.56	230.31	229.79	230.30	230.92	228.69	228.60	2.23	0.18	0.0692	2.15
M5	**END**	**1.042**	**0.5**	**0.52**	**2.24**	**25.7356**	**65.09**	**0.405**	**750**	**0.41**	**0.15**	**0.92**	**114.0**	**2.07**	**228.86**	**228.45**	**229.67**	**230.50**	**228.60**	**228.45**	**1.90**	**0.13**	**0.1435**	**2.82**
												SUM L =	**565.2**					Lower Critical HGL by		1.22				

Target = T.O.W. (228.00+0.45=228.45)

Note: Rows are coloured to assist in differentiate between branches off the critical path

APPENDIX C

Servicing Criteria Sheets

CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

SERVICING CRITERIA

TO BE SUBMITTED AS PART OF
APPROVAL PROCESS WITH SERVICING PLANS

LOCATION: Aurora at North Point Subdivision

DRAWING REFERENCES: Figures 1.0 – 8.2, Appendix A - C

SUBMITTED BY (FIRM): Stantec Consulting Inc. DATE: May 2016

WATER:

SERVICE AREA: (See Figure 1.0 – 2.0)

Present: 31.254 ha
Ultimate: 46.856 ha

FEEDPOINT LOCATIONS: McPhillips Street at Murray Avenue
McPhillips Street at Chief Peguis Trail

FEEDPOINT DESIGN PRESSURE (max day demand conditions):
- 400 kPa and 409 kPa

DESIGN FLOWS:

	Average		Peak		Fire	
Residential (single family)	225 + 10%	L/c/d		L/c/d	100	L/s
Residential (multi family)	225 + 10%	L/c/d		L/c/d	200	L/s
Commercial	16,800	L/ha/d		L/c/d	250	L/s
Industrial		L/c/d		L/c/d		L/s

MINIMUM SYSTEM PRESSURES:

Max. Hour: 207 (30) kPa (psi)

Fire: 140 (20) kPa (psi)

WASTEWATER

SERVICE AREA: (See Figure 3.0)

Present: 27.16 ha
Ultimate: 37.76 ha

DESIGN FLOWS:

		Average		Peak
Residential		270	L/c/d	Harmon's Peaking Factor
Commercial			L/c/d	28,100 L/hectare/day
Industrial			L/c/d	37,600 L/hectare/day

EXTRANEOUS FLOW ALLOWANCE:

Ground Water Infiltration: 2200 L/hectare/day
Manhole Inflow : 12 l/mh/min

GENERATED FLOWS FROM TOTAL SYSTEM:

Maximum: 35.73 l/s

LIFT STATION:

N/A

Note: See attached Appendix A for detailed computations.

LAND DRAINAGE

SERVICE AREA: (See Figure 4.0 & 5.0)

Present: 31.254 ha

Ultimate: 54.06 ha

PIPE SYSTEM:

Method Used: Rational X, Hydrograph ____.

Design Storm: (State formula used) $i = 1199/(t+8)^{0.828}$ (MacLaren 1974)

Design Hydraulic Grade Line - Minimum distance below gutter
(Degree of surcharge): Top of water at minimum 0.15m below gutter elevation

Describe any runoff retardation devices employed: Retention Pond, Orifice

Runoff Coefficients or % Imperviousness:

	Rational Method			Hydrograph Method
	Coefficient	Inlet Time		% Imperviousness
Single Family Dwelling	0.50	15	min.	
- conventional				
- zero lot line				
Multiple Family	0.60	10	min.	
Apartments				
Commercial	0.60	10	min.	
Parks	0.20	15	min.	
McPhillips Street	0.60	10	min.	

See Detailed Rational Spreadsheets for maximum generated flows from each outfall (Appendix B)

RETENTION SYSTEM:

Rainfall Formula: 25-year storm; $i = 1842/(t+9)^{0.842}$ (MacLaren 1974)
100-year storm; $i = 2318/(t+8)^{0.8555}$ (Acres 1978)

Normal Water Level (Elevation): 228.000 m

For Selected Rainfall Storms: See results in report section.

SUBMITTED BY: D. Mages, C.E.T, P.Eng.

DATE: May 2016

SEAL:





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Precinct 'G'
Municipal Servicing Brief



Stantec

Prepared for:
Ladco Company Limited

Prepared by:
Stantec Consulting Ltd.

APEGM
Certificate of Authorization
Stantec Consulting Ltd.
No. 1301

File: 116809411

May 10, 2017

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Figure 2.0 – Wastewater Sewer – Conceptual Plan

Figure 3.0 – Retention Pond – Conceptual Plan

1.0 Introduction

This brief has been prepared for the purposes of summarizing the conceptual servicing plan for the land that will be developed in Precinct G. The area is planned to be a combination of commercial, multi family residential and single family residential. The major land owner, Ladco Company Limited has initiated this study. It is important to note that the conceptual servicing shown in this brief can be deviated from, provided that the deviation can be supported through engineering. Such a deviation does not require an amendment to the Precinct Plan.

The Precinct encompasses approximately 338.5 Hectares and is bounded:

- on the north by the R.M of West St. Paul & City of Winnipeg Limits;
- on the east by the Canadian Pacific Railway Right of Way;
- on the south by Future Chief Peguis Trail Right of Way; and
- on the west by McPhillips Street.

2.0 Water

The water service area for the Precinct is shown on Figure 1.0. The system will have four feedpoints that are located;

- off Murray Ave between McPhillips Street and CPR Right of Way off a 250 mm watermain.
- at the intersection of Murray Avenue and the CPR Right of Way off a 200 mm watermain.
- the intersection of Red River Boulevard and the CPR Right of Way off a 300 mm watermain.
- The intersection of Fernbank Avenue and the CPR Right of Way off a 300 mm watermain.

The Systems performance will be analyzed at the detailed design stage, using various operating conditions with the EPA NET 2.0 computer simulation program produced by the Environmental Protection Agency (EPA).

The following design criteria and assumptions will be used in the analysis of the watermains:

1. Hazen-Williams coefficient of friction ("C" value) will be assumed to be 120 for watermains with diameters of 200 mm or smaller and 130 for diameters larger than 200 mm.

2. Population will be based on the following;
   - 3.05 persons per single family dwelling unit.
   - 2.30 persons per multi family dwelling unit.

3. The number of dwelling units served by each node will be calculated based on:
   - 12.29 dwelling units per hectare (single family)
   - 74.13 dwelling units per hectare (multi family)

4. The average daily per capita consumption will be 225 L + 10%.

5. The assumed average daily consumption for commercial will be 16,800 l/day/ha

6. The maximum day demand will be 1.6 x average day rate.

7. The peak hour multiplier will be 2.5.

8. Minimum design fire flows to be provided with maximum day demand on the system to be 100 l/s (single family) and 200 l/s (multifamily) and 250 l/s for commercial or greater based on FUS method.

9. For analysis purposes, the watermains will be assumed to be at a constant elevation considering the subdivision's ground elevations vary slightly. The watermain system will be tied into feedpoint nodes where simulated hydrant flow test data was provided by the City of Winnipeg.

10. Hydrant losses will be accounted for by calculating available fire flows using 25 psi as opposed to 20 psi.

3.0 Wastewater

The Precinct is located in Area 5 and the Area north of Area 5 of the North End Interceptor Sewer District.

The system will be separated into two catchment boundaries;

The southern catchment area (south of Murray Ave.) will flow through internal wastewater sewers then to the existing 1500 mm Interceptor Sewer within in the future Chief Peguis Trail Right of Way which eventually flows to the North End Pollution Control Centre. There is an existing 450mm stub that might be utilized as a connection to the existing 1500mm interceptor.

The northern catchment area (north of Murray Ave.) will flow through internal wastewater sewers that will be directed to Fernbank Ave. A new wastewater sewer will be installed within the Fernbank Right of Way Between the CPR tacks and Main Street and will be sized to handle the projected peak flows from the north catchment area. The new wastewater sewer will be connected to the existing 1350mm Interceptor Sewer on Main Street which flow to the North End Pollution Control Centre.

The contributing wastewater area (excluding the snow dump and old landfill) and proposed piping layout are shown on Figure 2.0.

Further details will be provided at the detailed design stage.

The design criteria and assumptions for the wastewater sewer system are:

1. Peak Design Flow = domestic sewage x peaking factor plus extraneous flow.
   The extraneous flows include groundwater infiltration and manhole cover inflow.

2. Domestic Sewage (Residential)
   Average Flow: 270 L/capita/day
   Peaking Factor: Harman's = 1 + 14/(4+(p/1000)^0.5))
   Population/dwelling = 3.05 persons (single family)
   = 2.30 persons (multi family)
   Dwelling Density = 12.29 dwellings per Hectare (single family)
   = 74.13 dwellings per Hectare (multi family)

3. Peak Commercial Flow: 28,100 L/hectare/day

4. Extraneous Flow
   a) Groundwater Infiltration: 2200 L/hectare/day
   b) Manhole Infiltration: 12 L/min/MH
   Manhole Spacing: 1.6 Manholes/hectare

5. Pipe selection was based on full flow pipe with Manning's N = 0.013 and minimum velocity of 0.60 m/sec. Adequate pipe cover and slope will be illustrated on the detailed design drawings.

4.0 Land Drainage

4.1 BACKGROUND

Precinct G is in the West Kildonan Drainage Area in Northwest Winnipeg and is comprised of approximately 338.5 ha. The precinct area is bounded:

- on the north by the R.M of West St. Paul & City of Winnipeg Limits;
- on the east by the Canadian Pacific Railway Right of Way;
- on the south by Future Chief Peguis Trail Right of Way; and
- on the west by McPhillips Street.

The precinct will contain naturalized retention ponds that will store and attenuate runoff from the development. The precinct area and retention ponds are illustrated in Figure 3.0.

The runoff from the lands south of Murray Avenue, the Murray Avenue Right of Way and the lands 20 meters north of Murray Avenue will flow to a future retention pond located on the south side of Murray Avenue. This retention pond will discharge to the existing interconnecting pipe on Murray Avenue. The normal water level of the proposed retention pond south of Murray Avenue will be controlled by an Orifice Manhole located approximately 166 meters West of the CPR Right of Way.

The remainder of Precinct G (except for the Snow Dump and Old Landfill) will flow to a network of proposed retention ponds located throughout Precinct G. The existing drainage from the City snow dump and old landfill drain south to existing ditch that runs through an easement along the south property line to a catch basin at the CPR line and Fernbank Avenue. The drainage for snow dump and landfill will remain unchanged during development and continue to drain to Fernbank Avenue. Interconnecting pipes will connect the network of retention ponds which will discharge to an existing 1050 LDS that has been stubbed at the rear property line of Spruce Thicket Walk. The runoff will then flow to Lake 3-5 and eventually to the Red River. The normal water level of these proposed ponds will be controlled by a Weir Manhole that will be located near the connection to the 1050 LDS Stub at the rear lots of Spruce Thicket Walk.

Interconnecting pipes will be stubbed to the west edge of Precinct G for connecting the future retention ponds from the lands West of McPhillips Street. The design engineer for the lands west of McPhillips Street will be responsible for controlling discharge to these stubs to flows that will be established during detailed design.

A 1350 mm Land Drainage Sewer will be installed in the Fernbank Avenue Right of Way from Main Street to River Grove Drive to alleviate the existing LDS System East of the CPR Right of Way from the additional runoff created by Precinct G. This was discussed in detail in the UMA Engineering LTD. 'West Kildonan Land Drainage Study' report that was prepared in July 1991.

Further analysis will be done at the detailed design stage.

4.2 MODEL

4.2.1 Design Criteria

The following design criteria and assumptions will be followed during the modeling analysis of the proposed drainage system.

4.2.1.1 Rainfall

The drainage system will be analyzed using design storm hyetographs discretized into 5 minute time steps. The intensity equations are presented in Table 1.0.

Table 1.0 – Rainfall Intensity

Storm	Type	Intensity (mm/hr)
5 yr Return Period MacLaren 1974	Chicago Distribution	$i_5 = \frac{1199}{(t+8)^{0.828}}$
25 yr Return Period MacLaren 1974	Chicago Distribution	$i_{25} = \frac{1842}{(t+9)^{0.842}}$
100 yr Return Period Acres 1978	Chicago Distribution	$i_{100} = \frac{2318}{(t+8)^{0.856}}$
Historic Bernie Wolfe 2010	Observed Event	Variable
5 yr Spring Return Period MacLaren	Chicago Distriubtion	$i_5 = \frac{329}{(t+2.7)^{0.8}}$

4.2.1.2 Retention Pond

The specific City of Winnipeg criteria guidelines applicable to the Retention Lake are as follows:

- Pond to be of naturalized design.
- 1.20 m lake rise for a 25 year storm (maximum).
- Freeboard Elevation 0.60 m above High Water Level (HWL).

- 7:1 side slopes above normal water level and extending 3.0 m horizontally into the water, and 4:1 side slopes below water.
- 2.5 m minimum water depth.
- Maximum pond drawdown times:
  - 48 hours for the 5 year storm
  - 120 hours for the 100 year storm

4.3 LAND DRAINAGE SEWERS

This section details the design criteria, parameters, and assumptions to be used in the design of the land drainage sewers. The piped system will be designed using the Rational Design method and will be based on the following criteria:

- 5 year storm intensity equation I (mm/hr) = $1199/(t+8)^{0.828}$ ---> (MacLaren 1974).
- Pipe friction factor (Manning's n): 0.013 (Concrete and PVC).
- Minimum full flow velocity: 0.90 m/s.
- Maximum full flow velocity: 3.05 m/s.
- The 1:5 year return frequency will be used for the design of the storm sewer system.
- Tailwater Condition at the Lake = NWL + 0.45 m

Runoff Design Criteria

The rational design method will be used to estimate rainfall runoff to be handled by the piped system:

Q = (1/360) CiA

Where:

Q = runoff (CMS)

C = runoff coefficient

i = rainfall intensity (mm/hr)

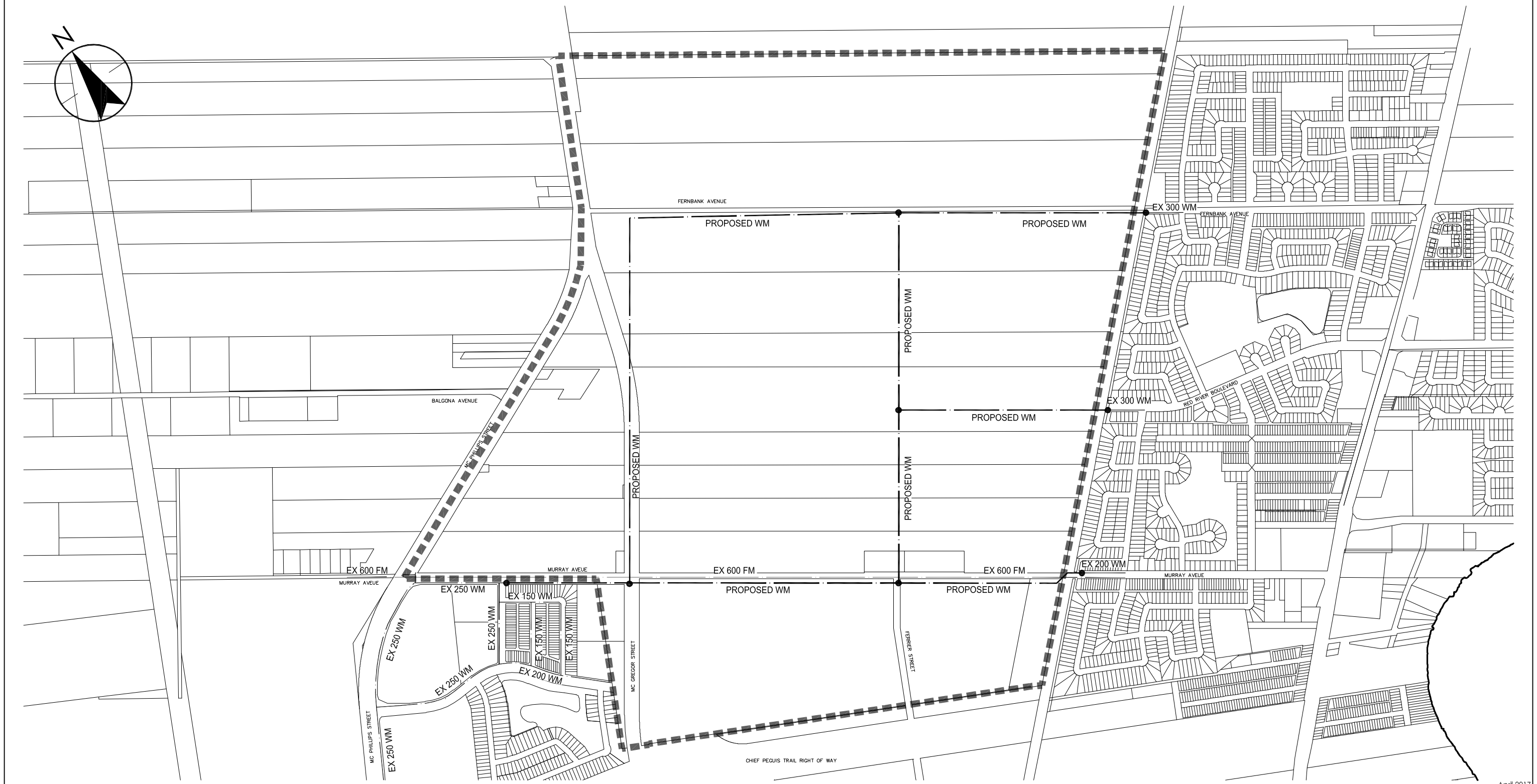
A = area (hectares)

The drainage catchments include single family residential (C=0.5), multi-family residential (C=0.6), Commercial (C=0.6) and park (C=0.20).

System Design Criteria

The land drainage sewers in the precinct will be designed as surcharged pipe systems to

accommodate the calculated runoffs. The surcharge level of the system will be designed to be at a minimum of 0.15m below the proposed gutter elevations. The Manning's Equation with an N = 0.013 for concrete or PVC pipe will be used to determine pipe sizes and hydraulic losses within the system. At the outfalls to the lakes, the hydraulic grade line will be assumed to be 0.45 m above the NWL elevation to ensure that the pipes can discharge the peak flows as the lake rises during the storm event.



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Legend

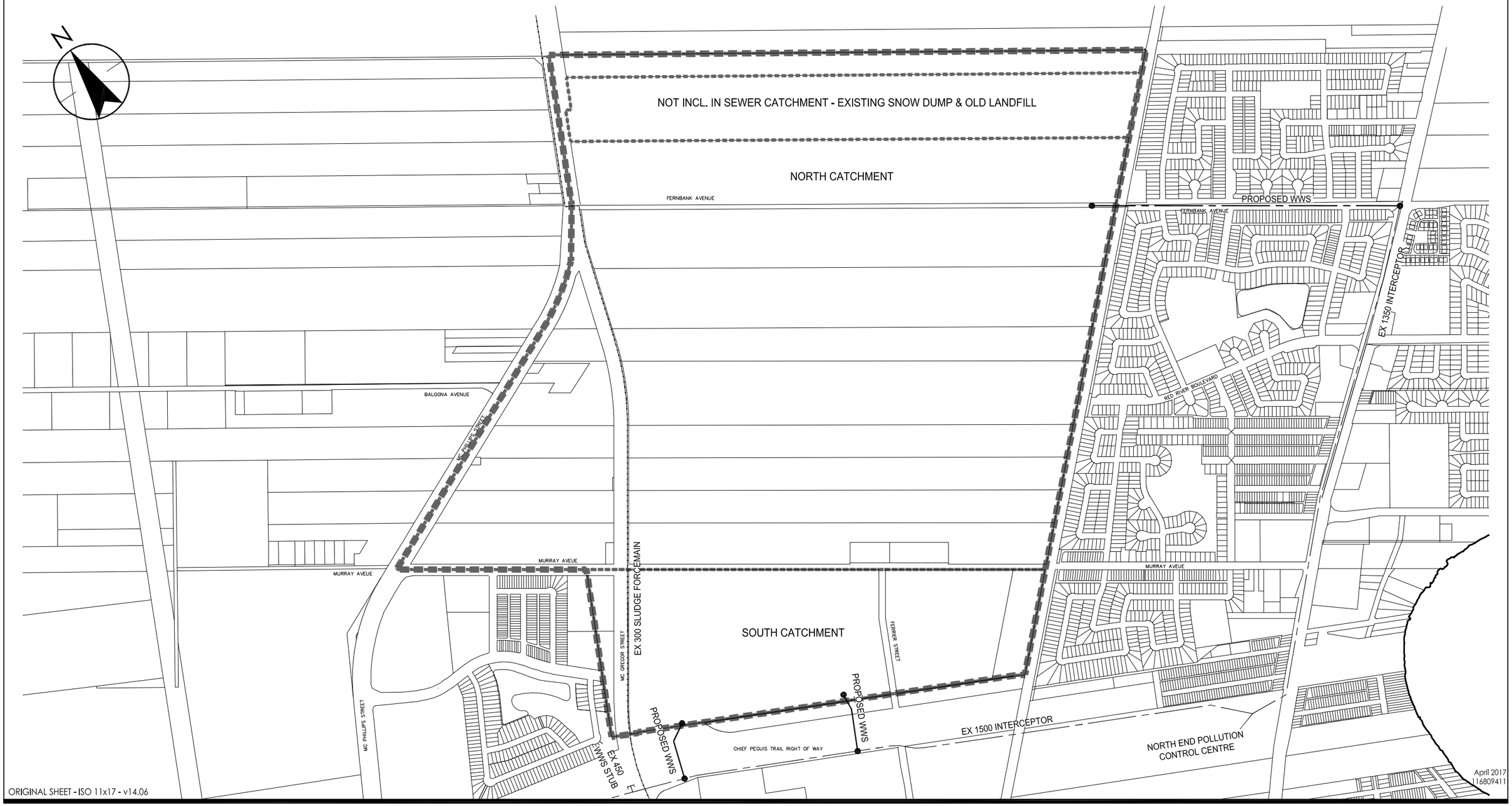
- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- PRECINCT G BOUNDARY (338.5 ha)

Notes

Client/Project
LADCO COMPANY LIMITED
PRECINCT 'G'

Figure No.
1.0

Title
WATERMAIN
CONCEPTUAL PLAN



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Legend

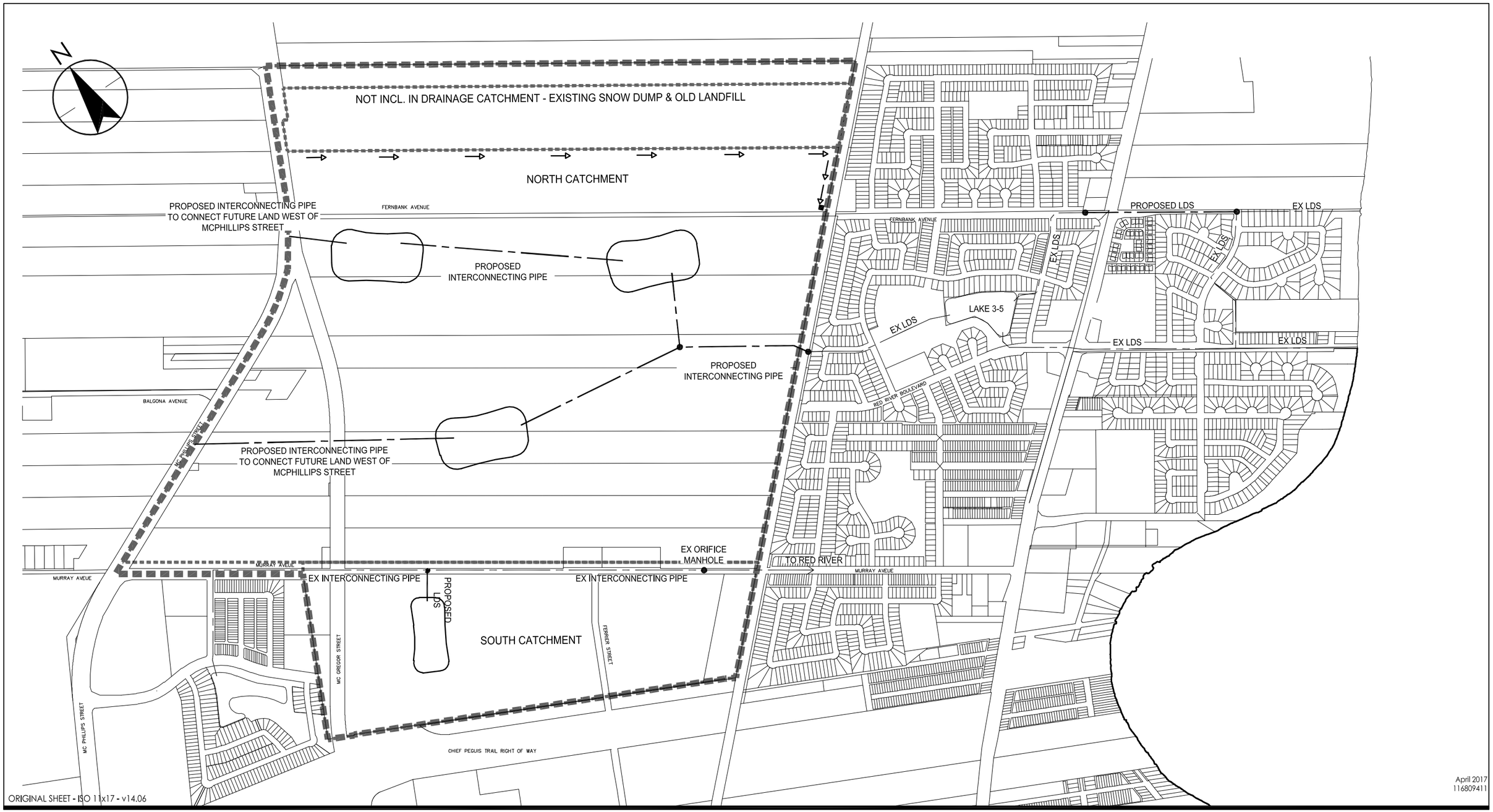
- PROPOSED WASTEWATER SEWER
- EXISTING INTERCEPTOR
- EXISTING SLUDGE FORCEMAIN
- PRECINCT G BOUNDARY (338.5 ha)
- WASTEWATER SEWER CATCHMENT BOUNDARIES

Notes

Client/Project
LADCO COMPANY LIMITED
PRECINCT 'G'

Figure No.
2.0

Title
WASTEWATER SEWER
CONCEPTUAL PLAN



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Legend

- PROPOSED LAND DRAINAGE SEWER
- EXISTING INTERCONNECTING PIPE AND LAND DRAINAGE SEWER
- PRECINCT G BOUNDARY (338.5 ha)
- DRAINAGE CATCHMENT BOUNDARIES
- EXISTING CATCHBASIN
- EXISTING DITCH FLOW

Notes

Client/Project
LADCO COMPANY LIMITED
PRECINCT 'G'

Figure No.
3.0

Title
LAND DRAINAGE SEWER
CONCEPTUAL PLAN

Precinct G
Transportation Study

Transportation Study

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February 15, 2018

Sign-off Sheet

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Prepared by 
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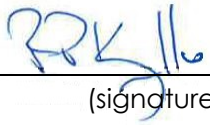
Steven Florko, EIT

Reviewed by 
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Robert Kurylko, P. Eng.

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Appendix A Peak Hour Traffic Operations Analysis Results
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1.0 BACKGROUND

1.1 PURPOSE

This report includes discussion on the development of collector street concepts for Precinct G, evaluation of those concepts, and evaluation of Precinct G impacts on the adjacent street network.

1.2 TRANSPORTATION PHILOSOPHY

The transportation system for Precinct G should conform to the key strategic goals in Winnipeg's *Transportation Master Plan (2011)*. Those goals are:

1. A transportation system that is dynamically integrated with land use.
2. A transportation system that supports active, accessible, and healthy lifestyle options.
3. A safe, efficient, and equitable transportation system for people, goods and services.
4. Transportation infrastructure that is well maintained.
5. A transportation system that is financially sustainable.
6. A transportation system that reduces its greenhouse gas emissions footprint and meets or surpasses climate change and emissions reduction goals set by the City and the Province.

Applied to Precinct G, these goals lead to the following priorities:

- Provisions should be made for short trips by active transportation modes to nearby neighborhoods, schools, and retail amenities.
- Provisions should be made for connections to regional transportation facilities (McPhillips Street, Main Street, Ferrier Street, Chief Peguis Trail) for longer distance trips to employment centres.
- Collector streets should be arranged in a manner favorable to transit operations.

With these priorities in mind, two street network concepts were evaluated for Precinct G.

1.3 STREET NETWORK CONCEPTS

Two street network concepts were compared to evaluate the impact of network configuration within Precinct G and the adjacent existing street network. At this stage only the general street layouts have been considered. Detailed residential street layouts and multi-use path alignments have not been identified. These features will be reviewed as part of the subdivision and rezoning process.

Figure 1 shows Street Network Concept 1.

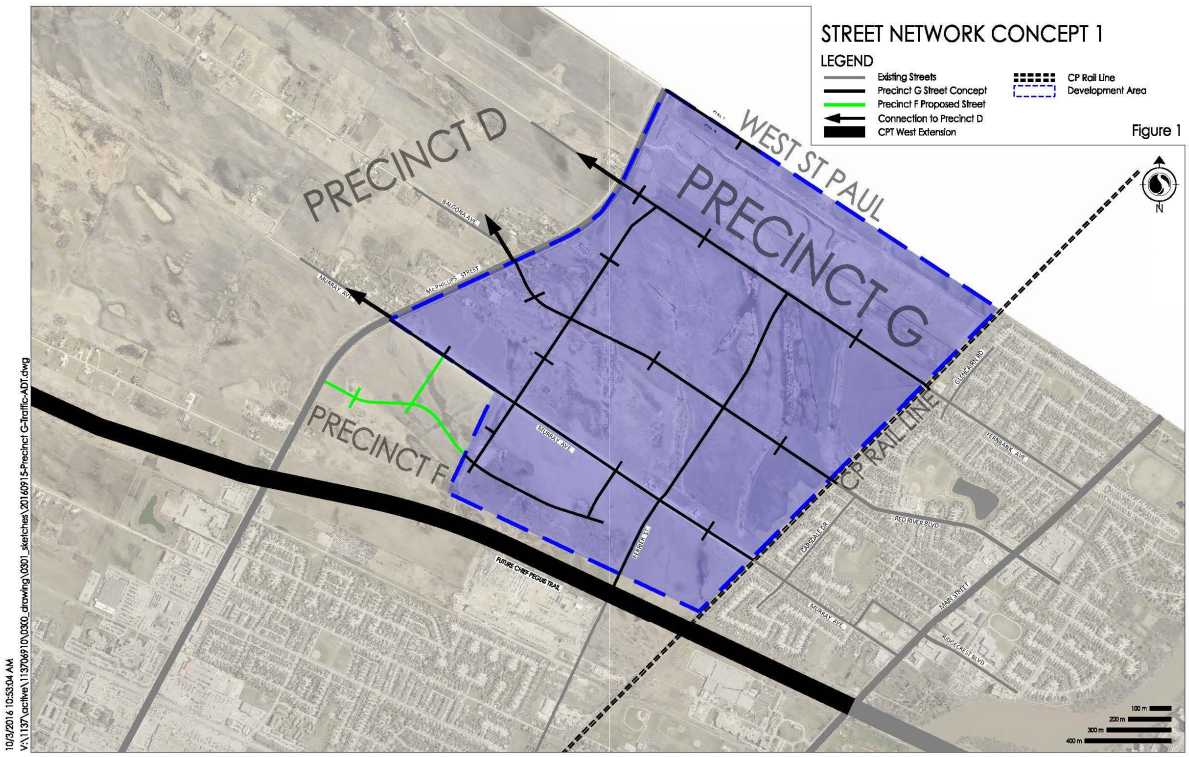


Figure 1: Street Network Concept 1

Concept 1 is based on a grid configuration with the following general street layout:

- Fernbank Avenue, Red River Boulevard, and Murray Avenue connect Main Street and McPhillips Street through the Precinct.
- Ferrier Street continues north from Murray Avenue to Fernbank Avenue.
- A second north-south link aligned along the former McGregor Street right-of-way approximately 700 m east of McPhillips Street.

Figure 2 shows Street Network Concept 2.

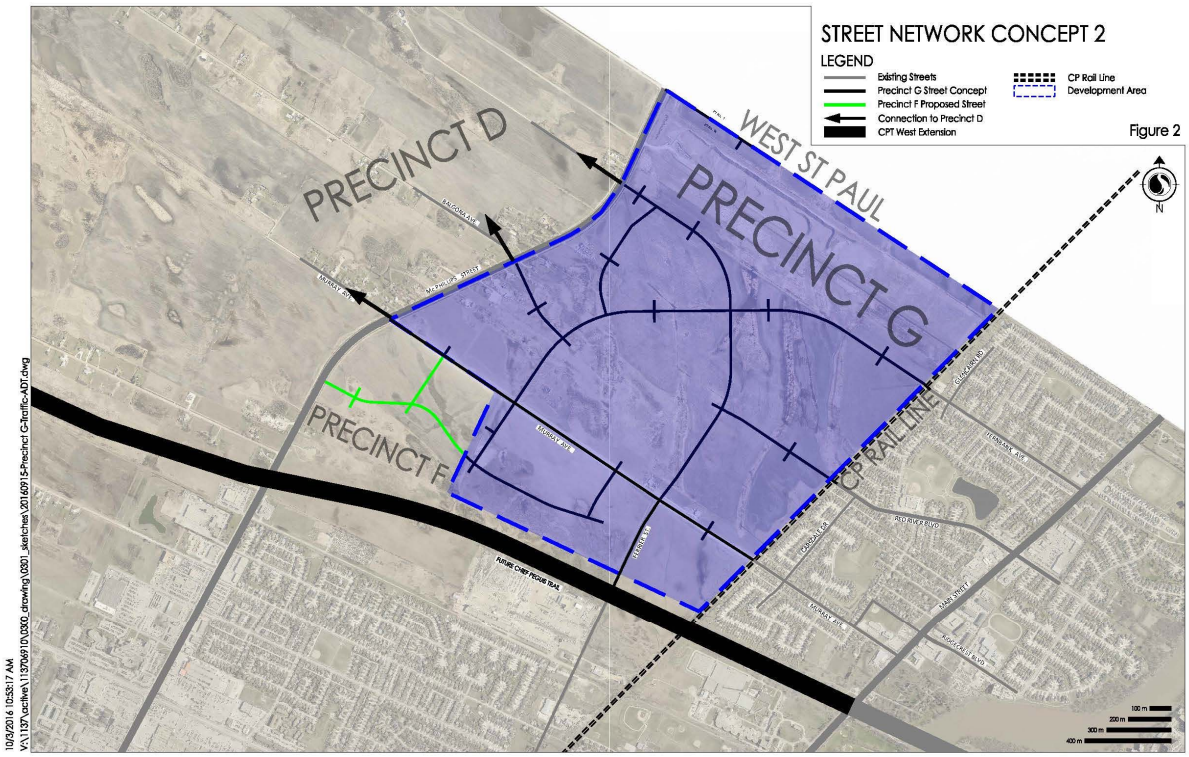


Figure 2: Street Network Concept 2

Concept 2 provides a continuoust connection between Precinct G and Precinct D to the west based on an indirect Ferrrier Street extension. The general street layout is:

- Ferrier Street continues north from Murray Avenue and curves to the west, providing a connection to McPhillips Street in line with the existing portion of Fernbank Avenue.
- Fernbank Avenue continues west across the CP Rail Line, curves to the south to intersect Ferrier Street, and continues south west before turning south to connect to Murray Avenue approximately 700 m east of McPhillips Street.
- Red River Boulevard and Balgona Avenue extend into, but terminate within the Precinct residential areas.

Note that the proposed street network for Precinct F—to the southwest of Precinct G—is shown to provide additional context of the street network.

1.4 DEVELOPMENT PARAMETERS

The developable area was determined using the following assumptions:

- Precinct G overall area of 815 acres.
- The existing snow dump and landfill areas with a gross area of approximately 100 acres was removed from developable area
- 4% of gross area was assigned to land drainage system (LDS).
- Public reserve designated as 8% of the area remaining after LDS is subtracted, plus an area equivalent to 25% of the LDS area.
- Developable area is the area remaining after LDS and Public Reserve areas are subtracted from the gross area.

This resulted in a developable area of approximately 625 acres. The developable area was distributed as follows:

- Single-Family Residential covering 85% of developable area.
- Multi-Family Residential covering 10% of developable area.
- Commercial/Business/Institutional areas covering 5% of developable area.

Development in these areas was estimated using the following assumptions:

- Single-Family Residential areas developed to a density of 5.5 dwelling units per acre.
- Multi-Family Residential areas developed to a density of 20 dwelling units per acre.
- Commercial/Business/Institutional areas consisting of a K-8 school, and retail areas.

These assumptions gave the following full build out unit count estimates:

- 2,920 Single family homes
- 1,240 Multi-family units
- 90,000 square foot K-8 School
- 255,000 square feet of commercial floor area

Table 1 shows the development parameters in table form.

Table 1: Development Parameters

Precinct G Component	Area
Gross Area	815 ac
Snow Dump and Landfill	100 ac
Remaining	715 ac
Land Drainage System (LDS)	29 ac
Remaining	686 ac
Public Reserve	62 ac
Developable Area	624 ac
Single Family Residential	531 ac
Develop at 5.5 du/ac	2,920 dwelling units
Multi-Family Residential	62 ac
Develop at 20 du/ac	1,240 dwelling units
Commercial/Business/Institutional	31 ac
K-8 School and Commercial Areas	90,000 ft^2 K-8 School 255,000 ft^2 Commercial Floor Area

For this study development of Precinct G was assumed to be 100% complete by 2040.

1.5 STUDY AREA

The study area is bounded by the north limit of the City of Winnipeg, the CP Rail Line running parallel to Main Street, The Chief Peguis Trail right of way, the boundary with Precinct F, and McPhillips Street. The study area also included Fernbank Avenue, Red River Boulevard, Ridgecrest Avenue, and Murray Avenue from the CP Rail Line to Main Street. Figure 3 shows the study area:



Figure 3: Study Area

With the west extension of the Chief Peguis Trail (CPT) and the construction of an interchange at CPT and Main Street, the intersection of Main Street and Murray Avenue will likely be reconfigured to prohibit left-turns from Murray Avenue to northbound Main Street. Vehicles wanting to make the eastbound to northbound movement will likely use the signalized intersection at Ridgecrest Avenue. The study area included Ridgecrest Avenue so that this effect could be considered.

1.6 CHIEF PEGUIS TRAIL TRANSPORTATION STUDY

A transportation study for the west extension of the Chief Peguis Trail (CPT) from Main Street to Brookside Boulevard was being completed at the time the Precinct G transportation study was conducted. The CPT extension is to run just south of Precinct G, with connections at Ferrier Street and McPhillips Street serving Precinct G and other nearby areas. Projections of traffic generated from Precinct G—and other areas of new development in north Winnipeg and West St Paul—were an integral part of the CPT study.

Later sections of this report include discussion on the integration of this study with the CPT study, considering several factors:

- Horizon year for analysis (Section 2.1)
- Background traffic growth (Section 2.3.1)
- Site generated traffic (Section 2.4)

2.0 TRAFFIC VOLUMES

2.1 HORIZON YEAR

Precinct G development was included in a transportation analysis on the Chief Peguis Trail west extension from Main Street to Brookside Boulevard. That study used an analysis year of 2031. Traffic projections for Precinct G and other areas were based on new housing projections in the Winnipeg area to 2031.

In this study the horizon year was set to 2040—consistent with the assumed horizon for full build out of Precinct G.

2.2 EXISTING TRAFFIC CONDITIONS

Existing traffic conditions were measured by a series of traffic counts conducted by Stantec in 2015. Traffic counts were conducted for the weekday AM and PM peak periods at the following intersections:

- Main Street at Fernbank Avenue
- Main Street at Ridgecrest Avenue
- Main Street at Murray Avenue
- McPhillips Street at Balgona Avenue
- McPhillips Street at Murray Avenue
- Murray Avenue at Ferrier Street

Additionally, 12-hour (6:00 AM – 6:00 PM) Traffic counts were conducted just east of the CP rail line:

- Fernbank Avenue at Glencairn Road
- Red River Boulevard at Carsdale Drive

Finally, a 24-hour count was conducted at Murray Avenue and Carsdale Drive. This count was used to determine the relationships between 24-hour traffic and traffic from shorter time frames, such as the peak hours. For McPhillips Street and Main Street, average daily traffic volumes were taken from the City of WInnipeg's 2015 Traffic Flow Map. The City of Winnipeg provided a peak period traffic count for the intersection of Main Street and Red River Boulevard from 2012.

Figure 4 shows the 2015 existing (background) average daily traffic (ADT) volumes from the study area.

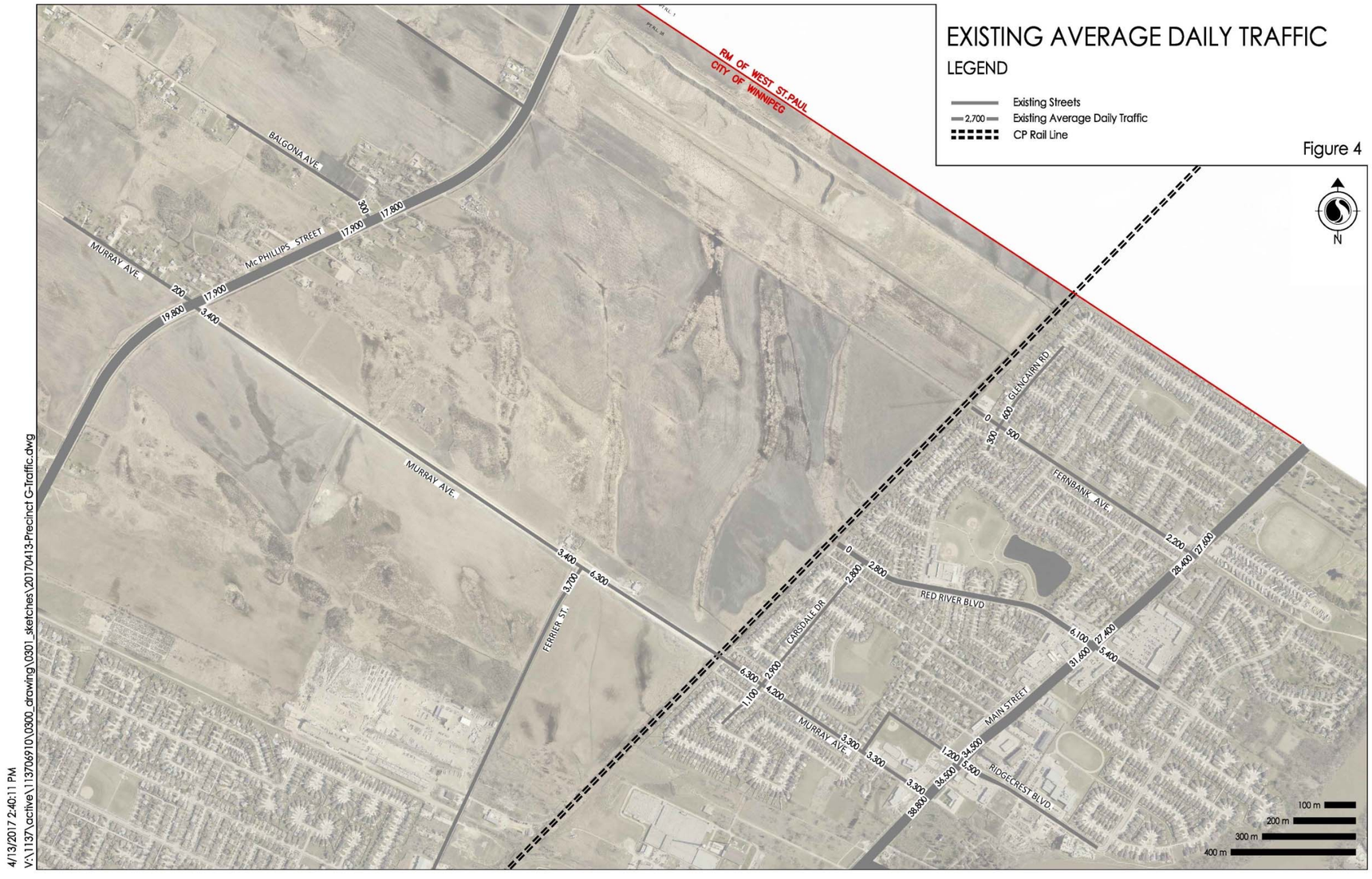


Figure 4: 2015 Background Traffic

2.3 FUTURE BACKGROUND TRAFFIC

2.3.1 Integration with Chief Peguis Trail Extension Transportation Study

Future background traffic growth on McPhillips Street, Ferrier Street, and Main Street was based on traffic growth projections from the Chief Peguis Trail (CPT) Transportation Study. That study identified the potential for 18,000 new residential dwelling units in north Winnipeg and the Rural Municipality (RM) of West St Paul by 2031.

The traffic projections are based on current transit share patterns existing in the City of Winnipeg and the surrounding municipalities. Current transit capture at the northern reaches of the City of Winnipeg, according to the 2007 Winnipeg Area Transportation Study, are estimated to be in the 5 to 10% range. The same study reports that auto driver and passenger trips account for 95% of all trips originating or destined to the East and West St. Paul municipalities.

In the CPT Transportation Study, background traffic growth projections on McPhillips Street, Ferrier Street, and Main Street were driven by new residential development in northwest Winnipeg and West St Paul. The study used an estimate of 18,000 new dwelling units in northwest Winnipeg and West St Paul by 2031. Other new developments—such as commercial areas or schools—were not included in the CPT study. The majority of the trips from beyond the City of Winnipeg boundaries were assumed to be auto based as the current transit network does not exist into these areas.

In the Precinct G Study background traffic estimates were driven by development in Precinct D, Precinct F, and West St Paul. Compared to the CPT Study which was conducted in 2014, more detailed information was available on Precinct D and Precinct F, so the residential unit count estimates in the Precinct G Study differ from the projections used in CPT Study. Since completion of the CPT Study, the City of Winnipeg's travel demand model has been updated. Projected residential unit counts for West St. Paul were adjusted to be more reflective of information used to develop the City of Winnipeg's updated travel demand model.

Table 2 shows the background traffic development areas used in the Precinct G study and the unit counts compared to the CPT Study.

Table 2: Background Traffic Development Areas

Area	Approximate Gross Acreage	CPT Study (2031 Horizon)		Precinct G Study (2040 Horizon)	
		Residential Units	Other Development	Residential Units	Other Development
Precinct D	1,600	4,258	-	3,000	-
Precinct F	100	643	-	547	500,000 ft² Commercial 55,000 ft² School
West St Paul	2,700	7,000	-	6,717	216 ac Industrial
Total	**4,400**	**11,901**	**-**	**10,264**	**500,000 ft² Commercial** **55,000 ft²School**

Information available in 2016 for the Precinct G Study included a concept plan for Precinct F, and an updated timeline for Precinct D. With a gross area of 1,600 acres, Precinct D was assumed to have 1,550 acres for residential development at a fully built density of 5 dwelling units per acre, at a split of 55% single family homes and 45% multi-family units. The other 50 acres of the gross area were assumed to be devoted to commercial use, with an estimated 500,000 ft² of retail floor area. Precinct D development is not anticipated to start until the servicing requirements are completed. These servicing requirements include services within Precinct G. Therefore, the 2040 timeframe for development of Precinct D may be unrealistic and as a result, only 40% of the Precinct D units were assumed to be developed for the 2040 analysis scenario. The actual timing of 40% development completion of Precinct D development may occur at some point beyond 2040.

Residential unit count estimates for West St. Paul were modified from those projected and used in the CPT Study, to produce background traffic volumes on McPhillips Street and Main Street that better align with the City of Winnipeg's travel demand model. West St. Paul residential unit estimates were modified to produce AM peak hour volumes more in line with the travel demand model results. This updated residential unit estimate resulted in PM peak hour northbound volumes that were also in line with the projected PM Peak outbound movements in the travel demand model. The reverse movements produced by the travel demand model did not align with expected traffic flows based on projected generation values and existing traffic patterns. The travel demand model predicted future background PM peak hour southbound volumes would be less than existing. This scenario was considered to be unrealistic. With the consent of City of Winnipeg Public Works Department, the PM peak hour southbound volumes were adjusted to reflect the same updated residential unit count derived to establish the AM peak hour volumes predicted in the travel demand model.

West St. Paul development parameters were further modified to include 216 acres of industrial development. This was based on known development plans.

Table 3 shows the background traffic growth on McPhillips Street, Ferrier Street, and Main Street as calculated in the CPT study and in the Precinct G study. These volumes assume little or no mode share for transit based on current transit service levels.

Note that for the background traffic growth rate calculations the 2015 traffic volumes on McPhillips Street, Ferrier Street, and Main Street have been adjusted from the existing volumes shown on Figure 4 to account for projected redistribution of existing traffic as a result of the Chief Peguis Trail west extension. Spreadsheets showing the projected redistribution of existing traffic are included in Appendix C.

Table 3: Background Traffic Growth

Street Segment	CPT Study			Precinct G Study		
	Background 2014 ADT*	Background 2031 ADT	Background Growth Rate 2014-2031	Background 2015 ADT*	Background 2040 ADT	Background Growth Rate 2015-2040
McPhillips St North of CPT	20,000	42,200	4.5%	23,700	52,500	3.2%
Ferrier St North of CPT	2,800	9,400	7.4%	3,700	6,200	2.1%
Main St North of CPT	21,700	42,300	4.0%	40,700	56,300	1.3%
Total	**44,500**	**93,900**	**-**	**68,100**	**115,000**	**-**

* Note there are discrepancies between the existing (2014) background traffic ADT used in the CPT study and the existing (2015) background traffic used in the Precinct G study. The discrepancies are due to the differences in methodologies used to calculate ADT volumes in each study. In the CPT Study ADT volumes were expanded from the peak hours, while in the Precinct G Study ADT volumes were taken from the City of Winnipeg's 2015 Traffic Flow Map and expanded from counts conducted in 2015.

Growth rates were calculated using the following formula:

$$g = \sqrt[(Year_{Future} - Year_{Base})]{\frac{V_{Future}}{V_{Base}}} - 1$$

Where

g	Calculated growth rate
$Year_{Future}$	The future year growth was projected to (2031 or 2040)
$Year_{Base}$	The base year the projection was made from (2014 or 2015)
V_{Future}	The volume in the future year (2031 or 2040)
V_{Base}	The volume in the base year (2014 or 2015)

Note that there were some differences in growth rates between the two studies. Growth rate differences can be attributed to the following factors:

- The projected 2040 background ADT volumes in the Precinct G Study were similar in magnitude to the projected 2031 Background ADT volumes in the CPT Study. Since the background ADT growth in the Precinct G Study occurred over a longer time frame (2015 to 2040 vs. 2014 to 2031) the resulting annual growth rates were smaller.

- The CPT study assumed Ferrier Street would extend north of Fernbank Avenue into West St Paul (south of PTH 101), but the Precinct G study assumed that Ferrier Street would terminate at Fernbank Avenue. In the Precinct G study there was no direct link to West St Paul through Precinct G[1]. This change shifted traffic growth from Ferrier Street to McPhillips Street and Main Street.

- Main Street 2015 background traffic was higher in the Precinct G study(based on actual counts), resulting in lower calculated growth rates.

Figures showing background traffic volumes for the 2040 study horizon are included in Section 3.1.

2.4 SITE GENERATED TRAFFIC

2.4.1 Integration with Chief Peguis Trail Transportation Study

Trip generation estimates for Precinct G were included as part of the Chief Peguis Trail (CPT) transportation study. In that study trip generation for Precinct G was based on estimated growth in housing in north Winnipeg and West St Paul to 2031. In the Precinct G transportation study trip

[1] Preliminary discussions with staff from the City of Winnipeg and the Rural Municipality of West St. Paul indicated that a Ferrier Street extension into the Rural Municipality of West St. Paul was not seen as necessary.

generation from Precinct G was based on full build out development plans, assumed for a 2040 horizon year. Table 4 shows the estimated unit counts used in the CPT study, compared to the unit counts based on Precinct G development plans, as used in this study.

Table 4: Precinct G Unit Counts - CPT Study vs Precinct G Study

Development Type	CPT Study Estimated Unit Count (2031 Build Out)	Precinct G Development Plan Unit Count (2040 Build Out)
Single Family Homes	1,249 du	2,940 du
Multi-Family Residential Units	1,022 du	1,220 du
Commercial Floor Area	-	255,000 ft^2
Schools	-	90,000 ft^2

The Precinct G development plans also include commercial floor area and a school which were not included in the CPT study.

2.4.2 Trip Generation

Trip generation estimates were conducted based on the Precinct G development parameters listed in Section 1.4. The parameters were:

- 2,940 Single family homes
- 1,220 Multi-family units
- 90,000 square foot K-8 School
- 255,000 square feet of commercial floor area

Trip generation data was taken from the Institute of Transportation Engineers *Trip Generation Manual, 9th Edition*. The *Trip Generation Manual* provides data that can be used to estimate vehicle trip demand resulting for various land uses. The *Trip Generation Manual* is a standard reference used throughout North America for trip generation estimates.

Trip generation data is shown in Table 5.

Table 5: Trip Generation

Land Use (Land Use Code)	Land Use Quantity (X)	Time Period	Trip Generation Rate (R)	Trip Generation Estimate (X × R)
Single Family Homes (210)	2,940 dwelling units	AM PM ADT	0.75 1.00 9.52	2,205 (551 in, 1,654 out) 2,940 (1,852 in, 1,088 out) 27,990 (13,995 in, 13,995 out)
Multi-Family Units (230)	1,220 dwelling units	AM PM ADT	0.44 0.52 5.81	537 (91 in, 446 out) 634 (425 in, 209 out) 7,090 (3,545 in, 3,545 out)
Elementary School (520)	90 x 1,000 square feet gross floor area	AM PM ADT	5.20 1.21 15.43	468 (262 in, 206 out) 109 (49 in, 60 out) 1,389 (694 in, 695 out)
Shopping Centre (820)	255 x 1,000 square feet gross floor area	AM PM ADT	0.96 3.71 42.70	245 (152 in, 93 out) 946 (454 in, 492 out) 10,890 (5,445 in, 5,445 out)
			Total	**3,455 (1,056 in, 2,399 out)** **4,629 (2,780 in, 1,849 out)** **47,359 (23,679 in, 23,680 out)**

Note that the *Trip Generation Manual* does not include a land use category for K-8 Schools, so the *Elementary School* category was used instead. The *Elementary School* category had slightly higher trip generation rates than the *Junior High School* category, and thus gives a more conservative (higher trip generation) estimate.

2.4.3 Mode Split Adjustments

At this stage of the planning process non-passenger-vehicle trips were subtracted from the trip generation estimates and not modeled in detail. A 10% modal split reduction was applied to all trip generation estimates. Existing city-wide transit usage accounts for approximately 6% of all trips. The 10% modal split assumes increased transit usage and some trips occurring via active transportation, rather than vehicular modes.

Reducing the total trip generation by 10% to account for modal split gives the following trip generation totals:

- AM: 3,110 (950 in, 2,160 out)
- PM: 4,166 (2,502 in, 1,664 out)
- ADT: 42,623 (21,311 in, 21,312 out)

2.4.4 Trip Distribution

The net trip generation estimates remaining after applying the modal split reduction were distributed by direction and trip type. Trips generated by residential land uses were distributed independently from trips generated by commercial or school land uses. Table 6 shows the trip distribution patterns for trips generated by the Precinct G residential land uses. For reference the trip distribution pattern used in the CPT transportation study is also shown.

Table 6: Precinct G Residential Trip Distribution

Distribution	CPT Study Distribution	AM Peak Hour Distribution	PM Peak Hour Distribution	ADT Distribution
External	100%	88%	91%	83%
McPhillips St North	32%	10%	10%	11%
McPhillips St South	15%	29%	27%	24%
Ferrier St South	53%	39%	44%	38%
Main St North	-	5%	5%	5%
Main St South	-	5%	5%	5%
Nearby	-	7%	6%	9%
Precinct F Commercial	-	6%	6%	8%
Precinct F School	-	1%	0%	1%
Internal	-	5%	2%	8%
Precinct G Commercial	-	2%	2%	6%
Precinct G School	-	3%	0%	2%

The trip distribution patterns differed somewhat from the distribution used in the CPT study. In the CPT study the distribution was only to the north and south on McPhillips Street, and to the south on Ferrier Street. In this study the distribution pattern included distribution to the north and south on Main Street, as well as to schools and commercial areas in Precinct G and in Precinct F.

Trip distribution was developed through referencing the 2009 *Winnipeg Area Transportation Study* and output from the current Winnipeg Transportation Model. The Transportation Model identified that there was sufficient capacity along the McPhillips Street corridor south of Precinct G to attract trips anticipated to be destined to trip generators in employment and service areas south and west of the McPhillips Street corridor.

Table 7 shows the trip distribution pattern used for trips generated by the commercial development in Precinct G. Recall that commercial development in Precinct G was not included in the CPT transportation study, so there was no distribution pattern to reference from that study.

Table 7: Precinct G Commercial Trip Distribution

Distribution	AM Peak Hour Distribution	PM Peak Hour Distribution	ADT Distribution
External	60%	20%	40%
McPhillips St North	24%	8%	16%
McPhillips St South	36%	12%	24%
Internal and Nearby	40%	80%	60%
Direct	40%	15%	30%
Linked	-	65%	30%

Engineering judgment suggests that a large portion of trips generated by Precinct G commercial development will occur to or from the new residential development in Precinct G, Precinct F, Precinct D, and West St Paul. These trips were categorized as "direct trips" or "linked trips":

- **Direct Trips:** Begin in a new residential area (Precinct G, Precinct F, Precinct D, or West St Paul) and end at Precinct G commercial areas, or vice-versa.

- **Linked Trips:** Begin in a new residential area (Precinct G, Precinct F, Precinct D, or West St Paul), stop in at Precinct G commercial areas, and end at some external destination (or the reverse).

Notice that the linked trip distribution varied from the AM peak hour to the PM peak hour and ADT. There were no linked trips during the AM peak hour because shopping centres often open after the AM peak hour, and AM peak hour traffic is usually heavily oriented towards commutes to work, with little demand to stop for shopping along the way. In the PM peak hour there was a large distribution towards linked trips, reflecting motorists stopping at the shopping centre on the way home from work. The ADT distribution was slightly decreased from the PM peak hour distribution, with an increased distribution towards direct trips to and from residential areas.

From the residential trip generation perspective, linked trips are included in the "External" distributions shown in Table 6. The linked portion of those distributions was routed to stop in at the Precinct G commercial development and continue their trip to an external destination.

Table 8 shows the trip distribution used for trips generated by the school in Precinct G. The Precinct G School was not included in the CPT study, so there was no distribution for school traffic in that study.

Table 8: Precinct G School Trip Distribution

Distribution	AM Peak Hour Distribution	PM Peak Hour Distribution	ADT Distribution
External	12.1%	15.2%	8.8%
McPhillips St North	1.2%	1.5%	0.9%
McPhillips St South	3.9%	4.6%	2.8%
Ferrier St South	5.8%	7.7%	4.3%
Main St North	0.6%	0.7%	0.4%
Main St South	0.6%	0.7%	0.4%
Internal and Nearby	87.9%	84.8%	91.2%
Direct	15.7%	17.4%	49.6%
Linked	72.2%	67.4%	41.6%

Similar to the Precinct G commercial development, a large proportion of the trip distribution was set to linked and direct trips coming from the Precinct G residential areas. The remaining trips were distributed among external destinations, with emphasis on trips to and from the south via Ferrier Street and McPhillips Street.

2.4.5 Net Site Generated Traffic

Table 9 shows the net site generated traffic, accounting for modal split reduction and interaction between land uses. Each cell includes three rows: the first indicates trips in the AM peak hour, the second indicates trips in the PM peak hour, and the third indicates ADT trips.

Table 9: Precinct G Net Trip Generation

Land Use	Gross Trip Generation	Mode Split Reduction	Interaction Trip Reduction	Net Trip Generation
Single Family Homes	2,205 2,940 27,990	220 294 2,799	-	1,985 2,646 25,191
Multi-Family Residential	537 634 7,090	54 63 709	-	483 571 6,381
K-8 School	468 109 1,389	47 11 139	370 83 1,140	51 15 110
Shopping Centre	245 946 10,890	24 94 1,089	89 680 6,060	132 172 3,741
Total	**3,455** **4,629** **47,359**	**345** **462** **4,736**	**459** **763** **7,200**	**2,651** **3,404** **35,423**

After accounting for mode split and linked trip reductions, Precinct G is estimated to produce 2,651 AM peak hour trips, 3,404 PM peak hour trips, and 35,423 ADT trips.

Figures showing projected average daily traffic volumes within Precinct G are included in the next section.

3.0 EVALUATION

Evaluation of the Precinct G collector street concepts included the following considerations for transportation within Precinct G:

- Sections of collector streets where traffic volumes may warrant consideration of four lane divided street sections.
- Active transportation
- Transit operations and cycling accessibility of potential transit centres within Precinct G
- Transportation demand management
- Rail crossing treatments

In addition to the consideration for transportation within Precinct G, consideration was given for how Precinct G might impact the adjacent street network. These considerations included:

- Peak hour traffic operations
- Traffic signal warrant analyses
- Precinct G contribution to projected future traffic volumes on adjacent streets

3.1 STREET NETWORKS

An average daily traffic (ADT) threshold of 5,000 vehicles per day is typically set to determine if a collector street should have a two-lane undivided cross-section or a four lane divided cross-section.

Where ADT exceeds 5,000 vehicles per day (vpd) on a collector street, a four-lane divided cross-section—rather than a two-lane undivided cross-section—is normally considered. In some cases, four lane divided cross-sections are appropriate, but where the surrounding land use is primarily residential and traffic volumes are projected to marginally exceed 5,000 vpd, a four-lane divided cross-section can influence travel patterns and speeds in an inappropriate way. An alternative cross section and appropriate intersection designs can provide sufficient traffic capacity while requiring less pavement and calming speeds to levels appropriate for residential areas. This alternate cross section consideration may include a two-lane road cross-section with appropriate parking accommodation, and intersections with stop sign or roundabout control.

The following series of figures shows projected ADT volumes for the two Street Network Concepts.

- Figure 5 shows Background traffic growth to 2040 for Street Network Concept 1.
- Figure 6 shows traffic growth generated by Precinct G at full build out using Street Network Concept 1.
- Figure 7 shows projected total 2040 volumes for Street Network Concept 1. Volumes are totaled from the existing background traffic (Figure 4), background traffic growth (Figure 5) and traffic growth generated by Precinct G (Figure 6). Red highlights indicate street segments where traffic volumes warrant consideration of four-lane divided cross-sections under current City of Winnipeg street design standards.
- Figure 8 shows Background traffic growth to 2040 for Street Network Concept 2.
- Figure 9 shows traffic growth generated by Precinct G at full build out using Street Network Concept 2.
- Figure 10 shows projected total 2040 volumes for Street Network Concept 2. Volumes are totaled from the existing background traffic (Figure 4), background traffic growth (Figure 8) and traffic growth generated by Precinct G (Figure 9). Red highlights indicate street segments where traffic volumes warrant consideration of four-lane divided cross-section under current City of Winnipeg street design standards.

Each figure shows conceptual locations for the Precinct G K-8 School, commercial areas, and multi-family areas.

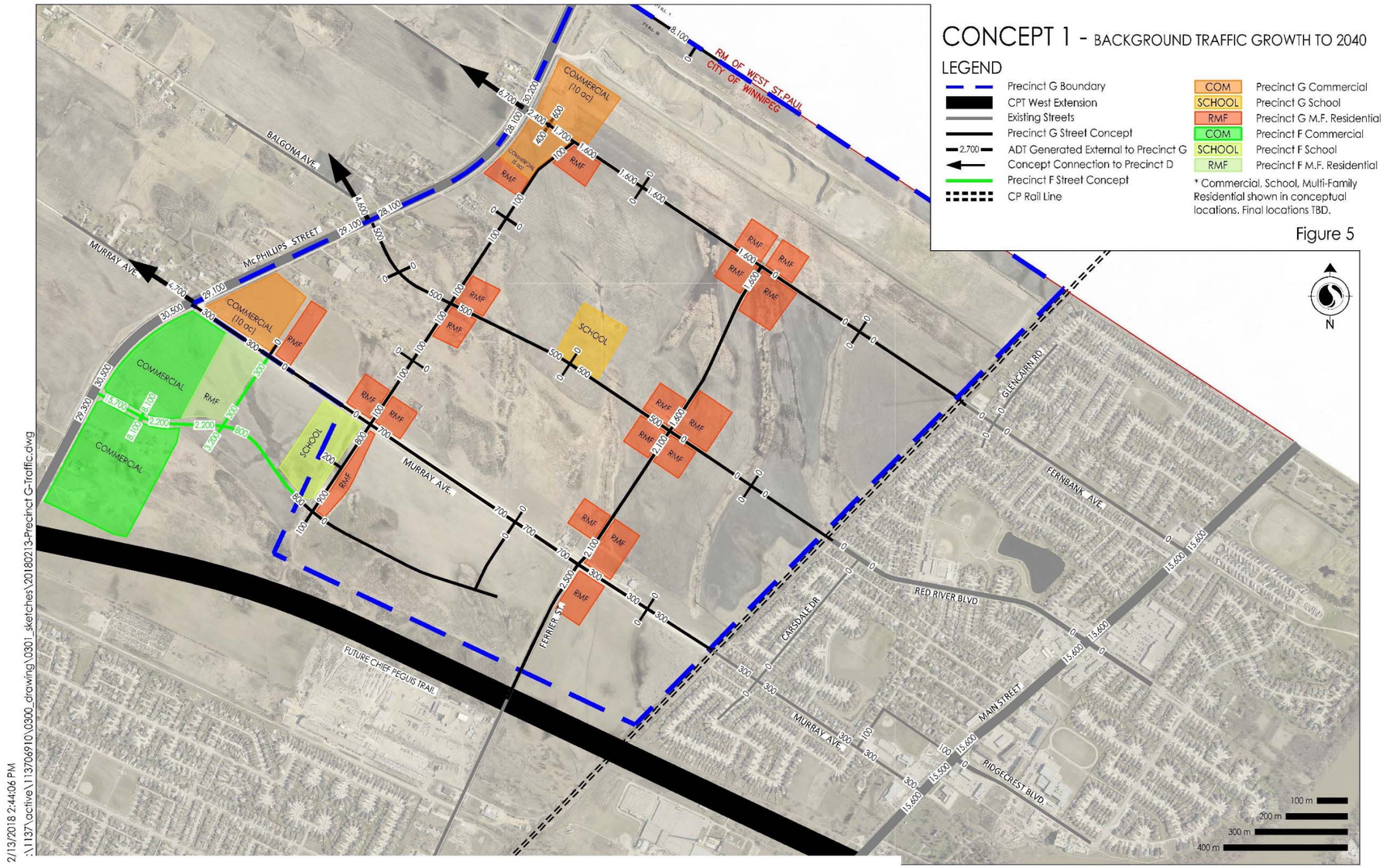


Figure 5: Street Network Concept 1 – Background Traffic Growth to 2040

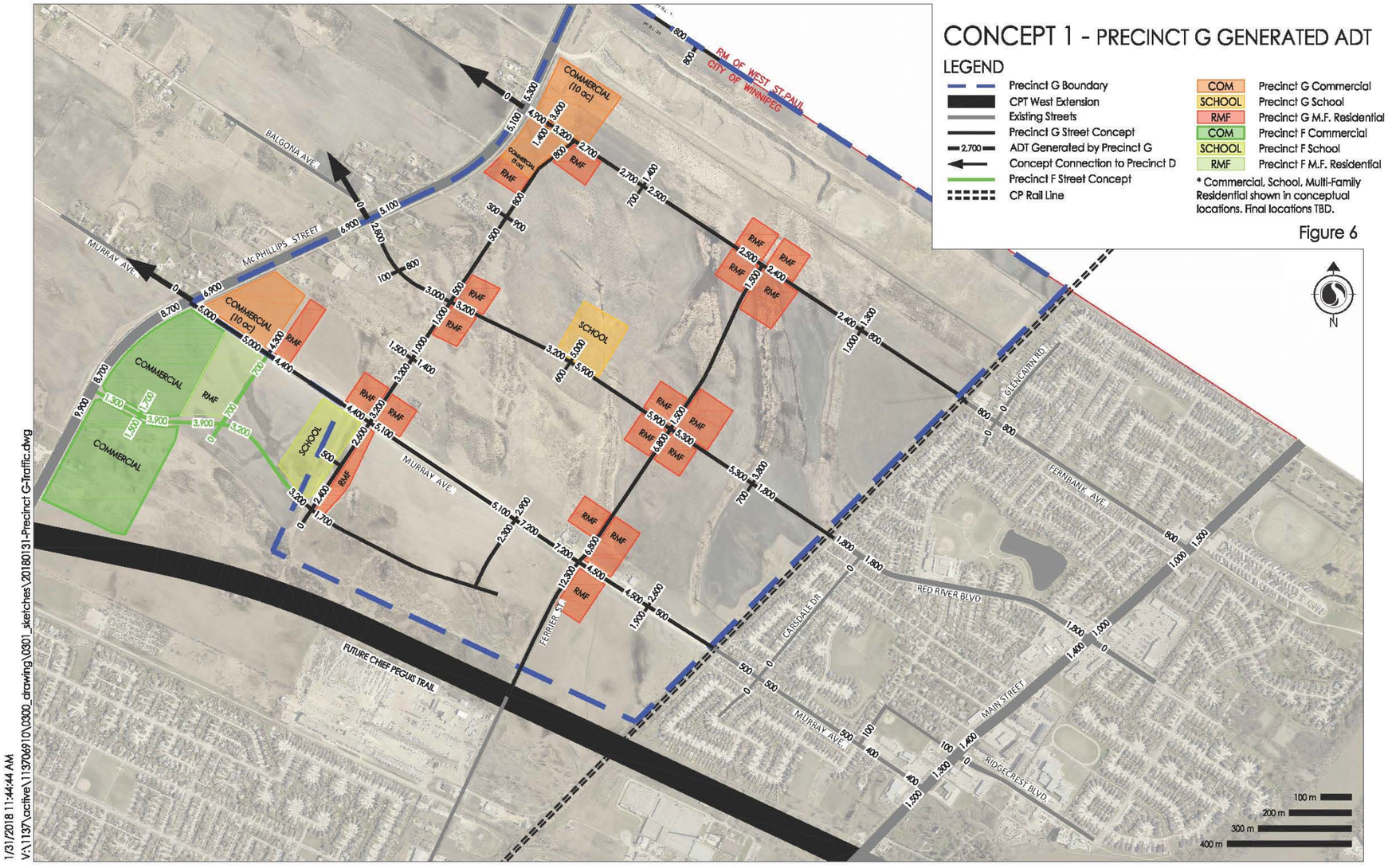


Figure 6: Street Network Concept 1 – Traffic Generated by Precinct G

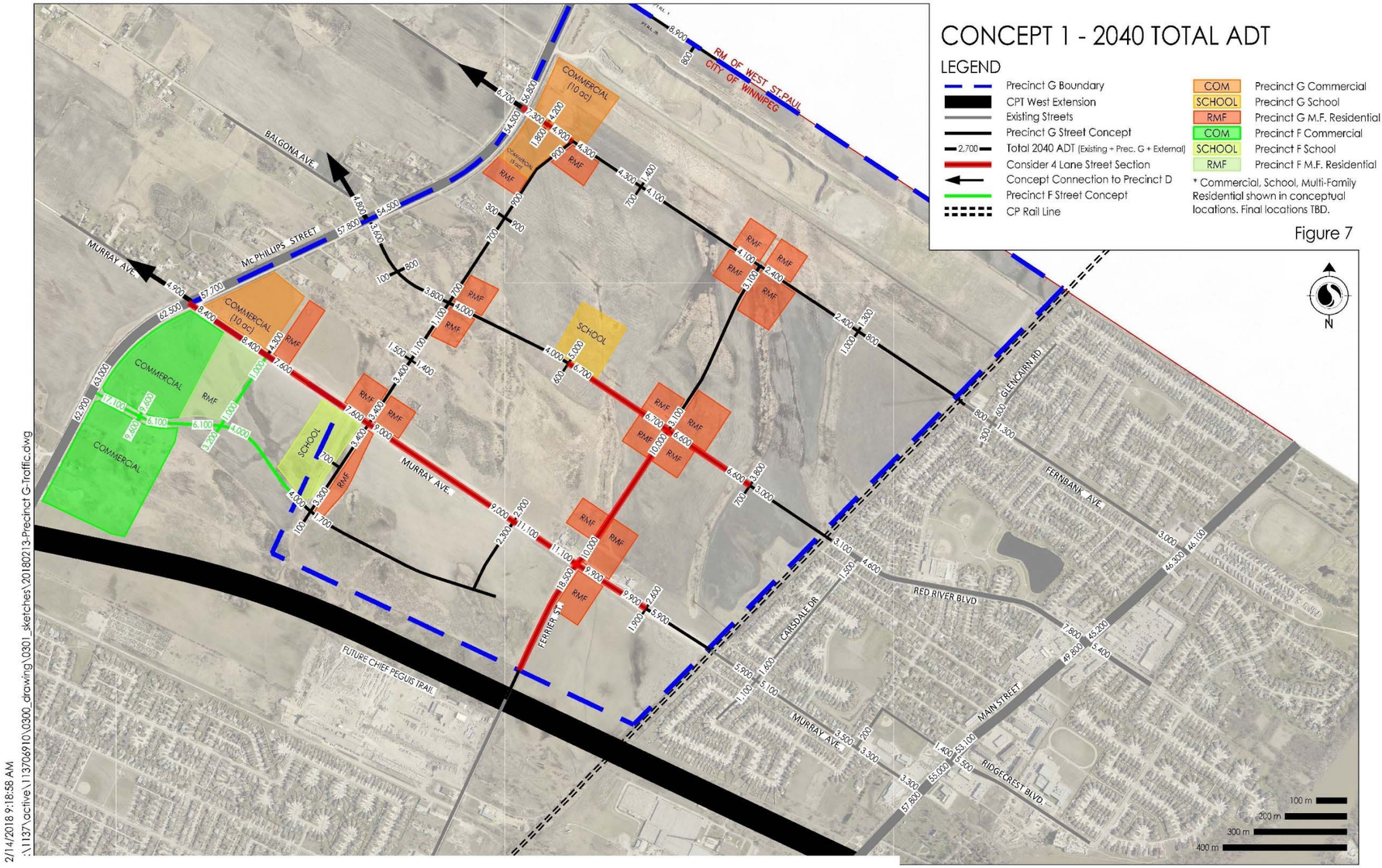


Figure 7: Street Network Concept 1 – 2040 Total ADT

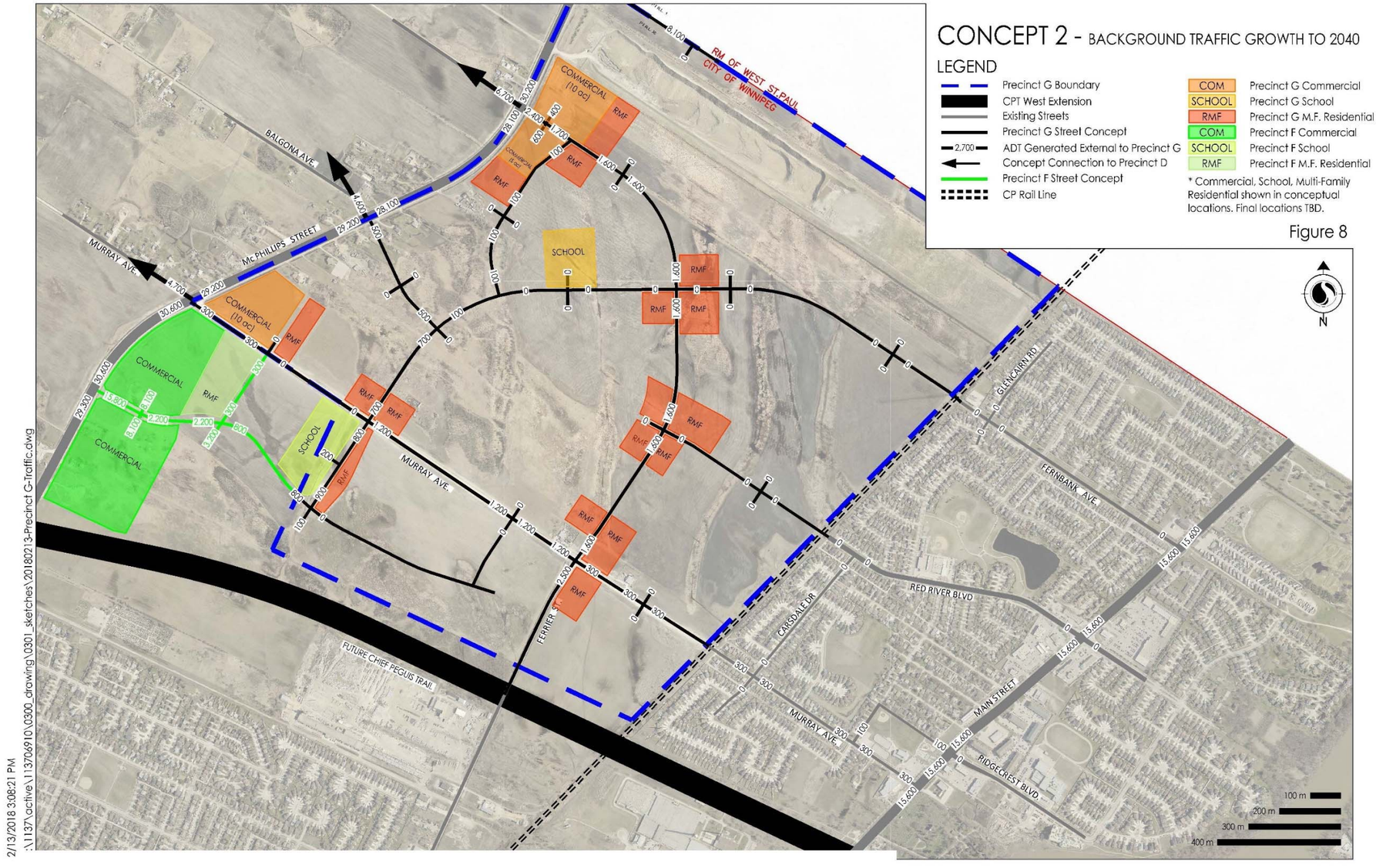


Figure 8: Street Network Concept 2 – Background Traffic Growth to 2040

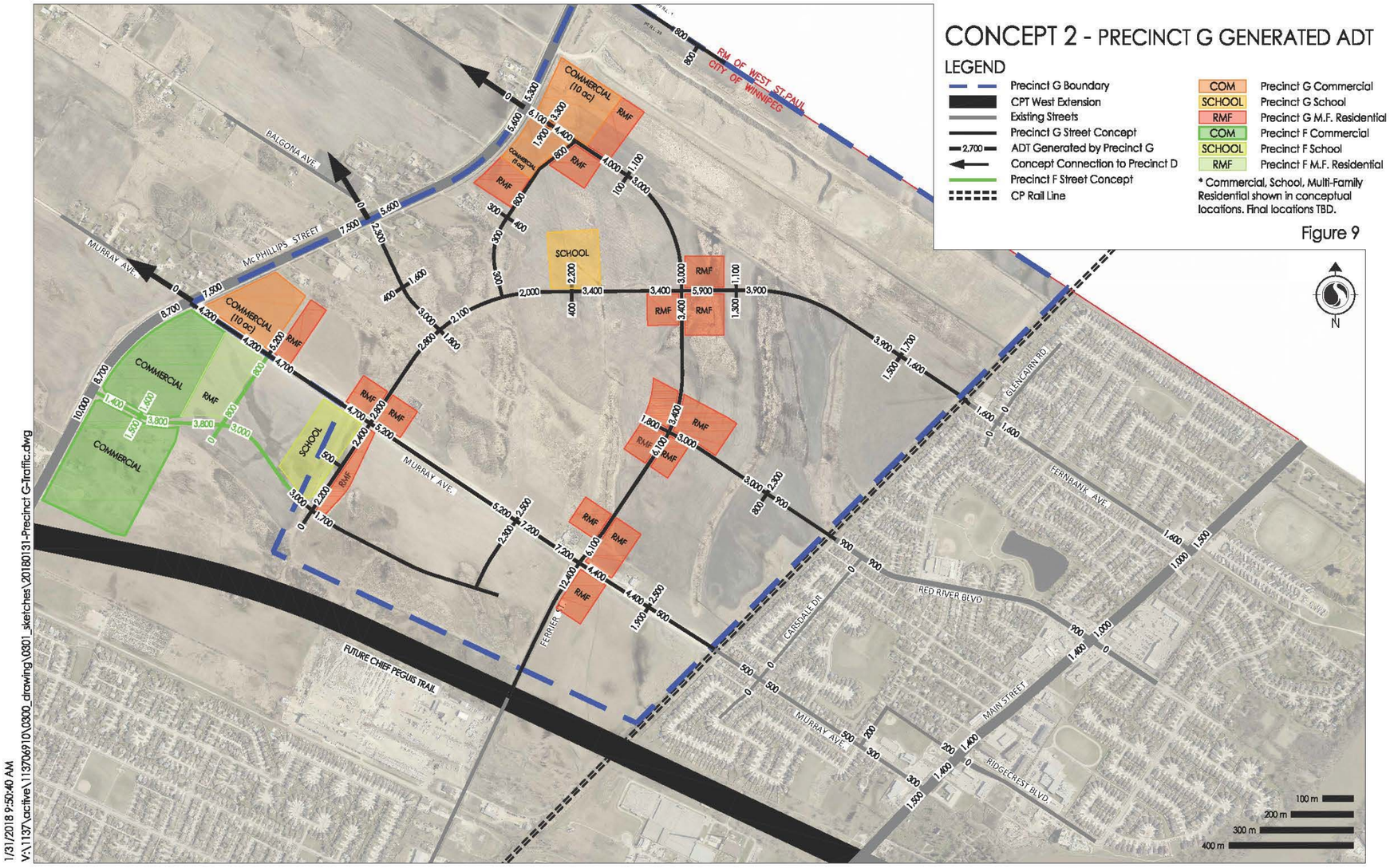


Figure 9: Street Network Concept 2 – Traffic Generated by Precinct G

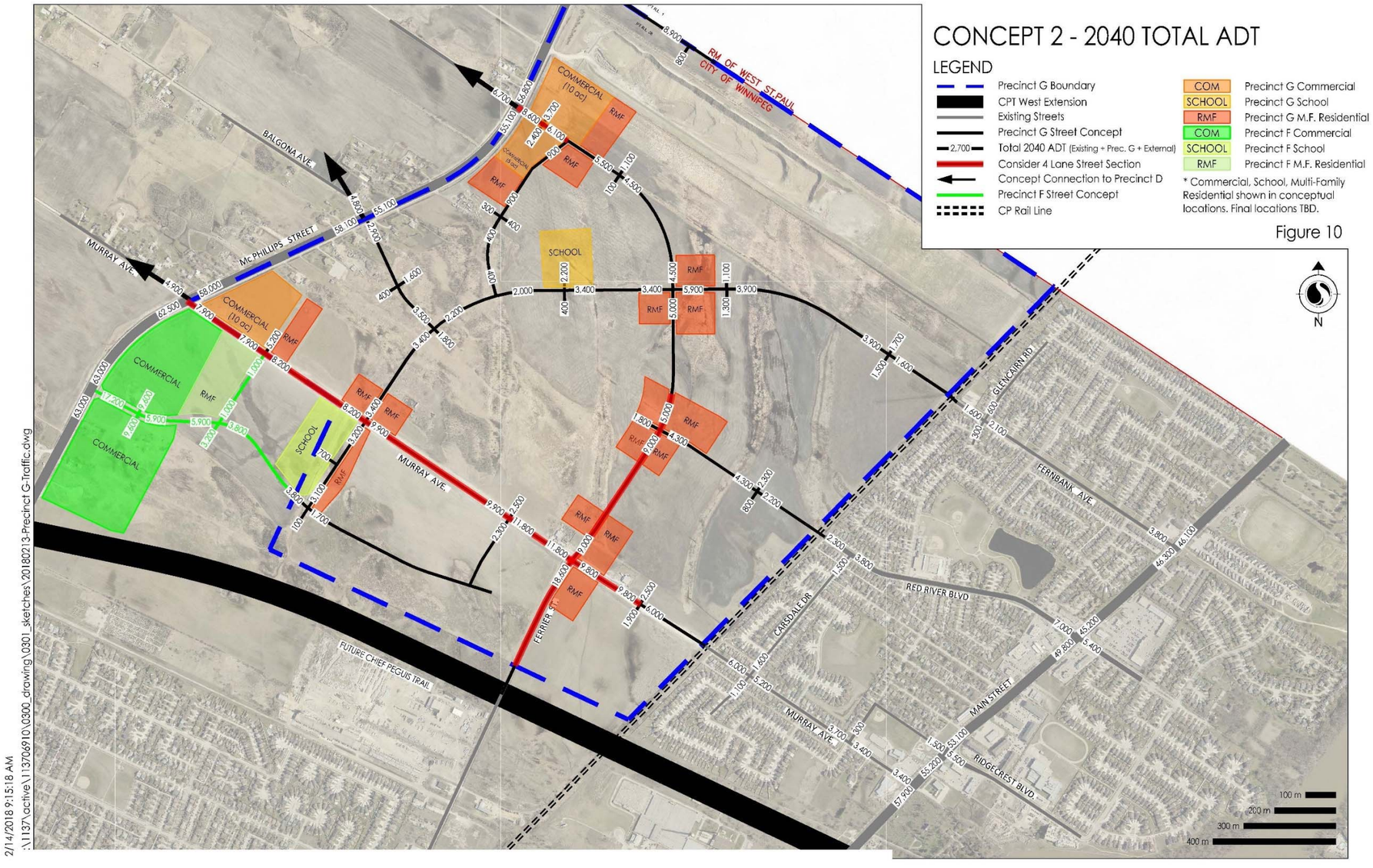


Figure 10: Street Network Concept 2 – 2040 Total ADT

3.1.1 Street Network Concept 1 – Four-Lane Sections

Figure 7 shows the Street Network Concept 1 street sections with projected 2040 ADT warranting consideration of four-lane divided cross-sections.

Murray Ave

Four-lane divided sections warranted consideration on Murray Avenue from McPhillips Street to Carsdale Drive, east of the CP Rail Line. Murray Avenue does not have sufficient right-of-way for a four-lane divided section east of the CP Rail Line, so the four-lane divided section would run from McPhillips Street to west of the CP Rail Line. Note that the projected ADT volumes on Murray Avenue west of Carsdale Drive—5,900 with Concept 1, 6,000 with Concept 2—are less than the existing ADT volume of 6,300 vehicles per day (vpd). The west extension of Chief Peguis Trail (CPT) is expected to draw some traffic away from Murray Avenue, and Precinct G is expected to only contribute a small amount of traffic to Murray Avenue, for a net traffic decrease compared to existing conditions.

Red River Boulevard

Red River Boulevard ADT volumes warranted consideration of four-lane divided sections from the conceptual school location west of Ferrier Street to the driveway access east of Ferrier Street. This conclusion is heavily influenced by the assumptions and analysis of the directional distribution of traffic bound for the school. The segment of Red River Boulevard west of the school had a projected ADT of 4,000 vpd, so, if the directional distribution is skewed more to the west than anticipated, an additional 1,000 vpd can be accommodated before the 5,000 vpd threshold is exceeded.

Additionally, the segment of Red River Boulevard just west of Main Street had projected ADT volumes of 7,000 vpd. This segment of Red River Boulevard exists with a four-lane divided cross-section, sufficient to carry this volume of traffic.

Ferrier Street

Ferrier Street ADT volumes warranted consideration of four-lane divided-sections from the connection with Chief Peguis Trail (CPT) to Red River Boulevard.

Fernbank Avenue

Fernbank Avenue four-lane divided sections were limited to a short stretch connecting to McPhillips Street and servicing the commercial areas.

3.1.2 Street Network Concept 2 – Four-Lane Sections

Figure 10 shows the Street Network Concept 2 street sections with projected 2040 ADT warranting consideration of four-lane divided cross-sections.

Murray Avenue

Murray Avenue had 2040 ADT volumes warranting consideration of four-lane divided sections from McPhillips Street to east of the CP Rail Line. As noted above, the four-lane section would likely be ended west of the CP Rail Line due to right-of-way constraints to the east.

Red River Boulevard

Red River Boulevard ADT volumes are not projected to exceed 5,000 vpd, except for in the segment just west of Main Street. That segment of Red River Boulevard exists with a four-lane cross-section, which can accommodate the projected traffic volume.

Ferrier Street

Ferrier Street 2040 ADT volumes warranted consideration of four-lane divided sections from the connection with CPT north to the intersection with Red River Boulevard. North of that intersection Ferrier Street volumes were 5,000 vpd to the intersection with Fernbank Avenue. North of Fernbank Avenue, volumes decreased to 4,500 vpd, before increasing to 8,600 vpd just east of McPhillips Street, and associated with the commercial development. It may be prudent to construct four-lane divided cross-sections from CPT to the north, terminating north of the intersection with Red River Boulevard. Further north a two-lane cross-section would be sufficient, widening to a four-lane divided cross-section at the commercial accesses east of McPhillips Street. Intersection treatments will influence the capacity of the roadway, with planned single lane roundabouts at major intersections providing sufficient capacity and superior efficiency, safety, and pedestrian accommodation.

Fernbank Avenue

Fernbank Avenue had ADT volumes moderately exceeding 5,000 vpd for a short section east of Ferrier Street. Given that Ferrier Street may have only a two-lane section at the intersection with Fernbank Avenue, it is not practical to construct Fernbank Avenue as a four-lane divided cross-section east of Ferrier Street. That section can exist as a two-lane undivided street that may serve volumes of 5,900 vpd for a short segment east of Ferrier Street. Intersection treatments will influence the capacity of the roadway, with planned single lane roundabouts at major intersections providing sufficient capacity and superior efficiency, safety, and pedestrian accommodation.

3.2 ACTIVE TRANSPORTATION

With either Street Network Concept, active transportation (AT) facilities can be categorized into the following types:

- **Regional AT Facilities** enabling longer-distance and commuting trips by active modes of transportation. These are planned along all major collector streets within Precinct G and along minor collectors connecting primary destinations, (schools, commercial and recreation facilities and major transit routes).

- **Recreation Paths** for leisure and local connectivity. These are likely to associated with parks, around stormwater retention ponds, and in other public reserves.

- **Sidewalks** for local connectivity and short trips. These are to be located along collector streets within Precinct G.

With Street Network Concept 1, regional AT facilities are provided along Ferrier Street and Fernbank Avenue. This would provide regional AT routes at north-south and east-west orientations, with the Ferrier Street route connecting to Chief Peguis Trail (CPT) active transportation paths. Sidewalks can be provided along Precinct G collector streets. Sidewalks on the streets aligned east-west can connect across the CP Rail Line to existing sidewalks east of the CP Rail Line. Recreation paths can be provided in parks and other public reserves.

Street Network Concept 2 accommodates regional AT facilities along the extent of Ferrier Street. This would provide a regional AT link from the Chief Peguis Trail AT paths to the conceptual commercial area locations near McPhillips Street. Red River Boulevard does not extend across the entire Precinct to McPhillips Street, but enhanced recreation paths in line with Red River Boulevard would follow public reserves to complete the link from the CP Rail Line to McPhillips Street. Sidewalks can be provided along Precinct G collector streets, with connections to existing sidewalks east of the CP Rail Line.

3.3 TRANSIT

Street Network Concept 1 provides a collector street grid network. These streets provide sufficient routing options streets for transit. Street Network Concept 2 provides reasonably direct transit routes along Murray Avenue and Fernbank Avenue, but transit routes along Red River Boulevard may require jogs or looping. Concept 2 does provide a more direct route from Ferrier Street to areas west of McPhillips Street, which may be useful.

At typical walking speeds people can travel 400 m in five minutes. One of the considerations when creating street layouts is the resulting area within 400 m of collector streets, assuming those streets are serviced by transit. Figure 11 and Figure 12 show the areas within 400 m of the Precinct G collector streets. For added contrast, Figure 13 and Figure 14 show the areas within 250 m of the Precinct G collector streets.

Previous traffic studies (Arlington, CPT) have shown that background traffic growth contributes to increased congestion on major routes. Improved transit service has proven to mitigate or slow the growth in background traffic in many jurisdictions. A strategy to improve transit ridership is the implementation of Transit Centers/Park and Ride facilities that provide access to routes that serve multiple destinations. The configuration of the road and active transportation network in Precinct G was developed to provide good access to transit routes and potential Transit Centers/Park and Ride facilities, making transit ridership more appealing.

Since the trip distribution for Precinct G shows that destinations both inside and outside the downtown are equally desirable, the location of Transit Centers/Park and Ride facilities should be determined with consideration for accommodating routes serving multiple destinations.

Figure 15 through Figure 18 show potential Transit center locations and cycling trip times along the proposed infrastructure. Pink shading indicates areas accessible within a five minute cycling trip, while blue shading indicates areas accessible within an eight minute cycling trip. These areas assume a 20 km/h travel speed along active transportation paths, with the speed perpendicular to the paths reduced to 1/3 speed. This perpendicular speed reduction represents less direct routing on local streets.

To allow comparison between the two Street Network Concepts, Figure 16 shows transit centre location “A” with Street Network Concept 1, while Figure 17 shows transit centre location “A” with Street Network Concept 2. Figure 15 and Figure 18 show other transit centre location options (both located on land already owned by the City of Winnipeg) with Street Network Concept 2.

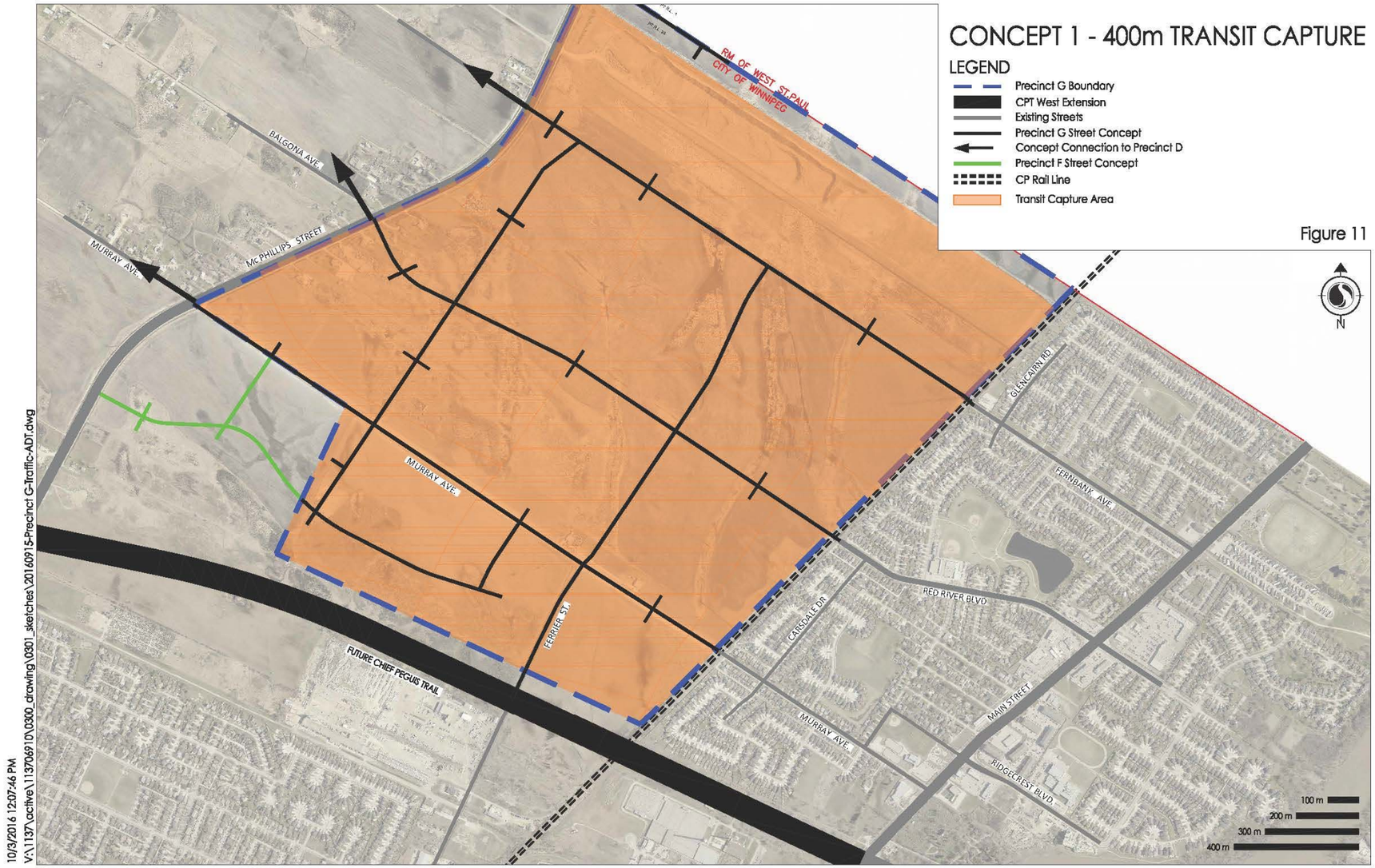


Figure 11: Concept 1 400 m Transit Capture Areas

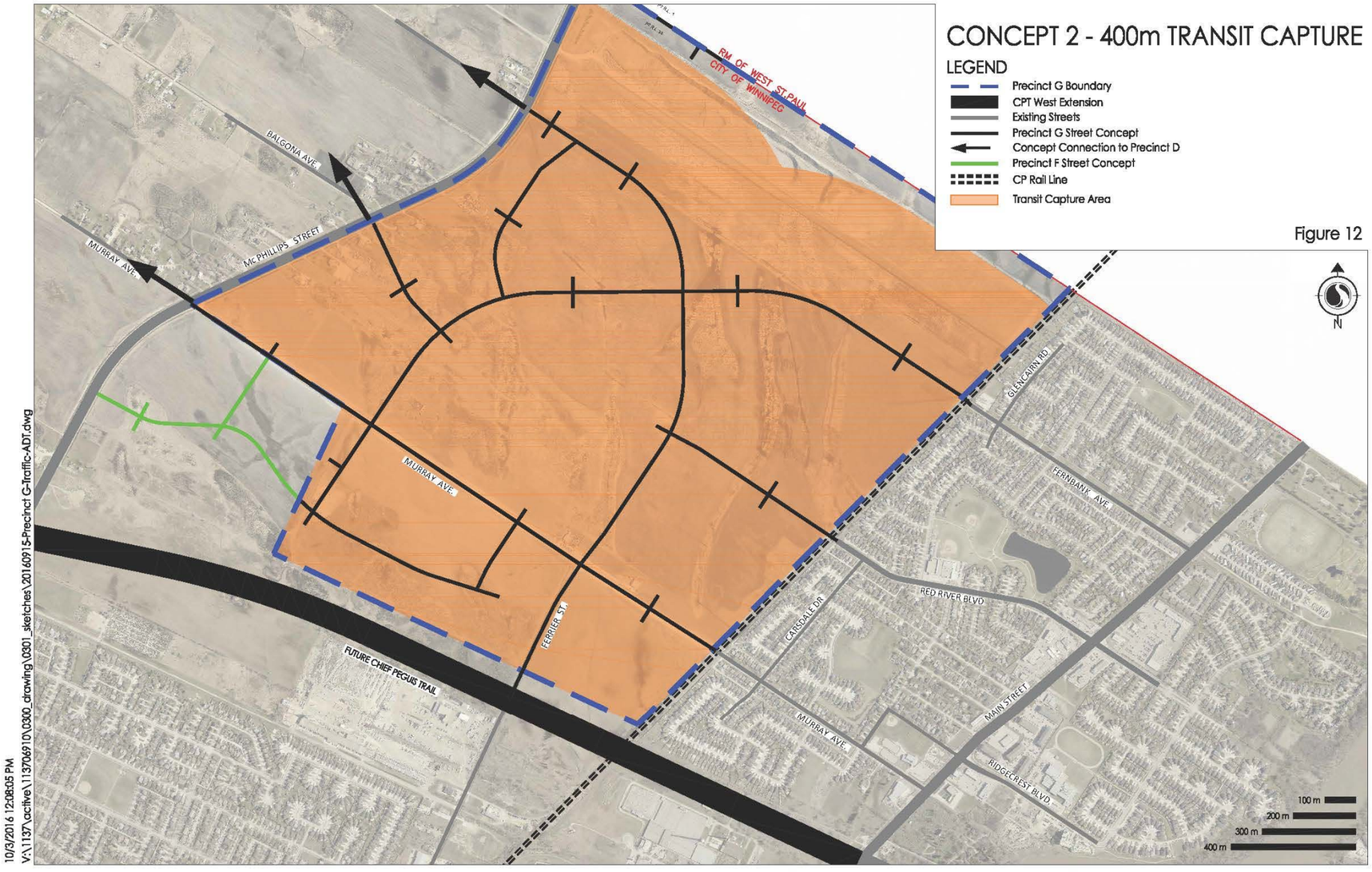


Figure 12: Concept 2 400 m Transit Capture Areas

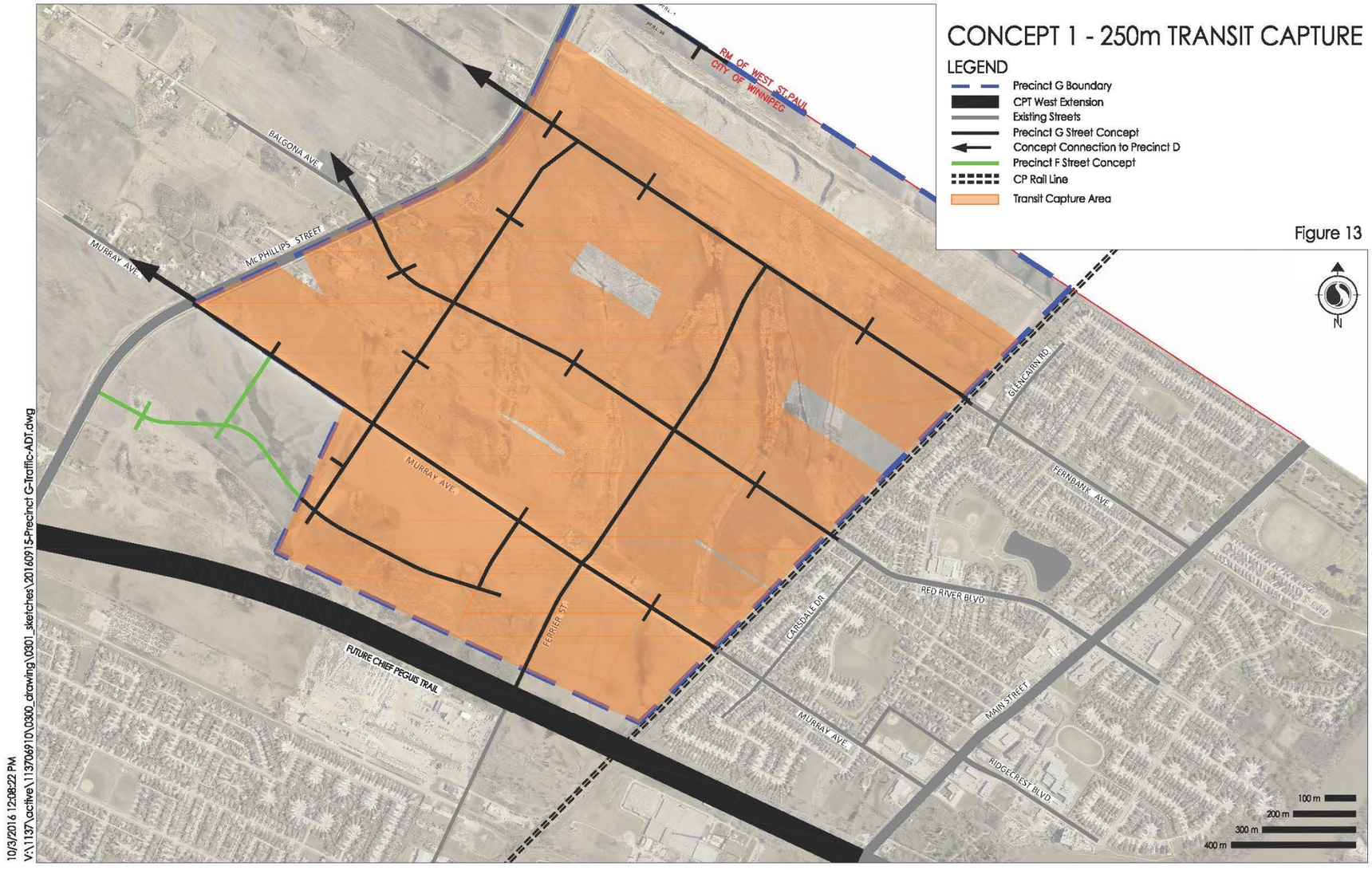


Figure 13: Concept 1 250 m Transit Capture Area

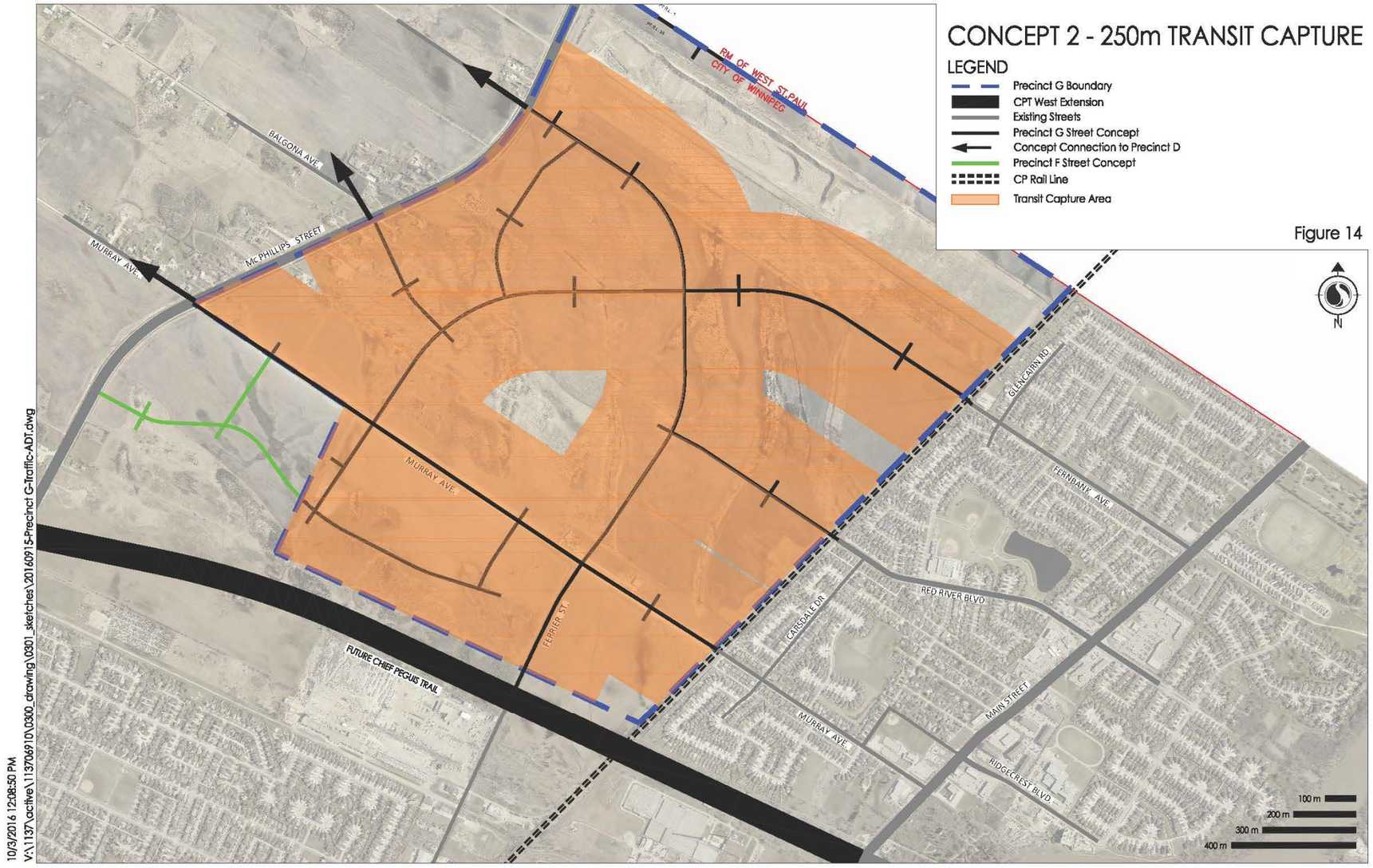


Figure 14

Figure 14: Concept 2 250 m Transit Capture Areas

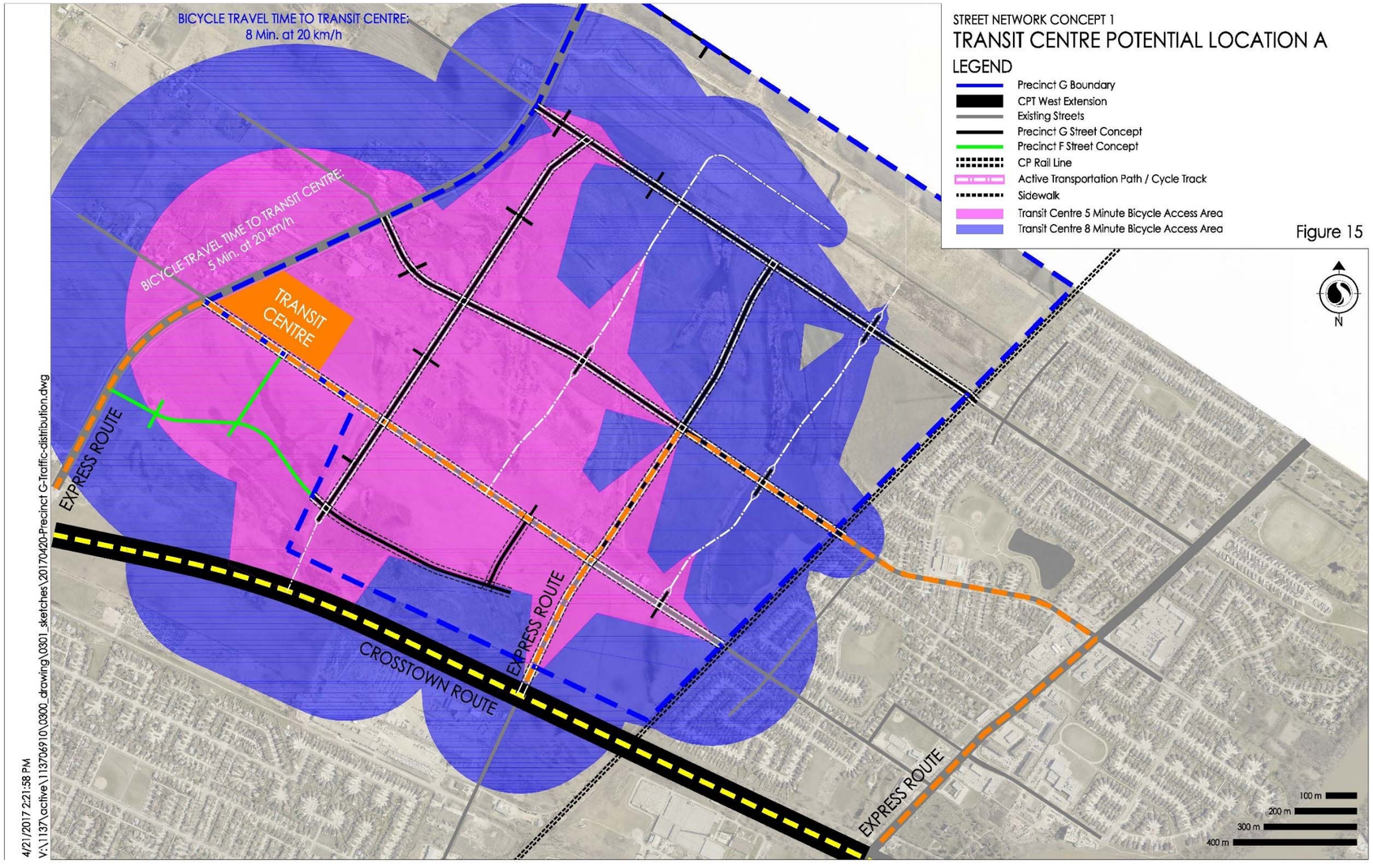


Figure 15: Street Network Concept 1 – Potential Transit Centre Location A

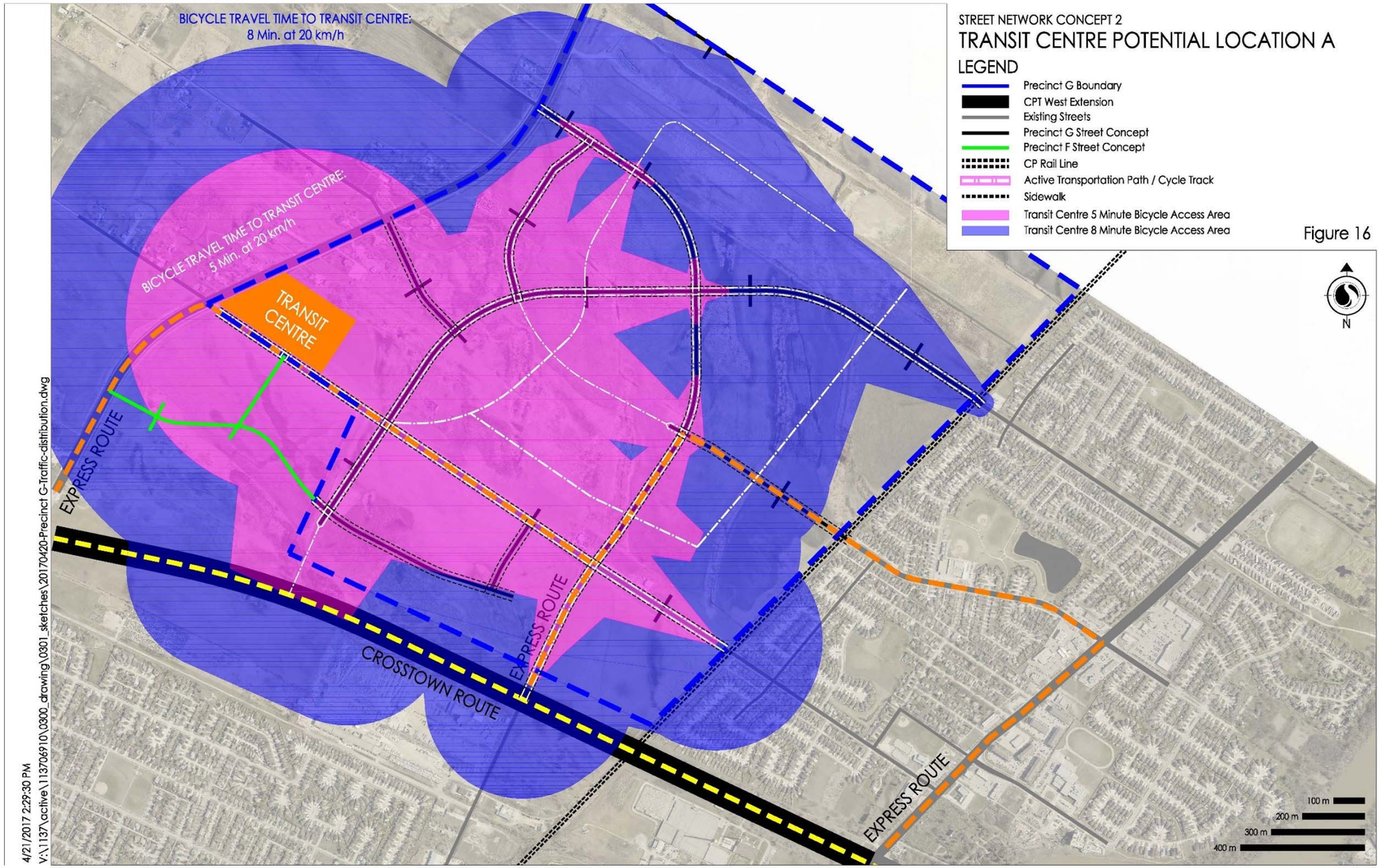


Figure 16: Street Network Concept 2 – Potential Transit Centre Location A

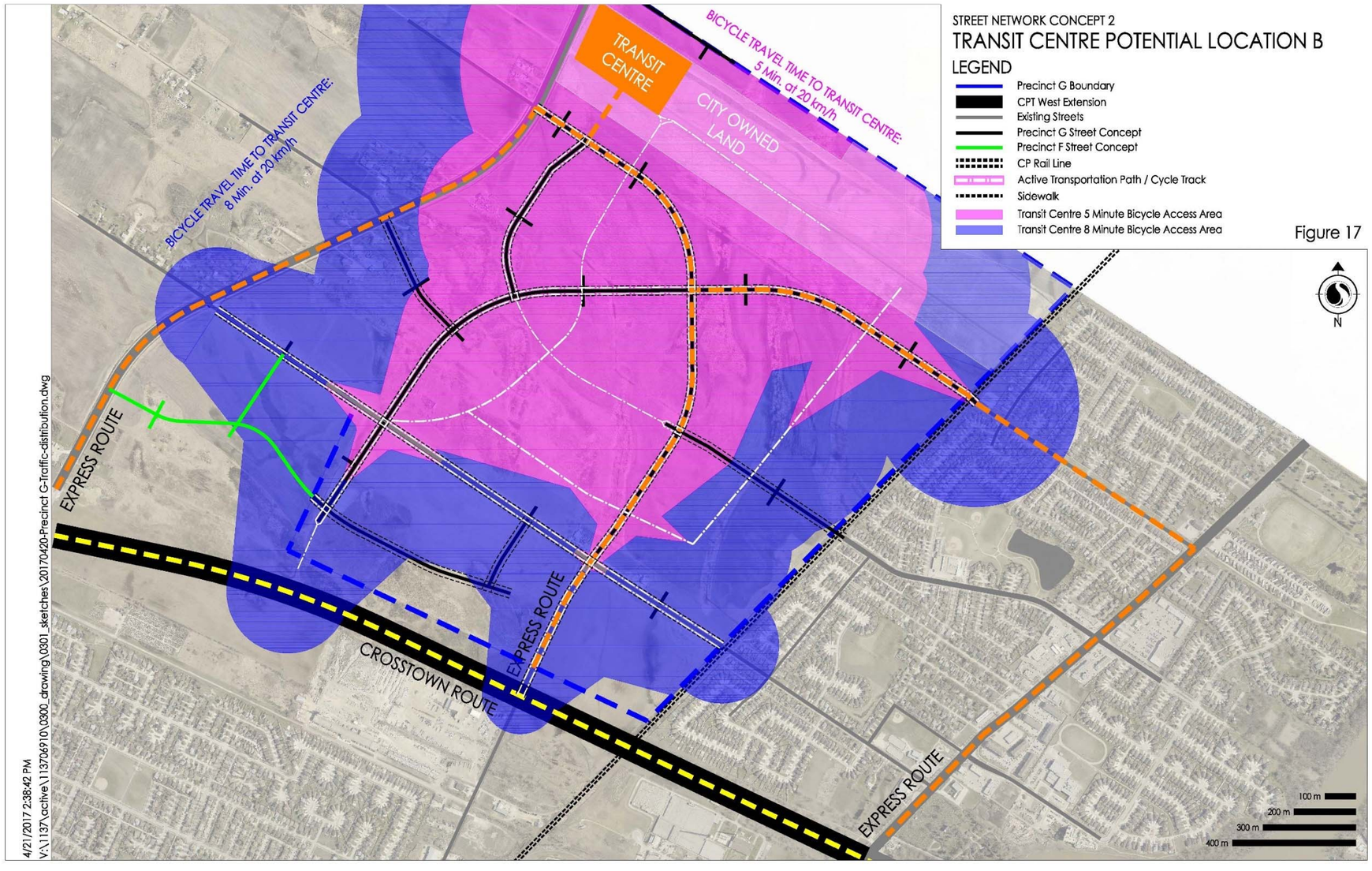


Figure 17

Figure 17: Street Network Concept 2 – Potential Transit Centre Location B

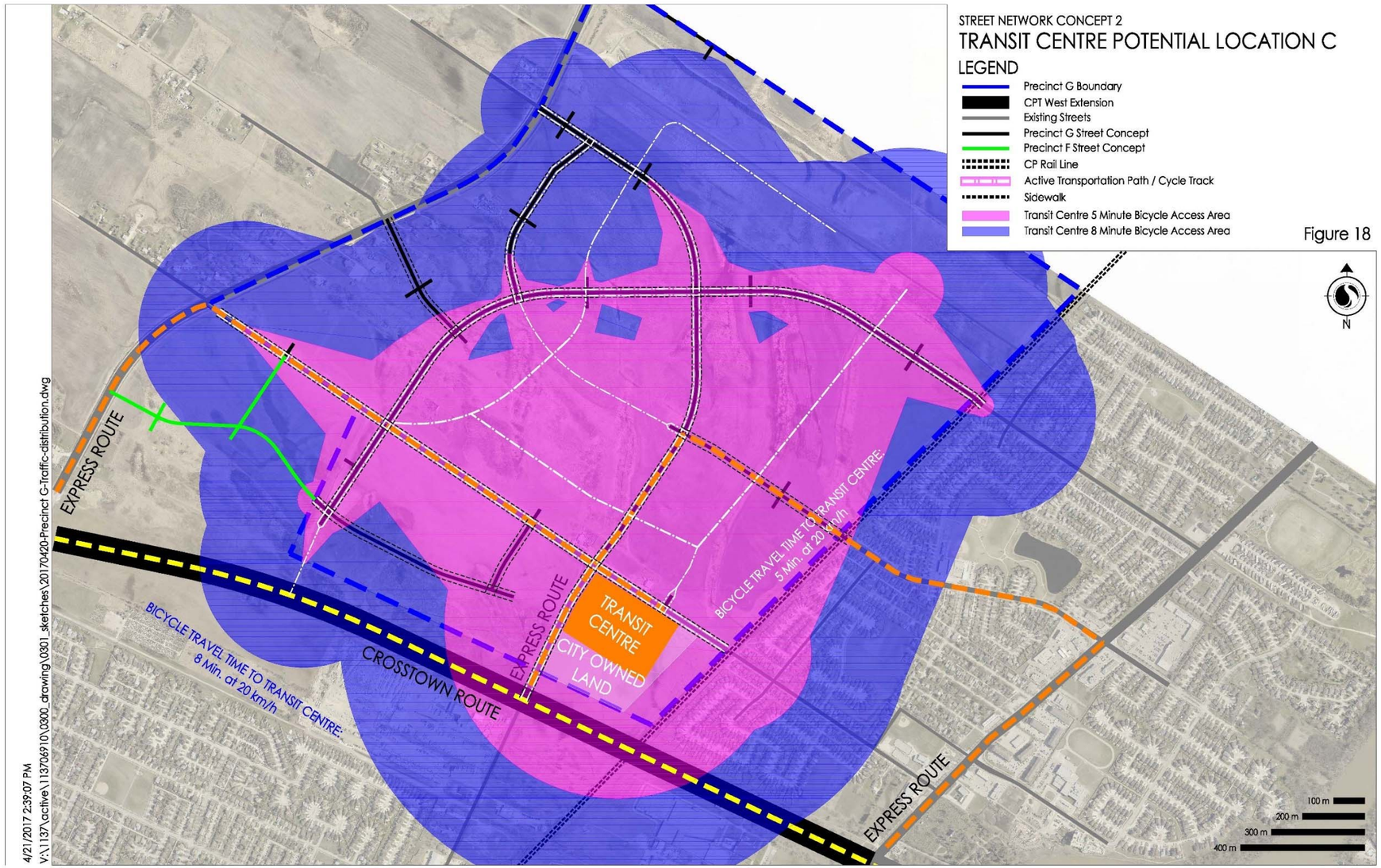


Figure 18

Figure 18: Street Network Concept 2 – Potential Transit Centre Location C

3.4 TRANSPORTATION DEMAND MANAGEMENT

Providing infrastructure facilities and transportation services relate to the supply elements of the transportation equation; however, demand considerations are required as well if there is a desire to reduce single person auto trips. Addressing transportation demand is known as Transportation Demand Management or TDM. One definition of TDM comes from the Canadian Urban Transit Association: "TDM deals with strategies, policies, programs, services, and products that influence how, why, when and where people travel." Over the years, Transportation Demand Management has focused on influencing the behavior of individual travelers and finding the appropriate mix of incentives and disincentives to encourage travelers to change their normal travel routine. An example of a successful TDM strategy used by the City of Portland, Oregon, to address transportation demand and reduce single occupancy vehicle travel includes:

- Ridesharing incentives – preferred parking for carpools, subsidies for carpool passengers, and employer-provided vehicles for ridesharing;
- Transit – selling transit tickets and passes on site; and
- Bike/Pedestrian – offer subsidies for cyclists/pedestrians and install showers and lockers at destination points.

These policy decisions are not the responsibility of proponents of Precinct G to implement as they reflect policy decisions impacting the entire Capital Region commuter shed. The proponents can and have allowed for infrastructure to support these initiatives within the planning context of the precinct.

3.5 RAIL CROSSING ANALYSIS

Transport Canada's *Grade Crossing Standards* specify crossing control types for at-grade crossings based on several factors, one of which is the cross-product of the projected average daily road and rail traffic. Warning systems without gates are required where the cross-product is 2,000 or more, and warning systems with gates are required where the cross-product is 50,000 or more. Warning systems can also be required regardless of cross-product if the crossing includes sidewalks and the rail design speed greater than 81 km/hr (50 mph).

The CP Winnipeg Beach Rail Subdivision runs north-south through the study area, with an existing at-grade crossing at Murray Avenue. With the development of Precinct G additional rail crossings are to be developed at Red River Boulevard and at Fernbank Avenue.

The current daily rail traffic volume on the CP Winnipeg Beach Subdivision is believed to average two trains per week. Table 10 shows the existing average daily traffic (ADT) volumes and resulting cross-products for the Murray Avenue crossing, as well as the projected ADT volumes for the

Murray Avenue and other crossings under future scenarios, assuming the collector street network is developed according to Street Network Concept 2.

Table 10: Rail Crossing Treatment Cross-Products

Scenario	Fernbank Ave Crossing	Red River Blvd Crossing	Murray Ave Crossing
2015 Background	n/a	n/a	ADT: 6,300 vpd X-Prod: 1,800
2025 Background	n/a	n/a	ADT: 6,500 vpd X-Prod: 1,857
2035 Background	n/a	n/a	ADT: 5,500 vpd X-Prod: 1,571
2040+ Background	n/a	n/a	ADT: 5,500 vpd X-Prod: 1,571
2025 Stage 1	ADT: 2,900 vpd X-Prod: 829	ADT: 4,500 vpd X-Prod: 1,286	ADT: 6,800 vpd X-Prod: 1,943
2035 Stage 2	ADT: 1,000 vpd X-Prod: 286	ADT: 1,900 vpd X-Prod: 543	ADT: 5,700 vpd X-Prod: 1,629
2040+ Full Build Out	ADT: 1,600 vpd X-Prod: 457	ADT: 2,200 vpd X-Prod: 629	ADT: 6,000 vpd X-Prod: 1,714

No crossing had a cross-product of 2,000 or more under any scenario. As such, warning systems with or without gates are not required. The only requirement is appropriate rail crossing signs.

Note that the Murray Avenue crossing had a higher ADT in the 2025 Background Scenario than in the 2035 Background Scenario. The reduction in 2035 is due to the re-routing of traffic from Murray Avenue to Chief Peguis Trail once the Chief Peguis Trail west extension is completed.

3.6 TRAFFIC OPERATIONS

3.6.1 Analysis Scenarios

Peak hour traffic operation analyses were conducted in order to approximate requirements for intersection configurations at full build out and at two intermediate stages of development. The analysis assumed Precinct G would be developed according to the Concept 2 Street Network. The projected traffic volumes assume 10% of trips occur via transit or active modes.

The following scenarios were analyzed:

Background Traffic

- 2015
    - Existing background traffic

- 2025
    - Precinct F assumed 50% developed
    - West St. Paul development assumed 15% complete
    - Precinct D development assumed not yet started
- 2035
    - Precinct F assumed 100% developed
    - West St. Paul development assumed 50% complete
    - Precinct D development assumed not yet started
- 2040+
    - Precinct F, and West St. Paul development assumed 100% complete. Precinct D assumed 40% complete (consistent with Precinct D volumes included in the 2040 total ADT projections).

Background Traffic plus Precinct G Trip Generation

- 2025 Stage 1 Precinct G Traffic
    - The 2025 Background Traffic plus Precinct G approximately 35% developed
- 2035 Stage 2 Precinct G Traffic
    - The 2035 Background Traffic plus Precinct G approximately 60% developed
- 2040+ Full Build Out Precinct G Traffic
    - The 2040+ Background Traffic plus Precinct G 100% developed

Note that Precinct D was assumed to begin development at some point after 2035, and the 2040+ Scenarios included Precinct D 40% developed. Precinct D may not develop to 40% by 2040, so the 2040+ Scenarios should be understood as a scenario representing conditions in 2040 or at some point beyond 2040, with the exact horizon dependent on the rate of development.

The Chief Peguis Trail west extension to McPhillips Street was assumed to be complete for the 2035 and 2040+ Scenarios. The 2015 and 2025 Scenarios assumed Chief Peguis Trail would terminate at Main Street.

For each of the scenarios with Precinct G generated trips, the traffic routing was based on the Concept 2 Street Network. In Stage 1, connections were assumed to be made to Red River Boulevard and Fernbank Avenue across the CP Winnipeg Beach Rail Subdivision with no new connections to Murray Avenue or to McPhillips Street. In Stage 2, the full Concept 2 Street Network was assumed to be developed.

Figures showing traffic volumes for the analysis scenarios are included in Appendix A.

3.6.2 Analysis Intersections

For each scenario the following intersections were evaluated:

- Main Street and Fernbank Avenue
- Main Street and Red River Boulevard
- Main Street and Ridgecrest Avenue
- Main Street and Murray Avenue
- McPhillips Street and Emes Road
- McPhillips Street and Fernbank Avenue
- McPhillips Street and Balgona Road
- McPhillips Street and Murray Avenue
- Ferrier Street and Murray Avenue

The intersection of McPhillips Street and Emes Road has not been included in the report up to this point. This intersection was included in the analysis because of its close proximity to the future intersection of McPhillips Street and Fernbank Avenue. Note that this intersection was analyzed independently as part of a traffic study completed by Stantec to consider development in West St. Paul south of PTH 101.

Note that the intersection of McPhillips Street and Fernbank Avenue does not currently exist. This intersection was added in the 2035 Stage 2 Scenario and in the 2040+ Full Build Out Scenario. Intersection legs were added as appropriate for the scenarios.

Also note that intersections to the south of the study area on McPhillips Street and Main Street were not included in the analysis. The nearest intersection to the south on McPhillips Street will be at the Precinct F collector, but that intersection will likely operate in coordination with an intersection at the west extension of Chief Peguis Trail and McPhillips Street. Since the configuration of that intersection (or interchange) is unknown, those intersections were left out of the model, with the McPhillips Street portion of the model beginning at Murray Avenue. On Main Street the exact configuration of a future interchange with Chief Peguis Trail is unknown, so it was left out of the model. The Main Street portion of the model began at Murray Avenue.

3.6.3 Analysis Results

This section provides a summary of the analysis results. A detailed account of the analysis assumptions and results is included in Appendix A.

Table 11 shows the intersection modifications required for each intersection under the Background Scenarios. Note that no intersection modifications were required for the 2015 Background Scenario, so that Scenario is not shown.

Table 11: Intersection Modifications – Background Scenarios

Intersection	2025 Background	2035 Background	2040+ Background
Main St & Fernbank Ave	None	- NB left-turn lane	- SB right-turn lane
Main St & Red River Blvd	None	None	None
Main St & Ridgecrest Ave	None	- Main St 6 lanes south of intersection	None
Main St & Murray Ave	None	- Main St 6 lanes	None
McPhillips St & Emes Road	- Traffic signal control	- NB right-turn lane - Eastbound 3 lane approach (left + thru + right) - Westbound 3 lane approach (left + thru + right)	- McPhillips St 6 lanes
McPhillips St & Fernbank Ave	N/A	N/A	- McPhillips St 6 lanes - Added west leg with a left-turn lane plus a right-turn lane approaching - Traffic signal control - NB left-turn lane - SB right-turn lane
McPhillips St & Balgona Rd	None	None	- McPhillips St 6 lanes - Added west leg with a left-turn lane plus a right-turn lane - Traffic signal control - NB left-turn lane - SB right-turn lane
McPhillips St & Murray Ave	- Traffic signal control	- NB right-turn lane - Westbound 3 lane approach (left + thru + right)	- McPhillips St 6 lanes - SB right-turn lane - Eastbound 3 lane approach (left + thru + right)
Ferrier St & Murray Ave	None	None	None

In the 2025 Background Scenario traffic signals were required on McPhillips Street at Emes Road and at Murray Avenue. In the 2035 Background scenario Main Street was assumed to be widened to six lanes from south of Murray Avenue up to Ridgecrest Avenue. By the 2040+ Background Scenario traffic signals were also required on McPhillips Street at Fernbank Avenue and at Murray Avenue, and McPhillips Street required widening to six lanes through all study intersections.

Table 12 shows the intersection modifications required for the Scenarios with traffic from Precinct G. Note that the modifications required for the Background Scenarios were also required in these scenarios, so the modifications shown in Table 12 are in addition to the modifications required for the background scenarios.

Table 12: Intersection Modifications – Post-Development

Intersection	2025 Stage 1	2035 Stage 2	2040+ Full Build Out
	2025 Background Scenario Modifications plus…	2035 Background Scenario Modifications plus…	2040+ Background Scenario Modifications plus…
Main St & Fernbank Ave	- NB left-turn lane	None	- EB right-turn lane
Main St & Red River Blvd	None	None	None
Main St & Ridgecrest Ave	None	None	None
Main St & Murray Ave	None	None	None
McPhillips St & Emes Road	None	None	None
McPhillips St & Fernbank Ave	N/A	- Added east leg with a left-turn lane plus a right-turn lane approaching, and a single lane departing - SB left-turn lane - NB right-turn lane	- Eastbound approach modified to 3 lanes (left + thru + right) - Westbound 3 lane approach (left + thru + right) - SB left-turn lane - NB right-turn lane
McPhillips St & Balgona Rd	None	- Added east leg with a single lane approaching - Traffic signal control - SB left-turn lane - NB right-turn lane	- Eastbound approach modified to 3 lanes (left + thru + right) - Westbound 3 lane approach (left + thru + right) - SB left-turn lane - NB right-turn lane
McPhillips St & Murray Ave	None	None	- Second NB left-turn lane - Second SB left-turn lane - East leg widened to receive dual SB left-turns - West leg widened to receive dual NB left-turns
Ferrier St & Murray Ave	None	- Added north leg with a single lane approaching and a single lane departing - Traffic signal control - NB left-turn lane - NB right-turn lane - EB right-turn lane - WB left-turn lane	- Added north leg with a single lane approaching and a single lane departing - Traffic signal control - NB left-turn lane - NB right-turn lane - EB right-turn lane - WB left-turn lane

The addition of traffic from Precinct G is anticipated to accelerate the need for a northbound left-turn lane at Main Street and Fernbank Avenue. Additionally, development of Precinct G will require east legs at McPhillips Street and Fernbank Avenue and at McPhillips Street and Balgona Road. This is projected to accelerate the need for traffic signals at McPhillips Street and Balgona Avenue, and to drive the need for dual northbound and southbound left-turn lanes at McPhillips Street and Murray Avenue. Finally, development of Precinct G will require the extension of Ferrier Street north of Murray Avenue, along with traffic signal control and additional lanes or a roundabout at that intersection.

Analysis of the background scenarios found that widening McPhillips Street to six lanes could be postponed to the 2040+ Background scenario. Analysis of the post-development scenarios found that in the 2035 Stage 2 scenario some movements on McPhillips Street would be over capacity if McPhillips remained a four-lane street. This performance may be acceptable, or it may represent a need to widen McPhillips Street prior to the 2040+ Full Build Out scenario. In any case, decisions related to the timing of widening McPhillips Street should consider future field observations to determine if operations are acceptable.

Note that at Ferrier Street and Murray Avenue in the 2040+ Full Build Out Scenario the average daily traffic volumes shown on Figure 10 were high enough for four lane sections to be considered on Ferrier Street and on Murray Avenue, but acceptable traffic operations were provided with single through lanes and additional turning lanes. An analysis of a roundabout at Murray Avenue and Ferrier Street indicated a two-lane roundabout would be required, but Murray Avenue could operate as a two lane street on each approach

3.7 TRAFFIC SIGNAL WARRANT ANALYSIS

Traffic signal warrant analyses (TSWA) consider the average traffic and pedestrian volumes over the six peak hours during the day and return a number of "warrant points". If a TSWA returns 100 warrant points, traffic signals are considered warranted based on the traffic volumes. This does not necessarily indicate that traffic signals must be installed—if left-turn and through movement volumes from the busiest minor street approach average less than 75 vehicles per hour (vph) over the peak six hours, the minor street volume is considered too low to warrant traffic signals.

Traffic signal warrant analyses were conducted for the following intersections:

- McPhillips Street and Emes Road
- McPhillips Street and Fernbank Avenue
- McPhillips Street and Balgona Road
- McPhillips Street and Murray Avenue
- Ferrier Street and Murray Avenue

These intersections currently operate under two-way stop control, with the exception of McPhillips Street and Fernbank Avenue, which currently does not exist. Note that the intersection of Main Street and Murray Avenue is located only 150 m from the signalized intersection at Ridgecrest Avenue, and Murray Avenue may be very close to the termination of ramps from a future interchange between Chief Peguis Trail and Main Street. For these reasons traffic signals were not considered at Main Street and Murray Avenue, and the traffic signal warrant analysis procedure was not completed for those locations.

Table 13 shows the results of the analysis. Warrant points are shown first, with the side street average volume following in parentheses. Where traffic signals were found to be warranted, the analysis procedure was omitted for subsequent scenarios. Green shading indicates that traffic signals were warranted, while yellow shading indicates that the warrant points exceeded 100, but the side street average volume was below the 75 vehicle per hour threshold.

Table 13: Traffic Signal Warrant Analysis Results

Scenario	McPhillips St & Emes Road	McPhillips St & Fernbank Ave	McPhillips St & Balgona Rd	McPhillips St & Murray Ave	Ferrier St & Murray Ave
2015 Background	51 (34)	N/A	6 (2)	67 (117)	21 (15)
2025 Background	109 (57)	N/A	7 (3)	97 (119)	26 (22)
2035 Background	315 (137)	N/A	10 (3)	159 (119)	29 (28)
2040+ Background	-	557 (153)	146 (67)	-	27 (24)
2025 Stage 1	113 (57)	N/A	7 (3)	116 (119)	37 (41)
2035 Stage 2	379 (166)	174 (110)	54 (50)	-	182 (322)
2040+ Full Build Out	-	-	241 (98)	-	-

As Table 13 shows, by the 2040+ Full Build Out Scenario, traffic signals were warranted at each intersection. The intersections of McPhillips Street and Emes Road and McPhillips Street and Murray Avenue were the intersections with traffic signals warranted the earliest, beginning in the 2035 Background Scenario. Note that these intersections nearly met the signal warrant thresholds in the 2025 Background Scenario, and that the peak hour traffic operations analysis (Section 3.6, Appendix A) indicated that traffic signals were required in order to prevent extreme side-street delay in the 2025 Background Scenario. It may be prudent to consider traffic signals at these locations for the 2025 Background Scenario, even though the warrant thresholds are not exceeded.

3.8 PROJECTED FUTURE TRAFFIC VOLUMES ON ADJACENT STREETS

In future years, traffic on the adjacent street network will include existing (2015) traffic, additional background traffic from developments other than Precinct G, and traffic from Precinct G. Figure 19 illustrates traffic volumes projected for the 2040+ Full Build Out scenario. Traffic volumes are shown in the study area as well as on the Chief Peguis Trail (CPT) West Extension. The thickness of lines correspond to traffic volumes on street segments, and the size of circles correspond to traffic volumes at intersections.

The Chief Peguis Trail Transportation Study included traffic growth from West St. Paul, and from Precincts B, C, D, E, F, and G. In the Precinct G Study traffic projections for West St. Paul and Precincts D, F, and G have been updated. Projections for Precincts B, C, and E were taken from the Chief Peguis Trail Study.

Figure 19 also shows AM and PM peak hour Intersection Capacity Utilization (ICU) values. On Main Street and McPhillips Street intersection configurations were taken from the Traffic Operations analysis. Note that the traffic operations analysis found that Main Street should be widened to six lanes from CPT to Fernbank Avenue to accommodate anticipated background traffic growth, but according to the City of Winnipeg future widening of Main Street will extend through the intersection with Ridgecrest Avenue, but no further north. ICU values reflect six lanes on Main Street from CPT to the Ridgecrest Avenue intersection, and four lanes on Main Street at the intersections with Red River Boulevard and Fernbank Avenue.

For the ICU calculations the following intersection/interchange configurations were assumed on CPT:

- CPT @ Main Street: Single Point Urban Interchange with CPT Free-Flowing
- CPT @ Ferrier Street: At-Grade Intersection
- CPT @ McPhillips Street: Diamond Interchange with CPT Free-Flowing

Projected traffic routing through the CPT intersections is included in Appendix C.

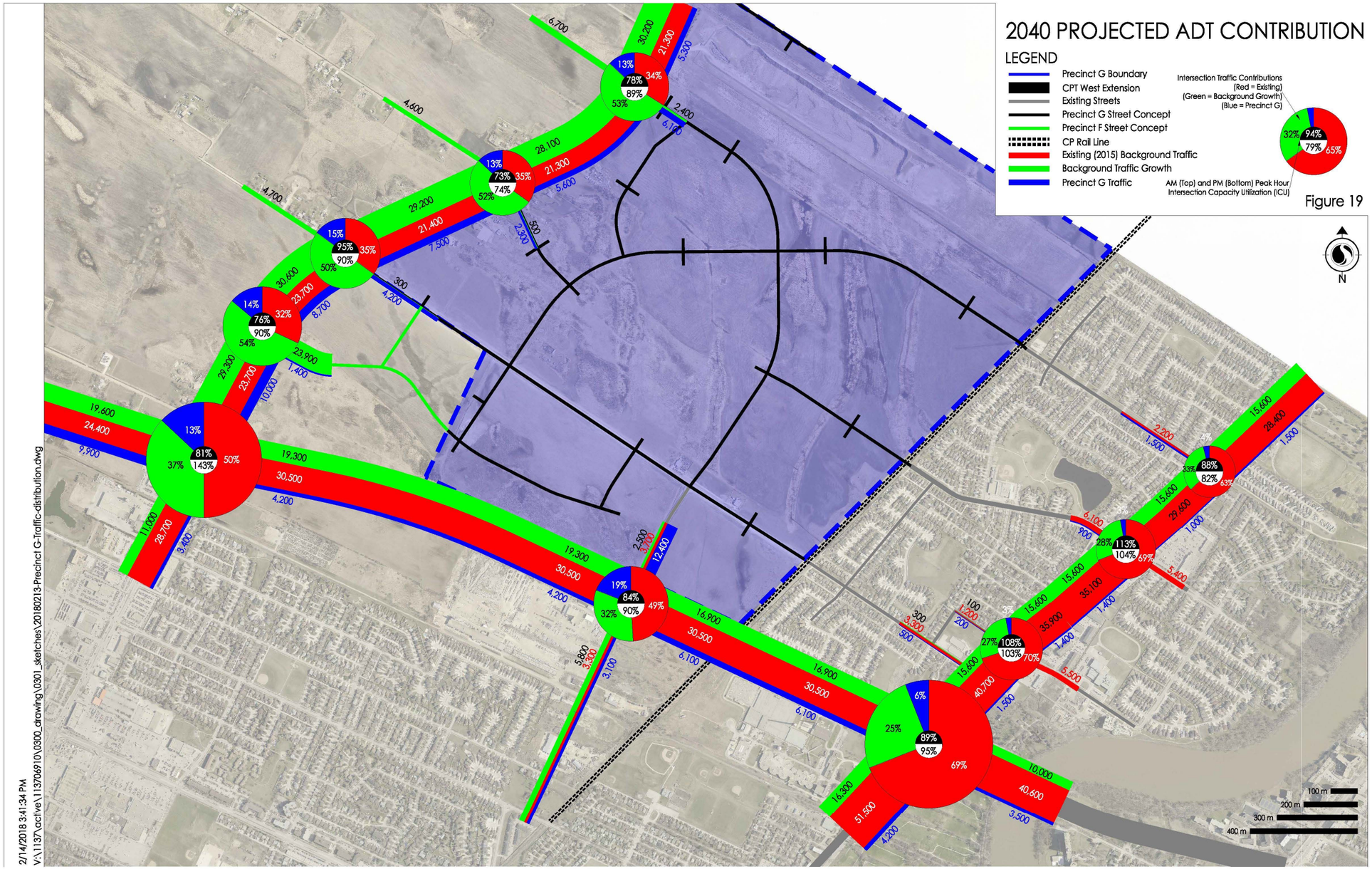


Figure 19: 2040 Projected ADT Contributions

4.0 CONCLUSIONS

Two street network concepts have been presented:

- Street Network Concept 1 is based on a grid network, with connections between Main Street and McPhillips Street via Fernbank Avenue, Red River Boulevard, and Murray Avenue. Ferrier Street is extended north from Murray Avenue to Fernbank Avenue.

- Street Network Concept 2 is based on providing a more direct connection of Ferrier Street to Precinct D, west of McPhillips Street.

Projections of transportation demand for Precinct G and surrounding areas have been developed in accordance with projections for the same areas in a transportation study for the west extension of the Chief Peguis Trail (CPT). The main difference in projections in the two studies is that the CPT study used a horizon year of 2031—based on housing growth projections—while this study used a horizon year of 2040—based on assumed full build out of Precinct G and updated information on nearby developments.

Evaluation of the street network concepts found the following suggestions:

- Concept 1 had east-west traffic dispersed between Fernbank Avenue, Red River Boulevard, and Murray Avenue, with north-south traffic concentrated on Ferrier Street. The resulting ADT volumes warranted consideration of four-lane divided sections on portions of Fernbank Avenue, Red River Boulevard, Murray Avenue, and Ferrier Street. There were no new requirements for four lane sections on streets in existing adjacent neighborhoods.

- In Concept 2 the street network had a strong connection between Ferrier Street and McPhillips Street. As a result more traffic was concentrated on this link. Additionally, Red River Boulevard was discontinuous through Precinct G, resulting in lower demand on that link east through existing neighborhoods. The ADT threshold for consideration of four-lane sections was exceeded on Ferrier Street, south of Red River Boulevard, on Murray Avenue, and on a short section of Fernbank Avenue within Precinct G. There were no new requirements for four lane sections on streets in existing adjacent neighborhoods.

- Active Transportation (AT) facilities can be developed to provide a regional AT link along Ferrier Street—connecting to Chief Peguis Trail AT facilities—recreation paths through public reserves, and sidewalks along streets classified as collector streets.

- Concept 1 allows for more direct transit routes, with less "looping". Concept 2 provides direct routes for transit along Murray Avenue and Fernbank Avenue, but routes along Red River Boulevard may require jogs and looping. Concept 2 also provides a more direct link between Ferrier Street and areas west of McPhillips Street.

- Projected average daily traffic (ADT) volumes on the existing rail crossing at Murray Avenue and future crossings at Red River Boulevard and at Fernbank Avenue suggest that warning systems without gates are appropriate crossing control treatments under all scenarios.

Analysis of peak hour traffic operations and traffic signal warrants under future scenarios with and without development of Precinct G indicates that growth in background traffic will create the need for traffic signals on McPhillips Street at Emes Road and at Murray Avenue in a 2025 Background Scenario with traffic growth from Precinct F and West St. Paul. With further growth in background traffic and development in Precinct D, traffic signals were found to be required on McPhillips Street at Fernbank Avenue and at Balgona Road. Additionally, Main Street and McPhillips Street both needed to be widened to six lanes to accommodate the growth in background traffic.

Traffic from Precinct G accelerated the need for some intersection modifications, compared to the Background Scenarios. Precinct G traffic required traffic signals and additional lanes at Ferrier Street and Murray Avenue. These modifications were not required in the Background Scenarios. On most streets near Precinct G future traffic volumes are expected to be composed primarily of existing (2015) traffic and background traffic growth. The one exception to this is Ferrier Street north of Chief Peguis Trail (CPT) where most traffic will likely be generated by Precinct G.

APPENDIX A
PEAK HOUR TRAFFIC OPERATIONS ANALYSIS RESULTS

Appendix A PEAK HOUR TRAFFIC OPERATIONS ANALYSIS RESULTS

A.1 ANALYSIS ASSUMPTIONS

The analysis was completed using *Synchro Studio 9.0* (Synchro) traffic analysis software. The following assumptions were used in the analysis:

- All peak hour factors were set to a typical value of 0.92
- Heavy vehicle percentages were set to a typical value of 2% for all movements
- Traffic signal clearance intervals were set to 4 second yellow intervals plus 2 second all red intervals
- Where a single traffic signal was operating with no adjacent signals within 800 m, the signal was set to operate under semi-actuated coordinated control, resting on the major street.
- Where there were two traffic signals within 800 m of each other, they were set to operate under actuated-coordinated control, with coordination on the major street through movements.
- Analysis results are reported for overall intersection performance and for critical movements that had v/c ratios of 0.95 or greater and/or were operating at LOS E or worse.

The following section describes the results of the analysis.

A.2 INTERSECTION CONFIGURATIONS

The following figures show the existing intersections configurations.

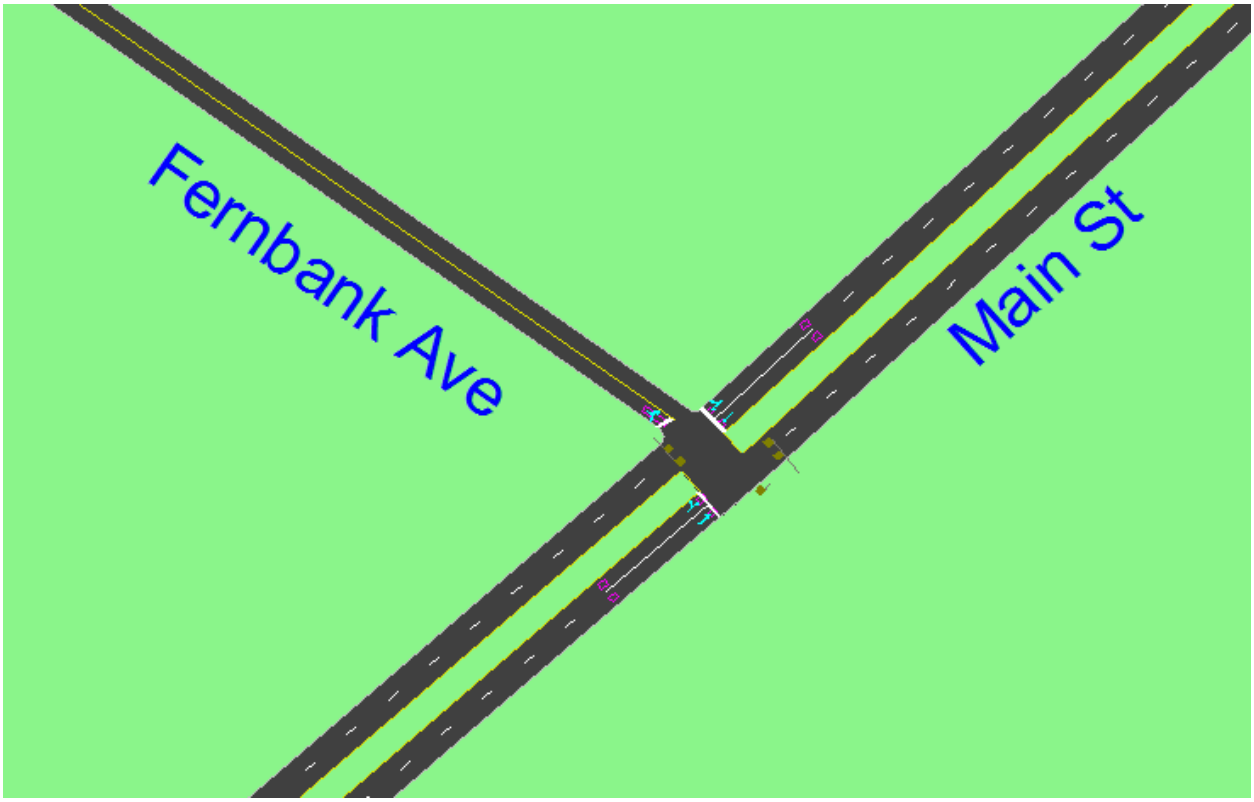


Figure A.1: Main Street and Fernbank Avenue

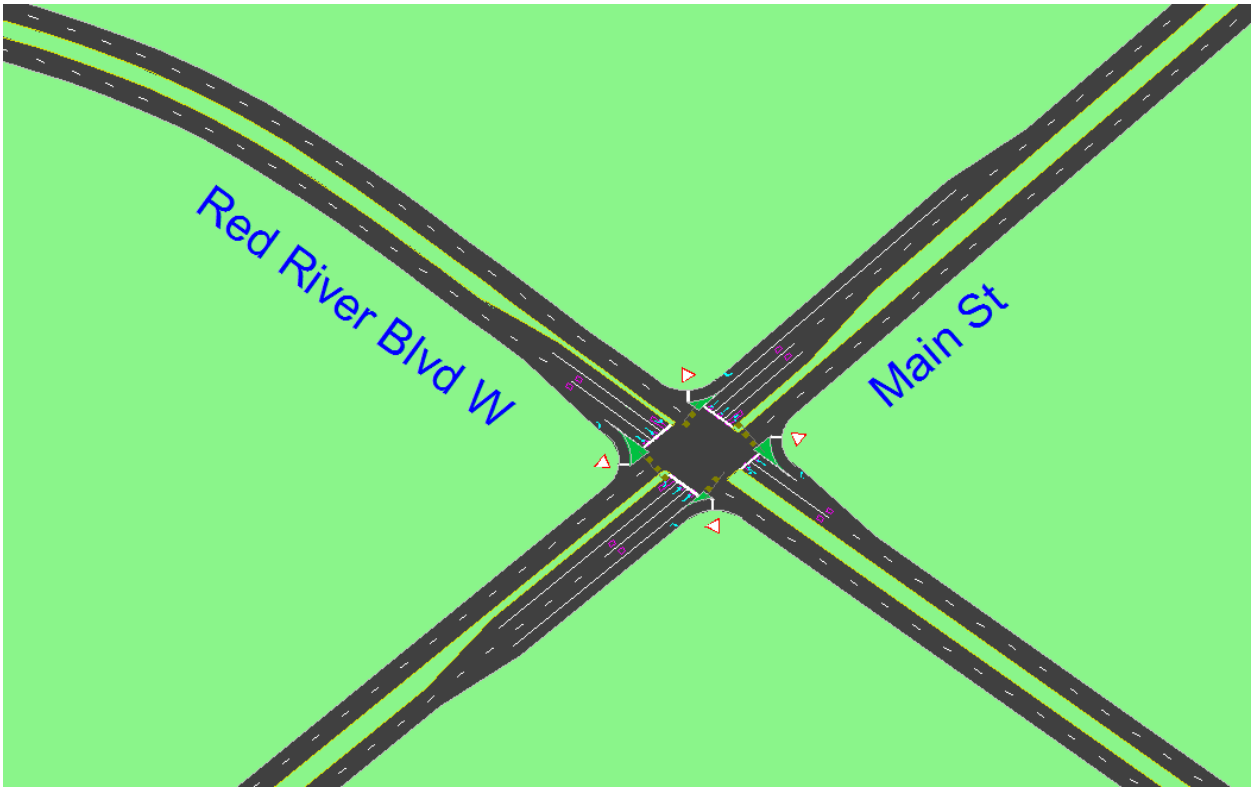


Figure A.2: Main Street and Red River Boulevard

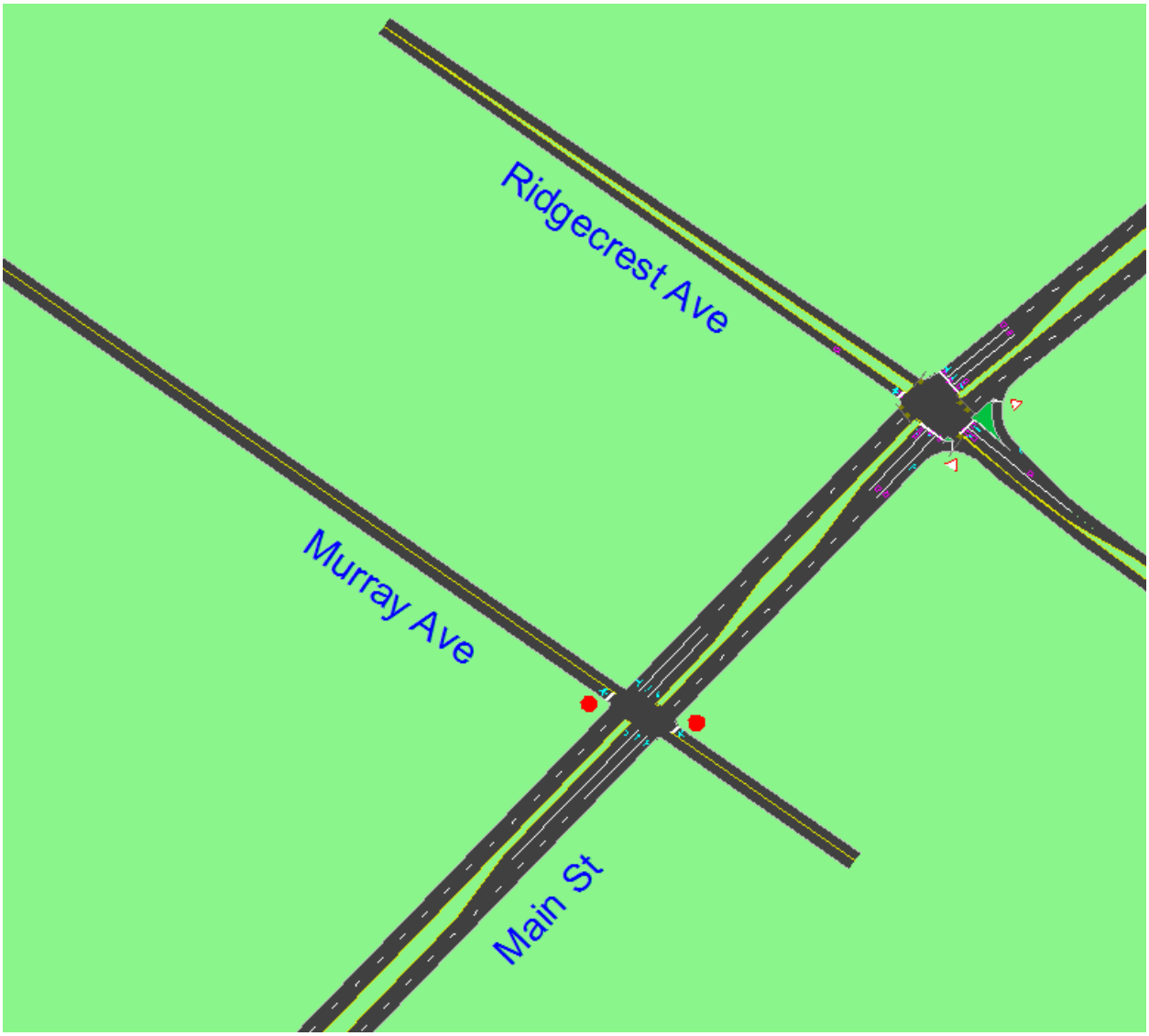


Figure A.3: Main Street - Ridgecrest Avenue to Murray Avenue

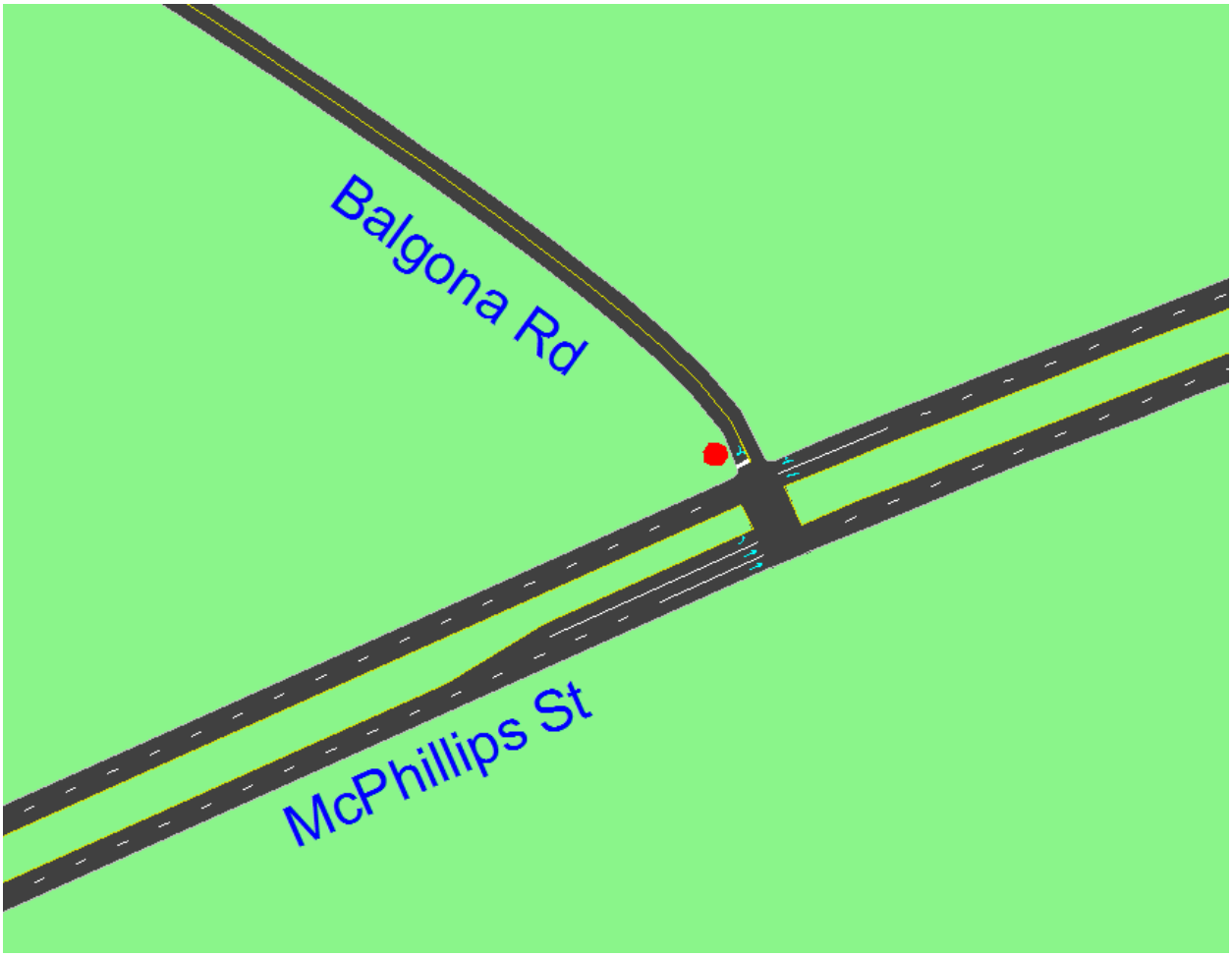


Figure A.4: McPhillips Street and Balgona Road

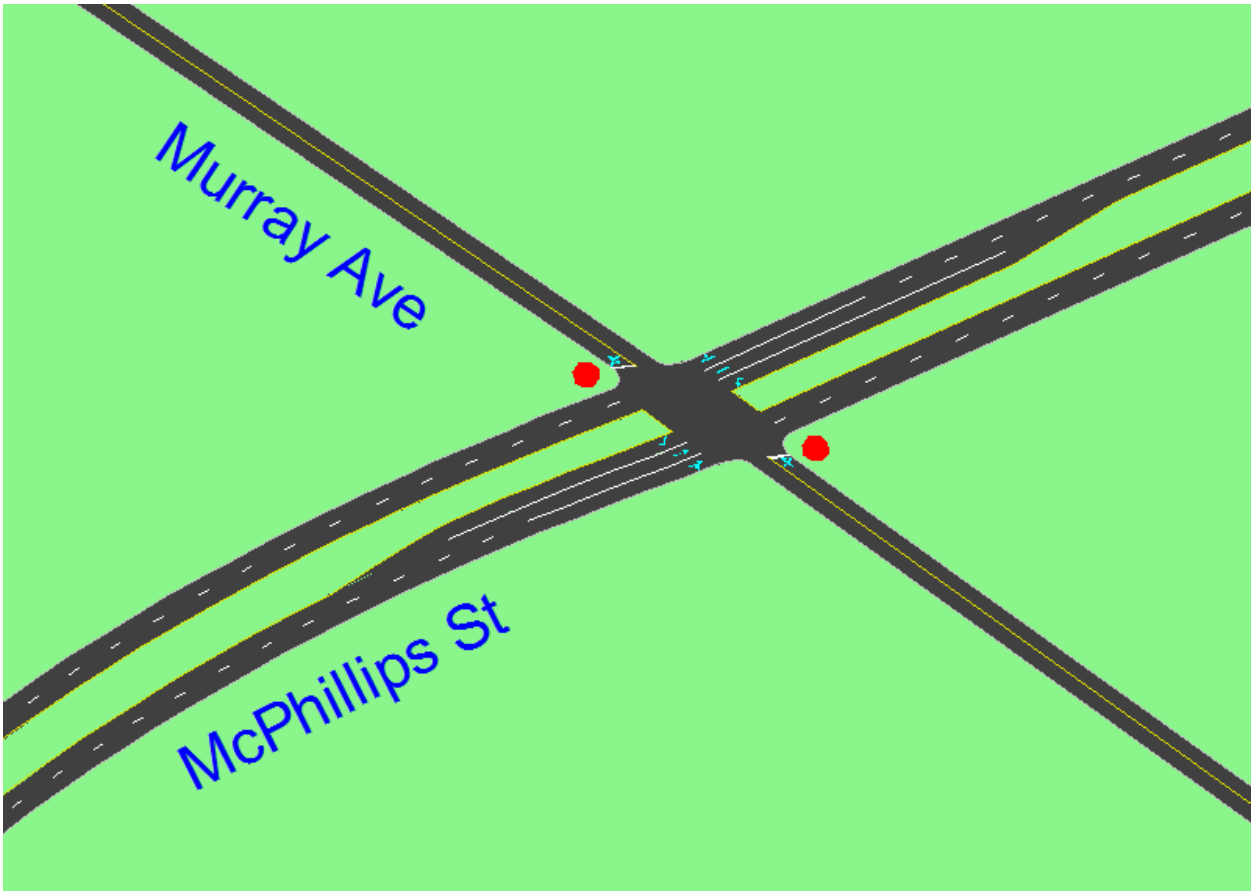


Figure A.5: McPhillips Street and Murray Avenue

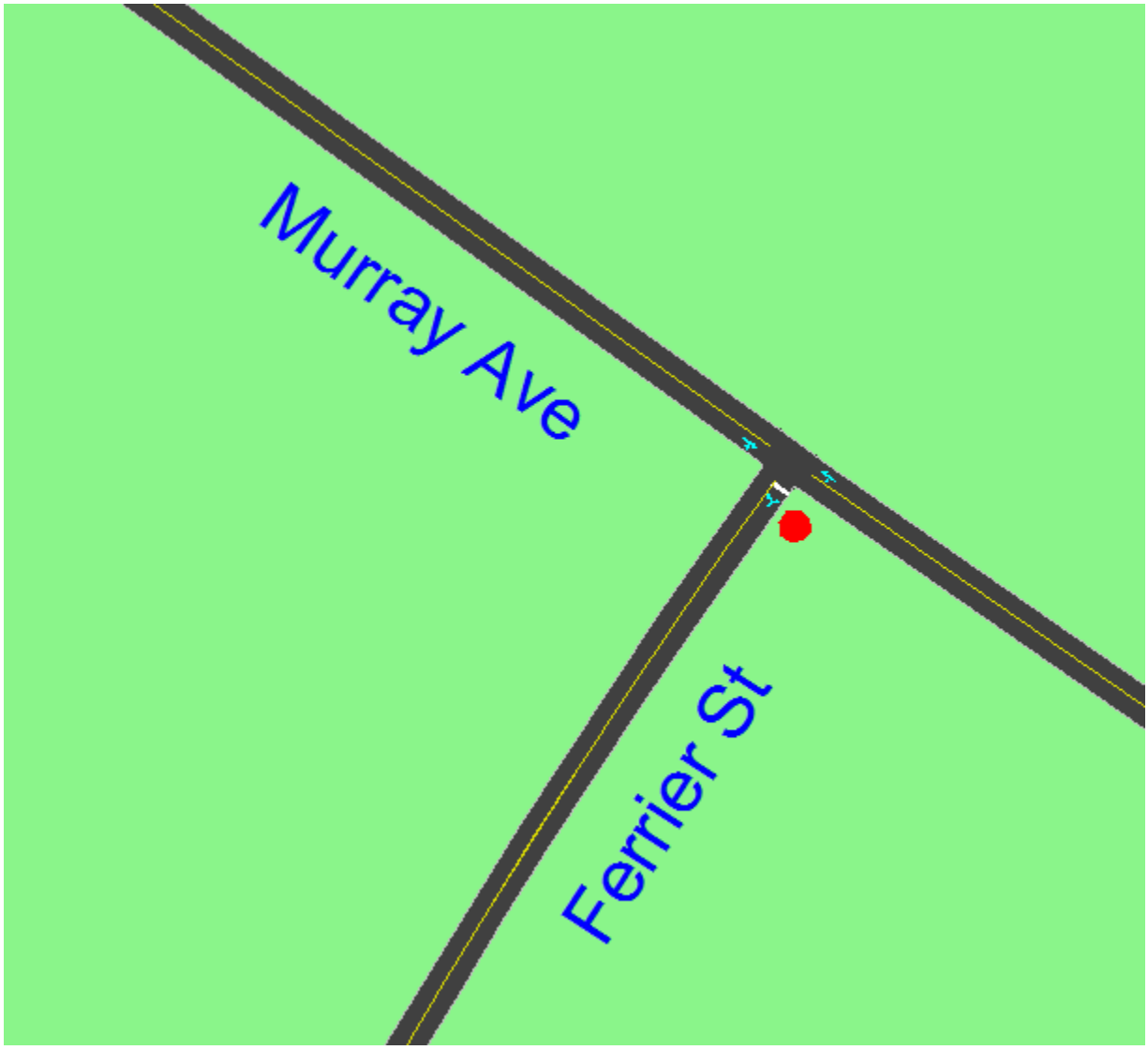


Figure A.6: Ferrier Street and Murray Avenue

A.3 TRAFFIC VOLUMES

Figure A.7 through Figure A.13 show AM and PM peak hour traffic volumes for the analysis scenarios.

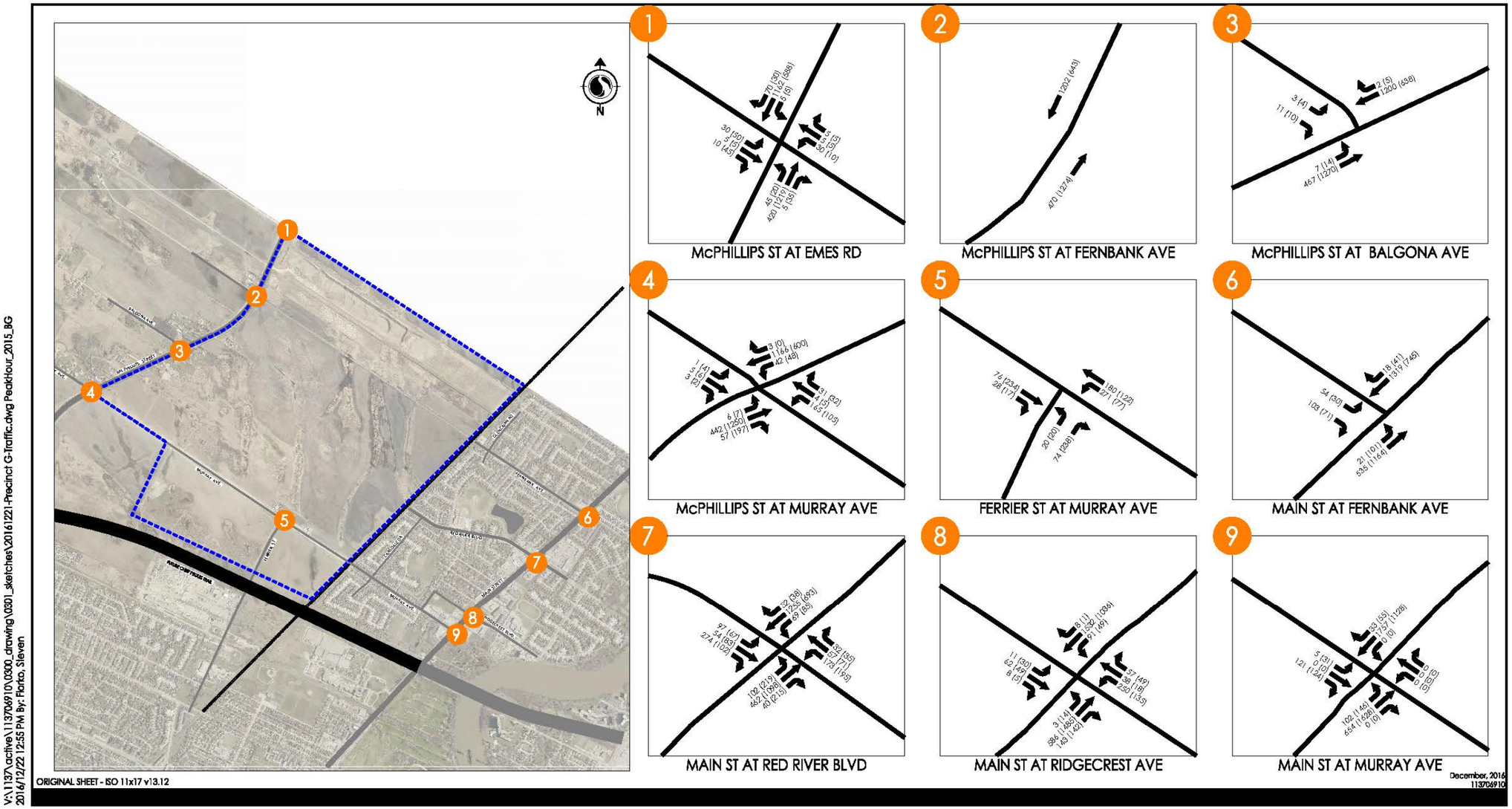


Figure A.7: 2015 Background Scenario AM (PM) Peak Hour Traffic Volumes

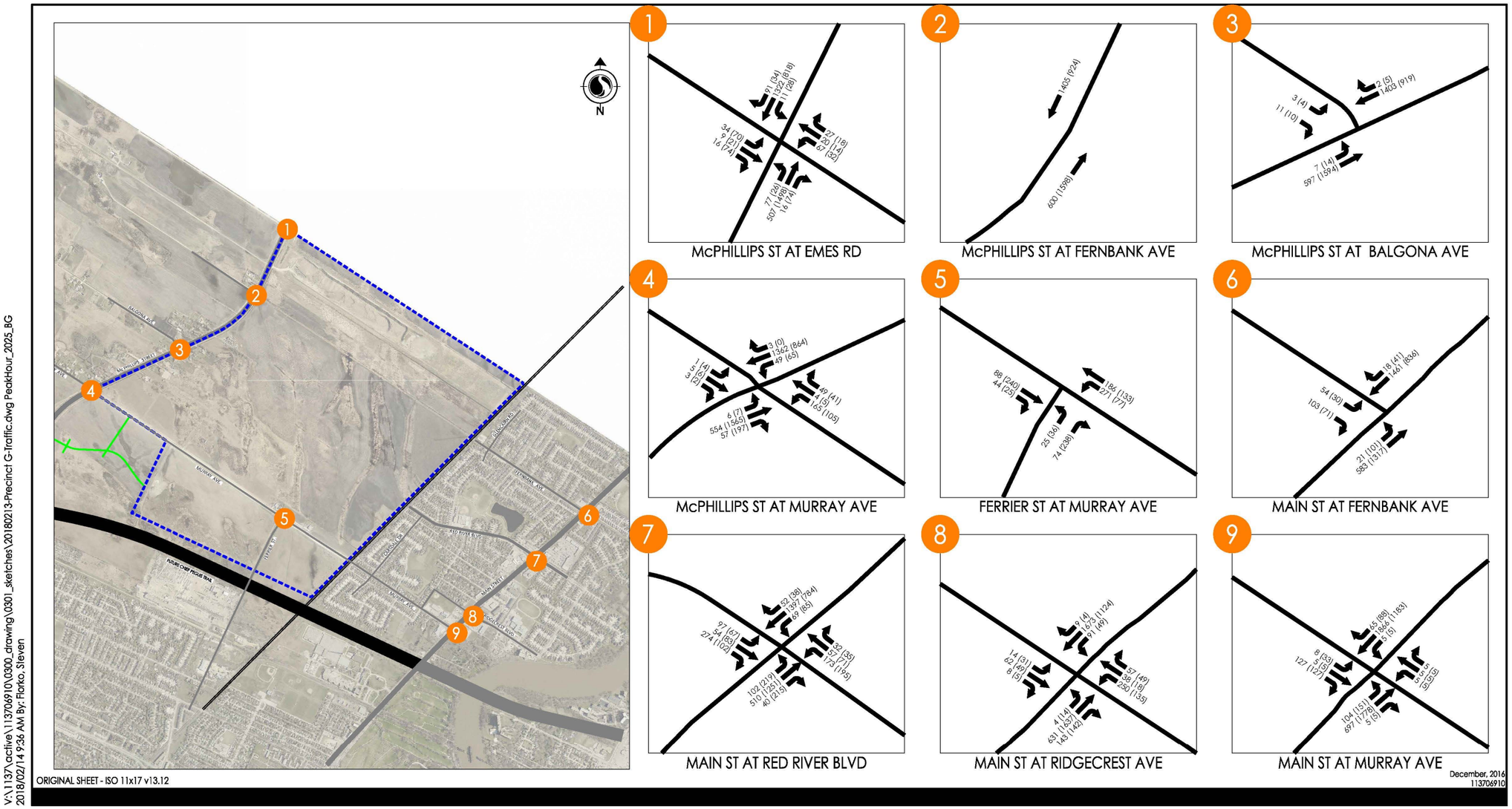


Figure A.8: 2025 Background Scenario AM (PM) Peak Hour Traffic Volumes

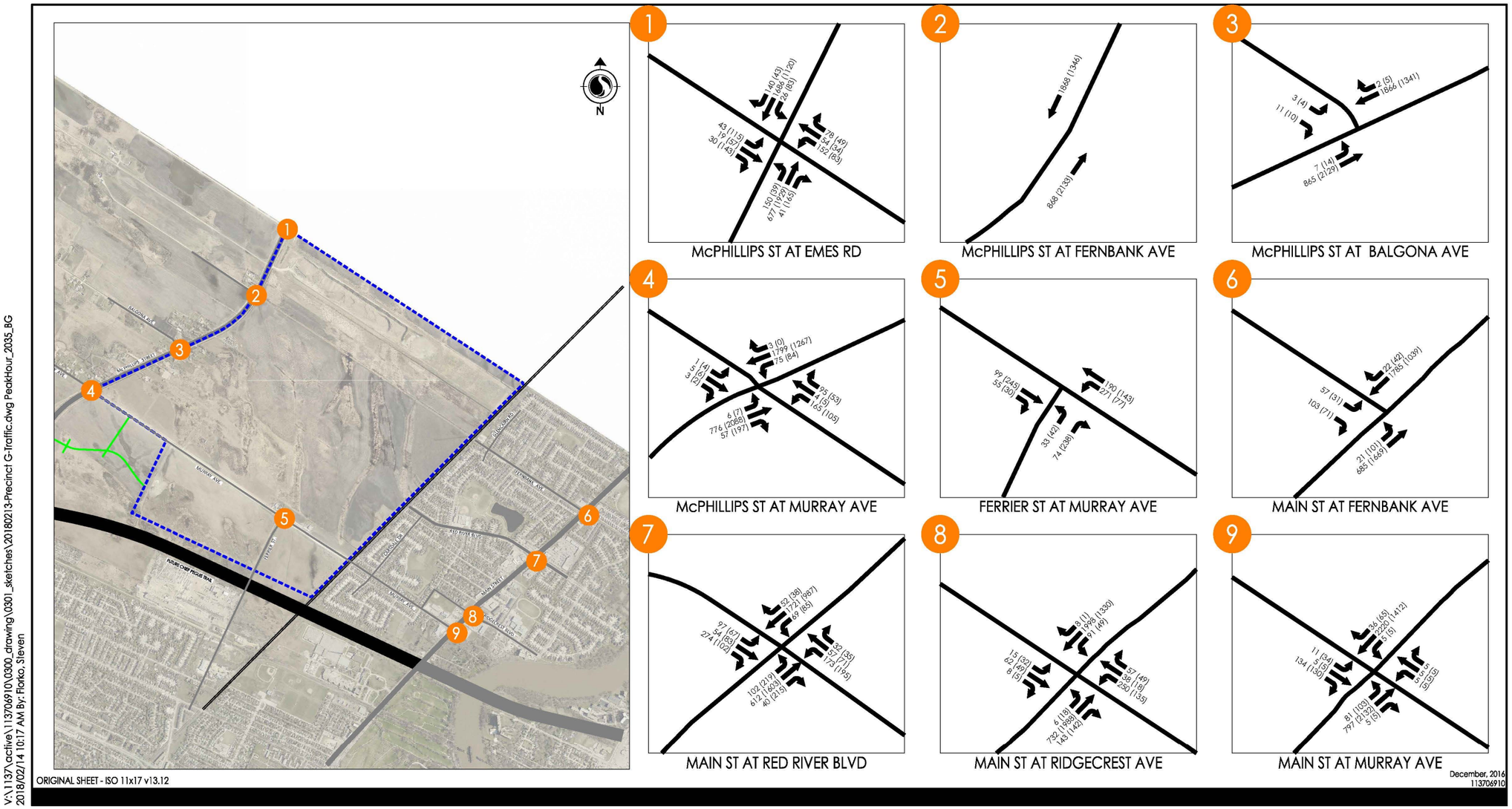


Figure A.9: 2035 Background Scenario AM (PM) Peak Hour Traffic Volumes

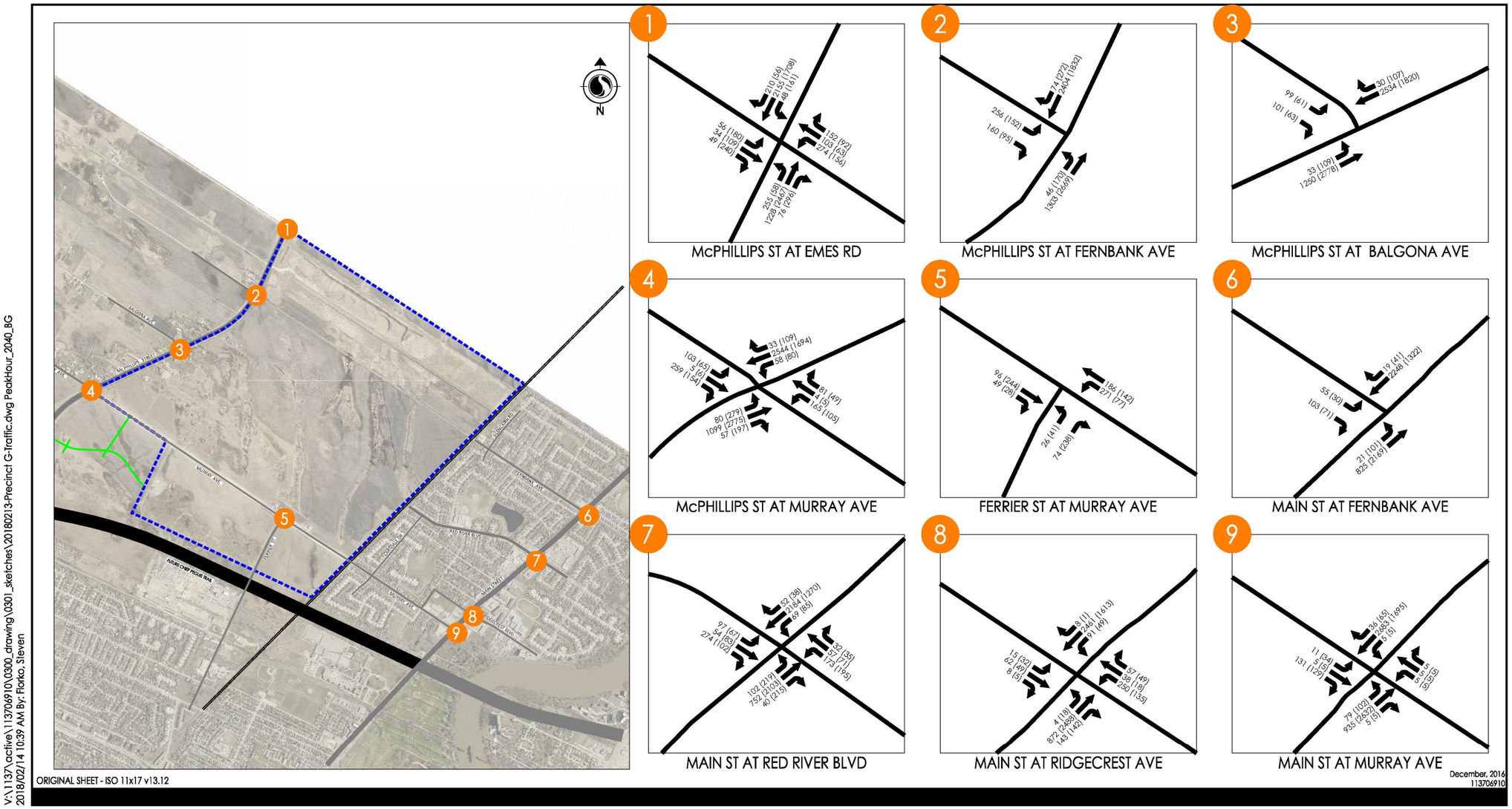


Figure A.10: 2040+ Background Scenario AM (PM) Peak Hour Traffic Volumes

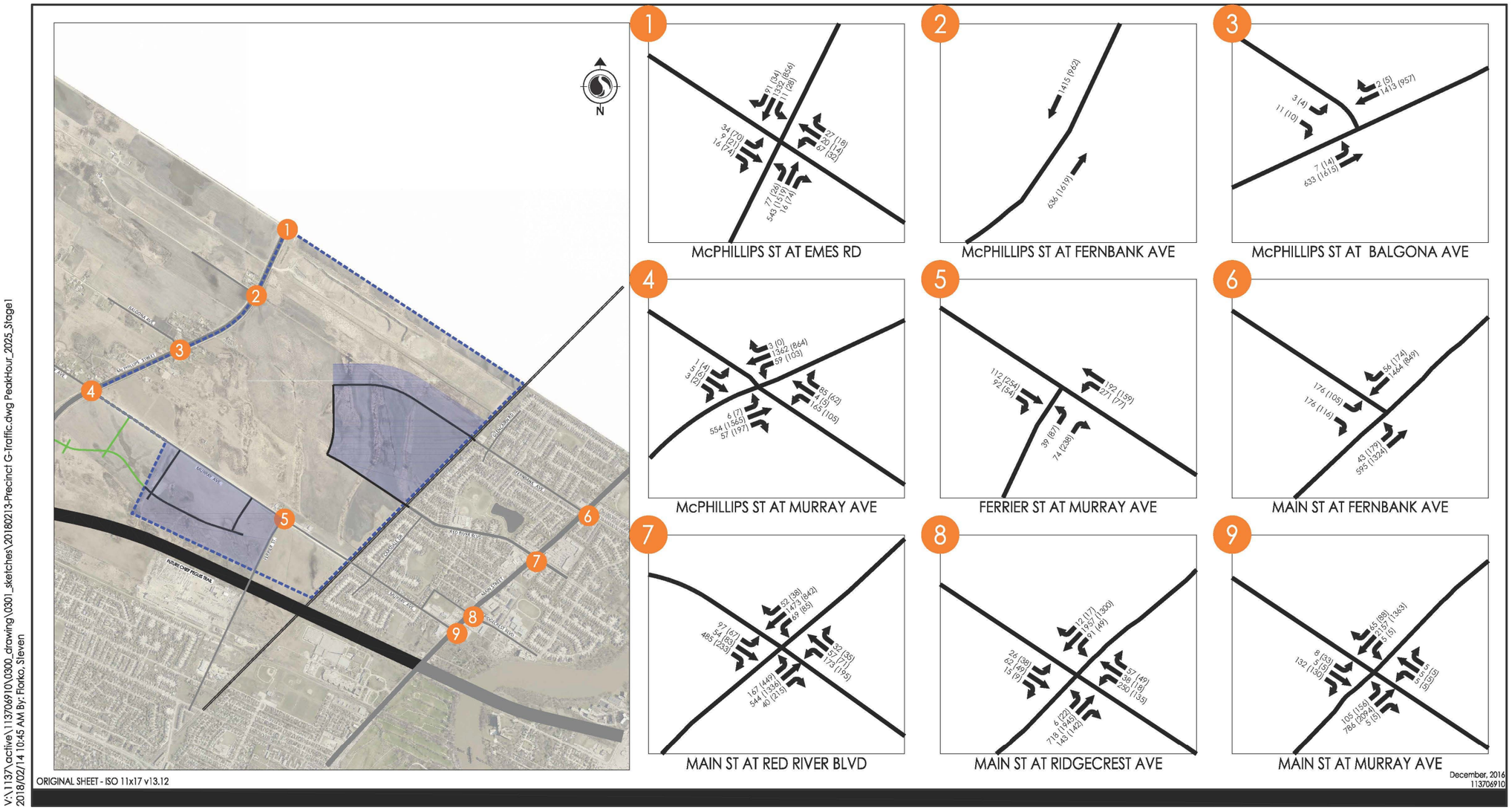


Figure A.11: 2025 Stage 1 Scenario AM (PM) Peak Hour Traffic Volumes

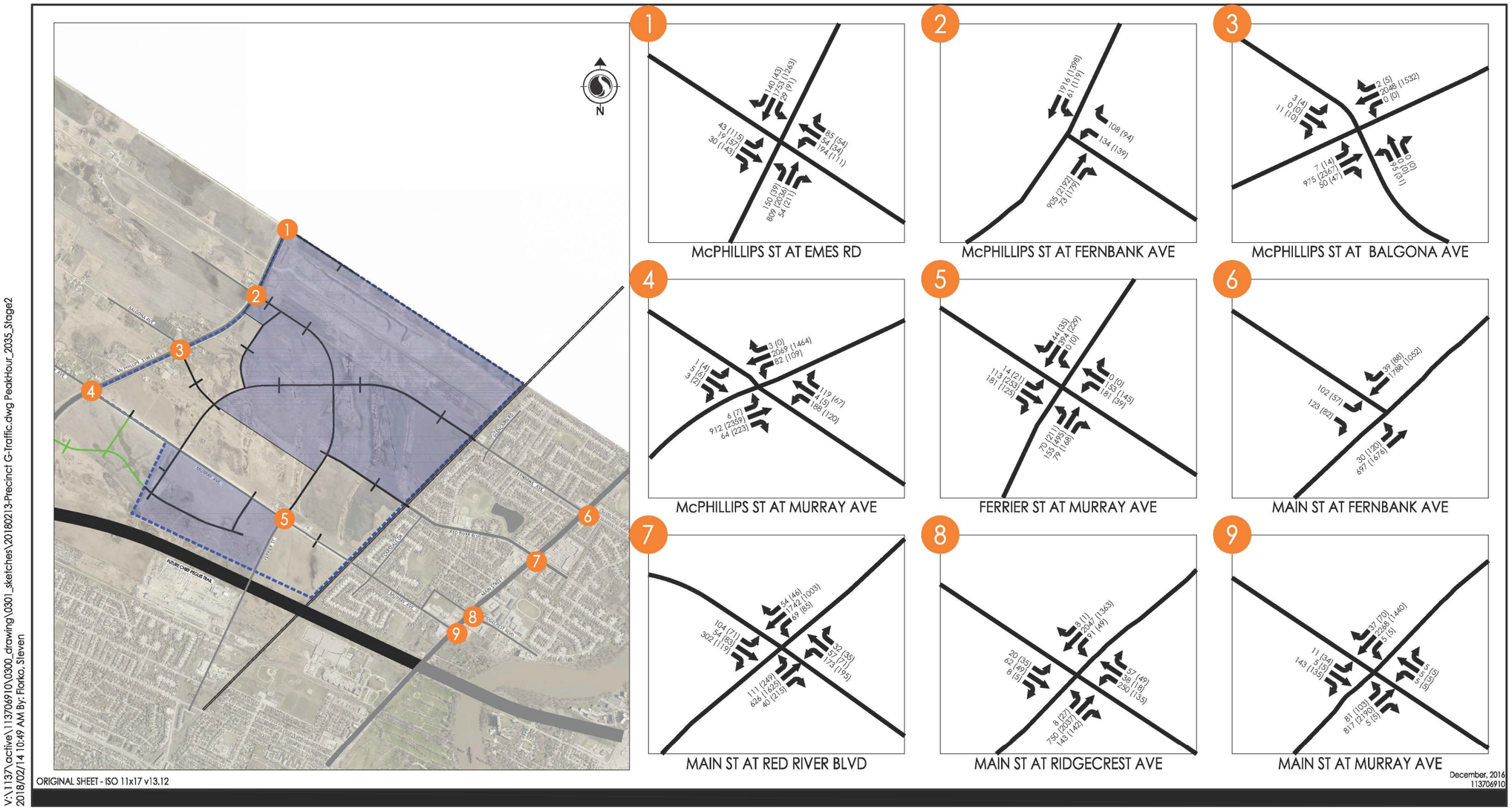


Figure A.12: 2035 Stage 2 Scenario AM (PM) Peak Hour Traffic Volumes

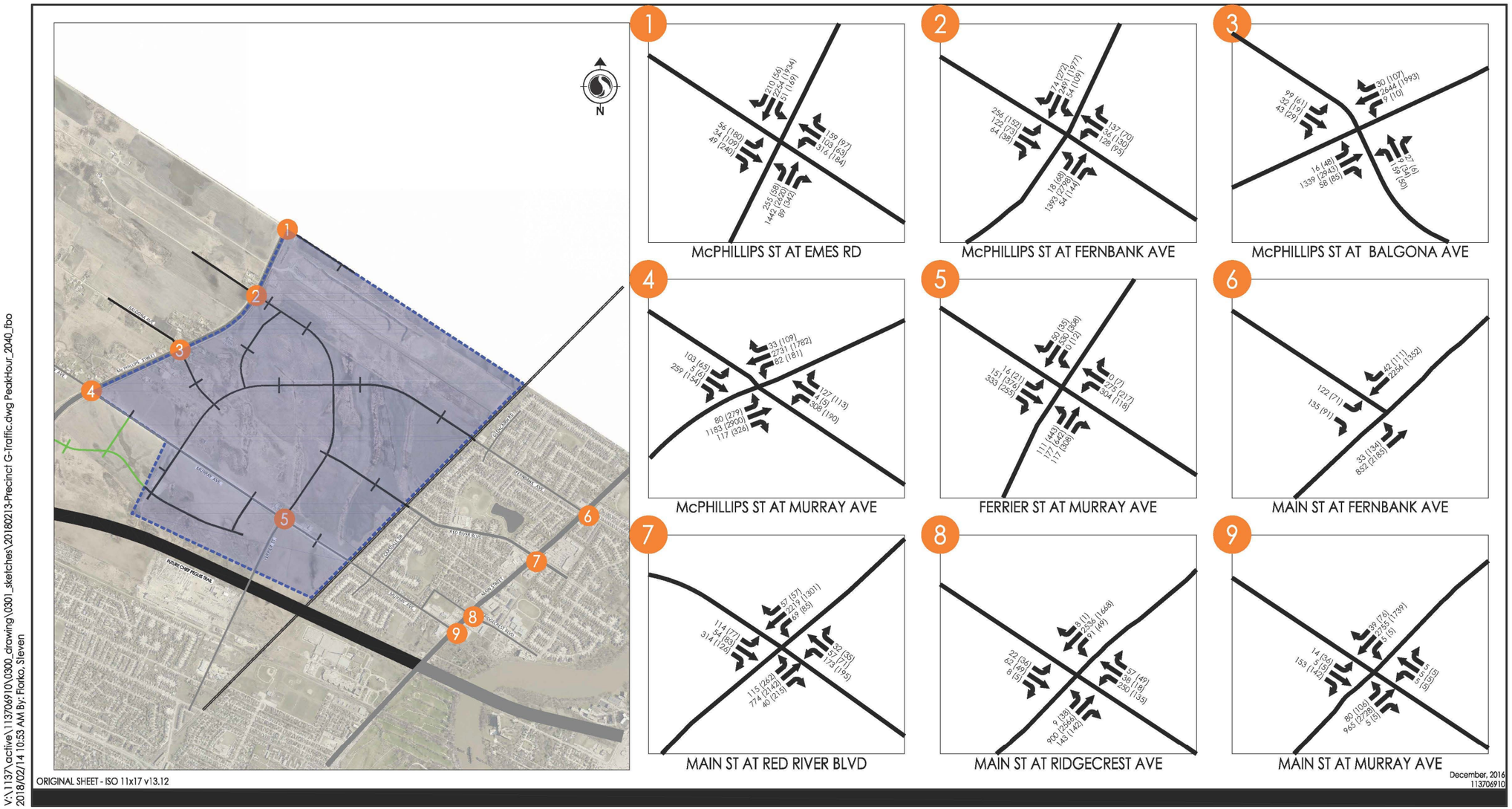


Figure A.13: 2040+ Full Build Out Scenario AM (PM) Peak Hour Traffic Volumes

A.4 ANALYSIS RESULTS

A.4.1 2015 Background

Analysis began using the existing intersection configurations with the 2015 Background Scenario traffic volumes.

Figure A.1 shows the results of the analyses for the AM and PM peak hours. Results from the AM peak hour are shown first, with PM peak hour results following in parentheses.

Table A.1: 2015 Background Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	A / 8 / 56% (A / 7 / 78%)	None (None)
Main St & Red River Blvd (Traffic Signal)	C / 22 / 76% (B / 16 / 68%)	SWR / E / 80 / 0.04 (NWT / D / 49 / 0.94dl)
Main St & Ridgecrest Ave (Traffic Signal)	B / 13 / 82% (B / 13 / 70%)	None (None)
Main St & Murray Ave (Two-Way Stop-Control)	D / 29 / 74% (Error)	SE 1 / F / 516 / 1.85 NW 1 / F / 567 / 0.99 (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err)
McPhillips St & Balgona Rd (Two-Way Stop-Control)	A / 0 / 43% (A / 0 / 45%)	None (None)
McPhillips St & Murray Ave (Two-Way Stop-Control)	A / 7 / 60% (B / 15 / 62%)	NW 1 / F / 61 / 0.83 (SE 1 / E / 38 / 0.11) (NW 1 / F / 228 / 1.24)
Ferrier St & Murray Ave (Two-Way Stop-Control)	A / 6 / 44% (A / 6 / 50%)	None (None)
McPhillips St & Emes Road (Two-Way Stop-Control)	A / 2 / 47% (A / 2 / 49%)	None (None)

In the 2015 scenario the worst performance was at Main Street and Murray Avenue and at McPhillips Street and Murray Avenue. At that intersection there were high delays on the Murray Avenue approaches (SE 1 and NW 1), so much so that Synchro returned errors for the PM peak hour. Because this intersection is only 150 m from the traffic signal at Ridgecrest Avenue, too close to implement traffic signal control. Additionally, this intersection may be near the ends of ramps for a future interchange at Chief Peguis Trail (CPT) and Main Street. A modest

improvement in performance can be gained from adding a right-turn lane to the approach, but traffic signal control is not an option for this location. The high delays will need to be accepted.

At McPhillips Street and Murray Avenue delays were most severe in the PM peak hour on Murray Avenue westbound (NW 1). As with the Murray Avenue approach at Main Street, some performance improvement can be gained from adding a westbound right-turn lane, but overall performance would still be poor. A traffic signal warrant (see Section 3.7) for this intersection indicated that traffic levels were not high enough to warrant traffic signal control, meaning that this delay will likely need to be accepted until traffic volumes increase to a level where traffic signals are warranted.

A.4.2 2025 Background

The analysis continued with the 2025 Background scenario. No modifications to the existing intersections were required in the 2015 Background scenario, so this analysis began with the existing intersection configurations.

With the existing intersection configurations performance at Main Street and Murray Avenue further degraded, but (as mentioned previously) the location of the intersection precludes significant intersection modifications, particularly the use of traffic signals.

At McPhillips Street and Murray Avenue performance on the Murray Avenue approaches was very poor, with PM peak hour delays in excess of 600 seconds and volume to capacity (v/c) ratios over 2.00. In this case a traffic signal warrant indicated that traffic volumes nearly warranted the use of traffic signals (see Section 3.7). Given that the warrant indicated that traffic signals were nearly warranted, and that side street delays were extreme, traffic signals were considered a reasonable modification, and were added to the analysis model.

A similar situation occurred at McPhillips Street and Emes Road, where intersection performance was poor and a traffic signal warrant indicated that traffic volumes were high enough to warrant signalization.

Traffic signals were added to the model at McPhillips Street and Murray Avenue and at McPhillips Street and Emes Road. Because the intersections are far apart (~1,700 m) each intersection was set to operate under semi-actuated uncoordinated operations, resting on McPhillips Street through movements. The posted speed limit was at least 80 km/h on McPhillips Street at both intersections, so left-turns from McPhillips Street were set to fully protected phasing.

Table A.2 shows the analysis results with these changes added to the analysis model.

Table A.2: 2025 Background Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	A / 9 / 60% (A / 7 / 85%)	None (None)
Main St & Red River Blvd (Traffic Signal)	C / 23 / 80% (B / 15 / 72%)	SER / E / 56 / 0.74 NER / E / 63 / 0.03 (None)
Main St & Ridgecrest Ave (Traffic Signal)	B / 16 / 86% (B / 15 / 74%)	NWL / E / 62 / 0.85 (None)
Main St & Murray Ave (Two-Way Stop-Control)	Error (Error)	SE 1 / Err / Err / Err NW 1 / Err / Err / Err (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err)
McPhillips St & Balgona Rd (Two-Way Stop-Control)	A / 0 / 49% (A / 0 / 54%)	None (None)
McPhillips St & Murray Ave (Traffic Signal)	B / 18 / 70% (C / 20 / 79%)	EBL / E / 56 / 0.44 (EBL / F / 101 / 0.57) (WBL / E / 77 / 0.74)
Ferrier St & Murray Ave (Two-Way Stop-Control)	A / 6 / 48% (A / 6 / 52%)	None (None)
McPhillips St & Emes Road (Traffic Signal)	B / 17 / 64% (B / 18 / 65%)	NBL / E / 65 / 0.76 SBL / F / 125 / 0.71 (NBL / F / 107 / 0.78) (SBL / F / 126 / 0.83)

Notice that performance on Murray Avenue at McPhillips Street and on Emes Road at McPhillips Street improved to the point of not being critical movements. However, left-turns off of McPhillips Street had worse performance. Under two-way stop control these movements were free to proceed at gaps in opposing McPhillips Street traffic, but with fully protected left-turns these movements need to wait for their phase at the traffic signal.

A.4.3 2035 Background

Analysis continued with the 2035 Background Scenario. The initial analysis for this scenario used the analysis model from the 2025 Background Scenario, with traffic signals on McPhillips Street at Emes Road and at Murray Avenue.

With these configurations McPhillips Street through movements were nearly at capacity at the two signalized intersections, particularly in the PM peak hour. One way to address this would be to widen McPhillips Street from the existing four-lane cross-section to a six-lane cross-section. This would come at significant expense. Other intersection modifications were tried to see if a less extensive option could provide acceptable performance.

The concept with these improvements was to provide more time in the traffic signal cycle to McPhillips Street through traffic by increasing capacity for opposing movements. The following modifications were used:

- McPhillips Street and Murray Avenue
    - Added a northbound right-turn lane with a right-turn cut-off
    - Westbound approach modified from a single lane to an exclusive left-turn lane plus a through lane plus an exclusive right-turn lane
- McPhillips Street and Emes Road
    - Added a northbound right-turn lane with a right-turn cut-off
    - Eastbound approach modified from a single lane to an exclusive left-turn lane plus a through lane plus an exclusive right-turn lane
    - Westbound approach modified from a single lane to an exclusive left-turn lane plus a through lane plus an exclusive right-turn lane
- Main Street and Fernbank Avenue
    - Added an exclusive northbound left-turn lane

Note that at Main Street and Fernbank Avenue the shared northbound left-turn and through lane had a v/c ratio of 1.02 in the PM peak hour. The exclusive northbound left-turn lane was added to resolve this.

Table A.3 shows the results with these modifications.

Table A.3: 2035 Background Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	B / 11 / 70% (A / 6 / 62%)	None (None)
Main St & Red River Blvd (Traffic Signal)	C / 28 / 89% (B / 17 / 82%)	SER / E / 56 / 0.75 NER / F / 115 / 0.03 SWT / C / 28 / 0.95 (NWT / D / 48 / 0.94dl)
Main St & Ridgecrest Ave (Traffic Signal)	B / 17 / 95% (C / 20 / 84%)	NWL / E / 62 / 0.85 SWT / B / 19 / 0.99 (SWL / F / 97 / 0.85)
Main St & Murray Ave (Two-Way Stop-Control)	Error (Error)	SE 1 / Err / Err / Err NW 1 / Err / Err / Err NE 1 / F / 106 / 0.79 SW 2 / A / 0 / 1.00 (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err) (NE 2 / A / 0 / 0.97)
McPhillips St & Balgona Rd (Two-Way Stop-Control)	A / 0 / 62% (A / 0 / 69%)	None (None)
McPhillips St & Murray Ave (Traffic Signal)	C / 21 / 85% (C / 25 / 90%)	EBL / E / 67 / 0.47 (EBL / F / 124 / 0.62) (EBT / C / 31 / 0.97) (WBL / F / 110 / 0.88)
Ferrier St & Murray Ave (Two-Way Stop-Control)	A / 6 / 50% (A / 6 / 54%)	None (None)
McPhillips St & Emes Road (Traffic Signal)	C / 28 / 85% (C / 24 / 86%)	WBL / E / 58 / 0.72 NBL / E / 79 / 0.84 SBL / E / 68 / 0.54 (NBL / E / 68 / 0.60) (SBL / F / 98 / 0.85)

The intersection of Main Street and Ridgecrest Avenue had an ICU of 99% in the AM peak hour, indicating that the intersection was nearly at capacity. Individual movement performance was still good, with one movement at LOS E and one movement nearly at capacity.

At McPhillips Street and Murray Avenue two movements operated at LOS F, but the v/c ratios were no greater than 0.88, indicating that there was unused capacity. Additionally, both movements operated under actuated control with relatively low volumes (less than 90 vehicles per hour), meaning that many of the vehicles making these movements would be the first vehicles arriving, and thus having to trigger the actuation and wait for their green phase,

increasing delay. There was an additional movement that operated at LOS C, but with a v/c ratio of 0.97. This movement was near capacity, but delay was acceptable.

At the intersection of McPhillips Street and Emes Road the northbound and southbound left-turns operated at LOS E or F, with v/c ratios of no more than 0.85. Although one movement operated at LOS F, delays did not exceed 98 seconds. This performance was acceptable.

A.4.4 2040+ Background

Analysis of the Beyond 240 Background Scenario began with the model used in the 2035 Background Scenario. The 2040+ Background Scenario included growth in Precinct G, which meant that the intersection of McPhillips Street and Fernbank Avenue was developed as a "T" intersection with a leg to the west, into Precinct D.

At this intersection and at the intersection of McPhillips Street and Balgona Road the side streets had delays high enough to return errors, with v/c ratios in excess of 3.00. At McPhillips Street and Fernbank Avenue the traffic signal warrant (see Section 3.7) confirmed that signals were warranted, but at Balgona Avenue the side street volume was considered slightly below the level where traffic signals are warranted. In spite of this the high delays on Balgona Road were deemed unacceptable and traffic signals were utilized at both locations.

Growth in through traffic McPhillips Street required widening to six lanes from south of Murray Avenue through to north of Emes Road. On Main Street through movement performance could have benefited from widening to six lanes, but lack of right-of-way prevented widening from Ridgecrest Avenue and further north. Main Street was analyzed with a six lane cross-section south of Ridgecrest Avenue.

The following points summarize the modifications from the model used for the 2035 Background Scenario.

- Main Street and Fernbank Avenue
    - Added a southbound right-turn lane with a right-turn cut-off
- Main Street and Ridgecrest Boulevard
    - Main Street widened to six lanes approaching the intersection from the south
- Main Street and Murray Avenue
    - Main Street widened to six lanes through the intersection
- McPhillips Street and Fernbank Avenue

  - Added a west intersection leg with an exclusive left-turn lane and an exclusive right-turn lane
  - Added traffic signal control
  - Added a northbound left-turn lane
  - Added a southbound right-turn lane with a right-turn cut-off
  - McPhillips Street widened to six lanes through the intersection

- McPhillips Street and Balgona Road
  - Added traffic signal control
  - Added a northbound left-turn lane
  - Added a southbound right-turn lane with a right-turn cut-off
  - Westbound approach modified to have an exclusive left-turn lane and an exclusive right-turn lane
  - McPhillips Street widened to six lanes through the intersection

- McPhillips Street and Murray Avenue
  - Added a southbound right-turn lane with a right-turn cut-off
  - Modified the eastbound approach to have an exclusive left-turn lane, a through lane, and an exclusive right-turn lane
  - McPhillips Street widened to six lanes through the intersection

- McPhillips Street and Emes Road
  - Southbound right-turn lane modified to include a right-turn cut-off
  - Added a second northbound left-turn lane and widened the west leg to receive the dual northbound left-turn lanes
  - McPhillips Street widened to six lanes through the intersection

Table A.4 shows the analysis results with these modifications.

Table A.4: 2040+ Background Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	B / 15 / 82% (A / 7 / 76%)	SEL / E / 66 / 0.66 (SEL / E / 62 / 0.25)
Main St & Red River Blvd (Traffic Signal)	D / 54 / 102% (C / 35 / 95%)	NEL / F / 87 / 0.68 NER / F / 88 / 0.03 SWT / E / 65 / 1.08 SEL / E / 55 / 0.51 SER / E / 66 / 0.75 (NEL / E / 56 / 0.75) (NET / D / 36 / 1.03) (NWL / E / 68 / 0.77)
Main St & Ridgecrest Ave (Traffic Signal)	E / 73 / 106% (E / 65 / 93%)	NWL / E / 77 / 0.87 SWT / F / 100 / 1.19 (NET / F / 102 / 1.16) (SWL / E / 57 / 0.47) (NWL / E / 60 / 0.61)
Main St & Murray Ave (Two-Way Stop-Control)	Error (Error)	SE 1 / Err / Err / Err NW 1 / Err / Err / Err (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err) (SW 1 / E / 44 / 0.05)
McPhillips St & Fernbank Ave (Traffic Signal)	B / 12 / 71% (B / 12 / 70%)	None (NBL / E / 60 / 0.84)
McPhillips St & Balgona Rd (Traffic Signal)	A / 7 / 65% (A / 9 / 68%)	EBL / F / 103 / 0.82 (EBL / E / 72 / 0.72)
McPhillips St & Murray Ave (Traffic Signal)	B / 19 / 89% (C / 31 / 86%)	EBL / E / 57 / 0.56 (EBT / D / 36 / 0.98) (WBL / E / 68 / 0.65)
Ferrier St & Murray Ave (Two-Way Stop-Control)	A / 6 / 49% (A / 7 / 56%)	None (None)
McPhillips St & Emes Road (Traffic Signal)	C / 29 / 86% (C / 37 / 88%)	NBL / E / 60 / 0.86 SBL / E / 58 / 0.50 (NBT / D / 44 / 1.03) (SBL / E / 65 / 0.73)

As Table A.4 shows, performance was poor at Main Street and Red River Boulevard and at Main Street and Ridgecrest Avenue. Many movements operated at LOS E or F, with several movements over capacity. Intersection performance could benefit from widening Main Street to six lanes, but this is prevented by geometric constraints.

Performance was much better at Main Street and Fernbank Avenue, with all movements operating at LOS E or better, with v/c ratios below 0.70.

Intersections on McPhillips Street operated at LOS C or better, with one movement operating at LOS F, and one movement over capacity. This indicates that some movements—particularly McPhillips Street through movements—were nearing or at capacity.

At Ferrier Street and Murray Avenue the two-way stop control intersection operated at LOS A in both peak hours, with no critical movements.

A.4.5 2025 Stage 1 Build Out

Analysis of the 2025 Stage 1 Build Out Scenario began with the model that provided acceptable performance for the 2025 Background Scenario. Recall from Section A.4.2 that that model included Traffic signals at McPhillips Street and Emes Road and at McPhillips Street and Murray Avenue. This model gave good performance, with the exception of the northbound through movement at Main Street and Fernbank Avenue. The shared northbound left-turn caused the northbound through movement to go over capacity with a v/c ratio of 1.07. Recall from Section A.4.3 that this movement had a v/c ratio of 1.02 in the 2035 Background Scenario, so the addition of traffic from Stage 1 of Precinct G appears to accelerate the need for modifications to that movement. An exclusive northbound left-turn lane was added to resolve the capacity issue.

Table A.5 shows the results of the analysis.

Table A.5: 2025 Stage 1 Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	B / 19 / 73% (A / 9 / 67%)	SEL / E / 61 / 0.87 (None)
Main St & Red River Blvd (Traffic Signal)	D / 41 / 95% (C / 22 / 81%)	SER / E / 77 / 0.98 NEL / F / 82 / 0.91 NER / F / 191 / 0.03 SWT / C / 33 / 0.95 (NWT / D / 49 / 0.94dl)
Main St & Ridgecrest Ave (Traffic Signal)	B / 18 / 94% (B / 16 / 83%)	NWL / E / 65 / 0.87 (SWL / E / 79 / 0.85)
Main St & Murray Ave (Two-Way Stop-Control)	Error (Error)	SE 1 / Err / Err / Err NW 1 / Err / Err / Err NE 1 / F / 57 / 0.65 SW 2 / A / 0 / 0.94 (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err)
McPhillips St & Balgona Rd (Two-Way Stop-Control)	A / 0 / 49% (A / 0 / 55%)	None (None)
McPhillips St & Murray Ave (Traffic Signal)	C / 20 / 78% (C / 25 / 87%)	EBL / E / 56 / 0.44 (EBL / F / 101 / 0.57) (WBL / F / 93 / 0.87)
Ferrier St & Murray Ave (Two-Way Stop-Control)	A / 6 / 53% (A / 8 / 59%)	None (None)
McPhillips St & Emes Road (Traffic Signal)	B / 17 / 64% (B / 18 / 66%)	SBL / F / 150 / 0.75 (NBL / F / 107 / 0.78) (SBL / F / 126 / 0.83)

Note that some movements were nearing capacity at Main Street and Red River Boulevard and at McPhillips Street and Murray Avenue. At this intersection the addition of traffic from stage 1 of Precinct G nearly requires modifications similar to those required for the 2035 Background Scenario. This performance nearly needed additional modifications, but it was considered acceptable.

A.4.6 2035 Stage 2 Build Out

In the 2035 Stage 2 Build Out Scenario the street network included Fernbank Avenue and Balgona Road east of McPhillips Street. These additions resulted in the creation of the intersection of McPhillips Street and Fernbank Avenue and the modification of McPhillips Street and Balgona Road from a "T" intersection to a four leg intersection.

The Stage 2 street network also included Ferrier Street extended north of Murray Avenue. This resulted in that intersection being modified from a "T" intersection to a four leg intersection.

The rest of the intersections were modeled as in the 2035 Background Scenario. The addition of traffic from Stage 2 of Precinct G required the following modifications:

- McPhillips Street and Fernbank Avenue
    - Added an east leg, creating a "T" intersection
    - Added traffic signal control
    - Added a northbound right-turn lane with a right-turn cut-off
    - Added a southbound left-turn lane
    - The westbound (Fernbank Avenue) approach modeled with an exclusive left-turn lane plus an exclusive right-turn lane
- McPhillips Street and Balgona Avenue
    - Added an east leg, modifying the intersection from a "T" intersection to a four leg intersection, remaining under two-way stop control
    - Added a northbound right-turn lane with a right-turn cut-off
    - Added a southbound left-turn lane
    - The westbound (Balgona Road) approach modeled with a single lane approaching the intersection
- Ferrier Street and Murray Avenue
    - Added a north leg, modifying the intersection from a "T" intersection to a four leg intersection
    - Added traffic signal control
    - Modified the northbound approach to have an exclusive left-turn lane plus a through lane plus an exclusive right-turn lane
    - Modified the eastbound approach to have a shared through and left-turn lane and an exclusive right-turn lane
    - Modified the westbound approach to have an exclusive left-turn lane and a shared through and right-turn lane
    - The southbound approach modeled with a single lane approaching the intersection

Table A.6 shows the results of the analysis with these modifications.

Table A.6: 2035 Stage 2 Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	B / 14 / 74% (A / 8 / 101%)	SEL / E / 58 / 0.76 (None)
Main St & Red River Blvd (Traffic Signal)	C / 31 / 91% (B / 18 / 82%)	SER / E / 57 / 0.79 NER / F / 171 / 0.03 SWT / C / 32 / 1.00 (NWT / D / 49 / 0.94dl)
Main St & Ridgecrest Ave (Traffic Signal)	B / 18 / 97% (B / 19 / 85%)	NWL / E / 63 / 0.86 SWT / B / 14 / 0.95 (SWL / F / 91 / 0.85)
Main St & Murray Ave (Two-Way Stop-Control)	Error (Error)	SE 1 / Err / Err / Err NW 1 / Err / Err / Err NE 1 / F / 64 / 0.62 SW 2 / A / 0 / 0.97 (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err)
McPhillips St & Fernbank Ave (Traffic Signal)	B / 10 / 70% (D / 41 / 90%)	SBL / E / 72 / 0.58 (NBT / E / 61 / 1.06) (SBL / F / 111 / 0.96)
McPhillips St & Balgona Rd (Two-Way Stop-Control)	A / 7 / 76% (A / 8 / 78%)	NB 1 / F / 208 / 1.13 SB 1 / F / 68 / 0.28 (NB 1 / F / >240 / 1.85) (SB 1 / F / 74 / 0.29)
McPhillips St & Murray Ave (Traffic Signal)	D / 41 / 94% (E / 55 / 100%)	EBL / E / 67 / 0.47 WBT / D / 54 / 1.05 (EBL / F / 194 / 0.73) (EBT / F / 86 / 1.12) (WBL / E / 71 / 0.67) (NWL / E / 68 / 0.69)
Ferrier St & Murray Ave (Traffic Signal)	B / 11 / 65% (B / 14 / 93%)	None (None)
McPhillips St & Emes Road (Traffic Signal)	C / 27 / 85% (B / 18 / 89%)	WBL / E / 58 / 0.77 SBL / E / 63 / 0.49 (NBL / E / 76 / 0.29) (NBT / B / 12 / 1.02) (SBL / E / 60 / 0.62)

Note that Main Street through movements were nearing or over capacity at Red River Boulevard and Ridgecrest Avenue, and that McPhillips Street through movements were nearing

or over capacity at Fernbank Avenue, Murray Avenue, and Emes Road. This indicates that traffic from development in Precinct G may accelerate the need for widening McPhillips Street to six lanes. Widening McPhillips Street to six lanes may be postponed to the 2040+ Full Build Out scenario, provided that this level of performance is acceptable. Field observations should be conducted in the future to help determine if operations are acceptable, or if widening to six lanes should occur prior to the 2040+ Full Build Out scenario.

A.4.7 2040+ Full Build Out

Analysis of the 2040+ Full Build Out Scenario considered the intersection modifications needed in the 2040+ Background Scenario and in the 2035 Stage 2 Build Out Scenario. McPhillips Street required widening to six lanes for the 2040+ Background Scenario, so that modification was assumed to be required for the 2040+ Full Build Out Scenario. The following points describe the intersection modifications made to the 2040+ Background Scenario model for the 2040+ Full Build Out Scenario:

- Main Street and Fernbank Avenue
    - Modified the eastbound (Fernbank Avenue) approach to have an exclusive left-turn lane and an exclusive right-turn lane
- McPhillips Street and Fernbank Avenue
    - Added an east leg to the intersection, modifying the intersection from a "T" intersection to a four leg intersection
    - The east leg had an exclusive left-turn lane, a through lane, and an exclusive right-turn lane
    - Modified the west leg to have an exclusive left-turn lane, a through lane, and an exclusive right-turn lane
    - Added a northbound right-turn lane with a right-turn cut-off
    - Added a southbound left-turn lane
- McPhillips Street and Balgona Road
    - Added an east leg to the intersection, modifying the intersection from a "T" intersection to a four leg intersection
    - The east leg had an exclusive left-turn lane, a through lane, and an exclusive right-turn lane
    - Modified the west leg to have an exclusive left-turn lane, a through lane, and an exclusive right-turn lane

  - Added a northbound right-turn lane with a right-turn cut-off
  - Added a southbound left-turn lane

- McPhillips Street and Emes Road
  - Added a second northbound left-turn lane and widened the west leg to receive the dual northbound left-turns
  - Add a second southbound left-turn lane and widened the east leg to receive the dual southbound left-turns

- Ferrier Street and Murray Avenue
  - Added a north leg, modifying the intersection from a "T" intersection to a four leg intersection
  - Added traffic signal control
  - Modified the northbound approach to have an exclusive left-turn lane plus a through lane plus an exclusive right-turn lane
  - Modified the eastbound approach to have a shared through and left-turn lane and an exclusive right-turn lane
  - Modified the westbound approach to have an exclusive left-turn lane and a shared through and right-turn lane
  - The southbound approach modeled with a single lane approaching the intersection

Table A.7 shows the results of the analysis with these modifications to the model used in the 2040+ Background Scenario analysis.

Table A.7: 2040+ Full Build Out Scenario Analysis Results

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
Main St & Fernbank Ave (Traffic Signal)	B / 17 / 81% (A / 7 / 75%)	NEL / E / 74 / 0.72 SEL / E / 62 / 0.52 SER / E / 66 / 0.62 (SEL / E / 62 / 0.35) (SER / E / 60 / 0.19)
Main St & Red River Blvd (Traffic Signal)	E / 73 / 105% (C / 28 / 96%)	NEL / F / 83 / 0.68 NER / F / 84 / 0.03 SWT / F / 99 / 1.16 SER / E / 70 / 0.82 (SEL / E / 57 / 0.50) (NWT / E / 57 / 0.85dl) (NEL / E / 68 / 0.80) (NET / C / 21 / 1.01)
Main St & Ridgecrest Ave (Traffic Signal)	F / 87 / 106% (E / 72 / 95%)	SWT / F / 123 / 1.25 NWL / E / 78 / 0.88 (NWL / E / 60 / 0.61) (NET / F / 112 / 1.18) (SWL / E / 78 / 0.54)
Main St & Murray Ave (Two-Way Stop-Control)	Error (Error)	SE 1 / Err / Err / Err NW 1 / Err / Err / Err (SE 1 / Err / Err / Err) (NW 1 / Err / Err / Err) (SW 1 / E / 37 / 0.04)
McPhillips St & Fernbank Ave (Traffic Signal)	B / 15 / 82% (C / 21 / 95%)	EBL / E / 78 / 0.87 NBL / F / 110 / 0.49 (EBL / E / 74 / 0.78) (NBL / F / 88 / 0.59) (NBT / B / 17 / 0.96) (SBL / F / 124 / 0.99)
McPhillips St & Balgona Rd (Traffic Signal) Note: McPhillips St denoted as EB/WB Balgona Rd denoted as NB/SB	B / 13 / 79% (B / 13 / 80%)	EBL / F / 117 / 0.74 WBL / F / 100 / 0.43 NBL / E / 63 / 0.66 (NBL / E / 59 / 0.28) (NBT / E / 57 / 0.14) (NBR / E / 56 / 0.00) (SBL / E / 59 / 0.34) (SBT / E / 56 / 0.08) (SBR / E / 56 / 0.02) (WBL / F / 93 / 0.48)

Table A.8: 2040+ Full Build Out Scenario Analysis Results - Continued

Intersection	Overall Performance (LOS / Delay / ICU)	Critical Movements (Movement / LOS / Delay / v/c)
McPhillips St & Murray Ave (Traffic Signal) Note: McPhillips St denoted as EB/WB Balgona Rd denoted as NB/SB	D / 36 / 101% (C / 34 / 93%)	EBL / E / 79 / 0.62 WBT / C / 25 / 0.99 NWL / F / 84 / 0.93 (EBL / E / 71 / 0.74) (EBT / D / 42 / 0.99) (WBL / F / 91 / 0.95) (NWL / E / 65 / 0.73)
Ferrier St & Murray Ave (Traffic Signal)	B / 17 / 86% (C / 35 / 106%)	None (NEL / E / 58 / 0.97) (SET / E / 64 / 0.93) (NWL / E / 59 / 0.83)
McPhillips St & Emes Road (Traffic Signal)	C / 33 / 90% (C / 28 / 92%)	WBL / F / 84 / 0.93 NBL / E / 62 / 0.84 SBL / F / 81 / 0.60 (SBL / F / 101 / 0.90) (NBT / B / 20 / 0.99) (EBL / E / 63 / 0.70) (WBL / E / 75 / 0.81)

Main Street intersections at Red River Boulevard and at Ridgecrest Avenue were at or over capacity. Widening Main Street to six lanes would increase capacity for through movements, but is precluded by geometric constraints.

McPhillips Street intersections had high delays on side streets and McPhillips Street through movements were nearly at capacity. These intersections were nearly at capacity, even with McPhillips Street widened to six lanes.

APPENDIX B
TRANSPORTATION ENGINEERING BACKGROUND INFORMATION

Appendix B TRANSPORTATION ENGINEERING BACKGROUND INFORMATION

This appendix contains background information on transportation engineering concepts and performance measures.

B.1 PERFORMANCE MEASURES

B.1.1 Highway Capacity Manual

The intersection capacity and level of service analysis was based in part on methodology from the *Highway Capacity Manual* (HCM). Several performance measures from the HCM methodology are detailed below:

- **Level of Service (LOS)** – Based on the average vehicle delay during a 15-minute analysis period. Levels of Service range from A (minimal delay) to F (unacceptable delay) and may be measured on an intersection, approach, or movement basis.

- **Degree of Saturation** – The ratio of demand flow rate (v) to maximum capacity (c). Where the v/c ratio is 1.0 or greater, the intersection is operating at full capacity and experiencing major congestion.

- **Vehicle Delay** – The average time that vehicles are delayed on an intersection, approach, or movement basis. Measured in seconds of delay per vehicle or total hours of delay during the peak hour being analyzed.

For design and planning purposes, LOS D or better under peak hour conditions is considered acceptable. Table A.1 and Table A.2 describe the characteristics of each LOS for signalized and unsignalized stop-controlled intersections, respectively, as listed in the HCM.

Table B.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 and speeds, volumes at/near capacity
F	> 80	Forced flow, low speed, volume above capacity

Table B.2: Stop Controlled 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

B.1.2 Intersection Capacity Utilization

Intersection Capacity Utilization (ICU) is another measure used to evaluate intersection performance. It is expressed as a ratio or percentage of intersection capacity used by the demand volumes. ICU can be expressed using Level of Service (ICU LOS), which is not equivalent to the HCM LOS described earlier, although the two may agree in some situations.

Table B.3: ICU Level of Service

Level of Service	Intersection Capacity Utilization (%)	Characteristics
A	≤ 60%	The intersection has no congestion. A cycle length of 80 sec. or less will move traffic efficiently. All traffic should be served on the first cycle. Traffic fluctuations, accidents, and lane closures can be handled with minimal congestion. This intersection can accommodate up to 40% more traffic on all movements.
B	> 60% and ≤ 70%	The intersection has very little congestion. Almost all traffic will be served on the first cycle. A cycle length of 90 sec. or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures can be handled with minimal congestion. This intersection can accommodate up to 30% more traffic on all movements
C	> 70% and ≤ 80%	The intersection has no major congestion. Most traffic should be served on the first cycle. A cycle length of 100 sec. or less will move traffic efficiently. Traffic fluctuations, accidents, and lane closures may cause some congestion. This intersection can accommodate up to 20% more traffic on all movements.
D	> 80% and ≤ 90%	The intersection normally has no congestion. The majority of traffic should be served on the first cycle. A cycle length of 110 sec. or less will move traffic efficiently. Traffic fluctuations, accidents, lane closures and sub-optimal timing can cause congestion. This intersection can accommodate up to 10% more traffic on all movements.
E	>90% and ≤ 100%	The intersection is on the verge of congested conditions. Many vehicles are not served on the first cycle. A cycle length of 120 sec. is required to move all traffic. Minor traffic fluctuations, accidents, lane closures and sub-optimal timing can cause significant congestion. This intersection has less than 10% reserve capacity available.
F	> 100% and ≤ 110%	The intersection is over capacity and likely experiences congestion periods of 15 to 60 min. per day. Residual queues at the end of green are common. A cycle length over 120 sec. is required to move all traffic. Minor traffic fluctuations, accidents, and lane closures can cause increased congestion. Sub optimal signal timings can cause increased congestion.

G	> 110% and ≤ 120%	The intersection is 10% to 20% over capacity and likely experiences congestion periods of 60 to 120 min. per day. Long queues are common. A cycle length over 120 sec. is required to move all traffic. Motorists may be choosing alternate routes, if they exist, or making fewer trips during the peak hour. Signal timings can be used to "ration" capacity to the priority movements.
H	> 120%	The intersection is 20% over capacity and could experience congestion periods of over 120 min. per day. Long queues are common. A cycle length over 120 sec. is required to move all traffic. Motorists may be choosing alternate routes, if they exist, or make fewer trips during the peak hour. Signal timings can be used to "ration" capacity to the priority movements.

Highway Capacity Manual Level of Service (HCM LOS) and Intersection Capacity Utilization Level of Service (ICU LOS) are different performance measures and cannot be directly compared. HCM LOS is delay-based, while ICU LOS is capacity-based. At times the two measures will give very different evaluations of overall traffic operations. In these situations, the HCM LOS can be used to determine average delays experienced by traffic while the ICU LOS can be used to determine how much reserve capacity is available at each intersection and how frequently each intersection experiences congestion.

APPENDIX C
TRAFFIC DATA

Raw traffic count data is available upon request

EXISTING BACKGROUND TRAFFIC

2015 Background Traffic — Balanced Volumes

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	21	535	0	0	1319	18	54	0	103	0	0	0
Main St & Red River Blvd	102	462	40	69	1255	52	97	54	274	173	57	32
Main St & Ridgecrest Ave	3	586	143	91	1532	8	11	62	8	250	38	57
Main St & Murray Ave	102	654	5	5	1727	63	5	5	121	5	5	5
McPhillips St & Balgona Rd	7	467	0	0	1200	2	3	0	11	0	0	0
McPhillips St & Murray Ave	6	442	57	42	1166	3	1	5	3	165	4	31
Ferrier St & Murray Ave	20	0	74	0	0	0	0	76	28	271	180	0
McPhillips St & Emes Road	45	420	5	5	1162	70	30	5	10	30	5	5

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	101	1164	0	0	745	41	30	0	71	0	0	0
Main St & Red River Blvd	219	1098	215	85	693	38	67	83	102	195	71	35
Main St & Ridgecrest Ave	14	1485	142	49	1036	1	30	49	5	135	18	49
Main St & Murray Ave	146	1628	5	5	1098	85	31	5	124	5	5	5
McPhillips St & Balgona Rd	14	1270	0	0	638	5	4	0	10	0	0	0
McPhillips St & Murray Ave	7	1250	197	48	600	0	4	6	2	105	5	32
Ferrier St & Murray Ave	20	0	238	0	0	0	0	234	17	77	122	0
McPhillips St & Emes Road	20	1219	35	5	588	30	50	5	45	10	5	5

2015 Background Traffic — Volume Redistribution to Account for Street Network Concept 2

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	0	0	0	0	0	0	0	0	0	0	0
Main St & Red River Blvd	0	0	0	0	0	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	0	0	0	0	0	0	0	0	0	0	0	0
Main St & Murray Ave	-25	0	0	0	30	-30	0	0	0	0	0	0
McPhillips St & Balgona Rd	0	0	0	0	0	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	0	0	0	0	0	0	0	0	0	0	0
Ferrier St & Murray Ave	0	20	5	0	60	40	0	0	0	-90	-40	0
McPhillips St & Emes Road	0	0	0	0	0	0	0	0	0	0	0	0

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	0	0	0	0	0	0	0	0	0	0	0
Main St & Red River Blvd	0	0	0	0	0	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	0	0	0	0	0	0	0	0	0	0	0	0
Main St & Murray Ave	-50	0	0	0	30	-30	0	0	0	0	0	0
McPhillips St & Balgona Rd	0	0	0	0	0	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	0	0	0	0	0	0	0	0	0	0	0
Ferrier St & Murray Ave	0	120	-70	0	8	12	0	0	0	-38	-12	0
McPhillips St & Emes Road	0	0	0	0	0	0	0	0	0	0	0	0

2015 Background Traffic — Redistributed Volumes for Street Network Concept 2

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	21	535	0	0	1319	18	54	0	103	0	0	0
Main St & Red River Blvd	102	462	40	69	1255	52	97	54	274	173	57	32
Main St & Ridgecrest Ave	3	586	143	91	1532	8	11	62	8	250	38	57
Main St & Murray Ave	77	654	5	5	1757	33	5	5	121	5	5	5
McPhillips St & Balgona Rd	7	467	0	0	1200	2	3	0	11	0	0	0
McPhillips St & Murray Ave	6	442	57	42	1166	3	1	5	3	165	4	31
Ferrier St & Murray Ave	20	20	79	0	60	40	0	76	28	181	140	0
McPhillips St & Emes Road	45	420	5	5	1162	70	30	5	10	30	5	5

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	101	1164	0	0	745	41	30	0	71	0	0	0
Main St & Red River Blvd	219	1098	215	85	693	38	67	83	102	195	71	35
Main St & Ridgecrest Ave	14	1485	142	49	1036	1	30	49	5	135	18	49
Main St & Murray Ave	96	1628	5	5	1128	55	31	5	124	5	5	5
McPhillips St & Balgona Rd	14	1270	0	0	638	5	4	0	10	0	0	0
McPhillips St & Murray Ave	7	1250	197	48	600	0	4	6	2	105	5	32
Ferrier St & Murray Ave	20	120	168	0	8	12	0	234	17	39	110	0
McPhillips St & Emes Road	20	1219	35	5	588	30	50	5	45	10	5	5

2015 Background Traffic — Based on expansions from AM and PM peak hours, with adjustments to better align with 2015 traffic flow map

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	582	13861	0	0	13057	287	426	0	878	0	0	0
Main St & Red River Blvd	1561	12694	1214	762	12331	453	827	673	1930	1826	633	333
Main St & Ridgecrest Ave	81	16821	1421	711	16156	47	198	557	66	1956	286	531
Main St & Murray Ave	856	18544	50	50	18180	431	171	50	1220	50	50	50
McPhillips St & Balgona Rd	102	8792	0	0	8914	34	35	0	105	0	0	0
McPhillips St & Murray Ave	65	8555	1220	447	8574	16	24	55	26	1365	45	314
Ferrier St & Murray Ave	199	665	1202	0	356	269	0	1493	228	1143	1256	0
McPhillips St & Emes Road	332	8281	190	50	8500	511	392	50	263	206	50	50

2015 Background Traffic — With adjustments to account for completion of the CPT West Extension to Brookside Boulevard

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	582	14554	0	0	13710	287	426	0	878	0	0	0
Main St & Red River Blvd	1561	13329	1214	762	12948	453	827	673	1930	1826	633	333
Main St & Ridgecrest Ave	81	17662	1421	711	16964	47	198	557	66	1956	286	531
Main St & Murray Ave	856	19471	50	50	19089	431	171	50	1220	50	50	50
McPhillips St & Balgona Rd	102	10550	0	0	10697	34	35	0	105	0	0	0
McPhillips St & Murray Ave	65	10266	1220	447	10289	16	24	55	26	1365	45	314
Ferrier St & Murray Ave	199	665	1202	0	356	269	0	1493	228	1143	1256	0
McPhillips St & Emes Road	332	9937	190	50	10200	511	392	50	263	206	50	50

BACKGROUND TRAFFIC GROWTH (WEST ST PAUL, PRECINCT D, PRECINCT F)

Background Traffic Growth (from 2015 to 2025)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	48	0	0	142	0	0	0	0	0	0	0
Main St & Red River Blvd	0	48	0	0	142	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	1	45	0	0	141	1	3	0	0	0	0	0
Main St & Murray Ave	2	43	0	0	139	2	3	0	6	0	0	0
McPhillips St & Balgona Rd	0	130	0	0	203	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	112	0	7	196	0	0	0	0	0	0	18
Ferrier St & Murray Ave	5	0	0	0	0	0	0	12	16	0	6	0
McPhillips St & Emes Road	32	87	11	6	160	21	4	4	6	37	15	22

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	153	0	0	91	0	0	0	0	0	0	0
Main St & Red River Blvd	0	153	0	0	91	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	0	152	0	0	88	3	1	0	0	0	0	0
Main St & Murray Ave	5	150	0	0	85	3	2	0	3	0	0	0
McPhillips St & Balgona Rd	0	324	0	0	281	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	315	0	17	264	0	0	0	0	0	0	9
Ferrier St & Murray Ave	16	0	0	0	0	0	0	6	8	0	11	0
McPhillips St & Emes Road	6	279	39	23	230	4	20	16	29	22	9	13

2015 Background + Background Traffic Growth to 2025

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	21	583	0	0	1461	18	54	0	103	0	0	0
Main St & Red River Blvd	102	510	40	69	1397	52	97	54	274	173	57	32
Main St & Ridgecrest Ave	4	631	143	91	1673	9	14	62	8	250	38	57
Main St & Murray Ave	104	697	5	5	1866	65	8	5	127	5	5	5
McPhillips St & Balgona Rd	7	597	0	0	1403	2	3	0	11	0	0	0
McPhillips St & Murray Ave	6	554	57	49	1362	3	1	5	3	165	4	49
Ferrier St & Murray Ave	25	0	74	0	0	0	0	88	44	271	186	0
McPhillips St & Emes Road	77	507	16	11	1322	91	34	9	16	67	20	27

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	101	1317	0	0	836	41	30	0	71	0	0	0
Main St & Red River Blvd	219	1251	215	85	784	38	67	83	102	195	71	35
Main St & Ridgecrest Ave	14	1637	142	49	1124	4	31	49	5	135	18	49
Main St & Murray Ave	151	1778	5	5	1183	88	33	5	127	5	5	5
McPhillips St & Balgona Rd	14	1594	0	0	919	5	4	0	10	0	0	0
McPhillips St & Murray Ave	7	1565	197	65	864	0	4	6	2	105	5	41
Ferrier St & Murray Ave	36	0	238	0	0	0	0	240	25	77	133	0
McPhillips St & Emes Road	26	1498	74	28	818	34	70	21	74	32	14	18

Background Traffic Growth (from 2015 to 2035)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	150	0	0	466	4	3	0	0	0	0	0
Main St & Red River Blvd	0	150	0	0	466	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	3	146	0	0	466	0	4	0	0	0	0	0
Main St & Murray Ave	4	143	0	0	463	3	6	0	13	0	0	0
McPhillips St & Balgona Rd	0	398	0	0	666	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	334	0	33	633	0	0	0	0	0	0	64
Ferrier St & Murray Ave	13	0	0	0	0	0	0	23	27	0	10	0
McPhillips St & Emes Road	105	257	36	21	524	70	13	14	20	122	49	73

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	505	0	0	294	1	1	0	0	0	0	0
Main St & Red River Blvd	0	505	0	0	294	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	4	503	0	0	294	0	2	0	0	0	0	0
Main St & Murray Ave	7	504	0	0	284	10	3	0	6	0	0	0
McPhillips St & Balgona Rd	0	859	0	0	703	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	838	0	36	667	0	0	0	0	0	0	21
Ferrier St & Murray Ave	22	0	0	0	0	0	0	11	13	0	21	0
McPhillips St & Emes Road	19	710	130	78	532	13	65	52	98	73	29	44

2015 Background + Background Traffic Growth to 2035

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	21	685	0	0	1785	22	57	0	103	0	0	0
Main St & Red River Blvd	102	612	40	69	1721	52	97	54	274	173	57	32
Main St & Ridgecrest Ave	6	732	143	91	1998	8	15	62	8	250	38	57
Main St & Murray Ave	81	797	5	5	2220	36	11	5	134	5	5	5
McPhillips St & Balgona Rd	7	865	0	0	1866	2	3	0	11	0	0	0
McPhillips St & Murray Ave	6	776	57	75	1799	3	1	5	3	165	4	95
Ferrier St & Murray Ave	33	0	74	0	0	0	0	99	55	271	190	0
McPhillips St & Emes Road	150	677	41	26	1686	140	43	19	30	152	54	78

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	101	1669	0	0	1039	42	31	0	71	0	0	0
Main St & Red River Blvd	219	1603	215	85	987	38	67	83	102	195	71	35
Main St & Ridgecrest Ave	18	1988	142	49	1330	1	32	49	5	135	18	49
Main St & Murray Ave	103	2132	5	5	1412	65	34	5	130	5	5	5
McPhillips St & Balgona Rd	14	2129	0	0	1341	5	4	0	10	0	0	0
McPhillips St & Murray Ave	7	2088	197	84	1267	0	4	6	2	105	5	53
Ferrier St & Murray Ave	42	0	238	0	0	0	0	245	30	77	143	0
McPhillips St & Emes Road	39	1929	165	83	1120	43	115	57	143	83	34	49

BACKGROUND TRAFFIC GROWTH (WEST ST PAUL, PRECINCT D, PRECINCT F)

Background Traffic Growth (from 2015 to 2040+)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	290	0	0	929	1	1	0	0	0	0	0
Main St & Red River Blvd	0	290	0	0	929	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	1	286	0	0	929	0	4	0	0	0	0	0
Main St & Murray Ave	2	281	0	0	926	3	6	0	10	0	0	0
McPhillips St & Balgona Rd	26	783	0	0	1334	28	96	0	90	0	0	0
McPhillips St & Murray Ave	74	657	0	16	1378	30	102	0	256	0	0	50
Ferrier St & Murray Ave	6	0	0	0	0	0	0	20	21	0	6	0
McPhillips St & Emes Road	210	808	71	43	993	140	26	29	39	244	98	147

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	0	1005	0	0	577	0	0	0	0	0	0	0
Main St & Red River Blvd	0	1005	0	0	577	0	0	0	0	0	0	0
Main St & Ridgecrest Ave	4	1003	0	0	577	0	2	0	0	0	0	0
Main St & Murray Ave	6	1004	0	0	567	10	3	0	5	0	0	0
McPhillips St & Balgona Rd	95	1508	0	0	1182	102	57	0	53	0	0	0
McPhillips St & Murray Ave	272	1525	0	32	1094	109	61	0	152	0	0	17
Ferrier St & Murray Ave	21	0	0	0	0	0	0	10	11	0	20	0
McPhillips St & Emes Road	38	1248	261	156	1120	26	130	104	195	146	58	87

2015 Background + Background Traffic Growth to 2040+

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	21	825	0	0	2248	19	55	0	103	0	0	0
Main St & Red River Blvd	102	752	40	69	2184	52	97	54	274	173	57	32
Main St & Ridgecrest Ave	4	872	143	91	2461	8	15	62	8	250	38	57
Main St & Murray Ave	79	935	5	5	2683	36	11	5	131	5	5	5
McPhillips St & Balgona Rd	33	1250	0	0	2534	30	99	0	101	0	0	0
McPhillips St & Murray Ave	80	1099	57	58	2544	33	103	5	259	165	4	81
Ferrier St & Murray Ave	26	0	74	0	0	0	0	96	49	271	186	0
McPhillips St & Emes Road	255	1228	76	48	2155	210	56	34	49	274	103	152

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	101	2169	0	0	1322	41	30	0	71	0	0	0
Main St & Red River Blvd	219	2103	215	85	1270	38	67	83	102	195	71	35
Main St & Ridgecrest Ave	18	2488	142	49	1613	1	32	49	5	135	18	49
Main St & Murray Ave	102	2632	5	5	1695	65	34	5	129	5	5	5
McPhillips St & Balgona Rd	109	2778	0	0	1820	107	61	0	63	0	0	0
McPhillips St & Murray Ave	279	2775	197	80	1694	109	65	6	154	105	5	49
Ferrier St & Murray Ave	41	0	238	0	0	0	0	244	28	77	142	0
McPhillips St & Emes Road	58	2467	296	161	1708	56	180	109	240	156	63	92

PRECINCT G TRAFFIC

Site Generated Traffic (Stage 1 Build Out)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	22	12	0	0	3	38	122	0	73	0	0	0
Main St & Red River Blvd	65	34	0	0	76	0	0	0	211	0	0	0
Main St & Ridgecrest Ave	2	87	0	0	284	3	12	0	7	0	0	0
Main St & Murray Ave	1	89	0	0	291	0	0	0	5	0	0	0
McPhillips St & Balgona Rd	0	36	0	0	10	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	0	0	10	0	0	0	0	0	0	0	36
Ferrier St & Murray Ave	14	0	0	0	0	0	0	24	48	0	6	0
McPhillips St & Emes Road	0	36	0	0	10	0	0	0	0	0	0	0

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	78	7	0	0	13	133	75	0	45	0	0	0
Main St & Red River Blvd	230	85	0	0	58	0	0	0	131	0	0	0
Main St & Ridgecrest Ave	8	308	0	0	176	13	7	0	4	0	0	0
Main St & Murray Ave	5	316	0	0	180	0	0	0	3	0	0	0
McPhillips St & Balgona Rd	0	21	0	0	38	0	0	0	0	0	0	0
McPhillips St & Murray Ave	0	0	0	38	0	0	0	0	0	0	0	21
Ferrier St & Murray Ave	51	0	0	0	0	0	0	14	29	0	26	0
McPhillips St & Emes Road	0	21	0	0	38	0	0	0	0	0	0	0

2015 Background + Background Growth to 2025 + Site Generated Traffic (Stage 1)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	43	595	0	0	1464	56	176	0	176	0	0	0
Main St & Red River Blvd	167	544	40	69	1473	52	97	54	485	173	57	32
Main St & Ridgecrest Ave	6	718	143	91	1957	12	26	62	15	250	38	57
Main St & Murray Ave	105	786	5	5	2157	65	8	5	132	5	5	5
McPhillips St & Balgona Rd	7	633	0	0	1413	2	3	0	11	0	0	0
McPhillips St & Murray Ave	6	554	57	59	1362	3	1	5	3	165	4	85
Ferrier St & Murray Ave	39	0	74	0	0	0	0	112	92	271	192	0
McPhillips St & Emes Road	77	543	16	11	1332	91	34	9	16	67	20	27

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	179	1324	0	0	849	174	105	0	116	0	0	0
Main St & Red River Blvd	449	1336	215	85	842	38	67	83	233	195	71	35
Main St & Ridgecrest Ave	22	1945	142	49	1300	17	38	49	9	135	18	49
Main St & Murray Ave	156	2094	5	5	1363	88	33	5	130	5	5	5
McPhillips St & Balgona Rd	14	1615	0	0	957	5	4	0	10	0	0	0
McPhillips St & Murray Ave	7	1565	197	103	864	0	4	6	2	105	5	62
Ferrier St & Murray Ave	87	0	238	0	0	0	0	254	54	77	159	0
McPhillips St & Emes Road	26	1519	74	28	856	34	70	21	74	32	14	18

Site Generated Traffic (Stage 1 + Stage 2 Build Out)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	9	12	0	0	3	17	45	0	20	0	0	0
Main St & Red River Blvd	9	14	0	0	21	2	7	0	28	0	0	0
Main St & Ridgecrest Ave	2	18	0	0	49	0	5	0	0	0	0	0
Main St & Murray Ave	0	20	0	0	48	1	0	0	9	0	0	0
McPhillips St & Balgona Rd	0	110	50	0	182	0	0	0	0	95	0	0
McPhillips St & Murray Ave	0	136	7	7	270	0	0	0	0	23	0	24
Ferrier St & Murray Ave	37	135	0	0	334	4	14	14	126	0	3	0
McPhillips St & Emes Road	0	132	13	3	67	0	0	0	0	42	0	7

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	19	7	0	0	13	46	26	0	11	0	0	0
Main St & Red River Blvd	30	22	0	0	16	8	4	0	17	0	0	0
Main St & Ridgecrest Ave	9	49	0	0	33	0	3	0	0	0	0	0
Main St & Murray Ave	0	58	0	0	28	5	0	0	5	0	0	0
McPhillips St & Balgona Rd	0	238	47	0	191	0	0	0	0	31	0	0
McPhillips St & Murray Ave	0	271	26	25	197	0	0	0	0	15	0	14
Ferrier St & Murray Ave	169	375	0	0	221	23	21	8	95	0	14	0
McPhillips St & Emes Road	0	107	46	8	143	0	0	0	0	28	0	5

2015 Background + Background Growth to 2035 + Site Generated Traffic (Stage 1 + Stage 2)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	30	697	0	0	1788	39	102	0	123	0	0	0
Main St & Red River Blvd	111	626	40	69	1742	54	104	54	302	173	57	32
Main St & Ridgecrest Ave	8	750	143	91	2047	8	20	62	8	250	38	57
Main St & Murray Ave	81	817	5	5	2268	37	11	5	143	5	5	5
McPhillips St & Balgona Rd	7	975	50	0	2048	2	3	0	11	95	0	0
McPhillips St & Murray Ave	6	912	64	82	2069	3	1	5	3	188	4	119
Ferrier St & Murray Ave	70	155	79	0	394	44	14	113	181	181	153	0
McPhillips St & Emes Road	150	809	54	29	1753	140	43	19	30	194	54	85

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	120	1676	0	0	1052	88	57	0	82	0	0	0
Main St & Red River Blvd	249	1625	215	85	1003	46	71	83	119	195	71	35
Main St & Ridgecrest Ave	27	2037	142	49	1363	1	35	49	5	135	18	49
Main St & Murray Ave	103	2190	5	5	1440	70	34	5	135	5	5	5
McPhillips St & Balgona Rd	14	2367	47	0	1532	5	4	0	10	31	0	0
McPhillips St & Murray Ave	7	2359	223	109	1464	0	4	6	2	120	5	67
Ferrier St & Murray Ave	211	495	168	0	229	35	21	253	125	39	145	0
McPhillips St & Emes Road	39	2036	211	91	1263	43	115	57	143	111	34	54

PRECINCT G TRAFFIC

Site Generated Traffic (Full Build Out)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	12	27	0	0	8	23	67	0	32	0	0	0
Main St & Red River Blvd	13	22	0	0	35	5	17	0	40	0	0	0
Main St & Ridgecrest Ave	5	28	0	0	75	0	7	0	0	0	0	0
Main St & Murray Ave	1	30	0	0	72	3	3	0	22	0	0	0
McPhillips St & Balgona Rd	0	113	58	9	193	0	0	0	0	159	0	27
McPhillips St & Murray Ave	0	125	60	24	328	0	0	0	0	143	0	46
Ferrier St & Murray Ave	76	129	38	0	374	10	16	55	252	123	129	0
McPhillips St & Emes Road	0	210	13	3	86	0	0	0	0	42	0	7

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	33	16	0	0	30	70	41	0	20	0	0	0
Main St & Red River Blvd	43	39	0	0	31	19	10	0	24	0	0	0
Main St & Ridgecrest Ave	20	78	0	0	55	0	4	0	0	0	0	0
Main St & Murray Ave	4	96	0	0	44	11	2	0	13	0	0	0
McPhillips St & Balgona Rd	0	253	85	10	223	0	0	0	0	50	0	6
McPhillips St & Murray Ave	0	274	129	101	172	0	0	0	0	85	0	64
Ferrier St & Murray Ave	368	420	140	12	243	23	21	132	208	79	87	7
McPhillips St & Emes Road	0	139	46	8	219	0	0	0	0	28	0	5

2015 Background + Background Growth to 2040+ + Site Generated Traffic (Full Build Out)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	21	825	0	0	2248	19	55	0	103	0	0	0
Main St & Red River Blvd	102	752	40	69	2184	52	97	54	274	173	57	32
Main St & Ridgecrest Ave	4	872	143	91	2461	8	15	62	8	250	38	57
Main St & Murray Ave	79	935	5	5	2683	36	11	5	131	5	5	5
McPhillips St & Balgona Rd	16	1226	0	0	2451	30	99	32	43	0	9	0
McPhillips St & Murray Ave	80	1058	57	58	2403	33	103	5	259	165	4	81
Ferrier St & Murray Ave	35	48	79	0	156	40	0	96	81	181	146	0
McPhillips St & Emes Road	255	1232	76	48	2168	210	56	34	49	274	103	152

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
Main St & Fernbank Ave	101	2169	0	0	1322	41	30	0	71	0	0	0
Main St & Red River Blvd	219	2103	215	85	1270	38	67	83	102	195	71	35
Main St & Ridgecrest Ave	18	2488	142	49	1613	1	32	49	5	135	18	49
Main St & Murray Ave	102	2632	5	5	1695	65	34	5	129	5	5	5
McPhillips St & Balgona Rd	48	2690	0	0	1770	107	61	19	29	0	34	0
McPhillips St & Murray Ave	279	2626	197	80	1610	109	65	6	154	105	5	49
Ferrier St & Murray Ave	75	222	168	0	65	12	0	244	47	39	130	0
McPhillips St & Emes Road	58	2481	296	161	1715	56	180	109	240	156	63	92

TRAFFIC AT CHIEF PEGUIS TRAIL INTERSECTIONS/INTERCHANGES

Existing Background Traffic (with redistribution to account for CPT)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	200	512	200	100	1,172	250	50	200	150	500	350	150
CPT and Ferrier St	50	93	50	100	317	50	75	350	75	50	900	50
CPT and Main St	200	388	400	100	1,700	200	100	200	200	500	600	230

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	150	1,292	500	150	714	50	250	350	200	200	200	100
CPT and Ferrier St	75	276	50	50	93	75	50	900	50	50	350	100
CPT and Main St	200	1,488	574	345	794	100	200	600	200	688	200	250

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	1,665	5,000	1,665	835	10,415	2,085	415	1,665	1,250	4,165	2,915	1,250
CPT and Ferrier St	415	80	415	835	420	420	625	2,915	625	415	7,500	415
CPT and Main St	1,665	2,500	3,335	835	14,165	1,665	835	1,665	1,665	4,165	5,000	1,665

Precinct G Traffic (Full Build Out)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	0	33	36	30	90	478	178	36	0	112	112	12
CPT and Ferrier St	0	61	0	337	187	224	72	30	0	0	12	110
CPT and Main St	67	17	0	42	52	0	0	165	202	0	55	14

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	0	91	139	18	56	297	487	139	0	80	80	30
CPT and Ferrier St	0	232	0	239	133	160	278	18	0	0	30	418
CPT and Main St	247	55	0	26	31	0	0	115	142	0	201	45

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	0	746	926	248	747	3,982	3,979	926	0	927	927	248
CPT and Ferrier St	0	1,544	0	2,781	1,545	1,854	1,852	248	0	0	248	2,779
CPT and Main St	1,668	425	0	348	426	0	0	1,360	1,669	0	1,359	348

Background Traffic from West St Paul, Precinct D, Precinct F (2040 Scenario)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	0	227	17	516	501	548	248	31	0	57	104	234
CPT and Ferrier St	78	14	14	95	54	20	6	386	172	47	297	24
CPT and Main St	95	142	0	281	468	188	56	199	240	0	85	85

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	0	546	60	387	375	411	597	110	0	34	62	564
CPT and Ferrier St	188	50	51	49	28	10	18	410	129	29	462	88
CPT and Main St	251	505	0	172	286	115	203	143	164	0	213	303

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	0	4,686	464	4,833	4,686	5,126	5,125	854	0	464	855	4,833
CPT and Ferrier St	1,611	393	390	687	393	148	148	4,392	1,611	390	4,393	687
CPT and Main St	2,102	3,902	0	2,342	3,903	1,561	1,560	1,807	2,102	0	1,807	2,341

Background Traffic from Precinct B, Precinct C, Precinct E (2040 Scenario)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	9	0	0	0	0	0	0	302	24	0	107	0
CPT and Ferrier St	15	0	0	0	0	0	0	260	42	0	92	0
CPT and Main St	65	0	0	0	0	0	0	73	186	0	26	0

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	27	0	0	0	0	0	0	217	19	0	321	0
CPT and Ferrier St	45	0	0	0	0	0	0	186	31	0	275	0
CPT and Main St	197	0	0	0	0	0	0	53	133	0	78	0

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	276	0	0	0	0	0	0	3,499	276	0	3,498	0
CPT and Ferrier St	488	0	0	0	0	0	0	3,011	488	0	3,010	0
CPT and Main St	2,160	0	0	0	0	0	0	850	2,161	0	849	0

Total (Existing Background Traffic + Precinct G Traffic + Background Traffic from West St Paul, Precinct D, Precinct F + Background Traffic from Precinct B, Precinct C, Precinct E)

AM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	209	772	253	646	1,763	1,276	476	569	174	669	673	396
CPT and Ferrier St	143	168	64	532	558	294	153	1,026	289	97	1,301	184
CPT and Main St	427	547	400	423	2,220	388	156	637	828	500	766	329

PM PEAK HOUR

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	177	1,929	699	555	1,145	758	1,334	816	219	314	663	694
CPT and Ferrier St	308	558	101	338	254	245	346	1,514	210	79	1,117	606
CPT and Main St	895	2,048	574	543	1,111	215	403	911	639	688	692	598

AVERAGE DAILY TRAFFIC

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CPT and McPhillips St	1,941	10,432	3,055	5,916	15,848	11,193	9,519	6,944	1,526	5,556	8,195	6,331
CPT and Ferrier St	2,514	2,017	805	4,303	2,358	2,422	2,625	10,566	2,724	805	15,151	3,881
CPT and Main St	7,595	6,827	3,335	3,525	18,494	3,226	2,395	5,682	7,597	4,165	9,015	4,354

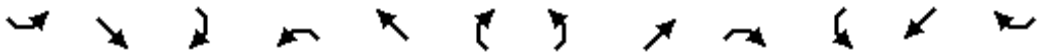
APPENDIX D
SYNCHRO REPORTS



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	54	103	21	535	1319	18
Future Volume (vph)	54	103	21	535	1319	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.91			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	1688			3572	3571	
Flt Permitted	0.98			0.86	1.00	
Satd. Flow (perm)	1688			3087	3571	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	59	112	23	582	1434	20
RTOR Reduction (vph)	30	0	0	0	1	0
Lane Group Flow (vph)	141	0	0	605	1453	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	14.4			63.6	63.6	
Effective Green, g (s)	14.4			63.6	63.6	
Actuated g/C Ratio	0.16			0.71	0.71	
Clearance Time (s)	6.0			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	270			2181	2523	
v/s Ratio Prot	c0.08				c0.41	
v/s Ratio Perm				0.20		
v/c Ratio	0.52			0.28	0.58	
Uniform Delay, d1	34.6			4.8	6.5	
Progression Factor	1.00			0.42	1.00	
Incremental Delay, d2	1.8			0.3	1.0	
Delay (s)	36.5			2.3	7.5	
Level of Service	D			A	A	
Approach Delay (s)	36.5			2.3	7.5	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	8.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	97	54	274	173	57	32	102	462	40	69	1255	52
Future Volume (vph)	97	54	274	173	57	32	102	462	40	69	1255	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.60	1.00	1.00		0.74	1.00	0.10	1.00	1.00	0.47	1.00	1.00
Satd. Flow (perm)	1124	3579	1601		2658	1601	192	3579	1601	881	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	59	298	188	62	35	111	502	43	75	1364	57
RTOR Reduction (vph)	0	0	119	0	0	28	0	0	20	0	0	27
Lane Group Flow (vph)	105	59	179	0	250	7	111	502	23	75	1364	30
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	17.9	17.9	17.9		17.9	17.9	55.8	49.1	49.1	52.4	47.4	47.4
Effective Green, g (s)	17.9	17.9	17.9		17.9	17.9	55.8	49.1	49.1	52.4	47.4	47.4
Actuated g/C Ratio	0.20	0.20	0.20		0.20	0.20	0.62	0.55	0.55	0.58	0.53	0.53
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	223	711	318		528	318	237	1952	873	563	1884	843
v/s Ratio Prot		0.02					c0.03	0.14		0.01	c0.38	
v/s Ratio Perm	0.09		c0.11		0.09	0.00	0.25		0.01	0.07		0.02
v/c Ratio	0.47	0.08	0.56		0.47	0.02	0.47	0.26	0.03	0.13	0.72	0.04
Uniform Delay, d1	31.9	29.4	32.5		31.9	29.0	11.5	10.8	9.4	8.2	16.3	10.3
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.08	0.58	1.00	1.08	1.10	7.78
Incremental Delay, d2	1.6	0.1	2.3		0.7	0.0	1.4	0.3	0.1	0.1	2.1	0.1
Delay (s)	33.4	29.4	34.8		32.6	29.0	13.7	6.5	9.5	8.9	20.0	80.0
Level of Service	C	C	C		C	C	B	A	A	A	C	E
Approach Delay (s)		33.8			32.1			7.9			21.8	
Approach LOS		C			C			A			C	

Intersection Summary			
HCM 2000 Control Delay	21.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	11	62	8	250	38	57	3	586	143	91	1532	8
Future Volume (vph)	11	62	8	250	38	57	3	586	143	91	1532	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1845		1789	1883	1601	1789	3473		1789	3576	
Flt Permitted		0.97		0.76	1.00	1.00	0.08	1.00		0.32	1.00	
Satd. Flow (perm)		1798		1440	1883	1601	142	3473		599	3576	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	67	9	272	41	62	3	637	155	99	1665	9
RTOR Reduction (vph)	0	5	0	0	0	45	0	18	0	0	0	0
Lane Group Flow (vph)	0	83	0	272	41	17	3	774	0	99	1674	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		24.9		24.9	24.9	24.9	53.1	53.1		53.1	53.1	
Effective Green, g (s)		24.9		24.9	24.9	24.9	53.1	53.1		53.1	53.1	
Actuated g/C Ratio		0.28		0.28	0.28	0.28	0.59	0.59		0.59	0.59	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		497		398	520	442	83	2049		353	2109	
v/s Ratio Prot					0.02			0.22			c0.47	
v/s Ratio Perm		0.05		c0.19		0.01	0.02			0.17		
v/c Ratio		0.17		0.68	0.08	0.04	0.04	0.38		0.28	0.79	
Uniform Delay, d1		24.7		29.0	24.1	23.8	7.7	9.7		9.1	14.2	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		0.38	0.52	
Incremental Delay, d2		0.2		4.8	0.1	0.0	0.8	0.5		1.5	2.5	
Delay (s)		24.8		33.8	24.1	23.8	8.5	10.3		5.0	9.8	
Level of Service		C		C	C	C	A	B		A	A	
Approach Delay (s)		24.8			31.1			10.3			9.6	
Approach LOS		C			C			B			A	

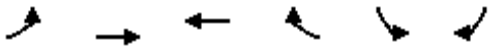
Intersection Summary			
HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	5	5	121	5	5	5	102	654	5	5	1727	63
Future Volume (Veh/h)	5	5	121	5	5	5	102	654	5	5	1727	63
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	5	132	5	5	5	111	711	5	5	1877	68
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.61	0.61	0.61	0.61	0.61		0.61					
vC, conflicting volume	2506	2859	972	2018	2890	358	1945			716		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2190	2769	0	1391	2821	358	1271			716		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	1	35	80	72	29	99	66			99		
cM capacity (veh/h)	5	8	662	18	7	638	331			880		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	142	15	111	474	242	5	1251	694
Volume Left	5	5	111	0	0	5	0	0
Volume Right	132	5	0	0	5	0	0	68
cSH	77	15	331	1700	1700	880	1700	1700
Volume to Capacity	1.85	0.99	0.34	0.28	0.14	0.01	0.74	0.41
Queue Length 95th (m)	94.4	18.0	10.9	0.0	0.0	0.1	0.0	0.0
Control Delay (s)	516.5	566.7	21.3	0.0	0.0	9.1	0.0	0.0
Lane LOS	F	F	C			A		
Approach Delay (s)	516.5	566.7	2.9			0.0		
Approach LOS	F	F						

Intersection Summary				
Average Delay	28.7			
Intersection Capacity Utilization	73.5%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	467	1200	2	3	11
Future Volume (Veh/h)	7	467	1200	2	3	11
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	508	1304	2	3	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1306				1575	653
vC1, stage 1 conf vol					1305	
vC2, stage 2 conf vol					270	
vCu, unblocked vol	1306				1575	653
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	97
cM capacity (veh/h)	526				182	410

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	8	254	254	869	437	15
Volume Left	8	0	0	0	0	3
Volume Right	0	0	0	0	2	12
cSH	526	1700	1700	1700	1700	328
Volume to Capacity	0.02	0.15	0.15	0.51	0.26	0.05
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	1.1
Control Delay (s)	12.0	0.0	0.0	0.0	0.0	16.5
Lane LOS	B					C
Approach Delay (s)	0.2			0.0		16.5
Approach LOS						C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	43.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	6	442	57	42	1166	3	1	5	3	165	4	31
Future Volume (Veh/h)	6	442	57	42	1166	3	1	5	3	165	4	31
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	480	62	46	1267	3	1	5	3	179	4	34
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1270			542			1650	1916	635	1256	1887	271
vC1, stage 1 conf vol							1360	1360		525	525	
vC2, stage 2 conf vol							290	556		731	1362	
vCu, unblocked vol	1270			542			1650	1916	635	1256	1887	271
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			96			99	97	99	25	97	95
cM capacity (veh/h)	543			1023			124	153	421	237	153	727

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SE 1	NW 1
Volume Total	7	320	222	46	845	425	9	217
Volume Left	7	0	0	46	0	0	1	179
Volume Right	0	0	62	0	0	3	3	34
cSH	543	1700	1700	1023	1700	1700	188	262
Volume to Capacity	0.01	0.19	0.13	0.04	0.50	0.25	0.05	0.83
Queue Length 95th (m)	0.3	0.0	0.0	1.1	0.0	0.0	1.1	50.4
Control Delay (s)	11.7	0.0	0.0	8.7	0.0	0.0	25.1	61.3
Lane LOS	B			A			D	F
Approach Delay (s)	0.1			0.3			25.1	61.3
Approach LOS							D	F

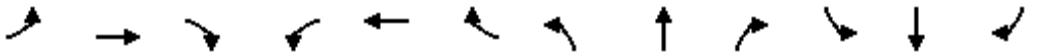
Intersection Summary				
Average Delay	6.7			
Intersection Capacity Utilization	59.5%	ICU Level of Service		B
Analysis Period (min)	15			



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	76	28	271	180	20	74
Future Volume (Veh/h)	76	28	271	180	20	74
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	83	30	295	196	22	80
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			113		884	98
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			113		884	98
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			80		91	92
cM capacity (veh/h)			1476		253	958

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	113	491	102
Volume Left	0	295	22
Volume Right	30	0	80
cSH	1700	1476	598
Volume to Capacity	0.07	0.20	0.17
Queue Length 95th (m)	0.0	5.7	4.6
Control Delay (s)	0.0	5.6	12.3
Lane LOS		A	B
Approach Delay (s)	0.0	5.6	12.3
Approach LOS			B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	43.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	30	5	10	30	5	5	45	420	5	5	1162	70
Future Volume (Veh/h)	30	5	10	30	5	5	45	420	5	5	1162	70
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	33	5	11	33	5	5	49	457	5	5	1263	76
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								Raised			Raised	
Median storage veh)								1			1	
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1607	1833	632	1212	1906	231	1339			462		
vC1, stage 1 conf vol	1273	1273		558	558							
vC2, stage 2 conf vol	334	560		655	1349							
vCu, unblocked vol	1607	1833	632	1212	1906	231	1339			462		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	77	97	97	86	96	99	90			100		
cM capacity (veh/h)	142	169	423	232	132	771	511			1095		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3	SB 4
Volume Total	49	43	49	305	157	5	632	632	76
Volume Left	33	33	49	0	0	5	0	0	0
Volume Right	11	5	0	0	5	0	0	0	76
cSH	170	230	511	1700	1700	1095	1700	1700	1700
Volume to Capacity	0.29	0.19	0.10	0.18	0.09	0.00	0.37	0.37	0.04
Queue Length 95th (m)	8.6	5.1	2.4	0.0	0.0	0.1	0.0	0.0	0.0
Control Delay (s)	34.5	24.2	12.8	0.0	0.0	8.3	0.0	0.0	0.0
Lane LOS	D	C	B			A			
Approach Delay (s)	34.5	24.2	1.2			0.0			
Approach LOS	D	C							

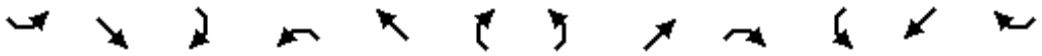
Intersection Summary				
Average Delay	1.7			
Intersection Capacity Utilization	47.4%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	30	71	101	1164	745	41
Future Volume (vph)	30	71	101	1164	745	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.91			1.00	0.99	
Flt Protected	0.99			1.00	1.00	
Satd. Flow (prot)	1680			3564	3550	
Flt Permitted	0.99			0.76	1.00	
Satd. Flow (perm)	1680			2709	3550	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	77	110	1265	810	45
RTOR Reduction (vph)	70	0	0	0	2	0
Lane Group Flow (vph)	40	0	0	1375	853	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	11.2			96.8	96.8	
Effective Green, g (s)	11.2			96.8	96.8	
Actuated g/C Ratio	0.09			0.81	0.81	
Clearance Time (s)	6.0			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	156			2185	2863	
v/s Ratio Prot	c0.02				0.24	
v/s Ratio Perm				c0.51		
v/c Ratio	0.26			0.63	0.30	
Uniform Delay, d1	50.5			4.6	3.0	
Progression Factor	1.00			0.85	1.00	
Incremental Delay, d2	0.9			1.2	0.3	
Delay (s)	51.4			5.1	3.2	
Level of Service	D			A	A	
Approach Delay (s)	51.4			5.1	3.2	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	6.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

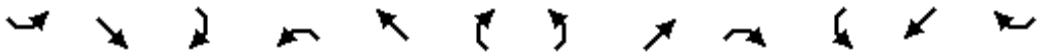


Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	67	83	102	195	71	35	219	1098	215	85	693	38
Future Volume (vph)	67	83	102	195	71	35	219	1098	215	85	693	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3452	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.49	1.00	1.00		0.73	1.00	0.30	1.00	1.00	0.19	1.00	1.00
Satd. Flow (perm)	917	3579	1601		2608	1601	559	3579	1601	360	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	73	90	111	212	77	38	238	1193	234	92	753	41
RTOR Reduction (vph)	0	0	92	0	0	31	0	0	86	0	0	18
Lane Group Flow (vph)	73	90	19	0	289	7	238	1193	148	92	753	23
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	20.7	20.7	20.7		20.7	20.7	86.8	74.1	74.1	75.8	68.6	68.6
Effective Green, g (s)	20.7	20.7	20.7		20.7	20.7	86.8	74.1	74.1	75.8	68.6	68.6
Actuated g/C Ratio	0.17	0.17	0.17		0.17	0.17	0.72	0.62	0.62	0.63	0.57	0.57
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	617	276		449	276	534	2210	988	313	2045	915
v/s Ratio Prot		0.03					c0.05	c0.33		0.02	0.21	
v/s Ratio Perm	0.08		0.01		c0.11	0.00	0.28		0.09	0.17		0.01
v/c Ratio	0.46	0.15	0.07		0.94dl	0.02	0.45	0.54	0.15	0.29	0.37	0.03
Uniform Delay, d1	44.6	42.1	41.6		46.2	41.3	6.5	13.2	9.7	9.5	13.9	11.2
Progression Factor	1.00	1.00	1.00		1.00	1.00	0.35	0.53	0.45	1.12	0.87	1.00
Incremental Delay, d2	2.1	0.1	0.1		3.2	0.0	0.4	0.7	0.2	0.5	0.5	0.1
Delay (s)	46.8	42.3	41.7		49.4	41.3	2.7	7.7	4.6	11.1	12.6	11.2
Level of Service	D	D	D		D	D	A	A	A	B	B	B
Approach Delay (s)		43.2			48.4			6.5			12.4	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	15.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	67.5%	ICU Level of Service	C
Analysis Period (min)	15		

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

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	30	49	5	135	18	49	14	1485	142	49	1036	1
Future Volume (vph)	30	49	5	135	18	49	14	1485	142	49	1036	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1836		1789	1883	1601	1789	3532		1789	3578	
Flt Permitted		0.89		0.69	1.00	1.00	0.22	1.00		0.09	1.00	
Satd. Flow (perm)		1657		1308	1883	1601	421	3532		166	3578	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	53	5	147	20	53	15	1614	154	53	1126	1
RTOR Reduction (vph)	0	2	0	0	0	22	0	4	0	0	0	0
Lane Group Flow (vph)	0	89	0	147	20	31	15	1764	0	53	1127	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Effective Green, g (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Actuated g/C Ratio		0.17		0.17	0.17	0.17	0.73	0.73		0.73	0.73	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		285		225	324	276	306	2569		120	2602	
v/s Ratio Prot					0.01			c0.50			0.31	
v/s Ratio Perm		0.05		c0.11		0.02	0.04			0.32		
v/c Ratio		0.31		0.65	0.06	0.11	0.05	0.69		0.44	0.43	
Uniform Delay, d1		43.4		46.3	41.5	41.9	4.6	8.9		6.6	6.5	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		1.21	1.11	
Incremental Delay, d2		0.6		6.7	0.1	0.2	0.3	1.5		10.9	0.5	
Delay (s)		44.0		53.0	41.6	42.1	4.9	10.4		18.9	7.8	
Level of Service		D		D	D	D	A	B		B	A	
Approach Delay (s)		44.0			49.3			10.4			8.3	
Approach LOS		D			D			B			A	

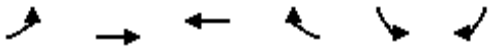
Intersection Summary			
HCM 2000 Control Delay	13.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	31	5	124	5	5	5	144	1628	5	5	1098	85
Future Volume (Veh/h)	31	5	124	5	5	5	144	1628	5	5	1098	85
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	34	5	135	5	5	5	157	1770	5	5	1193	92
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.87	0.87	0.87	0.87	0.87		0.87					
vC, conflicting volume	2456	3338	642	2830	3382	888	1285			1775		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2374	3388	291	2805	3438	888	1029			1775		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	78	0	0	98	73			99		
cM capacity (veh/h)	0	5	614	0	4	287	584			346		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	174	15	157	1180	595	5	795	490
Volume Left	34	5	157	0	0	5	0	0
Volume Right	135	5	0	0	5	0	0	92
cSH	0	0	584	1700	1700	346	1700	1700
Volume to Capacity	Err	Err	0.27	0.69	0.35	0.01	0.47	0.29
Queue Length 95th (m)	Err	Err	8.2	0.0	0.0	0.3	0.0	0.0
Control Delay (s)	Err	Err	13.4	0.0	0.0	15.5	0.0	0.0
Lane LOS	F	F	B			C		
Approach Delay (s)	Err	Err	1.1			0.1		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	69.5%	ICU Level of Service	C	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	1270	638	5	4	10
Future Volume (Veh/h)	14	1270	638	5	4	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	1380	693	5	4	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	698				1416	349
vC1, stage 1 conf vol					696	
vC2, stage 2 conf vol					720	
vCu, unblocked vol	698				1416	349
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	98
cM capacity (veh/h)	894				261	647

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	15	690	690	462	236	15
Volume Left	15	0	0	0	0	4
Volume Right	0	0	0	0	5	11
cSH	894	1700	1700	1700	1700	464
Volume to Capacity	0.02	0.41	0.41	0.27	0.14	0.03
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	0.8
Control Delay (s)	9.1	0.0	0.0	0.0	0.0	13.0
Lane LOS	A					B
Approach Delay (s)	0.1			0.0		13.0
Approach LOS						B

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	45.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	6	1250	197	48	600	3	4	6	2	105	5	32
Future Volume (Veh/h)	6	1250	197	48	600	3	4	6	2	105	5	32
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	1359	214	52	652	3	4	7	2	114	5	35
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	655			1573			1488	2344	328	1916	2239	786
vC1, stage 1 conf vol							758	758		1480	1480	
vC2, stage 2 conf vol							731	1587		436	759	
vCu, unblocked vol	655			1573			1488	2344	328	1916	2239	786
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			87			98	92	100	0	96	90
cM capacity (veh/h)	928			415			166	88	668	104	126	335

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	SE 1	NW 1
Volume Total	7	906	667	52	435	220	13	154
Volume Left	7	0	0	52	0	0	4	114
Volume Right	0	0	214	0	0	3	2	35
cSH	928	1700	1700	415	1700	1700	122	124
Volume to Capacity	0.01	0.53	0.39	0.13	0.26	0.13	0.11	1.24
Queue Length 95th (m)	0.2	0.0	0.0	3.2	0.0	0.0	2.6	73.9
Control Delay (s)	8.9	0.0	0.0	14.9	0.0	0.0	37.9	228.0
Lane LOS	A			B			E	F
Approach Delay (s)	0.0			1.1			37.9	228.0
Approach LOS							E	F

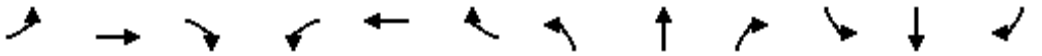
Intersection Summary				
Average Delay	14.9			
Intersection Capacity Utilization	62.2%	ICU Level of Service		B
Analysis Period (min)	15			



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	234	17	77	122	20	238
Future Volume (Veh/h)	234	17	77	122	20	238
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	254	18	84	133	22	259
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			272		564	263
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			272		564	263
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		95	67
cM capacity (veh/h)			1291		455	776

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	272	217	281
Volume Left	0	84	22
Volume Right	18	0	259
cSH	1700	1291	735
Volume to Capacity	0.16	0.07	0.38
Queue Length 95th (m)	0.0	1.6	13.7
Control Delay (s)	0.0	3.4	12.9
Lane LOS		A	B
Approach Delay (s)	0.0	3.4	12.9
Approach LOS			B

Intersection Summary			
Average Delay	5.7		
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	5	45	10	5	5	20	1219	35	5	588	30
Future Volume (Veh/h)	50	5	45	10	5	5	20	1219	35	5	588	30
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	5	49	11	5	5	22	1325	38	5	639	33
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								Raised			Raised	
Median storage veh)								1			1	
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1363	2056	320	1769	2070	682	672			1363		
vC1, stage 1 conf vol	649	649		1388	1388							
vC2, stage 2 conf vol	714	1407		381	682							
vCu, unblocked vol	1363	2056	320	1769	2070	682	672			1363		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	76	97	93	91	97	99	98			99		
cM capacity (veh/h)	222	144	676	118	145	393	915			500		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3	SB 4
Volume Total	108	21	22	883	480	5	320	320	33
Volume Left	54	11	22	0	0	5	0	0	0
Volume Right	49	5	0	0	38	0	0	0	33
cSH	308	150	915	1700	1700	500	1700	1700	1700
Volume to Capacity	0.35	0.14	0.02	0.52	0.28	0.01	0.19	0.19	0.02
Queue Length 95th (m)	11.6	3.6	0.6	0.0	0.0	0.2	0.0	0.0	0.0
Control Delay (s)	22.8	32.9	9.0	0.0	0.0	12.3	0.0	0.0	0.0
Lane LOS	C	D	A			B			
Approach Delay (s)	22.8	32.9	0.1			0.1			
Approach LOS	C	D							

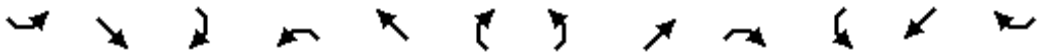
Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	48.7%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	54	103	21	583	1461	18
Future Volume (vph)	54	103	21	583	1461	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.91			1.00	1.00	
Flt Protected	0.98			1.00	1.00	
Satd. Flow (prot)	1688			3572	3572	
Flt Permitted	0.98			0.84	1.00	
Satd. Flow (perm)	1688			3021	3572	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	59	112	23	634	1588	20
RTOR Reduction (vph)	38	0	0	0	0	0
Lane Group Flow (vph)	133	0	0	657	1608	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	15.7			92.3	92.3	
Effective Green, g (s)	15.7			92.3	92.3	
Actuated g/C Ratio	0.13			0.77	0.77	
Clearance Time (s)	6.0			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	220			2323	2747	
v/s Ratio Prot	c0.08				c0.45	
v/s Ratio Perm				0.22		
v/c Ratio	0.60			0.28	0.59	
Uniform Delay, d1	49.2			4.1	5.8	
Progression Factor	1.00			0.55	1.00	
Incremental Delay, d2	4.6			0.3	0.9	
Delay (s)	53.8			2.5	6.7	
Level of Service	D			A	A	
Approach Delay (s)	53.8			2.5	6.7	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	8.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	97	54	274	173	57	32	102	510	40	69	1397	52
Future Volume (vph)	97	54	274	173	57	32	102	510	40	69	1397	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.55	1.00	1.00		0.74	1.00	0.09	1.00	1.00	0.44	1.00	1.00
Satd. Flow (perm)	1036	3579	1601		2646	1601	167	3579	1601	837	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	59	298	188	62	35	111	554	43	75	1518	57
RTOR Reduction (vph)	0	0	82	0	0	29	0	0	16	0	0	23
Lane Group Flow (vph)	105	59	216	0	250	6	111	554	27	75	1518	34
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	22.0	22.0	22.0		22.0	22.0	83.2	74.8	74.8	76.8	71.6	71.6
Effective Green, g (s)	22.0	22.0	22.0		22.0	22.0	83.2	74.8	74.8	76.8	71.6	71.6
Actuated g/C Ratio	0.18	0.18	0.18		0.18	0.18	0.69	0.62	0.62	0.64	0.60	0.60
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	189	656	293		485	293	229	2230	997	576	2135	955
v/s Ratio Prot		0.02					c0.03	0.15		0.01	c0.42	
v/s Ratio Perm	0.10		c0.14		0.09	0.00	c0.30		0.02	0.08		0.02
v/c Ratio	0.56	0.09	0.74		0.52	0.02	0.48	0.25	0.03	0.13	0.71	0.04
Uniform Delay, d1	44.6	40.7	46.3		44.2	40.2	14.2	10.1	8.7	8.1	17.0	10.0
Progression Factor	1.00	1.00	1.00		1.00	1.00	2.33	1.16	7.26	0.61	0.75	0.79
Incremental Delay, d2	3.5	0.1	9.3		0.9	0.0	1.5	0.3	0.0	0.1	1.7	0.1
Delay (s)	48.1	40.7	55.6		45.1	40.2	34.7	11.9	62.9	5.0	14.4	8.0
Level of Service	D	D	E		D	D	C	B	E	A	B	A
Approach Delay (s)		52.0			44.5			18.6			13.8	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	23.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	14	62	8	250	38	57	5	631	143	91	1673	11
Future Volume (vph)	14	62	8	250	38	57	5	631	143	91	1673	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1843		1789	1883	1601	1789	3480		1789	3575	
Flt Permitted		0.96		0.71	1.00	1.00	0.06	1.00		0.30	1.00	
Satd. Flow (perm)		1779		1330	1883	1601	112	3480		573	3575	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	67	9	272	41	62	5	686	155	99	1818	12
RTOR Reduction (vph)	0	4	0	0	0	47	0	14	0	0	0	0
Lane Group Flow (vph)	0	87	0	272	41	15	5	827	0	99	1830	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		28.9		28.9	28.9	28.9	79.1	79.1		79.1	79.1	
Effective Green, g (s)		28.9		28.9	28.9	28.9	79.1	79.1		79.1	79.1	
Actuated g/C Ratio		0.24		0.24	0.24	0.24	0.66	0.66		0.66	0.66	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		428		320	453	385	73	2293		377	2356	
v/s Ratio Prot					0.02			0.24			c0.51	
v/s Ratio Perm		0.05		c0.20		0.01	0.04			0.17		
v/c Ratio		0.20		0.85	0.09	0.04	0.07	0.36		0.26	0.78	
Uniform Delay, d1		36.4		43.5	35.4	34.9	7.3	9.1		8.4	14.3	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		0.78	0.60	
Incremental Delay, d2		0.2		18.6	0.1	0.0	1.8	0.4		1.3	2.0	
Delay (s)		36.6		62.1	35.4	34.9	9.1	9.6		7.8	10.5	
Level of Service		D		E	D	C	A	A		A	B	
Approach Delay (s)		36.6			54.7			9.6			10.4	
Approach LOS		D			D			A			B	

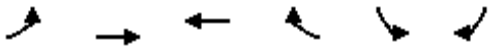
Intersection Summary			
HCM 2000 Control Delay	16.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	8	5	127	5	5	5	104	697	5	5	1866	65
Future Volume (Veh/h)	8	5	127	5	5	5	104	697	5	5	1866	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	5	138	5	5	5	113	758	5	5	2028	71
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.61	0.61	0.61	0.61	0.61		0.61					
vC, conflicting volume	2686	3062	1050	2151	3096	382	2099			763		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2484	3103	0	1605	3157	382	1519			763		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	79	0	0	99	57			99		
cM capacity (veh/h)	0	4	660	0	4	616	265			845		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	152	15	113	505	258	5	1352	747
Volume Left	9	5	113	0	0	5	0	0
Volume Right	138	5	0	0	5	0	0	71
cSH	0	0	265	1700	1700	845	1700	1700
Volume to Capacity	Err	Err	0.43	0.30	0.15	0.01	0.80	0.44
Queue Length 95th (m)	Err	Err	15.3	0.0	0.0	0.1	0.0	0.0
Control Delay (s)	Err	Err	28.3	0.0	0.0	9.3	0.0	0.0
Lane LOS	F	F	D			A		
Approach Delay (s)	Err	Err	3.7			0.0		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	78.2%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	597	1403	5	5	11
Future Volume (Veh/h)	7	597	1403	5	5	11
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	649	1525	5	5	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1530				1868	765
vC1, stage 1 conf vol					1528	
vC2, stage 2 conf vol					340	
vCu, unblocked vol	1530				1868	765
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	98				96	97
cM capacity (veh/h)	431				138	346

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	8	324	324	1017	513	17
Volume Left	8	0	0	0	0	5
Volume Right	0	0	0	0	5	12
cSH	431	1700	1700	1700	1700	239
Volume to Capacity	0.02	0.19	0.19	0.60	0.30	0.07
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	1.7
Control Delay (s)	13.5	0.0	0.0	0.0	0.0	21.2
Lane LOS	B					C
Approach Delay (s)	0.2			0.0		21.2
Approach LOS						C

Intersection Summary				
Average Delay	0.2			
Intersection Capacity Utilization	48.9%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	6	554	57	49	1362	5	5	5	5	165	4	49
Future Volume (vph)	6	554	57	49	1362	5	5	5	5	165	4	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.99		1.00	1.00			0.95			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.96	
Satd. Flow (prot)	1789	3528		1789	3577			1769			1760	
Flt Permitted	0.95	1.00		0.95	1.00			0.89			0.77	
Satd. Flow (perm)	1789	3528		1789	3577			1608			1403	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	602	62	53	1480	5	5	5	5	179	4	53
RTOR Reduction (vph)	0	7	0	0	0	0	0	4	0	0	12	0
Lane Group Flow (vph)	7	657	0	53	1485	0	0	11	0	0	224	0
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			6			2	
Permitted Phases							6			2		
Actuated Green, G (s)	0.7	36.1		4.5	39.9			18.0			18.0	
Effective Green, g (s)	0.7	36.1		4.5	39.9			18.0			18.0	
Actuated g/C Ratio	0.01	0.47		0.06	0.52			0.23			0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	16	1662		105	1863			377			329	
v/s Ratio Prot	0.00	0.19		c0.03	c0.42							
v/s Ratio Perm								0.01			c0.16	
v/c Ratio	0.44	0.40		0.50	0.80			0.03			0.68	
Uniform Delay, d1	37.8	13.2		35.0	15.0			22.6			26.7	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	18.0	0.2		3.8	2.5			0.0			5.7	
Delay (s)	55.7	13.3		38.7	17.5			22.6			32.4	
Level of Service	E	B		D	B			C			C	
Approach Delay (s)		13.8			18.2			22.6			32.4	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	18.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	76.6	Sum of lost time (s)	18.0
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		

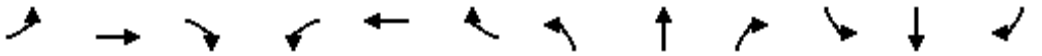
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	88	44	271	186	25	74
Future Volume (Veh/h)	88	44	271	186	25	74
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	96	48	295	202	27	80
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			144		912	120
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			144		912	120
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			79		89	91
cM capacity (veh/h)			1438		242	931

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	144	497	107
Volume Left	0	295	27
Volume Right	48	0	80
cSH	1700	1438	541
Volume to Capacity	0.08	0.21	0.20
Queue Length 95th (m)	0.0	5.9	5.5
Control Delay (s)	0.0	5.6	13.3
Lane LOS		A	B
Approach Delay (s)	0.0	5.6	13.3
Approach LOS			B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	9	16	67	20	27	77	507	16	11	1322	91
Future Volume (vph)	34	9	16	67	20	27	77	507	16	11	1322	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frt		0.96			0.97		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.97			0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1765			1772		1789	3562		1789	3579	1601
Flt Permitted		0.79			0.78		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1429			1427		1789	3562		1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	10	17	73	22	29	84	551	17	12	1437	99
RTOR Reduction (vph)	0	14	0	0	13	0	0	2	0	0	0	44
Lane Group Flow (vph)	0	50	0	0	111	0	84	566	0	12	1437	55
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		13.7			13.7		5.1	50.2		0.8	45.9	45.9
Effective Green, g (s)		13.7			13.7		5.1	50.2		0.8	45.9	45.9
Actuated g/C Ratio		0.17			0.17		0.06	0.61		0.01	0.56	0.56
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		236			236		110	2162		17	1986	888
v/s Ratio Prot							c0.05	c0.16		0.01	c0.40	
v/s Ratio Perm		0.03			c0.08							0.03
v/c Ratio		0.21			0.47		0.76	0.26		0.71	0.72	0.06
Uniform Delay, d1		29.8			31.2		38.2	7.6		40.8	13.7	8.5
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.4			1.5		26.4	0.1		84.0	1.3	0.0
Delay (s)		30.3			32.7		64.6	7.7		124.8	15.0	8.5
Level of Service		C			C		E	A		F	B	A
Approach Delay (s)		30.3			32.7			15.0			15.5	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	16.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	82.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		

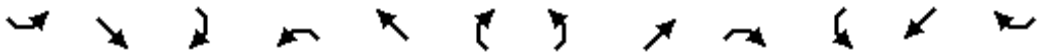
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	30	71	101	1317	836	41
Future Volume (vph)	30	71	101	1317	836	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.91			1.00	0.99	
Flt Protected	0.99			1.00	1.00	
Satd. Flow (prot)	1680			3566	3553	
Flt Permitted	0.99			0.75	1.00	
Satd. Flow (perm)	1680			2676	3553	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	77	110	1432	909	45
RTOR Reduction (vph)	70	0	0	0	2	0
Lane Group Flow (vph)	40	0	0	1542	952	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	11.2			96.8	96.8	
Effective Green, g (s)	11.2			96.8	96.8	
Actuated g/C Ratio	0.09			0.81	0.81	
Clearance Time (s)	6.0			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	156			2158	2866	
v/s Ratio Prot	c0.02				0.27	
v/s Ratio Perm				c0.58		
v/c Ratio	0.26			0.71	0.33	
Uniform Delay, d1	50.5			5.3	3.1	
Progression Factor	1.00			0.90	1.00	
Incremental Delay, d2	0.9			1.7	0.3	
Delay (s)	51.4			6.5	3.4	
Level of Service	D			A	A	
Approach Delay (s)	51.4			6.5	3.4	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	67	83	102	195	71	35	219	1251	215	85	784	38
Future Volume (vph)	67	83	102	195	71	35	219	1251	215	85	784	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3452	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.49	1.00	1.00		0.73	1.00	0.26	1.00	1.00	0.14	1.00	1.00
Satd. Flow (perm)	917	3579	1601		2608	1601	495	3579	1601	271	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	73	90	111	212	77	38	238	1360	234	92	852	41
RTOR Reduction (vph)	0	0	92	0	0	31	0	0	76	0	0	17
Lane Group Flow (vph)	73	90	19	0	289	7	238	1360	158	92	852	24
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	20.7	20.7	20.7		20.7	20.7	86.0	74.3	74.3	76.6	69.6	69.6
Effective Green, g (s)	20.7	20.7	20.7		20.7	20.7	86.0	74.3	74.3	76.6	69.6	69.6
Actuated g/C Ratio	0.17	0.17	0.17		0.17	0.17	0.72	0.62	0.62	0.64	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	617	276		449	276	480	2215	991	261	2075	928
v/s Ratio Prot		0.03					c0.05	c0.38		0.02	0.24	
v/s Ratio Perm	0.08		0.01		c0.11	0.00	0.31		0.10	0.20		0.01
v/c Ratio	0.46	0.15	0.07		0.94dl	0.02	0.50	0.61	0.16	0.35	0.41	0.03
Uniform Delay, d1	44.6	42.1	41.6		46.2	41.3	7.2	14.0	9.7	10.4	13.9	10.7
Progression Factor	1.00	1.00	1.00		1.00	1.00	0.50	0.43	0.20	1.47	0.90	1.00
Incremental Delay, d2	2.1	0.1	0.1		3.2	0.0	0.5	0.9	0.2	0.8	0.6	0.0
Delay (s)	46.8	42.3	41.7		49.4	41.3	4.1	6.9	2.2	16.0	13.1	10.8
Level of Service	D	D	D		D	D	A	A	A	B	B	B
Approach Delay (s)		43.2			48.4			6.0			13.3	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	15.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		

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

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	31	49	5	135	18	49	14	1637	142	49	1124	5
Future Volume (vph)	31	49	5	135	18	49	14	1637	142	49	1124	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1836		1789	1883	1601	1789	3536		1789	3576	
Flt Permitted		0.88		0.69	1.00	1.00	0.20	1.00		0.06	1.00	
Satd. Flow (perm)		1652		1304	1883	1601	370	3536		122	3576	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	53	5	147	20	53	15	1779	154	53	1222	5
RTOR Reduction (vph)	0	2	0	0	0	22	0	4	0	0	0	0
Lane Group Flow (vph)	0	90	0	147	20	31	15	1929	0	53	1227	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Effective Green, g (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Actuated g/C Ratio		0.17		0.17	0.17	0.17	0.73	0.73		0.73	0.73	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		284		224	324	276	269	2572		88	2601	
v/s Ratio Prot					0.01			c0.55			0.34	
v/s Ratio Perm		0.05		c0.11		0.02	0.04			0.43		
v/c Ratio		0.32		0.66	0.06	0.11	0.06	0.75		0.60	0.47	
Uniform Delay, d1		43.4		46.3	41.5	41.9	4.6	9.8		7.9	6.8	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		1.58	1.36	
Incremental Delay, d2		0.6		6.8	0.1	0.2	0.4	2.1		25.8	0.6	
Delay (s)		44.1		53.1	41.6	42.1	5.0	11.9		38.3	9.8	
Level of Service		D		D	D	D	A	B		D	A	
Approach Delay (s)		44.1			49.4			11.8			11.0	
Approach LOS		D			D			B			B	

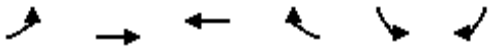
Intersection Summary			
HCM 2000 Control Delay	14.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	33	5	127	5	5	5	151	1778	5	5	1183	88
Future Volume (Veh/h)	33	5	127	5	5	5	151	1778	5	5	1183	88
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	5	138	5	5	5	164	1933	5	5	1286	96
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.85	0.85	0.85	0.85	0.85		0.85					
vC, conflicting volume	2646	3610	691	3057	3656	969	1382			1938		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2584	3717	288	3067	3770	969	1099			1938		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	77	0	0	98	69			98		
cM capacity (veh/h)	0	3	604	0	2	253	537			299		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	179	15	164	1289	649	5	857	525
Volume Left	36	5	164	0	0	5	0	0
Volume Right	138	5	0	0	5	0	0	96
cSH	0	0	537	1700	1700	299	1700	1700
Volume to Capacity	Err	Err	0.31	0.76	0.38	0.02	0.50	0.31
Queue Length 95th (m)	Err	Err	9.8	0.0	0.0	0.4	0.0	0.0
Control Delay (s)	Err	Err	14.6	0.0	0.0	17.2	0.0	0.0
Lane LOS	F	F	B			C		
Approach Delay (s)	Err	Err	1.1			0.1		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	74.0%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	1594	919	5	5	10
Future Volume (Veh/h)	14	1594	919	5	5	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	1733	999	5	5	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1004				1898	502
vC1, stage 1 conf vol					1002	
vC2, stage 2 conf vol					896	
vCu, unblocked vol	1004				1898	502
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	98				97	98
cM capacity (veh/h)	686				179	515

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	15	866	866	666	338	16
Volume Left	15	0	0	0	0	5
Volume Right	0	0	0	0	5	11
cSH	686	1700	1700	1700	1700	324
Volume to Capacity	0.02	0.51	0.51	0.39	0.20	0.05
Queue Length 95th (m)	0.5	0.0	0.0	0.0	0.0	1.2
Control Delay (s)	10.4	0.0	0.0	0.0	0.0	16.7
Lane LOS	B					C
Approach Delay (s)	0.1			0.0		16.7
Approach LOS						C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	7	1565	197	65	864	5	5	5	5	105	5	41
Future Volume (vph)	7	1565	197	65	864	5	5	5	5	105	5	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.98		1.00	1.00			0.95			0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.97	
Satd. Flow (prot)	1789	3519		1789	3576			1769			1753	
Flt Permitted	0.95	1.00		0.95	1.00			0.91			0.78	
Satd. Flow (perm)	1789	3519		1789	3576			1643			1421	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	1701	214	71	939	5	5	5	5	114	5	45
RTOR Reduction (vph)	0	6	0	0	0	0	0	4	0	0	13	0
Lane Group Flow (vph)	8	1909	0	71	944	0	0	11	0	0	151	0
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			6			2	
Permitted Phases							6			2		
Actuated Green, G (s)	0.9	69.5		6.0	74.6			17.7			17.7	
Effective Green, g (s)	0.9	69.5		6.0	74.6			17.7			17.7	
Actuated g/C Ratio	0.01	0.62		0.05	0.67			0.16			0.16	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	14	2199		96	2399			261			226	
v/s Ratio Prot	0.00	c0.54		c0.04	c0.26							
v/s Ratio Perm								0.01			c0.11	
v/c Ratio	0.57	0.87		0.74	0.39			0.04			0.67	
Uniform Delay, d1	55.0	17.1		51.8	8.2			39.6			44.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	46.0	3.9		25.5	0.1			0.1			7.2	
Delay (s)	100.9	21.0		77.3	8.3			39.6			51.2	
Level of Service	F	C		E	A			D			D	
Approach Delay (s)		21.3			13.1			39.6			51.2	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	111.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		

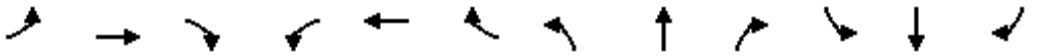
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	240	25	77	133	36	238
Future Volume (Veh/h)	240	25	77	133	36	238
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	261	27	84	145	39	259
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			288		588	274
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			288		588	274
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		91	66
cM capacity (veh/h)			1274		441	764

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	288	229	298
Volume Left	0	84	39
Volume Right	27	0	259
cSH	1700	1274	697
Volume to Capacity	0.17	0.07	0.43
Queue Length 95th (m)	0.0	1.6	16.3
Control Delay (s)	0.0	3.3	14.0
Lane LOS		A	B
Approach Delay (s)	0.0	3.3	14.0
Approach LOS			B

Intersection Summary			
Average Delay		6.0	
Intersection Capacity Utilization		52.1%	ICU Level of Service A
Analysis Period (min)		15	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	21	74	32	14	18	26	1498	74	28	818	34
Future Volume (vph)	70	21	74	32	14	18	26	1498	74	28	818	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frt		0.94			0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.98			0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1733			1767		1789	3553		1789	3579	1601
Flt Permitted		0.83			0.76		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1469			1382		1789	3553		1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	23	80	35	15	20	28	1628	80	30	889	37
RTOR Reduction (vph)	0	35	0	0	16	0	0	3	0	0	0	15
Lane Group Flow (vph)	0	144	0	0	54	0	28	1705	0	30	889	22
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		14.8			14.8		1.7	48.0		1.7	48.0	48.0
Effective Green, g (s)		14.8			14.8		1.7	48.0		1.7	48.0	48.0
Actuated g/C Ratio		0.18			0.18		0.02	0.58		0.02	0.58	0.58
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		263			247		36	2067		36	2082	931
v/s Ratio Prot							0.02	c0.48		c0.02	0.25	
v/s Ratio Perm		c0.10			0.04							0.01
v/c Ratio		0.55			0.22		0.78	0.83		0.83	0.43	0.02
Uniform Delay, d1		30.8			28.9		40.2	13.9		40.3	9.6	7.3
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		2.3			0.4		66.9	2.8		85.2	0.1	0.0
Delay (s)		33.1			29.3		107.1	16.7		125.5	9.7	7.3
Level of Service		C			C		F	B		F	A	A
Approach Delay (s)		33.1			29.3			18.2			13.3	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	82.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		

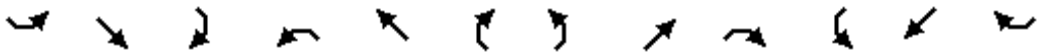
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	57	103	21	685	1785	22
Future Volume (vph)	57	103	21	685	1785	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	
Lane Util. Factor	1.00		1.00	0.95	0.95	
Frt	0.91		1.00	1.00	1.00	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1690		1789	3579	3572	
Flt Permitted	0.98		0.07	1.00	1.00	
Satd. Flow (perm)	1690		125	3579	3572	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	62	112	23	745	1940	24
RTOR Reduction (vph)	15	0	0	0	1	0
Lane Group Flow (vph)	159	0	23	745	1963	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	18.1		89.9	89.9	89.9	
Effective Green, g (s)	18.1		89.9	89.9	89.9	
Actuated g/C Ratio	0.15		0.75	0.75	0.75	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	254		93	2681	2676	
v/s Ratio Prot	c0.09			0.21	c0.55	
v/s Ratio Perm			0.18			
v/c Ratio	0.62		0.25	0.28	0.73	
Uniform Delay, d1	47.8		4.6	4.8	8.4	
Progression Factor	1.00		1.18	0.28	1.00	
Incremental Delay, d2	4.7		6.1	0.3	1.8	
Delay (s)	52.5		11.5	1.6	10.2	
Level of Service	D		B	A	B	
Approach Delay (s)	52.5			1.9	10.2	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	97	54	274	173	57	32	102	612	40	69	1721	52
Future Volume (vph)	97	54	274	173	57	32	102	612	40	69	1721	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.55	1.00	1.00		0.74	1.00	0.05	1.00	1.00	0.39	1.00	1.00
Satd. Flow (perm)	1040	3579	1601		2645	1601	102	3579	1601	730	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	59	298	188	62	35	111	665	43	75	1871	57
RTOR Reduction (vph)	0	0	71	0	0	28	0	0	16	0	0	23
Lane Group Flow (vph)	105	59	227	0	250	7	111	665	27	75	1871	34
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	22.6	22.6	22.6		22.6	22.6	82.4	74.2	74.2	76.4	71.2	71.2
Effective Green, g (s)	22.6	22.6	22.6		22.6	22.6	82.4	74.2	74.2	76.4	71.2	71.2
Actuated g/C Ratio	0.19	0.19	0.19		0.19	0.19	0.69	0.62	0.62	0.64	0.59	0.59
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	195	674	301		498	301	185	2213	989	510	2123	949
v/s Ratio Prot		0.02					c0.04	0.19		0.01	c0.52	
v/s Ratio Perm	0.10		c0.14		0.09	0.00	c0.37		0.02	0.09		0.02
v/c Ratio	0.54	0.09	0.75		0.50	0.02	0.60	0.30	0.03	0.15	0.88	0.04
Uniform Delay, d1	44.0	40.2	46.1		43.7	39.7	26.2	10.7	8.9	8.3	20.8	10.1
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.48	1.43	12.93	0.68	0.90	0.50
Incremental Delay, d2	2.8	0.1	10.2		0.8	0.0	4.9	0.3	0.0	0.1	4.0	0.0
Delay (s)	46.8	40.2	56.2		44.5	39.7	43.6	15.7	114.9	5.7	22.8	5.1
Level of Service	D	D	E		D	D	D	B	F	A	C	A
Approach Delay (s)		52.1			43.9			24.7			21.7	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	15	62	8	250	38	57	6	732	143	91	1998	8
Future Volume (vph)	15	62	8	250	38	57	6	732	143	91	1998	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.98		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1843		1789	1883	1601	1789	3491		1789	3576	
Flt Permitted		0.95		0.70	1.00	1.00	0.05	1.00		0.26	1.00	
Satd. Flow (perm)		1774		1327	1883	1601	95	3491		496	3576	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	67	9	272	41	62	7	796	155	99	2172	9
RTOR Reduction (vph)	0	4	0	0	0	47	0	11	0	0	0	0
Lane Group Flow (vph)	0	88	0	272	41	15	7	940	0	99	2181	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		29.0		29.0	29.0	29.0	79.0	79.0		79.0	79.0	
Effective Green, g (s)		29.0		29.0	29.0	29.0	79.0	79.0		79.0	79.0	
Actuated g/C Ratio		0.24		0.24	0.24	0.24	0.66	0.66		0.66	0.66	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		428		320	455	386	62	2298		326	2354	
v/s Ratio Prot					0.02			0.27			c0.61	
v/s Ratio Perm		0.05		c0.20		0.01	0.07			0.20		
v/c Ratio		0.21		0.85	0.09	0.04	0.11	0.41		0.30	0.93	
Uniform Delay, d1		36.3		43.4	35.3	34.8	7.6	9.6		8.8	18.0	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		0.63	0.47	
Incremental Delay, d2		0.2		18.6	0.1	0.0	3.7	0.5		1.4	4.8	
Delay (s)		36.6		62.0	35.4	34.9	11.2	10.1		6.9	13.3	
Level of Service		D		E	D	C	B	B		A	B	
Approach Delay (s)		36.6			54.6			10.1			13.0	
Approach LOS		D			D			B			B	

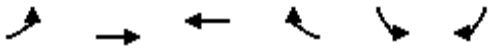
Intersection Summary			
HCM 2000 Control Delay	17.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	11	5	134	5	5	5	82	797	5	5	2220	36
Future Volume (Veh/h)	11	5	134	5	5	5	82	797	5	5	2220	36
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	5	146	5	5	5	89	866	5	5	2413	39
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.36	0.36	0.36	0.36	0.36		0.36					
vC, conflicting volume	3061	3492	1226	2412	3508	436	2452			871		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3170	4366	0	1365	4413	436	1477			871		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	63	0	0	99	45			99		
cM capacity (veh/h)	0	0	390	0	0	569	163			770		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	163	15	89	577	294	5	1609	843
Volume Left	12	5	89	0	0	5	0	0
Volume Right	146	5	0	0	5	0	0	39
cSH	0	0	163	1700	1700	770	1700	1700
Volume to Capacity	Err	Err	0.55	0.34	0.17	0.01	0.95	0.50
Queue Length 95th (m)	Err	Err	21.2	0.0	0.0	0.1	0.0	0.0
Control Delay (s)	Err	Err	51.1	0.0	0.0	9.7	0.0	0.0
Lane LOS	F	F	F			A		
Approach Delay (s)	Err	Err	4.7			0.0		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	84.3%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	865	1866	5	5	11
Future Volume (Veh/h)	7	865	1866	5	5	11
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	940	2028	5	5	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	2033				2516	1016
vC1, stage 1 conf vol					2030	
vC2, stage 2 conf vol					486	
vCu, unblocked vol	2033				2516	1016
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				93	95
cM capacity (veh/h)	275				73	235

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	8	470	470	1352	681	17
Volume Left	8	0	0	0	0	5
Volume Right	0	0	0	0	5	12
cSH	275	1700	1700	1700	1700	143
Volume to Capacity	0.03	0.28	0.28	0.80	0.40	0.12
Queue Length 95th (m)	0.7	0.0	0.0	0.0	0.0	3.0
Control Delay (s)	18.5	0.0	0.0	0.0	0.0	33.6
Lane LOS	C					D
Approach Delay (s)	0.2			0.0		33.6
Approach LOS						D

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	6	776	57	75	1799	5	5	5	5	165	4	95
Future Volume (vph)	6	776	57	75	1799	5	5	5	5	165	4	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00			0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3577			1769		1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.94		0.75	1.00	1.00
Satd. Flow (perm)	1789	3579	1601	1789	3577			1686		1408	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	843	62	82	1955	5	5	5	5	179	4	103
RTOR Reduction (vph)	0	0	29	0	0	0	0	4	0	0	0	84
Lane Group Flow (vph)	7	843	33	82	1960	0	0	11	0	179	4	19
Turn Type	Prot	NA	Perm	Prot	NA		Perm	NA		Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4				6			2		2
Actuated Green, G (s)	0.8	49.6	49.6	7.8	56.6			17.4		17.4	17.4	17.4
Effective Green, g (s)	0.8	49.6	49.6	7.8	56.6			17.4		17.4	17.4	17.4
Actuated g/C Ratio	0.01	0.53	0.53	0.08	0.61			0.19		0.19	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	15	1912	855	150	2181			316		264	353	300
v/s Ratio Prot	0.00	0.24		c0.05	c0.55						0.00	
v/s Ratio Perm			0.02					0.01		c0.13		0.01
v/c Ratio	0.47	0.44	0.04	0.55	0.90			0.03		0.68	0.01	0.06
Uniform Delay, d1	45.8	13.2	10.3	40.8	15.6			30.8		35.1	30.7	31.0
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	21.2	0.2	0.0	4.0	5.4			0.0		6.7	0.0	0.1
Delay (s)	67.0	13.3	10.3	44.8	21.0			30.9		41.8	30.7	31.1
Level of Service	E	B	B	D	C			C		D	C	C
Approach Delay (s)		13.5			22.0			30.9			37.8	
Approach LOS		B			C			C			D	

Intersection Summary			
HCM 2000 Control Delay	21.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	92.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	84.9%	ICU Level of Service	E
Analysis Period (min)	15		

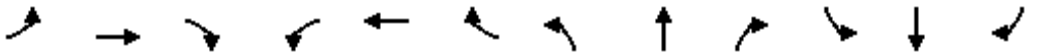
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	99	55	271	190	37	74
Future Volume (Veh/h)	99	55	271	190	37	74
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	108	60	295	207	40	80
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			168		935	138
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			168		935	138
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			79		83	91
cM capacity (veh/h)			1410		233	910

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	168	502	120
Volume Left	0	295	40
Volume Right	60	0	80
cSH	1700	1410	462
Volume to Capacity	0.10	0.21	0.26
Queue Length 95th (m)	0.0	6.0	7.8
Control Delay (s)	0.0	5.6	15.5
Lane LOS		A	C
Approach Delay (s)	0.0	5.6	15.5
Approach LOS			C

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	19	30	152	54	78	150	677	41	26	1686	140
Future Volume (vph)	43	19	30	152	54	78	150	677	41	26	1686	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.72	1.00	1.00	0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1353	1883	1601	1401	1883	1601	1789	3579	1601	1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	47	21	33	165	59	85	163	736	45	28	1833	152
RTOR Reduction (vph)	0	0	28	0	0	71	0	0	16	0	0	53
Lane Group Flow (vph)	47	21	5	165	59	14	163	736	29	28	1833	99
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	19.7	19.7	19.7	19.7	19.7	19.7	13.0	78.3	78.3	3.5	68.8	68.8
Effective Green, g (s)	19.7	19.7	19.7	19.7	19.7	19.7	13.0	78.3	78.3	3.5	68.8	68.8
Actuated g/C Ratio	0.16	0.16	0.16	0.16	0.16	0.16	0.11	0.66	0.66	0.03	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	223	310	263	230	310	263	194	2345	1049	52	2060	921
v/s Ratio Prot		0.01			0.03		c0.09	0.21		0.02	c0.51	
v/s Ratio Perm	0.03		0.00	c0.12		0.01			0.02			0.06
v/c Ratio	0.21	0.07	0.02	0.72	0.19	0.05	0.84	0.31	0.03	0.54	0.89	0.11
Uniform Delay, d1	43.2	42.1	41.8	47.3	43.0	42.0	52.2	8.9	7.2	57.2	22.1	11.5
Progression 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
Incremental Delay, d2	0.5	0.1	0.0	10.2	0.3	0.1	26.5	0.1	0.0	10.3	5.2	0.1
Delay (s)	43.6	42.2	41.8	57.5	43.3	42.1	78.7	9.0	7.2	67.5	27.2	11.5
Level of Service	D	D	D	E	D	D	E	A	A	E	C	B
Approach Delay (s)		42.8			50.5			21.0			26.6	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	119.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		

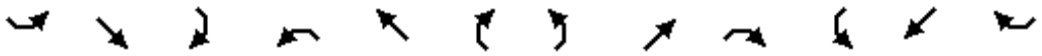
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	31	71	101	1669	1039	42
Future Volume (vph)	31	71	101	1669	1039	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	
Lane Util. Factor	1.00		1.00	0.95	0.95	
Frt	0.91		1.00	1.00	0.99	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1681		1789	3579	3558	
Flt Permitted	0.98		0.22	1.00	1.00	
Satd. Flow (perm)	1681		422	3579	3558	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	34	77	110	1814	1129	46
RTOR Reduction (vph)	69	0	0	0	1	0
Lane Group Flow (vph)	42	0	110	1814	1174	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	12.1		95.9	95.9	95.9	
Effective Green, g (s)	12.1		95.9	95.9	95.9	
Actuated g/C Ratio	0.10		0.80	0.80	0.80	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	169		337	2860	2843	
v/s Ratio Prot	c0.02			c0.51	0.33	
v/s Ratio Perm			0.26			
v/c Ratio	0.25		0.33	0.63	0.41	
Uniform Delay, d1	49.7		3.3	4.9	3.6	
Progression Factor	1.00		0.92	0.90	1.00	
Incremental Delay, d2	0.8		1.7	0.7	0.4	
Delay (s)	50.5		4.8	5.1	4.1	
Level of Service	D		A	A	A	
Approach Delay (s)	50.5			5.1	4.1	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	67	83	102	195	71	35	219	1603	215	85	987	38
Future Volume (vph)	67	83	102	195	71	35	219	1603	215	85	987	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3452	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.49	1.00	1.00		0.73	1.00	0.18	1.00	1.00	0.07	1.00	1.00
Satd. Flow (perm)	917	3579	1601		2608	1601	341	3579	1601	125	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	73	90	111	212	77	38	238	1742	234	92	1073	41
RTOR Reduction (vph)	0	0	92	0	0	31	0	0	63	0	0	18
Lane Group Flow (vph)	73	90	19	0	289	7	238	1742	171	92	1073	23
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	20.7	20.7	20.7		20.7	20.7	87.3	74.5	74.5	74.9	68.1	68.1
Effective Green, g (s)	20.7	20.7	20.7		20.7	20.7	87.3	74.5	74.5	74.9	68.1	68.1
Actuated g/C Ratio	0.17	0.17	0.17		0.17	0.17	0.73	0.62	0.62	0.62	0.57	0.57
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	617	276		449	276	407	2221	993	172	2031	908
v/s Ratio Prot		0.03					c0.06	c0.49		0.03	0.30	
v/s Ratio Perm	0.08		0.01		c0.11	0.00	0.36		0.11	0.30		0.01
v/c Ratio	0.46	0.15	0.07		0.94dl	0.02	0.58	0.78	0.17	0.53	0.53	0.03
Uniform Delay, d1	44.6	42.1	41.6		46.2	41.3	9.6	16.8	9.7	16.8	16.0	11.4
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.56	0.36	0.11	1.01	1.18	1.00
Incremental Delay, d2	2.1	0.1	0.1		3.2	0.0	1.0	1.4	0.2	3.0	0.9	0.0
Delay (s)	46.8	42.3	41.7		49.4	41.3	16.0	7.4	1.2	20.0	19.9	11.4
Level of Service	D	D	D		D	D	B	A	A	B	B	B
Approach Delay (s)		43.2			48.4			7.7			19.6	
Approach LOS		D			D			A			B	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		

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

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	32	49	5	135	18	49	18	1988	142	49	1330	5
Future Volume (vph)	32	49	5	135	18	49	18	1988	142	49	1330	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1835		1789	1883	1601	1789	3543		1789	3577	
Flt Permitted		0.88		0.69	1.00	1.00	0.14	1.00		0.05	1.00	
Satd. Flow (perm)		1647		1300	1883	1601	272	3543		86	3577	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	35	53	5	147	20	53	20	2161	154	53	1446	5
RTOR Reduction (vph)	0	2	0	0	0	22	0	3	0	0	0	0
Lane Group Flow (vph)	0	91	0	147	20	31	20	2312	0	53	1451	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Effective Green, g (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Actuated g/C Ratio		0.17		0.17	0.17	0.17	0.73	0.73		0.73	0.73	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		284		224	324	276	197	2577		62	2602	
v/s Ratio Prot					0.01			c0.65			0.41	
v/s Ratio Perm		0.06		c0.11		0.02	0.07			0.61		
v/c Ratio		0.32		0.66	0.06	0.11	0.10	0.90		0.85	0.56	
Uniform Delay, d1		43.5		46.3	41.5	41.9	4.8	12.8		11.8	7.5	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		1.99	1.83	
Incremental Delay, d2		0.7		6.8	0.1	0.2	1.0	5.5		73.3	0.8	
Delay (s)		44.2		53.1	41.6	42.1	5.8	18.3		96.7	14.5	
Level of Service		D		D	D	D	A	B		F	B	
Approach Delay (s)		44.2			49.4			18.2			17.4	
Approach LOS		D			D			B			B	

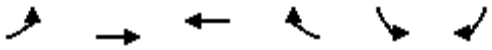
Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	34	5	130	5	5	5	103	2132	5	5	1412	65
Future Volume (Veh/h)	34	5	130	5	5	5	103	2132	5	5	1412	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	5	141	5	5	5	112	2317	5	5	1535	71
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.80	0.80	0.80	0.80	0.80		0.80					
vC, conflicting volume	2970	4126	803	3464	4160	1161	1606			2322		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2963	4405	259	3579	4446	1161	1261			2322		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	76	0	0	97	74			98		
cM capacity (veh/h)	0	1	593	0	1	188	439			211		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	183	15	112	1545	777	5	1023	583
Volume Left	37	5	112	0	0	5	0	0
Volume Right	141	5	0	0	5	0	0	71
cSH	0	0	439	1700	1700	211	1700	1700
Volume to Capacity	Err	Err	0.26	0.91	0.46	0.02	0.60	0.34
Queue Length 95th (m)	Err	Err	7.6	0.0	0.0	0.6	0.0	0.0
Control Delay (s)	Err	Err	16.0	0.0	0.0	22.5	0.0	0.0
Lane LOS	F	F	C			C		
Approach Delay (s)	Err	Err	0.7			0.1		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	84.1%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	2129	1341	5	5	10
Future Volume (Veh/h)	14	2129	1341	5	5	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	2314	1458	5	5	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1463				2648	732
vC1, stage 1 conf vol					1460	
vC2, stage 2 conf vol					1187	
vCu, unblocked vol	1463				2648	732
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				95	97
cM capacity (veh/h)	458				102	364

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	15	1157	1157	972	491	16
Volume Left	15	0	0	0	0	5
Volume Right	0	0	0	0	5	11
cSH	458	1700	1700	1700	1700	202
Volume to Capacity	0.03	0.68	0.68	0.57	0.29	0.08
Queue Length 95th (m)	0.8	0.0	0.0	0.0	0.0	1.9
Control Delay (s)	13.1	0.0	0.0	0.0	0.0	24.3
Lane LOS	B					C
Approach Delay (s)	0.1			0.0		24.3
Approach LOS						C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	7	2088	197	84	1267	5	5	5	5	105	5	53
Future Volume (vph)	7	2088	197	84	1267	5	5	5	5	105	5	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00			0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3577			1769		1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.93		0.75	1.00	1.00
Satd. Flow (perm)	1789	3579	1601	1789	3577			1675		1408	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	2270	214	91	1377	5	5	5	5	114	5	58
RTOR Reduction (vph)	0	0	29	0	0	0	0	4	0	0	0	50
Lane Group Flow (vph)	8	2270	185	91	1382	0	0	11	0	114	5	8
Turn Type	Prot	NA	Perm	Prot	NA		Perm	NA		Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4				6			2		2
Actuated Green, G (s)	0.9	79.8	79.8	7.0	85.9			16.6		16.6	16.6	16.6
Effective Green, g (s)	0.9	79.8	79.8	7.0	85.9			16.6		16.6	16.6	16.6
Actuated g/C Ratio	0.01	0.66	0.66	0.06	0.71			0.14		0.14	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	13	2352	1052	103	2531			229		192	257	218
v/s Ratio Prot	0.00	c0.63		c0.05	0.39						0.00	
v/s Ratio Perm			0.12					0.01		c0.08		0.00
v/c Ratio	0.62	0.97	0.18	0.88	0.55			0.05		0.59	0.02	0.04
Uniform Delay, d1	60.1	19.5	8.1	56.8	8.5			45.5		49.2	45.4	45.5
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	64.0	11.5	0.1	53.2	0.2			0.1		4.9	0.0	0.1
Delay (s)	124.1	31.0	8.1	110.0	8.7			45.6		54.1	45.4	45.5
Level of Service	F	C	A	F	A			D		D	D	D
Approach Delay (s)		29.3			15.0			45.6			51.0	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	121.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

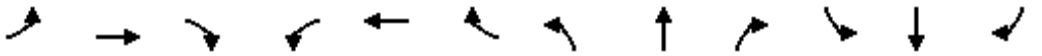
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	245	30	77	143	42	238
Future Volume (Veh/h)	245	30	77	143	42	238
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	266	33	84	155	46	259
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			299		606	282
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			299		606	282
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		89	66
cM capacity (veh/h)			1262		430	756

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	299	239	305
Volume Left	0	84	46
Volume Right	33	0	259
cSH	1700	1262	679
Volume to Capacity	0.18	0.07	0.45
Queue Length 95th (m)	0.0	1.6	17.7
Control Delay (s)	0.0	3.2	14.6
Lane LOS		A	B
Approach Delay (s)	0.0	3.2	14.6
Approach LOS			B

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	57	143	83	34	49	39	1929	165	83	1120	43
Future Volume (vph)	115	57	143	83	34	49	39	1929	165	83	1120	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.73	1.00	1.00	0.72	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1381	1883	1601	1350	1883	1601	1789	3579	1601	1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	62	155	90	37	53	42	2097	179	90	1217	47
RTOR Reduction (vph)	0	0	126	0	0	45	0	0	27	0	0	16
Lane Group Flow (vph)	125	62	29	90	37	8	42	2097	152	90	1217	31
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	17.2	17.2	17.2	17.2	17.2	17.2	4.6	74.9	74.9	7.0	77.3	77.3
Effective Green, g (s)	17.2	17.2	17.2	17.2	17.2	17.2	4.6	74.9	74.9	7.0	77.3	77.3
Actuated g/C Ratio	0.15	0.15	0.15	0.15	0.15	0.15	0.04	0.64	0.64	0.06	0.66	0.66
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	202	276	235	198	276	235	70	2289	1024	106	2362	1056
v/s Ratio Prot		0.03			0.02		0.02	c0.59		c0.05	0.34	
v/s Ratio Perm	c0.09		0.02	0.07		0.00			0.09			0.02
v/c Ratio	0.62	0.22	0.12	0.45	0.13	0.03	0.60	0.92	0.15	0.85	0.52	0.03
Uniform Delay, d1	46.9	44.1	43.4	45.7	43.5	42.8	55.3	18.4	8.4	54.5	10.2	6.9
Progression 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
Incremental Delay, d2	5.5	0.4	0.2	1.7	0.2	0.1	13.1	6.3	0.1	43.4	0.2	0.0
Delay (s)	52.4	44.5	43.6	47.3	43.7	42.9	68.4	24.7	8.5	97.9	10.4	6.9
Level of Service	D	D	D	D	D	D	E	C	A	F	B	A
Approach Delay (s)		47.0			45.3			24.2			16.1	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	24.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	117.1	Sum of lost time (s)	18.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		

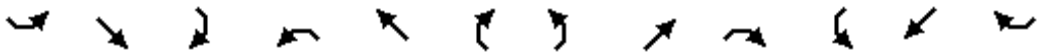
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	55	103	21	825	2248	19
Future Volume (vph)	55	103	21	825	2248	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	0.95	0.95	1.00
Frt	0.91		1.00	1.00	1.00	0.85
Flt Protected	0.98		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1688		1789	3579	3579	1601
Flt Permitted	0.98		0.03	1.00	1.00	1.00
Satd. Flow (perm)	1688		65	3579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	60	112	23	897	2443	21
RTOR Reduction (vph)	9	0	0	0	0	2
Lane Group Flow (vph)	163	0	23	897	2443	19
Turn Type	Prot		Perm	NA	NA	Perm
Protected Phases	3			6	2	
Permitted Phases			6			2
Actuated Green, G (s)	22.2		115.8	115.8	115.8	115.8
Effective Green, g (s)	22.2		115.8	115.8	115.8	115.8
Actuated g/C Ratio	0.15		0.77	0.77	0.77	0.77
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	249		50	2762	2762	1235
v/s Ratio Prot	c0.10			0.25	c0.68	
v/s Ratio Perm			0.35			0.01
v/c Ratio	0.66		0.46	0.32	0.88	0.02
Uniform Delay, d1	60.3		6.0	5.2	12.3	3.9
Progression Factor	1.00		1.79	0.15	1.00	1.00
Incremental Delay, d2	6.1		26.4	0.3	4.6	0.0
Delay (s)	66.4		37.2	1.1	16.9	4.0
Level of Service	E		D	A	B	A
Approach Delay (s)	66.4			2.0	16.8	
Approach LOS	E			A	B	

Intersection Summary			
HCM 2000 Control Delay	15.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	97	54	274	173	57	32	102	752	40	69	2184	52
Future Volume (vph)	97	54	274	173	57	32	102	752	40	69	2184	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.53	1.00	1.00		0.74	1.00	0.04	1.00	1.00	0.32	1.00	1.00
Satd. Flow (perm)	999	3579	1601		2631	1601	79	3579	1601	594	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	59	298	188	62	35	111	817	43	75	2374	57
RTOR Reduction (vph)	0	0	52	0	0	28	0	0	16	0	0	22
Lane Group Flow (vph)	105	59	246	0	250	7	111	817	27	75	2374	35
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	30.7	30.7	30.7		30.7	30.7	104.9	95.4	95.4	97.7	91.8	91.8
Effective Green, g (s)	30.7	30.7	30.7		30.7	30.7	104.9	95.4	95.4	97.7	91.8	91.8
Actuated g/C Ratio	0.20	0.20	0.20		0.20	0.20	0.70	0.64	0.64	0.65	0.61	0.61
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	204	732	327		538	327	163	2276	1018	433	2190	979
v/s Ratio Prot		0.02					c0.04	c0.23		0.01	c0.66	
v/s Ratio Perm	0.11		c0.15		0.10	0.00	0.43		0.02	0.11		0.02
v/c Ratio	0.51	0.08	0.75		0.46	0.02	0.68	0.36	0.03	0.17	1.08	0.04
Uniform Delay, d1	53.0	48.2	56.1		52.4	47.7	45.7	12.9	10.1	9.7	29.1	11.5
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.69	1.65	8.68	0.34	0.78	0.29
Incremental Delay, d2	2.2	0.0	9.4		0.6	0.0	10.3	0.4	0.0	0.1	42.3	0.0
Delay (s)	55.2	48.3	65.5		53.1	47.7	87.3	21.7	87.8	3.4	65.0	3.4
Level of Service	E	D	E		D	D	F	C	F	A	E	A
Approach Delay (s)		61.0			52.4			32.1			61.7	
Approach LOS		E			D			C			E	

Intersection Summary			
HCM 2000 Control Delay	54.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	101.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	15	62	8	250	38	57	4	872	143	91	2461	8
Future Volume (vph)	15	62	8	250	38	57	4	872	143	91	2461	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1843		1789	1883	1601	1789	3579	1601	1789	3577	
Flt Permitted		0.95		0.68	1.00	1.00	0.05	1.00	1.00	0.22	1.00	
Satd. Flow (perm)		1773		1276	1883	1601	86	3579	1601	422	3577	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	67	9	272	41	62	4	948	155	99	2675	9
RTOR Reduction (vph)	0	3	0	0	0	47	0	0	65	0	0	0
Lane Group Flow (vph)	0	89	0	272	41	15	4	948	90	99	2684	0
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4		4	6		6	2		
Actuated Green, G (s)		36.7		36.7	36.7	36.7	88.3	87.3	87.3	101.3	94.3	
Effective Green, g (s)		36.7		36.7	36.7	36.7	88.3	87.3	87.3	101.3	94.3	
Actuated g/C Ratio		0.24		0.24	0.24	0.24	0.59	0.58	0.58	0.68	0.63	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		433		312	460	391	61	2082	931	357	2248	
v/s Ratio Prot					0.02		0.00	0.26		c0.01	c0.75	
v/s Ratio Perm		0.05		c0.21		0.01	0.04		0.06	0.17		
v/c Ratio		0.21		0.87	0.09	0.04	0.07	0.46	0.10	0.28	1.19	
Uniform Delay, d1		45.1		54.4	43.7	43.2	35.9	17.8	13.9	10.7	27.9	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.61	0.41	
Incremental Delay, d2		0.2		22.4	0.1	0.0	0.5	0.7	0.2	0.1	88.5	
Delay (s)		45.3		76.8	43.8	43.2	36.4	18.5	14.1	6.6	99.9	
Level of Service		D		E	D	D	D	B	B	A	F	
Approach Delay (s)		45.3			67.6			18.0			96.6	
Approach LOS		D			E			B			F	

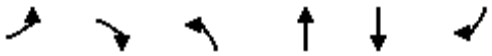
Intersection Summary			
HCM 2000 Control Delay	73.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	106.1%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	11	5	131	5	5	5	79	935	5	5	2683	36
Future Volume (Veh/h)	11	5	131	5	5	5	79	935	5	5	2683	36
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	5	142	5	5	5	86	1016	5	5	2916	39
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.40	0.40	0.40	0.40	0.40		0.40					
vC, conflicting volume	3464	4138	992	2317	4156	341	2955			1021		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1933	3604	0	0	3647	341	672			1021		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	68	0	0	99	77			99		
cM capacity (veh/h)	0	2	438	0	2	655	369			675		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	NE 4	SW 1	SW 2	SW 3	SW 4
Volume Total	159	15	86	406	406	208	5	1166	1166	622
Volume Left	12	5	86	0	0	0	5	0	0	0
Volume Right	142	5	0	0	0	5	0	0	0	39
cSH	0	0	369	1700	1700	1700	675	1700	1700	1700
Volume to Capacity	Err	Err	0.23	0.24	0.24	0.12	0.01	0.69	0.69	0.37
Queue Length 95th (m)	Err	Err	6.8	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Control Delay (s)	Err	Err	17.7	0.0	0.0	0.0	10.4	0.0	0.0	0.0
Lane LOS	F	F	C				B			
Approach Delay (s)	Err	Err	1.4				0.0			
Approach LOS	F	F								

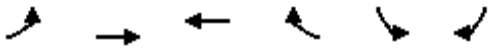
Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	76.3%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	256	160	46	1303	2404	74
Future Volume (vph)	256	160	46	1303	2404	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	5142	5142	1601
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	1789	5142	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	278	174	50	1416	2613	80
RTOR Reduction (vph)	0	71	0	0	0	28
Lane Group Flow (vph)	278	104	50	1416	2613	52
Turn Type	Prot	Perm	Prot	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	26.0	26.0	6.5	82.0	69.5	69.5
Effective Green, g (s)	26.0	26.0	6.5	82.0	69.5	69.5
Actuated g/C Ratio	0.22	0.22	0.05	0.68	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	387	346	96	3513	2978	927
v/s Ratio Prot	c0.16		0.03	c0.28	c0.51	
v/s Ratio Perm		0.06				0.03
v/c Ratio	0.72	0.30	0.52	0.40	0.88	0.06
Uniform Delay, d1	43.6	39.4	55.2	8.3	21.6	11.0
Progression Factor	1.00	1.00	0.67	1.73	0.14	0.00
Incremental Delay, d2	6.3	0.5	4.8	0.3	2.0	0.1
Delay (s)	49.9	39.9	41.6	14.7	5.1	0.1
Level of Service	D	D	D	B	A	A
Approach Delay (s)	46.0			15.6	4.9	
Approach LOS	D			B	A	

Intersection Summary			
HCM 2000 Control Delay	12.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	33	1250	2534	30	99	101
Future Volume (vph)	33	1250	2534	30	99	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	0.91	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1789	5142	5142	1601	1789	1601
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1789	5142	5142	1601	1789	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	36	1359	2754	33	108	110
RTOR Reduction (vph)	0	0	0	9	0	73
Lane Group Flow (vph)	36	1359	2754	24	108	37
Turn Type	Prot	NA	NA	Perm	Prot	Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	3.0	85.4	76.4	76.4	22.6	22.6
Effective Green, g (s)	3.0	85.4	76.4	76.4	22.6	22.6
Actuated g/C Ratio	0.02	0.71	0.64	0.64	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	44	3659	3273	1019	336	301
v/s Ratio Prot	c0.02	0.26	c0.54		c0.06	
v/s Ratio Perm				0.01		0.02
v/c Ratio	0.82	0.37	0.84	0.02	0.32	0.12
Uniform Delay, d1	58.2	6.8	17.1	8.0	42.1	40.5
Progression Factor	0.65	0.52	0.16	0.02	1.00	1.00
Incremental Delay, d2	65.4	0.3	1.5	0.0	0.6	0.2
Delay (s)	103.1	3.8	4.3	0.1	42.6	40.6
Level of Service	F	A	A	A	D	D
Approach Delay (s)		6.3	4.3		41.6	
Approach LOS		A	A		D	

Intersection Summary			
HCM 2000 Control Delay	6.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	80	1099	57	58	2544	33	103	5	259	165	4	81
Future Volume (vph)	80	1099	57	58	2544	33	103	5	259	165	4	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	5142	1601	1789	5142	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.76	1.00	1.00	0.75	1.00	1.00
Satd. Flow (perm)	1789	5142	1601	1789	5142	1601	1422	1883	1601	1421	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	1195	62	63	2765	36	112	5	282	179	4	88
RTOR Reduction (vph)	0	0	32	0	0	15	0	0	112	0	0	71
Lane Group Flow (vph)	87	1195	30	63	2765	21	112	5	170	179	4	17
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4			8	6		6	2		2
Actuated Green, G (s)	10.4	57.3	57.3	21.6	68.5	68.5	23.1	23.1	23.1	23.1	23.1	23.1
Effective Green, g (s)	10.4	57.3	57.3	21.6	68.5	68.5	23.1	23.1	23.1	23.1	23.1	23.1
Actuated g/C Ratio	0.09	0.48	0.48	0.18	0.57	0.57	0.19	0.19	0.19	0.19	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	155	2455	764	322	2935	913	273	362	308	273	362	308
v/s Ratio Prot	0.05	c0.23		0.04	c0.54			0.00			0.00	
v/s Ratio Perm			0.02			0.01	0.08		0.11	c0.13		0.01
v/c Ratio	0.56	0.49	0.04	0.20	0.94	0.02	0.41	0.01	0.55	0.66	0.01	0.05
Uniform Delay, d1	52.6	21.3	16.7	41.8	23.9	11.2	42.5	39.2	43.8	44.8	39.2	39.5
Progression Factor	1.00	1.00	1.00	0.43	0.22	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.6	0.7	0.1	0.2	4.9	0.0	1.0	0.0	2.1	5.6	0.0	0.1
Delay (s)	57.2	22.0	16.8	18.1	10.1	11.2	43.5	39.2	45.9	50.3	39.2	39.6
Level of Service	E	C	B	B	B	B	D	D	D	D	D	D
Approach Delay (s)		24.1			10.2			45.1			46.7	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	18.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.3%	ICU Level of Service	E
Analysis Period (min)	15		

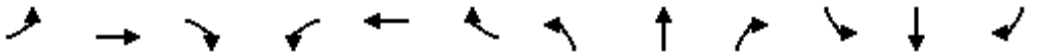
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	96	49	271	186	26	74
Future Volume (Veh/h)	96	49	271	186	26	74
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	53	295	202	28	80
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			157		922	130
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			157		922	130
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			79		88	91
cM capacity (veh/h)			1423		238	919

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	157	497	108
Volume Left	0	295	28
Volume Right	53	0	80
cSH	1700	1423	527
Volume to Capacity	0.09	0.21	0.20
Queue Length 95th (m)	0.0	5.9	5.8
Control Delay (s)	0.0	5.6	13.6
Lane LOS		A	B
Approach Delay (s)	0.0	5.6	13.6
Approach LOS			B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	48.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	34	49	274	103	152	255	1228	76	48	2155	210
Future Volume (vph)	56	34	49	274	103	152	255	1228	76	48	2155	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	3471	5142	1601	1789	5142	1601
Flt Permitted	0.68	1.00	1.00	0.73	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1290	1883	1601	1381	1883	1601	3471	5142	1601	1789	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	37	53	298	112	165	277	1335	83	52	2342	228
RTOR Reduction (vph)	0	0	39	0	0	121	0	0	39	0	0	99
Lane Group Flow (vph)	61	37	14	298	112	44	277	1335	44	52	2342	129
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	31.7	31.7	31.7	31.7	31.7	31.7	11.2	63.2	63.2	7.1	59.1	59.1
Effective Green, g (s)	31.7	31.7	31.7	31.7	31.7	31.7	11.2	63.2	63.2	7.1	59.1	59.1
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26	0.26	0.09	0.53	0.53	0.06	0.49	0.49
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	340	497	422	364	497	422	323	2708	843	105	2532	788
v/s Ratio Prot		0.02			0.06		c0.08	0.26		0.03	c0.46	
v/s Ratio Perm	0.05		0.01	c0.22		0.03			0.03			0.08
v/c Ratio	0.18	0.07	0.03	0.82	0.23	0.10	0.86	0.49	0.05	0.50	0.92	0.16
Uniform Delay, d1	34.1	33.1	32.8	41.5	34.5	33.4	53.6	18.2	13.8	54.7	28.4	16.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.35	0.08	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.1	0.0	13.4	0.2	0.1	18.4	0.6	0.1	3.6	7.2	0.4
Delay (s)	34.4	33.2	32.8	54.8	34.8	33.5	60.4	6.9	1.2	58.4	35.6	17.2
Level of Service	C	C	C	D	C	C	E	A	A	E	D	B
Approach Delay (s)		33.5			44.8			15.4			34.5	
Approach LOS		C			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	29.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.8%	ICU Level of Service	E
Analysis Period (min)	15		

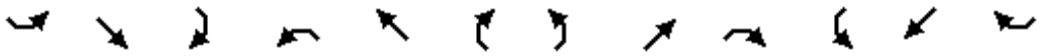
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	30	71	101	2169	1322	41
Future Volume (vph)	30	71	101	2169	1322	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	1.00		1.00	0.95	0.95	1.00
Frt	0.91		1.00	1.00	1.00	0.85
Flt Protected	0.99		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1680		1789	3579	3579	1601
Flt Permitted	0.99		0.16	1.00	1.00	1.00
Satd. Flow (perm)	1680		306	3579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	77	110	2358	1437	45
RTOR Reduction (vph)	63	0	0	0	0	7
Lane Group Flow (vph)	47	0	110	2358	1437	38
Turn Type	Prot		Perm	NA	NA	Perm
Protected Phases	3			6	2	
Permitted Phases			6			2
Actuated Green, G (s)	16.6		121.4	121.4	121.4	121.4
Effective Green, g (s)	16.6		121.4	121.4	121.4	121.4
Actuated g/C Ratio	0.11		0.81	0.81	0.81	0.81
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	185		247	2896	2896	1295
v/s Ratio Prot	c0.03			c0.66	0.40	
v/s Ratio Perm			0.36			0.02
v/c Ratio	0.25		0.45	0.81	0.50	0.03
Uniform Delay, d1	61.0		4.3	8.0	4.6	2.8
Progression Factor	1.00		0.15	0.60	1.00	1.00
Incremental Delay, d2	0.7		1.8	0.8	0.6	0.0
Delay (s)	61.8		2.4	5.6	5.2	2.8
Level of Service	E		A	A	A	A
Approach Delay (s)	61.8			5.5	5.1	
Approach LOS	E			A	A	

Intersection Summary			
HCM 2000 Control Delay	6.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		

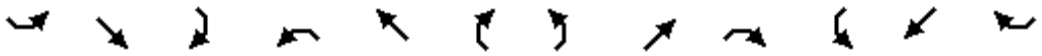
c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	67	83	102	195	71	35	219	2103	215	85	1270	38
Future Volume (vph)	67	83	102	195	71	35	219	2103	215	85	1270	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.70	1.00	1.00	0.70	1.00	1.00	0.09	1.00	1.00	0.05	1.00	1.00
Satd. Flow (perm)	1327	3579	1601	1310	3579	1601	178	3579	1601	91	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	73	90	111	212	77	38	238	2286	234	92	1380	41
RTOR Reduction (vph)	0	0	88	0	0	30	0	0	42	0	0	18
Lane Group Flow (vph)	73	90	23	212	77	8	238	2286	192	92	1380	23
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	31.7	31.7	31.7	31.7	31.7	31.7	106.3	93.2	93.2	89.5	82.4	82.4
Effective Green, g (s)	31.7	31.7	31.7	31.7	31.7	31.7	106.3	93.2	93.2	89.5	82.4	82.4
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.21	0.21	0.71	0.62	0.62	0.60	0.55	0.55
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	280	756	338	276	756	338	318	2223	994	134	1966	879
v/s Ratio Prot		0.03			0.02		c0.09	c0.64		0.03	0.39	
v/s Ratio Perm	0.06		0.01	c0.16		0.01	0.44		0.12	0.37		0.01
v/c Ratio	0.26	0.12	0.07	0.77	0.10	0.02	0.75	1.03	0.19	0.69	0.70	0.03
Uniform Delay, d1	49.4	47.9	47.3	55.7	47.7	46.9	31.7	28.4	12.2	34.6	24.8	15.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.73	0.74	1.34	1.22	0.79	1.00
Incremental Delay, d2	0.5	0.1	0.1	12.1	0.1	0.0	0.9	15.0	0.0	12.2	1.9	0.0
Delay (s)	49.9	47.9	47.4	67.8	47.7	46.9	55.8	36.2	16.4	54.5	21.6	15.5
Level of Service	D	D	D	E	D	D	E	D	B	D	C	B
Approach Delay (s)		48.2			60.6			36.2			23.4	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM 2000 Control Delay	34.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	32	49	5	135	18	49	18	2488	142	49	1613	5
Future Volume (vph)	32	49	5	135	18	49	18	2488	142	49	1613	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1835		1789	1883	1601	1789	3579	1601	1789	3577	
Flt Permitted		0.88		0.67	1.00	1.00	0.06	1.00	1.00	0.04	1.00	
Satd. Flow (perm)		1654		1261	1883	1601	111	3579	1601	80	3577	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	35	53	5	147	20	53	20	2704	154	53	1753	5
RTOR Reduction (vph)	0	2	0	0	0	43	0	0	23	0	0	0
Lane Group Flow (vph)	0	91	0	147	20	10	20	2704	131	53	1758	0
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4		4	6		6	2		
Actuated Green, G (s)		28.9		28.9	28.9	28.9	97.9	97.9	97.9	99.9	99.9	
Effective Green, g (s)		28.9		28.9	28.9	28.9	97.9	97.9	97.9	99.9	99.9	
Actuated g/C Ratio		0.19		0.19	0.19	0.19	0.65	0.65	0.65	0.67	0.67	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		318		242	362	308	108	2335	1044	112	2382	
v/s Ratio Prot					0.01		0.00	c0.76		0.02	c0.49	
v/s Ratio Perm		0.06		c0.12		0.01	0.12		0.08	0.30		
v/c Ratio		0.29		0.61	0.06	0.03	0.19	1.16	0.13	0.47	0.74	
Uniform Delay, d1		51.7		55.4	49.4	49.2	19.3	26.0	9.9	67.0	16.5	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.81	0.73	
Incremental Delay, d2		0.5		4.3	0.1	0.0	0.8	76.4	0.2	2.5	1.7	
Delay (s)		52.3		59.6	49.5	49.2	20.2	102.4	10.1	57.0	13.7	
Level of Service		D		E	D	D	C	F	B	E	B	
Approach Delay (s)		52.3			56.2			96.9			15.0	
Approach LOS		D			E			F			B	

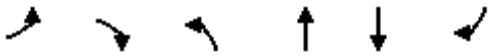
Intersection Summary			
HCM 2000 Control Delay	64.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	34	5	129	5	5	5	103	2632	5	5	1695	65
Future Volume (Veh/h)	34	5	129	5	5	5	103	2632	5	5	1695	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	5	140	5	5	5	112	2861	5	5	1842	71
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.71	0.71	0.71	0.71	0.71		0.71					
vC, conflicting volume	3073	4978	650	3854	5010	956	1913			2866		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2480	5176	0	3586	5223	956	838			2866		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	82	0	0	98	80			96		
cM capacity (veh/h)	0	0	766	0	0	258	559			128		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	NE 4	SW 1	SW 2	SW 3	SW 4
Volume Total	182	15	112	1144	1144	577	5	737	737	439
Volume Left	37	5	112	0	0	0	5	0	0	0
Volume Right	140	5	0	0	0	5	0	0	0	71
cSH	0	0	559	1700	1700	1700	128	1700	1700	1700
Volume to Capacity	Err	Err	0.20	0.67	0.67	0.34	0.04	0.43	0.43	0.26
Queue Length 95th (m)	Err	Err	5.6	0.0	0.0	0.0	0.9	0.0	0.0	0.0
Control Delay (s)	Err	Err	13.0	0.0	0.0	0.0	34.3	0.0	0.0	0.0
Lane LOS	F	F	B				D			
Approach Delay (s)	Err	Err	0.5				0.1			
Approach LOS	F	F								

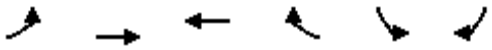
Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	75.9%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	152	95	170	2669	1832	272
Future Volume (vph)	152	95	170	2669	1832	272
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	5142	5142	1601
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	1789	5142	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	103	185	2901	1991	296
RTOR Reduction (vph)	0	83	0	0	0	128
Lane Group Flow (vph)	165	20	185	2901	1991	168
Turn Type	Prot	Perm	Prot	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	25.1	25.1	16.1	92.9	70.8	70.8
Effective Green, g (s)	25.1	25.1	16.1	92.9	70.8	70.8
Actuated g/C Ratio	0.19	0.19	0.12	0.71	0.54	0.54
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	345	309	221	3674	2800	871
v/s Ratio Prot	c0.09		0.10	c0.56	0.39	
v/s Ratio Perm		0.01				0.11
v/c Ratio	0.48	0.06	0.84	0.79	0.71	0.19
Uniform Delay, d1	46.6	42.9	55.7	12.1	22.0	15.1
Progression Factor	1.00	1.00	0.80	0.53	0.44	0.18
Incremental Delay, d2	1.0	0.1	15.3	1.1	1.3	0.4
Delay (s)	47.7	42.9	59.7	7.5	10.9	3.2
Level of Service	D	D	E	A	B	A
Approach Delay (s)	45.9			10.7	9.9	
Approach LOS	D			B	A	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.0%	ICU Level of Service	C
Analysis Period (min)	15		

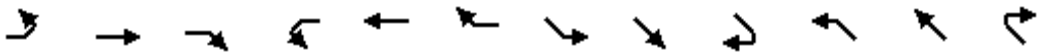
c Critical Lane Group



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	109	2778	1820	107	61	63
Future Volume (vph)	109	2778	1820	107	61	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	0.91	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1789	5142	5142	1601	1789	1601
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1789	5142	5142	1601	1789	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	118	3020	1978	116	66	68
RTOR Reduction (vph)	0	0	0	45	0	57
Lane Group Flow (vph)	118	3020	1978	71	66	11
Turn Type	Prot	NA	NA	Perm	Prot	Perm
Protected Phases	7	4	8		6	
Permitted Phases				8		6
Actuated Green, G (s)	11.9	96.6	78.7	78.7	21.4	21.4
Effective Green, g (s)	11.9	96.6	78.7	78.7	21.4	21.4
Actuated g/C Ratio	0.09	0.74	0.61	0.61	0.16	0.16
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	163	3820	3112	969	294	263
v/s Ratio Prot	0.07	c0.59	0.38		c0.04	
v/s Ratio Perm				0.04		0.01
v/c Ratio	0.72	0.79	0.64	0.07	0.22	0.04
Uniform Delay, d1	57.5	10.4	16.5	10.6	47.1	45.7
Progression Factor	1.16	0.75	0.32	0.28	1.00	1.00
Incremental Delay, d2	5.3	0.6	0.7	0.1	0.4	0.1
Delay (s)	72.3	8.4	6.1	3.1	47.5	45.7
Level of Service	E	A	A	A	D	D
Approach Delay (s)		10.8	5.9		46.6	
Approach LOS		B	A		D	

Intersection Summary			
HCM 2000 Control Delay	9.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	279	2775	197	80	1694	109	65	6	154	105	5	49
Future Volume (vph)	279	2775	197	80	1694	109	65	6	154	105	5	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	5142	1601	1789	5142	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.75	1.00	1.00	0.75	1.00	1.00
Satd. Flow (perm)	1789	5142	1601	1789	5142	1601	1421	1883	1601	1418	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	303	3016	214	87	1841	118	71	7	167	114	5	53
RTOR Reduction (vph)	0	0	32	0	0	42	0	0	136	0	0	43
Lane Group Flow (vph)	303	3016	182	87	1841	76	71	7	31	114	5	10
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4			8	6		6	2		2
Actuated Green, G (s)	30.0	78.2	78.2	9.7	57.9	57.9	24.1	24.1	24.1	24.1	24.1	24.1
Effective Green, g (s)	30.0	78.2	78.2	9.7	57.9	57.9	24.1	24.1	24.1	24.1	24.1	24.1
Actuated g/C Ratio	0.23	0.60	0.60	0.07	0.45	0.45	0.19	0.19	0.19	0.19	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	412	3093	963	133	2290	713	263	349	296	262	349	296
v/s Ratio Prot	0.17	c0.59		0.05	c0.36			0.00			0.00	
v/s Ratio Perm			0.11			0.05	0.05		0.02	c0.08		0.01
v/c Ratio	0.74	0.98	0.19	0.65	0.80	0.11	0.27	0.02	0.10	0.44	0.01	0.03
Uniform Delay, d1	46.3	25.0	11.6	58.5	31.1	21.0	45.4	43.3	44.0	46.9	43.2	43.4
Progression Factor	1.00	1.00	1.00	1.01	0.48	0.37	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.7	11.3	0.4	8.8	2.5	0.2	0.6	0.0	0.2	1.2	0.0	0.0
Delay (s)	53.0	36.3	12.1	68.1	17.5	8.0	46.0	43.3	44.1	48.1	43.3	43.4
Level of Service	D	D	B	E	B	A	D	D	D	D	D	D
Approach Delay (s)		36.3			19.1			44.6			46.5	
Approach LOS		D			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	31.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.5%	ICU Level of Service	E
Analysis Period (min)	15		

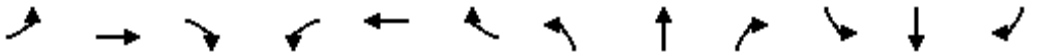
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	244	28	77	142	41	288
Future Volume (Veh/h)	244	28	77	142	41	288
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	265	30	84	154	45	313
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			295		602	280
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			295		602	280
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		90	59
cM capacity (veh/h)			1266		432	759

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	295	238	358
Volume Left	0	84	45
Volume Right	30	0	313
cSH	1700	1266	693
Volume to Capacity	0.17	0.07	0.52
Queue Length 95th (m)	0.0	1.6	22.7
Control Delay (s)	0.0	3.2	15.6
Lane LOS		A	C
Approach Delay (s)	0.0	3.2	15.6
Approach LOS			C

Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	56.3%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	180	109	240	156	63	92	58	2467	296	161	1708	56
Future Volume (vph)	180	109	240	156	63	92	58	2467	296	161	1708	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	3471	5142	1601	1789	5142	1601
Flt Permitted	0.71	1.00	1.00	0.65	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1342	1883	1601	1233	1883	1601	3471	5142	1601	1789	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	118	261	170	68	100	63	2682	322	175	1857	61
RTOR Reduction (vph)	0	0	98	0	0	78	0	0	62	0	0	28
Lane Group Flow (vph)	196	118	163	170	68	22	63	2682	260	175	1857	33
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	28.7	28.7	28.7	28.7	28.7	28.7	13.4	65.9	65.9	17.4	69.9	69.9
Effective Green, g (s)	28.7	28.7	28.7	28.7	28.7	28.7	13.4	65.9	65.9	17.4	69.9	69.9
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22	0.22	0.10	0.51	0.51	0.13	0.54	0.54
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	296	415	353	272	415	353	357	2606	811	239	2764	860
v/s Ratio Prot		0.06			0.04		0.02	c0.52		0.10	c0.36	
v/s Ratio Perm	c0.15		0.10	0.14		0.01			0.16			0.02
v/c Ratio	0.66	0.28	0.46	0.62	0.16	0.06	0.18	1.03	0.32	0.73	0.67	0.04
Uniform Delay, d1	46.2	42.1	43.9	45.8	40.9	40.0	53.3	32.0	18.9	54.1	21.7	14.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.85	0.67	0.76	1.00	1.00	1.00
Incremental Delay, d2	5.5	0.4	1.0	4.4	0.2	0.1	0.1	22.1	0.7	11.0	1.3	0.1
Delay (s)	51.7	42.5	44.9	50.2	41.1	40.1	45.6	43.7	15.1	65.0	23.1	14.3
Level of Service	D	D	D	D	D	D	D	D	B	E	C	B
Approach Delay (s)		46.7			45.4			40.8			26.3	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	36.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	88.2%	ICU Level of Service	E
Analysis Period (min)	15		

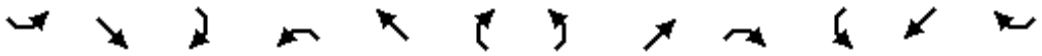
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	176	176	43	595	1464	56
Future Volume (vph)	176	176	43	595	1464	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	
Lane Util. Factor	1.00		1.00	0.95	0.95	
Frt	0.93		1.00	1.00	0.99	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1713		1789	3579	3559	
Flt Permitted	0.98		0.09	1.00	1.00	
Satd. Flow (perm)	1713		167	3579	3559	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	191	191	47	647	1591	61
RTOR Reduction (vph)	28	0	0	0	2	0
Lane Group Flow (vph)	354	0	47	647	1650	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	28.7		79.3	79.3	79.3	
Effective Green, g (s)	28.7		79.3	79.3	79.3	
Actuated g/C Ratio	0.24		0.66	0.66	0.66	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	409		110	2365	2351	
v/s Ratio Prot	c0.21			0.18	c0.46	
v/s Ratio Perm			0.28			
v/c Ratio	0.87		0.43	0.27	0.70	
Uniform Delay, d1	43.8		9.6	8.4	12.9	
Progression Factor	1.00		1.48	0.91	1.00	
Incremental Delay, d2	17.1		11.3	0.3	1.8	
Delay (s)	60.9		25.5	8.0	14.7	
Level of Service	E		C	A	B	
Approach Delay (s)	60.9			9.2	14.7	
Approach LOS	E			A	B	

Intersection Summary			
HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	97	54	485	173	57	32	167	544	40	69	1473	52
Future Volume (vph)	97	54	485	173	57	32	167	544	40	69	1473	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.59	1.00	1.00		0.73	1.00	0.06	1.00	1.00	0.42	1.00	1.00
Satd. Flow (perm)	1102	3579	1601		2625	1601	120	3579	1601	798	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	105	59	527	188	62	35	182	591	43	75	1601	57
RTOR Reduction (vph)	0	0	68	0	0	25	0	0	21	0	0	30
Lane Group Flow (vph)	105	59	459	0	250	10	182	591	22	75	1601	27
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	35.3	35.3	35.3		35.3	35.3	72.0	62.7	62.7	61.4	57.4	57.4
Effective Green, g (s)	35.3	35.3	35.3		35.3	35.3	72.0	62.7	62.7	61.4	57.4	57.4
Actuated g/C Ratio	0.29	0.29	0.29		0.29	0.29	0.60	0.52	0.52	0.51	0.48	0.48
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	324	1052	470		772	470	201	1870	836	441	1711	765
v/s Ratio Prot		0.02					c0.07	0.17		0.01	0.45	
v/s Ratio Perm	0.10		c0.29		0.10	0.01	c0.47		0.01	0.08		0.02
v/c Ratio	0.32	0.06	0.98		0.32	0.02	0.91	0.32	0.03	0.17	0.94	0.04
Uniform Delay, d1	33.0	30.4	41.9		33.0	30.1	35.3	16.4	13.9	14.9	29.6	16.6
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.28	1.37	13.74	0.60	0.80	0.19
Incremental Delay, d2	0.6	0.0	34.9		0.2	0.0	36.5	0.4	0.1	0.1	8.2	0.1
Delay (s)	33.6	30.4	76.8		33.3	30.1	81.8	22.8	190.7	9.1	31.8	3.3
Level of Service	C	C	E		C	C	F	C	F	A	C	A
Approach Delay (s)		66.3			32.9			44.8			29.9	
Approach LOS		E			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	40.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	26	62	15	250	38	57	6	718	143	91	1957	12
Future Volume (vph)	26	62	15	250	38	57	6	718	143	91	1957	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.98		1.00	1.00	0.85	1.00	0.98		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1824		1789	1883	1601	1789	3490		1789	3575	
Flt Permitted		0.92		0.67	1.00	1.00	0.05	1.00		0.27	1.00	
Satd. Flow (perm)		1707		1265	1883	1601	96	3490		505	3575	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	28	67	16	272	41	62	7	780	155	99	2127	13
RTOR Reduction (vph)	0	5	0	0	0	47	0	12	0	0	0	0
Lane Group Flow (vph)	0	106	0	272	41	15	7	923	0	99	2140	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		29.7		29.7	29.7	29.7	78.3	78.3		78.3	78.3	
Effective Green, g (s)		29.7		29.7	29.7	29.7	78.3	78.3		78.3	78.3	
Actuated g/C Ratio		0.25		0.25	0.25	0.25	0.65	0.65		0.65	0.65	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		422		313	466	396	62	2277		329	2332	
v/s Ratio Prot					0.02			0.26			c0.60	
v/s Ratio Perm		0.06		c0.21		0.01	0.07			0.20		
v/c Ratio		0.25		0.87	0.09	0.04	0.11	0.41		0.30	0.92	
Uniform Delay, d1		36.2		43.3	34.7	34.3	7.8	9.9		9.0	18.1	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		0.77	0.58	
Incremental Delay, d2		0.3		21.7	0.1	0.0	3.7	0.5		1.0	3.4	
Delay (s)		36.5		64.9	34.8	34.3	11.5	10.4		8.0	13.9	
Level of Service		D		E	C	C	B	B		A	B	
Approach Delay (s)		36.5			56.6			10.4			13.7	
Approach LOS		D			E			B			B	

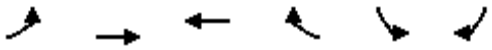
Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	8	5	132	5	5	5	105	786	5	5	2157	65
Future Volume (Veh/h)	8	5	132	5	5	5	105	786	5	5	2157	65
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	5	143	5	5	5	114	854	5	5	2345	71
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.37	0.37	0.37	0.37	0.37		0.37					
vC, conflicting volume	3053	3478	1208	2412	3510	430	2416			859		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3145	4304	0	1396	4394	430	1406			859		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	64	0	0	99	35			99		
cM capacity (veh/h)	0	0	397	0	0	574	176			778		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	157	15	114	569	290	5	1563	853
Volume Left	9	5	114	0	0	5	0	0
Volume Right	143	5	0	0	5	0	0	71
cSH	0	0	176	1700	1700	778	1700	1700
Volume to Capacity	Err	Err	0.65	0.33	0.17	0.01	0.92	0.50
Queue Length 95th (m)	Err	Err	28.2	0.0	0.0	0.1	0.0	0.0
Control Delay (s)	Err	Err	56.6	0.0	0.0	9.7	0.0	0.0
Lane LOS	F	F	F			A		
Approach Delay (s)	Err	Err	6.6			0.0		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	86.6%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	633	1413	5	5	11
Future Volume (Veh/h)	7	633	1413	5	5	11
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	688	1536	5	5	12
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1541				1898	770
vC1, stage 1 conf vol					1538	
vC2, stage 2 conf vol					360	
vCu, unblocked vol	1541				1898	770
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	98				96	97
cM capacity (veh/h)	427				135	343

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	8	344	344	1024	517	17
Volume Left	8	0	0	0	0	5
Volume Right	0	0	0	0	5	12
cSH	427	1700	1700	1700	1700	236
Volume to Capacity	0.02	0.20	0.20	0.60	0.30	0.07
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	1.8
Control Delay (s)	13.6	0.0	0.0	0.0	0.0	21.4
Lane LOS	B					C
Approach Delay (s)	0.2			0.0		21.4
Approach LOS						C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	49.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	6	554	57	59	1362	5	5	5	5	165	5	85
Future Volume (vph)	6	554	57	59	1362	5	5	5	5	165	5	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.99		1.00	1.00			0.95			0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.97	
Satd. Flow (prot)	1789	3528		1789	3577			1769			1742	
Flt Permitted	0.95	1.00		0.95	1.00			0.89			0.80	
Satd. Flow (perm)	1789	3528		1789	3577			1601			1430	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	602	62	64	1480	5	5	5	5	179	5	92
RTOR Reduction (vph)	0	7	0	0	0	0	0	4	0	0	20	0
Lane Group Flow (vph)	7	657	0	64	1485	0	0	11	0	0	256	0
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			6			2	
Permitted Phases							6			2		
Actuated Green, G (s)	0.7	33.8		6.3	39.4			19.1			19.1	
Effective Green, g (s)	0.7	33.8		6.3	39.4			19.1			19.1	
Actuated g/C Ratio	0.01	0.44		0.08	0.51			0.25			0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	16	1544		145	1825			396			353	
v/s Ratio Prot	0.00	0.19		c0.04	c0.42							
v/s Ratio Perm								0.01			c0.18	
v/c Ratio	0.44	0.43		0.44	0.81			0.03			0.72	
Uniform Delay, d1	38.1	15.0		33.8	15.8			22.0			26.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	18.0	0.2		2.1	2.9			0.0			7.2	
Delay (s)	56.0	15.2		35.9	18.7			22.0			33.8	
Level of Service	E	B		D	B			C			C	
Approach Delay (s)		15.6			19.4			22.0			33.8	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	20.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	77.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		

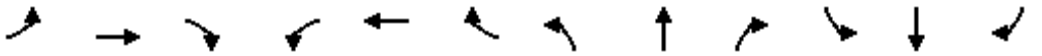
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	112	92	271	192	39	74
Future Volume (Veh/h)	112	92	271	192	39	74
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	122	100	295	209	42	80
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			222		971	172
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			222		971	172
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			78		81	91
cM capacity (veh/h)			1347		219	872

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	222	504	122
Volume Left	0	295	42
Volume Right	100	0	80
cSH	1700	1347	430
Volume to Capacity	0.13	0.22	0.28
Queue Length 95th (m)	0.0	6.4	8.8
Control Delay (s)	0.0	5.8	16.6
Lane LOS		A	C
Approach Delay (s)	0.0	5.8	16.6
Approach LOS			C

Intersection Summary			
Average Delay	5.8		
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	34	9	16	67	20	27	77	543	16	11	1332	91
Future Volume (vph)	34	9	16	67	20	27	77	543	16	11	1332	91
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frt		0.96			0.97		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.97			0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1765			1772		1789	3564		1789	3579	1601
Flt Permitted		0.78			0.78		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1424			1427		1789	3564		1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	10	17	73	22	29	84	590	17	12	1448	99
RTOR Reduction (vph)	0	14	0	0	13	0	0	2	0	0	0	44
Lane Group Flow (vph)	0	50	0	0	111	0	84	605	0	12	1448	55
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		13.8			13.8		6.1	52.1		0.8	46.8	46.8
Effective Green, g (s)		13.8			13.8		6.1	52.1		0.8	46.8	46.8
Actuated g/C Ratio		0.16			0.16		0.07	0.62		0.01	0.55	0.55
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		232			232		128	2192		16	1977	884
v/s Ratio Prot							c0.05	c0.17		0.01	c0.40	
v/s Ratio Perm		0.03			c0.08							0.03
v/c Ratio		0.21			0.48		0.66	0.28		0.75	0.73	0.06
Uniform Delay, d1		30.7			32.2		38.3	7.6		41.9	14.2	8.8
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		0.5			1.5		11.5	0.1		106.0	1.4	0.0
Delay (s)		31.2			33.7		49.8	7.6		147.9	15.7	8.8
Level of Service		C			C		D	A		F	B	A
Approach Delay (s)		31.2			33.7			12.8			16.3	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	84.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		

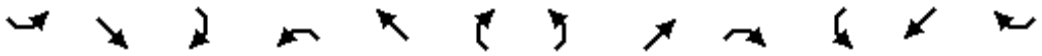
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	105	116	179	1324	849	174
Future Volume (vph)	105	116	179	1324	849	174
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	
Lane Util. Factor	1.00		1.00	0.95	0.95	
Frt	0.93		1.00	1.00	0.97	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1709		1789	3579	3487	
Flt Permitted	0.98		0.23	1.00	1.00	
Satd. Flow (perm)	1709		430	3579	3487	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	114	126	195	1439	923	189
RTOR Reduction (vph)	37	0	0	0	11	0
Lane Group Flow (vph)	203	0	195	1439	1101	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	20.2		87.8	87.8	87.8	
Effective Green, g (s)	20.2		87.8	87.8	87.8	
Actuated g/C Ratio	0.17		0.73	0.73	0.73	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	287		314	2618	2551	
v/s Ratio Prot	c0.12			0.40	0.32	
v/s Ratio Perm			c0.45			
v/c Ratio	0.71		0.62	0.55	0.43	
Uniform Delay, d1	47.1		7.9	7.2	6.3	
Progression Factor	1.00		0.60	0.30	1.00	
Incremental Delay, d2	7.7		7.3	0.7	0.5	
Delay (s)	54.8		12.0	2.9	6.8	
Level of Service	D		B	A	A	
Approach Delay (s)	54.8			3.9	6.8	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	9.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	67	83	233	195	71	35	449	1336	215	85	842	38
Future Volume (vph)	67	83	233	195	71	35	449	1336	215	85	842	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3452	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.49	1.00	1.00		0.73	1.00	0.17	1.00	1.00	0.18	1.00	1.00
Satd. Flow (perm)	917	3579	1601		2608	1601	311	3579	1601	330	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	73	90	253	212	77	38	488	1452	234	92	915	41
RTOR Reduction (vph)	0	0	209	0	0	31	0	0	73	0	0	24
Lane Group Flow (vph)	73	90	44	0	289	7	488	1452	161	92	915	17
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	20.7	20.7	20.7		20.7	20.7	87.3	74.7	74.7	55.7	49.1	49.1
Effective Green, g (s)	20.7	20.7	20.7		20.7	20.7	87.3	74.7	74.7	55.7	49.1	49.1
Actuated g/C Ratio	0.17	0.17	0.17		0.17	0.17	0.73	0.62	0.62	0.46	0.41	0.41
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	617	276		449	276	622	2227	996	233	1464	655
v/s Ratio Prot		0.03					c0.21	0.41		0.02	0.26	
v/s Ratio Perm	0.08		0.03		c0.11	0.00	c0.36		0.10	0.16		0.01
v/c Ratio	0.46	0.15	0.16		0.94dl	0.02	0.78	0.65	0.16	0.39	0.62	0.03
Uniform Delay, d1	44.6	42.1	42.2		46.2	41.3	22.6	14.4	9.5	18.2	28.1	21.2
Progression Factor	1.00	1.00	1.00		1.00	1.00	0.72	0.75	0.85	0.81	0.82	1.00
Incremental Delay, d2	2.1	0.1	0.3		3.2	0.0	3.3	0.8	0.2	1.0	1.9	0.1
Delay (s)	46.8	42.3	42.5		49.4	41.3	19.5	11.5	8.2	15.8	25.0	21.2
Level of Service	D	D	D		D	D	B	B	A	B	C	C
Approach Delay (s)		43.2			48.4			12.9			24.1	
Approach LOS		D			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		

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

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	38	49	9	135	18	49	22	1945	142	49	1300	17
Future Volume (vph)	38	49	9	135	18	49	22	1945	142	49	1300	17
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1823		1789	1883	1601	1789	3542		1789	3572	
Flt Permitted		0.87		0.67	1.00	1.00	0.15	1.00		0.05	1.00	
Satd. Flow (perm)		1619		1260	1883	1601	279	3542		86	3572	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	53	10	147	20	53	24	2114	154	53	1413	18
RTOR Reduction (vph)	0	4	0	0	0	22	0	3	0	0	1	0
Lane Group Flow (vph)	0	100	0	147	20	31	24	2265	0	53	1430	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		20.9		20.9	20.9	20.9	87.1	87.1		87.1	87.1	
Effective Green, g (s)		20.9		20.9	20.9	20.9	87.1	87.1		87.1	87.1	
Actuated g/C Ratio		0.17		0.17	0.17	0.17	0.73	0.73		0.73	0.73	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		281		219	327	278	202	2570		62	2592	
v/s Ratio Prot					0.01			c0.64			0.40	
v/s Ratio Perm		0.06		c0.12		0.02	0.09			0.61		
v/c Ratio		0.36		0.67	0.06	0.11	0.12	0.88		0.85	0.55	
Uniform Delay, d1		43.6		46.3	41.4	41.7	4.9	12.5		11.9	7.5	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		0.73	0.58	
Incremental Delay, d2		0.8		7.8	0.1	0.2	1.2	4.8		71.3	0.7	
Delay (s)		44.4		54.2	41.4	41.9	6.1	17.3		80.0	5.1	
Level of Service		D		D	D	D	A	B		E	A	
Approach Delay (s)		44.4			50.1			17.2			7.8	
Approach LOS		D			D			B			A	

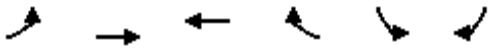
Intersection Summary			
HCM 2000 Control Delay	16.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	33	5	130	5	5	5	156	2094	5	5	1363	88
Future Volume (Veh/h)	33	5	130	5	5	5	156	2094	5	5	1363	88
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	5	141	5	5	5	170	2276	5	5	1482	96
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.81	0.81	0.81	0.81	0.81		0.81					
vC, conflicting volume	3026	4161	789	3513	4206	1140	1578			2281		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3032	4440	258	3636	4497	1140	1236			2281		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	76	0	0	97	62			98		
cM capacity (veh/h)	0	1	598	0	1	194	451			219		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	182	15	170	1517	764	5	988	590
Volume Left	36	5	170	0	0	5	0	0
Volume Right	141	5	0	0	5	0	0	96
cSH	0	0	451	1700	1700	219	1700	1700
Volume to Capacity	Err	Err	0.38	0.89	0.45	0.02	0.58	0.35
Queue Length 95th (m)	Err	Err	13.2	0.0	0.0	0.5	0.0	0.0
Control Delay (s)	Err	Err	17.7	0.0	0.0	21.8	0.0	0.0
Lane LOS	F	F	C			C		
Approach Delay (s)	Err	Err	1.2			0.1		
Approach LOS	F	F						

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	82.9%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	14	1615	957	5	5	10
Future Volume (Veh/h)	14	1615	957	5	5	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	1755	1040	5	5	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		Raised	Raised			
Median storage veh)		1	1			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1045				1950	522
vC1, stage 1 conf vol					1042	
vC2, stage 2 conf vol					908	
vCu, unblocked vol	1045				1950	522
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)	2.2				3.5	3.3
p0 queue free %	98				97	98
cM capacity (veh/h)	661				172	499

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	SB 1
Volume Total	15	878	878	693	352	16
Volume Left	15	0	0	0	0	5
Volume Right	0	0	0	0	5	11
cSH	661	1700	1700	1700	1700	313
Volume to Capacity	0.02	0.52	0.52	0.41	0.21	0.05
Queue Length 95th (m)	0.5	0.0	0.0	0.0	0.0	1.2
Control Delay (s)	10.6	0.0	0.0	0.0	0.0	17.1
Lane LOS	B					C
Approach Delay (s)	0.1			0.0		17.1
Approach LOS						C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	7	1565	197	103	864	5	5	5	5	105	5	62
Future Volume (vph)	7	1565	197	103	864	5	5	5	5	105	5	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	
Frt	1.00	0.98		1.00	1.00			0.95			0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.98			0.97	
Satd. Flow (prot)	1789	3519		1789	3576			1769			1739	
Flt Permitted	0.95	1.00		0.95	1.00			0.92			0.80	
Satd. Flow (perm)	1789	3519		1789	3576			1649			1441	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	1701	214	112	939	5	5	5	5	114	5	67
RTOR Reduction (vph)	0	6	0	0	0	0	0	4	0	0	19	0
Lane Group Flow (vph)	8	1909	0	112	944	0	0	11	0	0	167	0
Turn Type	Prot	NA		Prot	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			6			2	
Permitted Phases							6			2		
Actuated Green, G (s)	0.9	66.4		8.0	73.5			18.4			18.4	
Effective Green, g (s)	0.9	66.4		8.0	73.5			18.4			18.4	
Actuated g/C Ratio	0.01	0.60		0.07	0.66			0.17			0.17	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0			6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	14	2108		129	2372			273			239	
v/s Ratio Prot	0.00	c0.54		c0.06	0.26							
v/s Ratio Perm								0.01			c0.12	
v/c Ratio	0.57	0.91		0.87	0.40			0.04			0.70	
Uniform Delay, d1	54.8	19.4		50.9	8.5			38.8			43.6	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	46.0	6.0		41.8	0.1			0.1			8.6	
Delay (s)	100.7	25.5		92.7	8.6			38.8			52.2	
Level of Service	F	C		F	A			D			D	
Approach Delay (s)		25.8			17.6			38.8			52.2	
Approach LOS		C			B			D			D	

Intersection Summary			
HCM 2000 Control Delay	24.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	110.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	15		

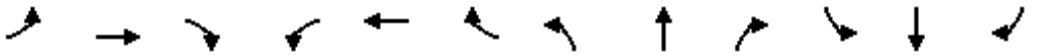
c Critical Lane Group



Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	254	54	77	159	87	238
Future Volume (Veh/h)	254	54	77	159	87	238
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	276	59	84	173	95	259
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			335		646	306
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			335		646	306
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		77	65
cM capacity (veh/h)			1224		406	734

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	335	257	354
Volume Left	0	84	95
Volume Right	59	0	259
cSH	1700	1224	603
Volume to Capacity	0.20	0.07	0.59
Queue Length 95th (m)	0.0	1.7	28.9
Control Delay (s)	0.0	3.1	19.1
Lane LOS		A	C
Approach Delay (s)	0.0	3.1	19.1
Approach LOS			C

Intersection Summary			
Average Delay	8.0		
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	21	74	32	14	18	26	1519	74	28	856	34
Future Volume (vph)	70	21	74	32	14	18	26	1519	74	28	856	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frt		0.94			0.96		1.00	0.99		1.00	1.00	0.85
Flt Protected		0.98			0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1733			1767		1789	3554		1789	3579	1601
Flt Permitted		0.83			0.76		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1469			1382		1789	3554		1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	23	80	35	15	20	28	1651	80	30	930	37
RTOR Reduction (vph)	0	35	0	0	16	0	0	3	0	0	0	15
Lane Group Flow (vph)	0	144	0	0	54	0	28	1728	0	30	930	22
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)		14.8			14.8		1.7	48.0		1.7	48.0	48.0
Effective Green, g (s)		14.8			14.8		1.7	48.0		1.7	48.0	48.0
Actuated g/C Ratio		0.18			0.18		0.02	0.58		0.02	0.58	0.58
Clearance Time (s)		6.0			6.0		6.0	6.0		6.0	6.0	6.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		263			247		36	2067		36	2082	931
v/s Ratio Prot							0.02	c0.49		c0.02	0.26	
v/s Ratio Perm		c0.10			0.04							0.01
v/c Ratio		0.55			0.22		0.78	0.84		0.83	0.45	0.02
Uniform Delay, d1		30.8			28.9		40.2	14.0		40.3	9.7	7.3
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		2.3			0.4		66.9	3.1		85.2	0.2	0.0
Delay (s)		33.1			29.3		107.1	17.2		125.5	9.9	7.3
Level of Service		C			C		F	B		F	A	A
Approach Delay (s)		33.1			29.3			18.6			13.3	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	82.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

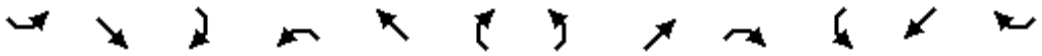
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	102	123	30	697	1788	39
Future Volume (vph)	102	123	30	697	1788	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	
Lane Util. Factor	1.00		0.91	0.91	0.95	
Frt	0.93		1.00	1.00	1.00	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1706		1628	3427	3567	
Flt Permitted	0.98		0.06	0.95	1.00	
Satd. Flow (perm)	1706		98	3245	3567	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	111	134	33	758	1943	42
RTOR Reduction (vph)	16	0	0	0	1	0
Lane Group Flow (vph)	229	0	30	761	1984	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	21.2		86.8	86.8	86.8	
Effective Green, g (s)	21.2		86.8	86.8	86.8	
Actuated g/C Ratio	0.18		0.72	0.72	0.72	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	301		70	2347	2580	
v/s Ratio Prot	c0.13				c0.56	
v/s Ratio Perm			0.31	0.23		
v/c Ratio	0.76		0.43	0.32	0.77	
Uniform Delay, d1	47.0		6.7	6.0	10.3	
Progression Factor	1.00		1.61	0.28	1.00	
Incremental Delay, d2	10.5		17.5	0.4	2.3	
Delay (s)	57.5		28.2	2.1	12.6	
Level of Service	E		C	A	B	
Approach Delay (s)	57.5			3.1	12.6	
Approach LOS	E			A	B	

Intersection Summary			
HCM 2000 Control Delay	13.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	104	54	302	173	57	32	111	626	40	69	1742	54
Future Volume (vph)	104	54	302	173	57	32	111	626	40	69	1742	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.56	1.00	1.00		0.74	1.00	0.06	1.00	1.00	0.38	1.00	1.00
Satd. Flow (perm)	1054	3579	1601		2641	1601	104	3579	1601	713	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	113	59	328	188	62	35	121	680	43	75	1893	59
RTOR Reduction (vph)	0	0	69	0	0	28	0	0	17	0	0	25
Lane Group Flow (vph)	113	59	259	0	250	7	121	680	26	75	1893	34
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	24.6	24.6	24.6		24.6	24.6	80.7	72.1	72.1	74.1	68.8	68.8
Effective Green, g (s)	24.6	24.6	24.6		24.6	24.6	80.7	72.1	72.1	74.1	68.8	68.8
Actuated g/C Ratio	0.21	0.21	0.21		0.21	0.21	0.67	0.60	0.60	0.62	0.57	0.57
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	216	733	328		541	328	190	2150	961	487	2051	917
v/s Ratio Prot		0.02					c0.05	0.19		0.01	c0.53	
v/s Ratio Perm	0.11		c0.16		0.09	0.00	c0.38		0.02	0.09		0.02
v/c Ratio	0.52	0.08	0.79		0.46	0.02	0.64	0.32	0.03	0.15	0.92	0.04
Uniform Delay, d1	42.5	38.6	45.2		41.9	38.1	29.1	11.8	9.7	9.2	23.2	11.2
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.35	1.65	17.57	0.70	0.82	0.37
Incremental Delay, d2	2.3	0.0	11.9		0.6	0.0	6.4	0.4	0.0	0.1	5.7	0.0
Delay (s)	44.8	38.6	57.1		42.5	38.1	45.7	19.8	170.8	6.5	24.6	4.1
Level of Service	D	D	E		D	D	D	B	F	A	C	A
Approach Delay (s)		52.2			42.0			31.2			23.4	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	30.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	91.4%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	20	62	8	250	38	57	8	750	143	91	2047	8
Future Volume (vph)	20	62	8	250	38	57	8	750	143	91	2047	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.98		1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1839		1789	1883	1601	1789	3493		1789	3576	
Flt Permitted		0.94		0.69	1.00	1.00	0.05	1.00		0.26	1.00	
Satd. Flow (perm)		1742		1307	1883	1601	96	3493		483	3576	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	67	9	272	41	62	9	815	155	99	2225	9
RTOR Reduction (vph)	0	3	0	0	0	47	0	11	0	0	0	0
Lane Group Flow (vph)	0	95	0	272	41	15	9	959	0	99	2234	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		29.2		29.2	29.2	29.2	78.8	78.8		78.8	78.8	
Effective Green, g (s)		29.2		29.2	29.2	29.2	78.8	78.8		78.8	78.8	
Actuated g/C Ratio		0.24		0.24	0.24	0.24	0.66	0.66		0.66	0.66	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		423		318	458	389	63	2293		317	2348	
v/s Ratio Prot					0.02			0.27			c0.62	
v/s Ratio Perm		0.05		c0.21		0.01	0.09			0.20		
v/c Ratio		0.22		0.86	0.09	0.04	0.14	0.42		0.31	0.95	
Uniform Delay, d1		36.3		43.4	35.1	34.7	7.8	9.8		8.9	18.8	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		0.55	0.43	
Incremental Delay, d2		0.3		19.6	0.1	0.0	4.7	0.6		1.3	6.1	
Delay (s)		36.6		62.9	35.2	34.7	12.5	10.3		6.2	14.1	
Level of Service		D		E	D	C	B	B		A	B	
Approach Delay (s)		36.6			55.2			10.3			13.7	
Approach LOS		D			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	11	5	143	5	5	5	81	817	5	5	2268	37
Future Volume (Veh/h)	11	5	143	5	5	5	81	817	5	5	2268	37
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	5	155	5	5	5	88	888	5	5	2465	40
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.36	0.36	0.36	0.36	0.36		0.36					
vC, conflicting volume	3122	3564	1252	2466	3582	446	2505			893		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3340	4564	0	1520	4613	446	1627			893		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	60	0	0	99	38			99		
cM capacity (veh/h)	0	0	391	0	0	559	143			755		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	172	15	88	592	301	5	1643	862
Volume Left	12	5	88	0	0	5	0	0
Volume Right	155	5	0	0	5	0	0	40
cSH	0	0	143	1700	1700	755	1700	1700
Volume to Capacity	Err	Err	0.62	0.35	0.18	0.01	0.97	0.51
Queue Length 95th (m)	Err	Err	24.8	0.0	0.0	0.2	0.0	0.0
Control Delay (s)	Err	Err	64.2	0.0	0.0	9.8	0.0	0.0
Lane LOS	F	F	F			A		
Approach Delay (s)	Err	Err	5.8			0.0		
Approach LOS	F	F						

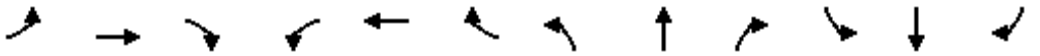
Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	84.0%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	134	108	905	73	61	1916
Future Volume (vph)	134	108	905	73	61	1916
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1789	1601	3579	1601	1789	3579
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1789	1601	3579	1601	1789	3579
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	117	984	79	66	2083
RTOR Reduction (vph)	0	100	0	25	0	0
Lane Group Flow (vph)	146	17	984	54	66	2083
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	17.6	17.6	76.7	76.7	7.7	90.4
Effective Green, g (s)	17.6	17.6	76.7	76.7	7.7	90.4
Actuated g/C Ratio	0.15	0.15	0.64	0.64	0.06	0.75
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	262	234	2287	1023	114	2696
v/s Ratio Prot	c0.08		0.27		0.04	c0.58
v/s Ratio Perm		0.01		0.03		
v/c Ratio	0.56	0.07	0.43	0.05	0.58	0.77
Uniform Delay, d1	47.6	44.2	10.8	8.1	54.6	8.7
Progression Factor	1.00	1.00	1.00	1.00	1.25	0.25
Incremental Delay, d2	2.6	0.1	0.6	0.1	3.7	1.2
Delay (s)	50.1	44.3	11.4	8.2	72.0	3.4
Level of Service	D	D	B	A	E	A
Approach Delay (s)	47.5		11.1			5.5
Approach LOS	D		B			A

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	7	975	50	5	2048	5	95	5	5	5	5	11
Future Volume (Veh/h)	7	975	50	5	2048	5	95	5	5	5	5	11
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	1060	54	5	2226	5	103	5	5	5	5	12
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	2231			1060			2214	3317	530	2792	3314	1116
vC1, stage 1 conf vol							1076	1076		2238	2238	
vC2, stage 2 conf vol							1138	2241		554	1076	
vCu, unblocked vol	2231			1060			2214	3317	530	2792	3314	1116
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			99			0	91	99	86	91	94
cM capacity (veh/h)	229			653			101	53	493	37	58	202

Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	8	530	530	54	5	1484	747	113	22
Volume Left	8	0	0	0	5	0	0	103	5
Volume Right	0	0	0	54	0	0	5	5	12
cSH	229	1700	1700	1700	653	1700	1700	100	78
Volume to Capacity	0.03	0.31	0.31	0.03	0.01	0.87	0.44	1.13	0.28
Queue Length 95th (m)	0.8	0.0	0.0	0.0	0.2	0.0	0.0	56.0	7.8
Control Delay (s)	21.3	0.0	0.0	0.0	10.6	0.0	0.0	208.3	68.4
Lane LOS	C				B			F	F
Approach Delay (s)	0.2				0.0			208.3	68.4
Approach LOS								F	F

Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	6	912	64	82	2069	5	5	5	5	188	5	119
Future Volume (vph)	6	912	64	82	2069	5	5	5	5	188	5	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00			0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3577			1769		1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.94		0.75	1.00	1.00
Satd. Flow (perm)	1789	3579	1601	1789	3577			1690		1408	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	991	70	89	2249	5	5	5	5	204	5	129
RTOR Reduction (vph)	0	0	33	0	0	0	0	4	0	0	0	103
Lane Group Flow (vph)	7	991	37	89	2254	0	0	11	0	204	5	26
Turn Type	Prot	NA	Perm	Prot	NA		Perm	NA		Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4				6			2		2
Actuated Green, G (s)	0.8	48.7	48.7	7.8	55.7			18.5		18.5	18.5	18.5
Effective Green, g (s)	0.8	48.7	48.7	7.8	55.7			18.5		18.5	18.5	18.5
Actuated g/C Ratio	0.01	0.52	0.52	0.08	0.60			0.20		0.20	0.20	0.20
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	15	1874	838	150	2142			336		280	374	318
v/s Ratio Prot	0.00	0.28		c0.05	c0.63						0.00	
v/s Ratio Perm			0.02					0.01		c0.14		0.02
v/c Ratio	0.47	0.53	0.04	0.59	1.05			0.03		0.73	0.01	0.08
Uniform Delay, d1	45.9	14.6	10.8	41.1	18.6			30.0		34.9	29.9	30.3
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	21.2	0.3	0.0	6.2	34.9			0.0		9.1	0.0	0.1
Delay (s)	67.1	14.9	10.8	47.2	53.6			30.1		44.0	29.9	30.4
Level of Service	E	B	B	D	D			C		D	C	C
Approach Delay (s)		14.9			53.3			30.1			38.6	
Approach LOS		B			D			C			D	

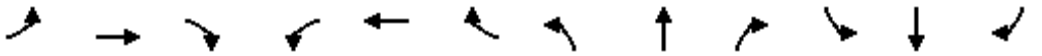
Intersection Summary			
HCM 2000 Control Delay	41.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	93.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	93.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	14	113	181	181	153	11	70	155	79	5	394	44
Future Volume (vph)	14	113	181	181	153	11	70	155	79	5	394	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0		6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	0.99		1.00	1.00	0.85		0.99	
Flt Protected		0.99	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1873	1601	1789	1864		1789	1883	1601		1857	
Flt Permitted		0.95	1.00	0.67	1.00		0.47	1.00	1.00		1.00	
Satd. Flow (perm)		1794	1601	1260	1864		895	1883	1601		1852	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	15	123	197	197	166	12	76	168	86	5	428	48
RTOR Reduction (vph)	0	0	136	0	3	0	0	0	51	0	5	0
Lane Group Flow (vph)	0	138	61	197	175	0	76	168	35	0	476	0
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6		6	2			4		4	8		
Actuated Green, G (s)		13.1	13.1	13.1	13.1		17.5	17.5	17.5		17.5	
Effective Green, g (s)		13.1	13.1	13.1	13.1		17.5	17.5	17.5		17.5	
Actuated g/C Ratio		0.31	0.31	0.31	0.31		0.41	0.41	0.41		0.41	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		551	492	387	573		367	773	657		760	
v/s Ratio Prot					0.09			0.09				
v/s Ratio Perm		0.08	0.04	c0.16			0.08		0.02		c0.26	
v/c Ratio		0.25	0.12	0.51	0.30		0.21	0.22	0.05		0.63	
Uniform Delay, d1		11.1	10.6	12.1	11.3		8.1	8.1	7.6		10.0	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		0.2	0.1	1.1	0.3		0.3	0.1	0.0		1.6	
Delay (s)		11.3	10.7	13.2	11.6		8.4	8.3	7.6		11.6	
Level of Service		B	B	B	B		A	A	A		B	
Approach Delay (s)		11.0			12.4			8.1			11.6	
Approach LOS		B			B			A			B	

Intersection Summary			
HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	42.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	43	19	30	194	54	85	150	809	54	29	1753	140
Future Volume (vph)	43	19	30	194	54	85	150	809	54	29	1753	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	3471	3579	1601	1789	3579	1601
Flt Permitted	0.72	1.00	1.00	0.74	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1353	1883	1601	1401	1883	1601	3471	3579	1601	1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	47	21	33	211	59	92	163	879	59	32	1905	152
RTOR Reduction (vph)	0	0	27	0	0	74	0	0	23	0	0	57
Lane Group Flow (vph)	47	21	6	211	59	18	163	879	36	32	1905	95
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	23.6	23.6	23.6	23.6	23.6	23.6	8.4	74.0	74.0	4.4	70.0	70.0
Effective Green, g (s)	23.6	23.6	23.6	23.6	23.6	23.6	8.4	74.0	74.0	4.4	70.0	70.0
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.07	0.62	0.62	0.04	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	266	370	314	275	370	314	242	2207	987	65	2087	933
v/s Ratio Prot		0.01			0.03		c0.05	0.25		0.02	c0.53	
v/s Ratio Perm	0.03		0.00	c0.15		0.01			0.02			0.06
v/c Ratio	0.18	0.06	0.02	0.77	0.16	0.06	0.67	0.40	0.04	0.49	0.91	0.10
Uniform Delay, d1	40.1	39.2	38.9	45.6	40.0	39.2	54.5	11.7	9.0	56.7	22.3	11.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.82	0.64	0.58	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.1	0.0	12.1	0.2	0.1	6.7	0.5	0.1	5.8	7.6	0.2
Delay (s)	40.4	39.2	38.9	57.7	40.2	39.2	51.3	8.0	5.3	62.5	29.8	11.3
Level of Service	D	D	D	E	D	D	D	A	A	E	C	B
Approach Delay (s)		39.7			50.1			14.3			29.0	
Approach LOS		D			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	27.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		

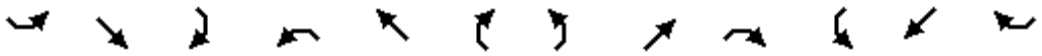
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	57	82	120	1676	1052	88
Future Volume (vph)	57	82	120	1676	1052	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0	
Lane Util. Factor	1.00		0.91	0.91	0.95	
Frt	0.92		1.00	1.00	0.99	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1699		1628	3427	3537	
Flt Permitted	0.98		0.20	0.94	1.00	
Satd. Flow (perm)	1699		349	3224	3537	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	62	89	130	1822	1143	96
RTOR Reduction (vph)	51	0	0	0	3	0
Lane Group Flow (vph)	100	0	117	1835	1236	0
Turn Type	Prot		Perm	NA	NA	
Protected Phases	3			6	2	
Permitted Phases			6			
Actuated Green, G (s)	14.7		93.3	93.3	93.3	
Effective Green, g (s)	14.7		93.3	93.3	93.3	
Actuated g/C Ratio	0.12		0.78	0.78	0.78	
Clearance Time (s)	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	208		271	2506	2750	
v/s Ratio Prot	c0.06				0.35	
v/s Ratio Perm			0.34	c0.57		
v/c Ratio	0.48		0.43	0.73	0.45	
Uniform Delay, d1	49.1		4.5	6.9	4.6	
Progression Factor	1.00		0.39	0.82	1.00	
Incremental Delay, d2	1.8		3.3	1.3	0.5	
Delay (s)	50.8		5.0	6.9	5.1	
Level of Service	D		A	A	A	
Approach Delay (s)	50.8			6.8	5.1	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	8.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	101.4%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	71	83	119	195	71	35	249	1625	215	85	1003	46
Future Volume (vph)	71	83	119	195	71	35	249	1625	215	85	1003	46
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3452	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.49	1.00	1.00		0.73	1.00	0.17	1.00	1.00	0.06	1.00	1.00
Satd. Flow (perm)	917	3579	1601		2608	1601	320	3579	1601	120	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	77	90	129	212	77	38	271	1766	234	92	1090	50
RTOR Reduction (vph)	0	0	107	0	0	31	0	0	61	0	0	23
Lane Group Flow (vph)	77	90	22	0	289	7	271	1766	173	92	1090	28
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	20.7	20.7	20.7		20.7	20.7	87.3	74.5	74.5	72.8	66.0	66.0
Effective Green, g (s)	20.7	20.7	20.7		20.7	20.7	87.3	74.5	74.5	72.8	66.0	66.0
Actuated g/C Ratio	0.17	0.17	0.17		0.17	0.17	0.73	0.62	0.62	0.61	0.55	0.55
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	158	617	276		449	276	420	2221	993	167	1968	880
v/s Ratio Prot		0.03					c0.08	c0.49		0.03	0.30	
v/s Ratio Perm	0.08		0.01		c0.11	0.00	0.39		0.11	0.30		0.02
v/c Ratio	0.49	0.15	0.08		0.94dl	0.02	0.65	0.80	0.17	0.55	0.55	0.03
Uniform Delay, d1	44.9	42.1	41.7		46.2	41.3	11.1	17.0	9.7	17.5	17.5	12.4
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.31	0.65	0.46	1.21	0.76	1.00
Incremental Delay, d2	2.4	0.1	0.1		3.2	0.0	1.5	1.4	0.2	3.6	1.0	0.1
Delay (s)	47.2	42.3	41.8		49.4	41.3	16.1	12.3	4.6	24.7	14.4	12.4
Level of Service	D	D	D		D	D	B	B	A	C	B	B
Approach Delay (s)		43.3			48.4			12.0			15.1	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	18.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		

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

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	35	49	5	135	18	49	27	2037	142	49	1363	5
Future Volume (vph)	35	49	5	135	18	49	27	2037	142	49	1363	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95		1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1834		1789	1883	1601	1789	3544		1789	3577	
Flt Permitted		0.87		0.69	1.00	1.00	0.14	1.00		0.05	1.00	
Satd. Flow (perm)		1632		1290	1883	1601	258	3544		86	3577	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	53	5	147	20	53	29	2214	154	53	1482	5
RTOR Reduction (vph)	0	2	0	0	0	22	0	3	0	0	0	0
Lane Group Flow (vph)	0	94	0	147	20	31	29	2365	0	53	1487	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4		4	6			2		
Actuated Green, G (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Effective Green, g (s)		20.7		20.7	20.7	20.7	87.3	87.3		87.3	87.3	
Actuated g/C Ratio		0.17		0.17	0.17	0.17	0.73	0.73		0.73	0.73	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		281		222	324	276	187	2578		62	2602	
v/s Ratio Prot					0.01			c0.67			0.42	
v/s Ratio Perm		0.06		c0.11		0.02	0.11			0.61		
v/c Ratio		0.34		0.66	0.06	0.11	0.16	0.92		0.85	0.57	
Uniform Delay, d1		43.6		46.4	41.5	41.9	5.0	13.4		11.8	7.6	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00		1.56	1.41	
Incremental Delay, d2		0.7		7.2	0.1	0.2	1.8	6.6		72.8	0.8	
Delay (s)		44.3		53.6	41.6	42.1	6.8	20.0		91.2	11.6	
Level of Service		D		D	D	D	A	B		F	B	
Approach Delay (s)		44.3			49.7			19.8			14.3	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	34	5	135	5	5	5	103	2190	5	5	1440	70
Future Volume (Veh/h)	34	5	135	5	5	5	103	2190	5	5	1440	70
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	5	147	5	5	5	112	2380	5	5	1565	76
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.79	0.79	0.79	0.79	0.79		0.79					
vC, conflicting volume	3034	4222	820	3548	4258	1192	1641			2385		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3044	4542	250	3692	4587	1192	1285			2385		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	75	0	0	97	74			97		
cM capacity (veh/h)	0	1	594	0	1	179	425			199		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	SW 1	SW 2	SW 3
Volume Total	189	15	112	1587	798	5	1043	598
Volume Left	37	5	112	0	0	5	0	0
Volume Right	147	5	0	0	5	0	0	76
cSH	0	0	425	1700	1700	199	1700	1700
Volume to Capacity	Err	Err	0.26	0.93	0.47	0.03	0.61	0.35
Queue Length 95th (m)	Err	Err	8.0	0.0	0.0	0.6	0.0	0.0
Control Delay (s)	Err	Err	16.5	0.0	0.0	23.5	0.0	0.0
Lane LOS	F	F	C			C		
Approach Delay (s)	Err	Err	0.7			0.1		
Approach LOS	F	F						

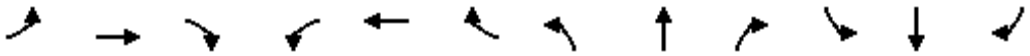
Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	86.0%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	139	94	2192	179	119	1398
Future Volume (vph)	139	94	2192	179	119	1398
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1789	1601	3579	1601	1789	3579
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1789	1601	3579	1601	1789	3579
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	151	102	2383	195	129	1520
RTOR Reduction (vph)	0	87	0	27	0	0
Lane Group Flow (vph)	151	15	2383	168	129	1520
Turn Type	Prot	Perm	NA	Perm	Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	17.8	17.8	75.2	75.2	9.0	90.2
Effective Green, g (s)	17.8	17.8	75.2	75.2	9.0	90.2
Actuated g/C Ratio	0.15	0.15	0.63	0.63	0.08	0.75
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	265	237	2242	1003	134	2690
v/s Ratio Prot	c0.08		c0.67		c0.07	0.42
v/s Ratio Perm		0.01		0.11		
v/c Ratio	0.57	0.06	1.06	0.17	0.96	0.57
Uniform Delay, d1	47.5	43.9	22.4	9.3	55.3	6.4
Progression Factor	1.00	1.00	1.00	1.00	0.91	1.12
Incremental Delay, d2	2.8	0.1	38.3	0.4	60.5	0.7
Delay (s)	50.3	44.1	60.7	9.7	110.7	7.9
Level of Service	D	D	E	A	F	A
Approach Delay (s)	47.8		56.9			16.0
Approach LOS	D		E			B

Intersection Summary			
HCM 2000 Control Delay	41.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	2367	47	5	1532	5	31	5	5	5	5	10
Future Volume (Veh/h)	14	2367	47	5	1532	5	31	5	5	5	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	2573	51	5	1665	5	34	5	5	5	5	11
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1670			2573			3459	4283	1286	3002	4280	835
vC1, stage 1 conf vol							2603	2603		1678	1678	
vC2, stage 2 conf vol							856	1680		1324	2603	
vCu, unblocked vol	1670			2573			3459	4283	1286	3002	4280	835
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			97			0	85	97	91	84	96
cM capacity (veh/h)	381			168			20	33	155	53	31	311

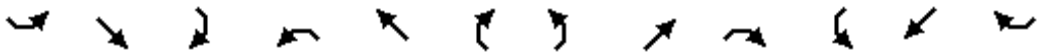
Direction, Lane #	EB 1	EB 2	EB 3	EB 4	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	15	1286	1286	51	5	1110	560	44	21
Volume Left	15	0	0	0	5	0	0	34	5
Volume Right	0	0	0	51	0	0	5	5	11
cSH	381	1700	1700	1700	168	1700	1700	24	72
Volume to Capacity	0.04	0.76	0.76	0.03	0.03	0.65	0.33	1.85	0.29
Queue Length 95th (m)	0.9	0.0	0.0	0.0	0.7	0.0	0.0	42.0	8.1
Control Delay (s)	14.8	0.0	0.0	0.0	27.1	0.0	0.0	752.4	74.4
Lane LOS	B				D			F	F
Approach Delay (s)	0.1				0.1			752.4	74.4
Approach LOS								F	F

Intersection Summary				
Average Delay	8.0			
Intersection Capacity Utilization	77.9%	ICU Level of Service		D
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	7	2359	223	109	1464	5	5	5	5	120	5	67
Future Volume (vph)	7	2359	223	109	1464	5	5	5	5	120	5	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00			0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98		0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3577			1769		1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.93		0.75	1.00	1.00
Satd. Flow (perm)	1789	3579	1601	1789	3577			1680		1408	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	2564	242	118	1591	5	5	5	5	130	5	73
RTOR Reduction (vph)	0	0	30	0	0	0	0	4	0	0	0	56
Lane Group Flow (vph)	8	2564	212	118	1596	0	0	11	0	130	5	17
Turn Type	Prot	NA	Perm	Prot	NA		Perm	NA		Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4				6			2		2
Actuated Green, G (s)	0.9	90.3	90.3	13.9	103.3			19.0		19.0	19.0	19.0
Effective Green, g (s)	0.9	90.3	90.3	13.9	103.3			19.0		19.0	19.0	19.0
Actuated g/C Ratio	0.01	0.64	0.64	0.10	0.73			0.13		0.13	0.13	0.13
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0			6.0		6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	11	2288	1023	176	2616			226		189	253	215
v/s Ratio Prot	0.00	c0.72		c0.07	0.45						0.00	
v/s Ratio Perm			0.13					0.01		c0.09		0.01
v/c Ratio	0.73	1.12	0.21	0.67	0.61			0.05		0.69	0.02	0.08
Uniform Delay, d1	70.0	25.4	10.6	61.4	9.2			53.2		58.3	53.0	53.4
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00		1.00	1.00	1.00
Incremental Delay, d2	123.5	60.8	0.1	9.6	0.4			0.1		10.0	0.0	0.2
Delay (s)	193.6	86.3	10.7	71.1	9.6			53.3		68.2	53.1	53.6
Level of Service	F	F	B	E	A			D		E	D	D
Approach Delay (s)		80.1			13.8			53.3			62.7	
Approach LOS		F			B			D			E	

Intersection Summary			
HCM 2000 Control Delay	55.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	141.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	99.6%	ICU Level of Service	F
Analysis Period (min)	15		

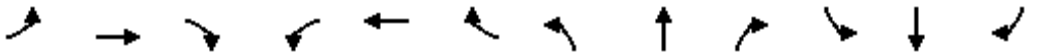
c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	21	253	125	39	145	5	211	495	168	5	229	35
Future Volume (vph)	21	253	125	39	145	5	211	495	168	5	229	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.96			0.98	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00			1.00	
Satd. Flow (prot)		1876	1601	1789	1875		1789	1812			1849	
Flt Permitted		0.97	1.00	0.49	1.00		0.62	1.00			0.99	
Satd. Flow (perm)		1819	1601	923	1875		1163	1812			1830	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	275	136	42	158	5	229	538	183	5	249	38
RTOR Reduction (vph)	0	0	98	0	1	0	0	15	0	0	6	0
Lane Group Flow (vph)	0	298	38	42	162	0	229	706	0	0	286	0
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6		6	2			4			8		
Actuated Green, G (s)		16.5	16.5	16.5	16.5		30.9	30.9			30.9	
Effective Green, g (s)		16.5	16.5	16.5	16.5		30.9	30.9			30.9	
Actuated g/C Ratio		0.28	0.28	0.28	0.28		0.52	0.52			0.52	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		505	444	256	520		604	942			951	
v/s Ratio Prot					0.09			c0.39				
v/s Ratio Perm		c0.16	0.02	0.05			0.20				0.16	
v/c Ratio		0.59	0.09	0.16	0.31		0.38	0.75			0.30	
Uniform Delay, d1		18.5	15.9	16.2	17.0		8.5	11.2			8.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.8	0.1	0.3	0.3		0.4	3.3			0.2	
Delay (s)		20.4	15.9	16.5	17.3		8.9	14.5			8.3	
Level of Service		C	B	B	B		A	B			A	
Approach Delay (s)		19.0			17.1			13.2			8.3	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	14.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	59.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	115	57	143	111	34	54	39	2036	211	91	1263	43
Future Volume (vph)	115	57	143	111	34	54	39	2036	211	91	1263	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	3471	3579	1601	1789	3579	1601
Flt Permitted	0.73	1.00	1.00	0.72	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1381	1883	1601	1350	1883	1601	3471	3579	1601	1789	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	62	155	121	37	59	42	2213	229	99	1373	47
RTOR Reduction (vph)	0	0	115	0	0	50	0	0	34	0	0	16
Lane Group Flow (vph)	125	62	40	121	37	9	42	2213	195	99	1373	31
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	18.2	18.2	18.2	18.2	18.2	18.2	5.1	73.1	73.1	10.7	78.7	78.7
Effective Green, g (s)	18.2	18.2	18.2	18.2	18.2	18.2	5.1	73.1	73.1	10.7	78.7	78.7
Actuated g/C Ratio	0.15	0.15	0.15	0.15	0.15	0.15	0.04	0.61	0.61	0.09	0.66	0.66
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	209	285	242	204	285	242	147	2180	975	159	2347	1049
v/s Ratio Prot		0.03			0.02		0.01	c0.62		0.06	c0.38	
v/s Ratio Perm	c0.09		0.02	0.09		0.01			0.12			0.02
v/c Ratio	0.60	0.22	0.16	0.59	0.13	0.04	0.29	1.02	0.20	0.62	0.59	0.03
Uniform Delay, d1	47.5	44.7	44.3	47.4	44.0	43.4	55.7	23.5	10.4	52.7	11.5	7.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.36	0.08	0.00	1.00	1.00	1.00
Incremental Delay, d2	4.6	0.4	0.3	4.6	0.2	0.1	0.1	10.2	0.0	7.4	1.1	0.1
Delay (s)	52.0	45.0	44.6	52.0	44.3	43.5	76.0	12.1	0.1	60.1	12.6	7.3
Level of Service	D	D	D	D	D	D	E	B	A	E	B	A
Approach Delay (s)		47.4			48.4			12.1			15.5	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	89.4%	ICU Level of Service	E
Analysis Period (min)	15		

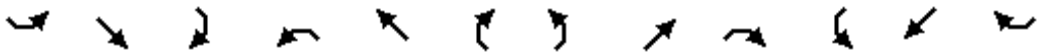
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	122	135	33	852	2256	42
Future Volume (vph)	122	135	33	852	2256	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Flt Permitted	0.95	1.00	0.03	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	65	3579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	133	147	36	926	2452	46
RTOR Reduction (vph)	0	8	0	0	0	5
Lane Group Flow (vph)	133	139	36	926	2452	41
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	3			6	2	
Permitted Phases		3	6			2
Actuated Green, G (s)	21.4	21.4	116.6	116.6	116.6	116.6
Effective Green, g (s)	21.4	21.4	116.6	116.6	116.6	116.6
Actuated g/C Ratio	0.14	0.14	0.78	0.78	0.78	0.78
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	255	228	50	2782	2782	1244
v/s Ratio Prot	0.07			0.26	c0.69	
v/s Ratio Perm		c0.09	0.56			0.03
v/c Ratio	0.52	0.61	0.72	0.33	0.88	0.03
Uniform Delay, d1	59.6	60.4	8.4	5.0	11.8	3.8
Progression Factor	1.00	1.00	1.76	0.18	1.00	1.00
Incremental Delay, d2	1.9	4.8	59.4	0.3	4.4	0.0
Delay (s)	61.5	65.2	74.2	1.2	16.2	3.9
Level of Service	E	E	E	A	B	A
Approach Delay (s)	63.4			4.0	16.0	
Approach LOS	E			A	B	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	114	54	314	173	57	32	115	774	40	69	2219	57
Future Volume (vph)	114	54	314	173	57	32	115	774	40	69	2219	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3449	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.54	1.00	1.00		0.73	1.00	0.04	1.00	1.00	0.31	1.00	1.00
Satd. Flow (perm)	1015	3579	1601		2628	1601	81	3579	1601	579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	124	59	341	188	62	35	125	841	43	75	2412	62
RTOR Reduction (vph)	0	0	51	0	0	27	0	0	16	0	0	26
Lane Group Flow (vph)	124	59	290	0	250	8	125	841	27	75	2412	36
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	33.2	33.2	33.2		33.2	33.2	104.1	92.8	92.8	93.5	87.5	87.5
Effective Green, g (s)	33.2	33.2	33.2		33.2	33.2	104.1	92.8	92.8	93.5	87.5	87.5
Actuated g/C Ratio	0.22	0.22	0.22		0.22	0.22	0.69	0.62	0.62	0.62	0.58	0.58
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	224	792	354		581	354	184	2214	990	409	2087	933
v/s Ratio Prot		0.02					c0.05	0.24		0.01	c0.67	
v/s Ratio Perm	0.12		c0.18		0.10	0.00	0.42		0.02	0.11		0.02
v/c Ratio	0.55	0.07	0.82		0.43	0.02	0.68	0.38	0.03	0.18	1.16	0.04
Uniform Delay, d1	51.8	46.2	55.6		50.3	45.7	46.4	14.3	11.1	11.3	31.2	13.3
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.60	1.55	7.59	0.41	0.82	0.30
Incremental Delay, d2	2.9	0.0	14.1		0.5	0.0	8.8	0.5	0.0	0.1	73.1	0.0
Delay (s)	54.8	46.3	69.6		50.8	45.7	83.1	22.5	84.2	4.7	98.6	4.1
Level of Service	D	D	E		D	D	F	C	F	A	F	A
Approach Delay (s)		63.5			50.2			32.6			93.5	
Approach LOS		E			D			C			F	

Intersection Summary			
HCM 2000 Control Delay	73.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	105.4%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	22	62	8	250	38	57	9	900	143	91	2536	8
Future Volume (vph)	22	62	8	250	38	57	9	900	143	91	2536	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.99		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1838		1789	1883	1601	1789	3579	1601	1789	3577	
Flt Permitted		0.93		0.67	1.00	1.00	0.05	1.00	1.00	0.22	1.00	
Satd. Flow (perm)		1730		1255	1883	1601	85	3579	1601	412	3577	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	24	67	9	272	41	62	10	978	155	99	2757	9
RTOR Reduction (vph)	0	2	0	0	0	47	0	0	64	0	0	0
Lane Group Flow (vph)	0	98	0	272	41	15	10	978	91	99	2766	0
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4		4	6		6	2		
Actuated Green, G (s)		37.0		37.0	37.0	37.0	90.2	88.2	88.2	99.8	93.0	
Effective Green, g (s)		37.0		37.0	37.0	37.0	90.2	88.2	88.2	99.8	93.0	
Actuated g/C Ratio		0.25		0.25	0.25	0.25	0.60	0.59	0.59	0.67	0.62	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		426		309	464	394	73	2104	941	336	2217	
v/s Ratio Prot					0.02		0.00	0.27		c0.01	c0.77	
v/s Ratio Perm		0.06		c0.22		0.01	0.08		0.06	0.18		
v/c Ratio		0.23		0.88	0.09	0.04	0.14	0.46	0.10	0.29	1.25	
Uniform Delay, d1		45.1		54.4	43.5	43.0	35.7	17.5	13.5	11.1	28.5	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.59	0.39	
Incremental Delay, d2		0.3		24.0	0.1	0.0	0.9	0.7	0.2	0.0	111.8	
Delay (s)		45.4		78.3	43.6	43.0	36.6	18.3	13.7	6.6	123.0	
Level of Service		D		E	D	D	D	B	B	A	F	
Approach Delay (s)		45.4			68.7			17.8			119.0	
Approach LOS		D			E			B			F	

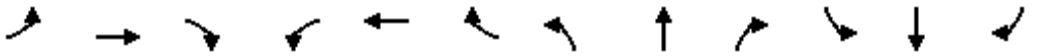
Intersection Summary			
HCM 2000 Control Delay	87.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	106.1%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	14	5	153	5	5	5	80	965	5	5	2755	39
Future Volume (Veh/h)	14	5	153	5	5	5	80	965	5	5	2755	39
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	5	166	5	5	5	87	1049	5	5	2995	42
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.41	0.41	0.41	0.41	0.41		0.41					
vC, conflicting volume	3557	4254	1019	2402	4272	352	3037			1054		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2213	3903	0	0	3948	352	951			1054		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	63	0	0	99	71			99		
cM capacity (veh/h)	0	1	447	0	1	644	296			656		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	NE 4	SW 1	SW 2	SW 3	SW 4
Volume Total	186	15	87	420	420	215	5	1198	1198	641
Volume Left	15	5	87	0	0	0	5	0	0	0
Volume Right	166	5	0	0	0	5	0	0	0	42
cSH	0	0	296	1700	1700	1700	656	1700	1700	1700
Volume to Capacity	Err	Err	0.29	0.25	0.25	0.13	0.01	0.70	0.70	0.38
Queue Length 95th (m)	Err	Err	9.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Control Delay (s)	Err	Err	22.1	0.0	0.0	0.0	10.5	0.0	0.0	0.0
Lane LOS	F	F	C				B			
Approach Delay (s)	Err	Err	1.7				0.0			
Approach LOS	F	F								

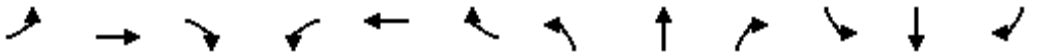
Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	79.5%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	256	122	64	128	36	137	18	1393	54	54	2491	74
Future Volume (vph)	256	122	64	128	36	137	18	1393	54	54	2491	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	5142	1601	1789	5142	1601
Flt Permitted	0.73	1.00	1.00	0.61	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1378	1883	1601	1149	1883	1601	1789	5142	1601	1789	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	278	133	70	139	39	149	20	1514	59	59	2708	80
RTOR Reduction (vph)	0	0	54	0	0	115	0	0	31	0	0	24
Lane Group Flow (vph)	278	133	16	139	39	34	20	1514	28	59	2708	56
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	34.7	34.7	34.7	34.7	34.7	34.7	3.5	72.0	72.0	25.3	93.8	93.8
Effective Green, g (s)	34.7	34.7	34.7	34.7	34.7	34.7	3.5	72.0	72.0	25.3	93.8	93.8
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23	0.23	0.02	0.48	0.48	0.17	0.63	0.63
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	318	435	370	265	435	370	41	2468	768	301	3215	1001
v/s Ratio Prot		0.07			0.02		0.01	c0.29		0.03	c0.53	
v/s Ratio Perm	c0.20		0.01	0.12		0.02			0.02			0.03
v/c Ratio	0.87	0.31	0.04	0.52	0.09	0.09	0.49	0.61	0.04	0.20	0.84	0.06
Uniform Delay, d1	55.5	47.7	44.8	50.4	45.3	45.3	72.4	28.7	20.6	53.6	22.2	10.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.40	0.38	0.28	0.54	0.14	0.00
Incremental Delay, d2	22.3	0.4	0.0	1.9	0.1	0.1	8.3	1.1	0.1	0.1	1.3	0.0
Delay (s)	77.9	48.1	44.8	52.3	45.3	45.4	109.9	11.9	5.8	29.0	4.3	0.1
Level of Service	E	D	D	D	D	D	F	B	A	C	A	A
Approach Delay (s)		64.8			48.3			12.9			4.7	
Approach LOS		E			D			B			A	

Intersection Summary			
HCM 2000 Control Delay	15.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		

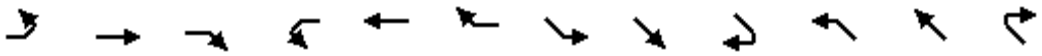
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	16	1339	58	9	2644	30	159	9	27	99	32	43
Future Volume (vph)	16	1339	58	9	2644	30	159	9	27	99	32	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	5142	1601	1789	5142	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.73	1.00	1.00	0.75	1.00	1.00
Satd. Flow (perm)	1789	5142	1601	1789	5142	1601	1383	1883	1601	1415	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	17	1455	63	10	2874	33	173	10	29	108	35	47
RTOR Reduction (vph)	0	0	20	0	0	11	0	0	24	0	0	38
Lane Group Flow (vph)	17	1455	43	10	2874	22	173	10	5	108	35	9
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	2.0	101.6	101.6	2.0	101.6	101.6	28.4	28.4	28.4	28.4	28.4	28.4
Effective Green, g (s)	2.0	101.6	101.6	2.0	101.6	101.6	28.4	28.4	28.4	28.4	28.4	28.4
Actuated g/C Ratio	0.01	0.68	0.68	0.01	0.68	0.68	0.19	0.19	0.19	0.19	0.19	0.19
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	23	3482	1084	23	3482	1084	261	356	303	267	356	303
v/s Ratio Prot	0.01	c0.28		0.01	c0.56			0.01			0.02	
v/s Ratio Perm			0.03			0.01	c0.13		0.00	0.08		0.01
v/c Ratio	0.74	0.42	0.04	0.43	0.83	0.02	0.66	0.03	0.02	0.40	0.10	0.03
Uniform Delay, d1	73.7	10.9	8.0	73.4	17.7	7.9	56.4	49.6	49.5	53.4	50.2	49.6
Progression Factor	0.59	0.19	0.07	1.25	0.54	1.63	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	73.3	0.3	0.1	7.6	1.4	0.0	6.2	0.0	0.0	1.0	0.1	0.0
Delay (s)	116.8	2.5	0.7	99.7	11.1	12.9	62.6	49.6	49.5	54.4	50.3	49.6
Level of Service	F	A	A	F	B	B	E	D	D	D	D	D
Approach Delay (s)		3.7			11.4			60.2			52.5	
Approach LOS		A			B			E			D	

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	79.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	80	1183	117	82	2731	33	103	5	259	308	5	127
Future Volume (vph)	80	1183	117	82	2731	33	103	5	259	308	5	127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	5142	1601	3471	5142	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.75	1.00	1.00	0.75	1.00	1.00
Satd. Flow (perm)	3471	5142	1601	3471	5142	1601	1421	1883	1601	1421	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	1286	127	89	2968	36	112	5	282	335	5	138
RTOR Reduction (vph)	0	0	70	0	0	15	0	0	81	0	0	103
Lane Group Flow (vph)	87	1286	57	89	2968	21	112	5	201	335	5	35
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4			8	6		6	2		2
Actuated Green, G (s)	6.1	54.0	54.0	39.8	87.7	87.7	38.2	38.2	38.2	38.2	38.2	38.2
Effective Green, g (s)	6.1	54.0	54.0	39.8	87.7	87.7	38.2	38.2	38.2	38.2	38.2	38.2
Actuated g/C Ratio	0.04	0.36	0.36	0.27	0.58	0.58	0.25	0.25	0.25	0.25	0.25	0.25
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	141	1851	576	920	3006	936	361	479	407	361	479	407
v/s Ratio Prot	0.03	c0.25		0.03	c0.58			0.00			0.00	
v/s Ratio Perm			0.04			0.01	0.08		0.13	c0.24		0.02
v/c Ratio	0.62	0.69	0.10	0.10	0.99	0.02	0.31	0.01	0.49	0.93	0.01	0.09
Uniform Delay, d1	70.8	41.0	31.8	41.5	30.6	13.1	45.2	41.8	47.6	54.6	41.8	42.6
Progression Factor	1.00	1.00	1.00	0.69	0.49	1.61	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.8	2.2	0.3	0.0	10.3	0.0	0.5	0.0	0.9	29.4	0.0	0.1
Delay (s)	78.6	43.1	32.2	28.6	25.3	21.2	45.7	41.8	48.6	83.9	41.8	42.7
Level of Service	E	D	C	C	C	C	D	D	D	F	D	D
Approach Delay (s)		44.3			25.3			47.7			71.6	
Approach LOS		D			C			D			E	

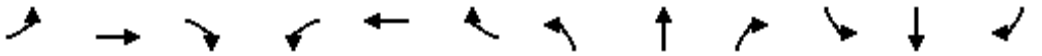
Intersection Summary			
HCM 2000 Control Delay	36.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	100.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	16	151	333	304	275	5	111	177	117	5	530	50
Future Volume (vph)	16	151	333	304	275	5	111	177	117	5	530	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0		6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1875	1601	1789	1879		1789	1883	1601		1861	
Flt Permitted		0.96	1.00	0.64	1.00		0.33	1.00	1.00		1.00	
Satd. Flow (perm)		1799	1601	1211	1879		619	1883	1601		1858	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	17	164	362	330	299	5	121	192	127	5	576	54
RTOR Reduction (vph)	0	0	130	0	1	0	0	0	72	0	4	0
Lane Group Flow (vph)	0	181	232	330	303	0	121	192	55	0	631	0
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6		6	2			4		4	8		
Actuated Green, G (s)		24.2	24.2	24.2	24.2		28.0	28.0	28.0		28.0	
Effective Green, g (s)		24.2	24.2	24.2	24.2		28.0	28.0	28.0		28.0	
Actuated g/C Ratio		0.38	0.38	0.38	0.38		0.44	0.44	0.44		0.44	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		678	603	456	708		269	821	698		810	
v/s Ratio Prot					0.16			0.10				
v/s Ratio Perm		0.10	0.15	c0.27			0.20		0.03		c0.34	
v/c Ratio		0.27	0.39	0.72	0.43		0.45	0.23	0.08		0.78	
Uniform Delay, d1		13.9	14.6	17.1	14.9		12.7	11.4	10.6		15.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		0.2	0.4	5.6	0.4		1.2	0.1	0.0		4.8	
Delay (s)		14.1	15.0	22.8	15.3		13.9	11.5	10.6		20.2	
Level of Service		B	B	C	B		B	B	B		C	
Approach Delay (s)		14.7			19.2			11.9			20.2	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	17.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	64.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	34	49	316	103	159	255	1442	89	51	2254	210
Future Volume (vph)	56	34	49	316	103	159	255	1442	89	51	2254	210
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	3471	5142	1601	1789	5142	1601
Flt Permitted	0.66	1.00	1.00	0.73	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1248	1883	1601	1381	1883	1601	3471	5142	1601	1789	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	37	53	343	112	173	277	1567	97	55	2450	228
RTOR Reduction (vph)	0	0	39	0	0	108	0	0	29	0	0	85
Lane Group Flow (vph)	61	37	14	343	112	65	277	1567	68	55	2450	143
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	39.9	39.9	39.9	39.9	39.9	39.9	14.2	84.4	84.4	7.7	77.9	77.9
Effective Green, g (s)	39.9	39.9	39.9	39.9	39.9	39.9	14.2	84.4	84.4	7.7	77.9	77.9
Actuated g/C Ratio	0.27	0.27	0.27	0.27	0.27	0.27	0.09	0.56	0.56	0.05	0.52	0.52
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	331	500	425	367	500	425	328	2893	900	91	2670	831
v/s Ratio Prot		0.02			0.06		c0.08	0.30		0.03	c0.48	
v/s Ratio Perm	0.05		0.01	c0.25		0.04			0.04			0.09
v/c Ratio	0.18	0.07	0.03	0.93	0.22	0.15	0.84	0.54	0.08	0.60	0.92	0.17
Uniform Delay, d1	42.5	41.2	40.8	53.8	43.0	42.1	66.8	20.6	15.0	69.7	33.1	19.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.70	0.20	0.09	1.00	1.00	1.00
Incremental Delay, d2	0.3	0.1	0.0	30.5	0.2	0.2	15.7	0.6	0.1	10.8	6.4	0.4
Delay (s)	42.8	41.3	40.8	84.3	43.2	42.3	62.2	4.7	1.4	80.5	39.5	19.5
Level of Service	D	D	D	F	D	D	E	A	A	F	D	B
Approach Delay (s)		41.7			65.4			12.8			38.7	
Approach LOS		D			E			B			D	

Intersection Summary			
HCM 2000 Control Delay	32.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	90.0%	ICU Level of Service	E
Analysis Period (min)	15		

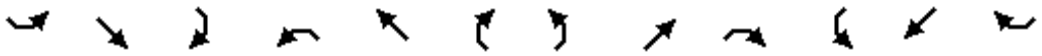
c Critical Lane Group



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Traffic Volume (vph)	71	91	134	2185	1352	111
Future Volume (vph)	71	91	134	2185	1352	111
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1789	1601	1789	3579	3579	1601
Flt Permitted	0.95	1.00	0.15	1.00	1.00	1.00
Satd. Flow (perm)	1789	1601	290	3579	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	77	99	146	2375	1470	121
RTOR Reduction (vph)	0	62	0	0	0	20
Lane Group Flow (vph)	77	37	146	2375	1470	101
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	3			6	2	
Permitted Phases		3	6			2
Actuated Green, G (s)	18.2	18.2	119.8	119.8	119.8	119.8
Effective Green, g (s)	18.2	18.2	119.8	119.8	119.8	119.8
Actuated g/C Ratio	0.12	0.12	0.80	0.80	0.80	0.80
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	217	194	231	2858	2858	1278
v/s Ratio Prot	c0.04			c0.66	0.41	
v/s Ratio Perm		0.02	0.50			0.06
v/c Ratio	0.35	0.19	0.63	0.83	0.51	0.08
Uniform Delay, d1	60.5	59.3	6.1	9.0	5.2	3.2
Progression Factor	1.00	1.00	0.33	0.41	1.00	1.00
Incremental Delay, d2	1.0	0.5	4.4	1.0	0.7	0.1
Delay (s)	61.5	59.8	6.4	4.8	5.8	3.4
Level of Service	E	E	A	A	A	A
Approach Delay (s)	60.5			4.9	5.6	
Approach LOS	E			A	A	

Intersection Summary			
HCM 2000 Control Delay	7.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	77	83	126	195	71	35	262	2142	215	85	1301	57
Future Volume (vph)	77	83	126	195	71	35	262	2142	215	85	1301	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601		3452	1601	1789	3579	1601	1789	3579	1601
Flt Permitted	0.47	1.00	1.00		0.72	1.00	0.08	1.00	1.00	0.05	1.00	1.00
Satd. Flow (perm)	883	3579	1601		2592	1601	159	3579	1601	93	3579	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	84	90	137	212	77	38	285	2328	234	92	1414	62
RTOR Reduction (vph)	0	0	111	0	0	31	0	0	38	0	0	28
Lane Group Flow (vph)	84	90	26	0	289	7	285	2328	196	92	1414	34
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8		8	4		4	6		6	2		2
Actuated Green, G (s)	28.4	28.4	28.4		28.4	28.4	109.6	96.7	96.7	88.2	81.3	81.3
Effective Green, g (s)	28.4	28.4	28.4		28.4	28.4	109.6	96.7	96.7	88.2	81.3	81.3
Actuated g/C Ratio	0.19	0.19	0.19		0.19	0.19	0.73	0.64	0.64	0.59	0.54	0.54
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	167	677	303		490	303	358	2307	1032	132	1939	867
v/s Ratio Prot		0.03					c0.12	c0.65		0.03	0.40	
v/s Ratio Perm	0.10		0.02		c0.11	0.00	0.46		0.12	0.38		0.02
v/c Ratio	0.50	0.13	0.09		0.85dl	0.02	0.80	1.01	0.19	0.70	0.73	0.04
Uniform Delay, d1	54.5	50.6	50.1		55.5	49.5	38.9	26.6	10.8	34.4	26.0	16.1
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.73	0.49	0.74	1.02	0.79	0.02
Incremental Delay, d2	2.4	0.1	0.1		1.8	0.0	1.2	8.1	0.0	13.2	2.2	0.1
Delay (s)	56.9	50.7	50.2		57.3	49.5	68.3	21.0	8.0	48.2	22.7	0.4
Level of Service	E	D	D		E	D	E	C	A	D	C	A
Approach Delay (s)		52.1			56.4			24.7			23.3	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	28.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	96.4%	ICU Level of Service	F
Analysis Period (min)	15		

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

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	36	49	5	135	18	49	38	2566	142	49	1668	5
Future Volume (vph)	36	49	5	135	18	49	38	2566	142	49	1668	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor		1.00		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.98		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1833		1789	1883	1601	1789	3579	1601	1789	3577	
Flt Permitted		0.87		0.66	1.00	1.00	0.05	1.00	1.00	0.04	1.00	
Satd. Flow (perm)		1636		1252	1883	1601	90	3579	1601	80	3577	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	39	53	5	147	20	53	41	2789	154	53	1813	5
RTOR Reduction (vph)	0	2	0	0	0	43	0	0	22	0	0	0
Lane Group Flow (vph)	0	95	0	147	20	10	41	2789	132	53	1818	0
Turn Type	Perm	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4		4	6		6	2		
Actuated Green, G (s)		29.0		29.0	29.0	29.0	99.0	99.0	99.0	98.5	98.5	
Effective Green, g (s)		29.0		29.0	29.0	29.0	99.0	99.0	99.0	98.5	98.5	
Actuated g/C Ratio		0.19		0.19	0.19	0.19	0.66	0.66	0.66	0.66	0.66	
Clearance Time (s)		6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		316		242	364	309	110	2362	1056	98	2348	
v/s Ratio Prot					0.01		0.01	c0.78		0.01	c0.51	
v/s Ratio Perm		0.06		c0.12		0.01	0.23		0.08	0.34		
v/c Ratio		0.30		0.61	0.05	0.03	0.37	1.18	0.12	0.54	0.77	
Uniform Delay, d1		51.8		55.3	49.3	49.1	22.7	25.5	9.4	68.2	18.0	
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.07	1.08	
Incremental Delay, d2		0.5		4.3	0.1	0.0	2.1	86.1	0.2	4.7	2.0	
Delay (s)		52.4		59.6	49.4	49.2	24.8	111.6	9.7	77.7	21.4	
Level of Service		D		E	D	D	C	F	A	E	C	
Approach Delay (s)		52.4			56.1			105.1			23.0	
Approach LOS		D			E			F			C	

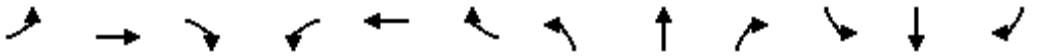
Intersection Summary			
HCM 2000 Control Delay	72.3	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (veh/h)	36	5	142	5	5	5	106	2728	5	5	1739	76
Future Volume (Veh/h)	36	5	142	5	5	5	106	2728	5	5	1739	76
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	39	5	154	5	5	5	115	2965	5	5	1890	83
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (m)											158	
pX, platoon unblocked	0.67	0.67	0.67	0.67	0.67		0.67					
vC, conflicting volume	3167	5142	672	3994	5180	991	1973			2970		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2523	5452	0	3749	5509	991	752			2970		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	79	0	0	98	80			96		
cM capacity (veh/h)	0	0	731	0	0	245	575			116		

Direction, Lane #	SE 1	NW 1	NE 1	NE 2	NE 3	NE 4	SW 1	SW 2	SW 3	SW 4
Volume Total	198	15	115	1186	1186	598	5	756	756	461
Volume Left	39	5	115	0	0	0	5	0	0	0
Volume Right	154	5	0	0	0	5	0	0	0	83
cSH	0	0	575	1700	1700	1700	116	1700	1700	1700
Volume to Capacity	Err	Err	0.20	0.70	0.70	0.35	0.04	0.44	0.44	0.27
Queue Length 95th (m)	Err	Err	5.6	0.0	0.0	0.0	1.0	0.0	0.0	0.0
Control Delay (s)	Err	Err	12.8	0.0	0.0	0.0	37.4	0.0	0.0	0.0
Lane LOS	F	F	B				E			
Approach Delay (s)	Err	Err	0.5				0.1			
Approach LOS	F	F								

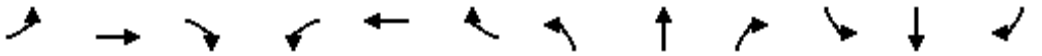
Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	78.7%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	152	73	38	95	130	70	68	2798	144	109	1977	272
Future Volume (vph)	152	73	38	95	130	70	68	2798	144	109	1977	272
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	5142	1601	1789	5142	1601
Flt Permitted	0.57	1.00	1.00	0.71	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1076	1883	1601	1329	1883	1601	1789	5142	1601	1789	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	79	41	103	141	76	74	3041	157	118	2149	296
RTOR Reduction (vph)	0	0	33	0	0	61	0	0	40	0	0	104
Lane Group Flow (vph)	165	79	8	103	141	15	74	3041	117	118	2149	192
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	29.5	29.5	29.5	29.5	29.5	29.5	10.5	92.5	92.5	10.0	92.0	92.0
Effective Green, g (s)	29.5	29.5	29.5	29.5	29.5	29.5	10.5	92.5	92.5	10.0	92.0	92.0
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20	0.20	0.07	0.62	0.62	0.07	0.61	0.61
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	211	370	314	261	370	314	125	3170	987	119	3153	981
v/s Ratio Prot		0.04			0.07		0.04	c0.59		c0.07	0.42	
v/s Ratio Perm	c0.15		0.01	0.08		0.01			0.07			0.12
v/c Ratio	0.78	0.21	0.03	0.39	0.38	0.05	0.59	0.96	0.12	0.99	0.68	0.20
Uniform Delay, d1	57.2	50.5	48.6	52.5	52.3	48.9	67.7	27.0	11.9	70.0	19.3	12.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.24	0.42	0.24	0.79	0.59	0.59
Incremental Delay, d2	17.0	0.3	0.0	1.0	0.7	0.1	4.3	5.9	0.1	69.1	0.9	0.3
Delay (s)	74.2	50.8	48.7	53.5	53.0	48.9	87.9	17.1	3.0	124.0	12.3	7.9
Level of Service	E	D	D	D	D	D	F	B	A	F	B	A
Approach Delay (s)		64.0			52.2			18.0			16.9	
Approach LOS		E			D			B			B	

Intersection Summary			
HCM 2000 Control Delay	21.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	95.4%	ICU Level of Service	F
Analysis Period (min)	15		

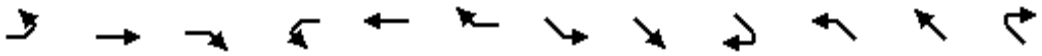
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	2943	85	10	1993	107	50	34	6	61	19	29
Future Volume (vph)	48	2943	85	10	1993	107	50	34	6	61	19	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.91	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	5142	1601	1789	5142	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.74	1.00	1.00	0.73	1.00	1.00
Satd. Flow (perm)	1789	5142	1601	1789	5142	1601	1401	1883	1601	1381	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	52	3199	92	11	2166	116	54	37	7	66	21	32
RTOR Reduction (vph)	0	0	18	0	0	42	0	0	6	0	0	28
Lane Group Flow (vph)	52	3199	74	11	2166	74	54	37	1	66	21	4
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	18.7	109.0	109.0	2.0	92.3	92.3	21.0	21.0	21.0	21.0	21.0	21.0
Effective Green, g (s)	18.7	109.0	109.0	2.0	92.3	92.3	21.0	21.0	21.0	21.0	21.0	21.0
Actuated g/C Ratio	0.12	0.73	0.73	0.01	0.62	0.62	0.14	0.14	0.14	0.14	0.14	0.14
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	223	3736	1163	23	3164	985	196	263	224	193	263	224
v/s Ratio Prot	0.03	c0.62		0.01	c0.42			0.02			0.01	
v/s Ratio Perm			0.05			0.05	0.04		0.00	c0.05		0.00
v/c Ratio	0.23	0.86	0.06	0.48	0.68	0.07	0.28	0.14	0.00	0.34	0.08	0.02
Uniform Delay, d1	59.2	14.8	5.9	73.5	19.2	11.6	57.7	56.6	55.5	58.3	56.1	55.6
Progression Factor	0.77	0.58	1.03	1.12	0.60	0.89	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.9	0.0	11.3	0.9	0.1	0.8	0.2	0.0	1.1	0.1	0.0
Delay (s)	46.0	9.5	6.1	93.4	12.4	10.4	58.5	56.8	55.5	59.3	56.2	55.7
Level of Service	D	A	A	F	B	B	E	E	E	E	E	E
Approach Delay (s)		10.0			12.7			57.6			57.8	
Approach LOS		A			B			E			E	

Intersection Summary			
HCM 2000 Control Delay	12.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		

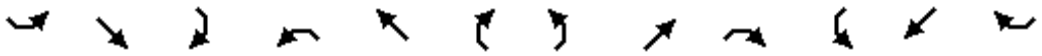
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	279	2900	326	181	1782	109	65	6	154	190	5	113
Future Volume (vph)	279	2900	326	181	1782	109	65	6	154	190	5	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3471	5142	1601	3471	5142	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.75	1.00	1.00	0.75	1.00	1.00
Satd. Flow (perm)	3471	5142	1601	3471	5142	1601	1421	1883	1601	1418	1883	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	303	3152	354	197	1937	118	71	7	167	207	5	123
RTOR Reduction (vph)	0	0	47	0	0	29	0	0	133	0	0	93
Lane Group Flow (vph)	303	3152	307	197	1937	89	71	7	34	207	5	30
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			6			2	
Permitted Phases			4			8	6		6	2		2
Actuated Green, G (s)	17.7	92.9	92.9	9.0	84.2	84.2	30.1	30.1	30.1	30.1	30.1	30.1
Effective Green, g (s)	17.7	92.9	92.9	9.0	84.2	84.2	30.1	30.1	30.1	30.1	30.1	30.1
Actuated g/C Ratio	0.12	0.62	0.62	0.06	0.56	0.56	0.20	0.20	0.20	0.20	0.20	0.20
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	409	3184	991	208	2886	898	285	377	321	284	377	321
v/s Ratio Prot	0.09	c0.61		c0.06	0.38			0.00			0.00	
v/s Ratio Perm			0.19			0.06	0.05		0.02	c0.15		0.02
v/c Ratio	0.74	0.99	0.31	0.95	0.67	0.10	0.25	0.02	0.10	0.73	0.01	0.09
Uniform Delay, d1	63.9	28.1	13.5	70.3	23.2	15.3	50.4	48.1	48.9	56.1	48.0	48.8
Progression Factor	1.00	1.00	1.00	0.71	0.30	0.27	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.1	13.8	0.8	40.7	1.0	0.2	0.5	0.0	0.1	9.0	0.0	0.1
Delay (s)	71.0	41.9	14.3	90.8	7.9	4.4	50.9	48.1	49.1	65.1	48.1	49.0
Level of Service	E	D	B	F	A	A	D	D	D	E	D	D
Approach Delay (s)		41.6			15.0			49.6			59.0	
Approach LOS		D			B			D			E	

Intersection Summary			
HCM 2000 Control Delay	33.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	93.4%	ICU Level of Service	F
Analysis Period (min)	15		

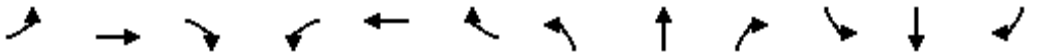
c Critical Lane Group



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	21	376	255	118	217	7	443	642	308	12	308	35
Future Volume (vph)	21	376	255	118	217	7	443	642	308	12	308	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0		6.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00		1.00	1.00	0.85		0.99	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1878	1601	1789	1874		1789	1883	1601		1855	
Flt Permitted		0.97	1.00	0.12	1.00		0.49	1.00	1.00		0.97	
Satd. Flow (perm)		1830	1601	234	1874		929	1883	1601		1807	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	23	409	277	128	236	8	482	698	335	13	335	38
RTOR Reduction (vph)	0	0	161	0	1	0	0	0	118	0	4	0
Lane Group Flow (vph)	0	432	116	128	243	0	482	698	217	0	382	0
Turn Type	Perm	NA	Perm	pm+pt	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6		5	2			4			8	
Permitted Phases	6		6	2			4		4	8		
Actuated Green, G (s)		27.8	27.8	38.8	38.8		58.0	58.0	58.0		58.0	
Effective Green, g (s)		27.8	27.8	38.8	38.8		58.0	58.0	58.0		58.0	
Actuated g/C Ratio		0.26	0.26	0.36	0.36		0.53	0.53	0.53		0.53	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0	6.0		6.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		467	409	154	668		495	1003	853		963	
v/s Ratio Prot				c0.04	0.13			0.37				
v/s Ratio Perm		c0.24	0.07	0.26			c0.52		0.14		0.21	
v/c Ratio		0.93	0.28	0.83	0.36		0.97	0.70	0.25		0.40	
Uniform Delay, d1		39.5	32.5	29.1	25.9		24.7	18.9	13.7		15.0	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		24.2	0.4	30.0	0.3		33.5	2.1	0.2		0.3	
Delay (s)		63.7	32.9	59.1	26.2		58.1	21.0	13.9		15.3	
Level of Service		E	C	E	C		E	C	B		B	
Approach Delay (s)		51.6			37.5			31.2			15.3	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	34.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	108.8	Sum of lost time (s)	18.0
Intersection Capacity Utilization	105.6%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	180	109	240	184	63	97	58	2620	342	169	1934	56
Future Volume (vph)	180	109	240	184	63	97	58	2620	342	169	1934	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	3471	5142	1601	1789	5142	1601
Flt Permitted	0.71	1.00	1.00	0.63	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1342	1883	1601	1187	1883	1601	3471	5142	1601	1789	5142	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	118	261	200	68	105	63	2848	372	184	2102	61
RTOR Reduction (vph)	0	0	86	0	0	83	0	0	58	0	0	25
Lane Group Flow (vph)	196	118	175	200	68	22	63	2848	314	184	2102	36
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)	31.2	31.2	31.2	31.2	31.2	31.2	11.6	83.6	83.6	17.2	89.2	89.2
Effective Green, g (s)	31.2	31.2	31.2	31.2	31.2	31.2	11.6	83.6	83.6	17.2	89.2	89.2
Actuated g/C Ratio	0.21	0.21	0.21	0.21	0.21	0.21	0.08	0.56	0.56	0.11	0.59	0.59
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	279	391	333	246	391	333	268	2865	892	205	3057	952
v/s Ratio Prot		0.06			0.04		0.02	c0.55		c0.10	0.41	
v/s Ratio Perm	0.15		0.11	c0.17		0.01			0.20			0.02
v/c Ratio	0.70	0.30	0.52	0.81	0.17	0.07	0.24	0.99	0.35	0.90	0.69	0.04
Uniform Delay, d1	55.1	50.2	52.8	56.6	48.8	47.7	65.0	33.0	18.3	65.5	20.8	12.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.76	0.33	0.24	1.00	1.00	1.00
Incremental Delay, d2	7.8	0.4	1.5	18.2	0.2	0.1	0.2	9.1	0.4	35.7	1.3	0.1
Delay (s)	62.9	50.6	54.3	74.8	49.0	47.8	49.5	19.9	4.8	101.2	22.1	12.7
Level of Service	E	D	D	E	D	D	D	B	A	F	C	B
Approach Delay (s)		56.5			62.5			18.7			28.1	
Approach LOS		E			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	27.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	91.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX E
TRAFFIC SIGNAL WARRANT ANALYSES

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Emes Road	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2015 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		3,350	2
McPhillips Street	SB	1		2			1	2,150	2
Emes Road	WB				1				
Emes Road	EB				1				

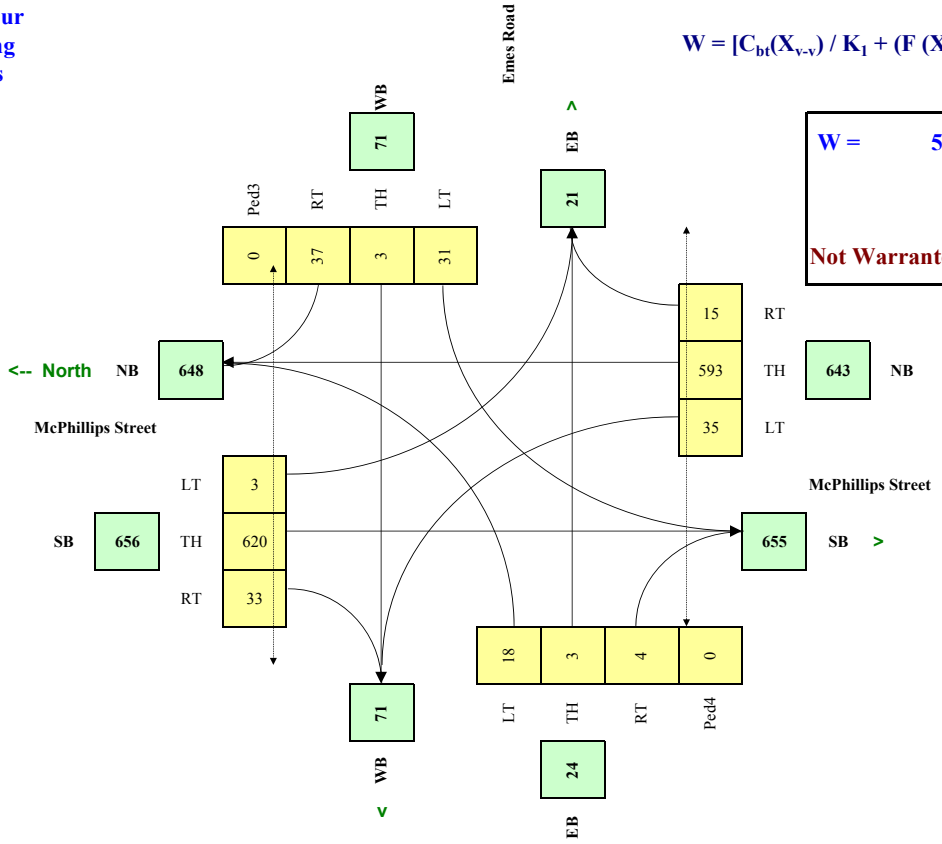
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	4.9%	n	10.0
Emes Road	EW		12.6%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	80	670	10	5	1945	100	45	5	40	55	5	5				
8:00 - 9:00																
12:00 - 13:00	85	780	25	5	790	40	45	5	85	30	5	10				
13:00 - 14:00																
4:00 - 5:00	45	2110	55	10	985	55	95	10	95	20	5	10				
5:00 - 6:00																
Total (6-hour peak)	210	3,560	90	20	3,720	195	185	20	220	105	15	25	0	0	0	0
Average (6-hour peak)	35	593	15	3	620	33	31	3	37	18	3	4	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	51	51	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Emes Road	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2025 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		3,350	2
McPhillips Street	SB	1		2			1	2,150	2
Emes Road	WB				1				
Emes Road	EB				1				

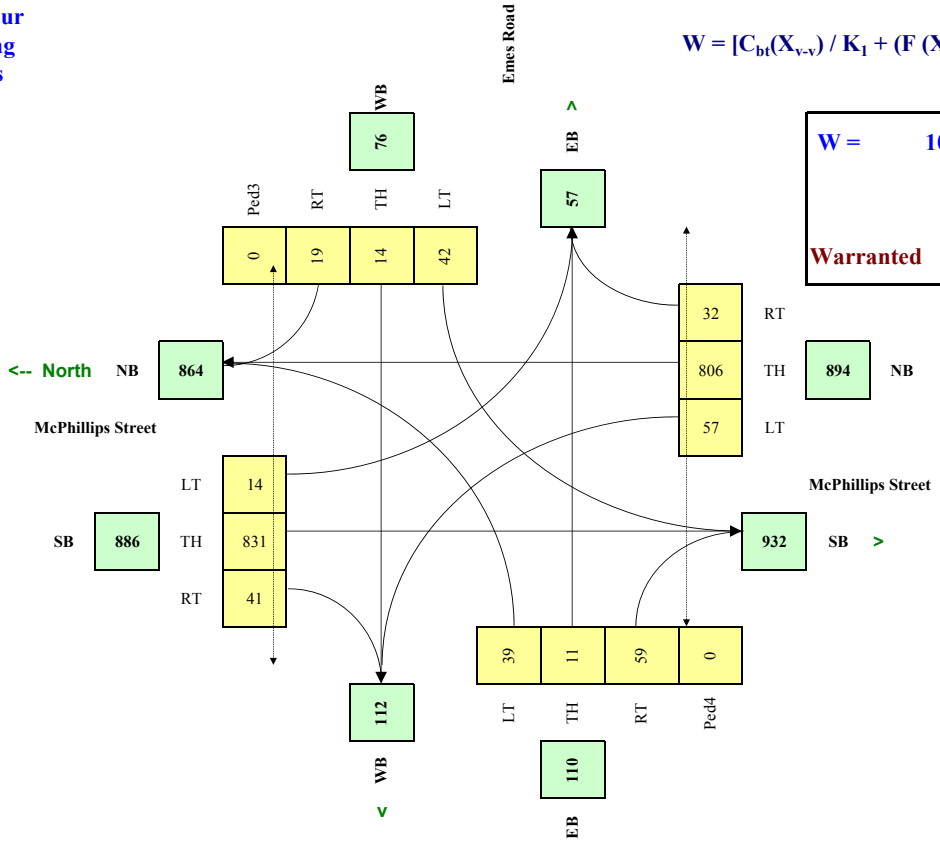
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	4.9%	n	10.0
Emes Road	EW		12.6%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	137	918	28	19	2338	130	123	35	48	51	16	64				
8:00 - 9:00																
12:00 - 13:00	145	1069	18	12	949	52	67	23	31	51	10	136				
13:00 - 14:00																
4:00 - 5:00	59	2848	144	55	1696	62	64	27	35	133	41	156				
5:00 - 6:00																
Total (6-hour peak)	341	4,835	190	86	4,983	244	254	85	114	235	67	356	0	0	0	0
Average (6-hour peak)	57	806	32	14	831	41	42	14	19	39	11	59	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	109	109	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Emes Road	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2035 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		3,350	2
McPhillips Street	SB	1		2			1	2,150	2
Emes Road	WB				1				
Emes Road	EB				1				

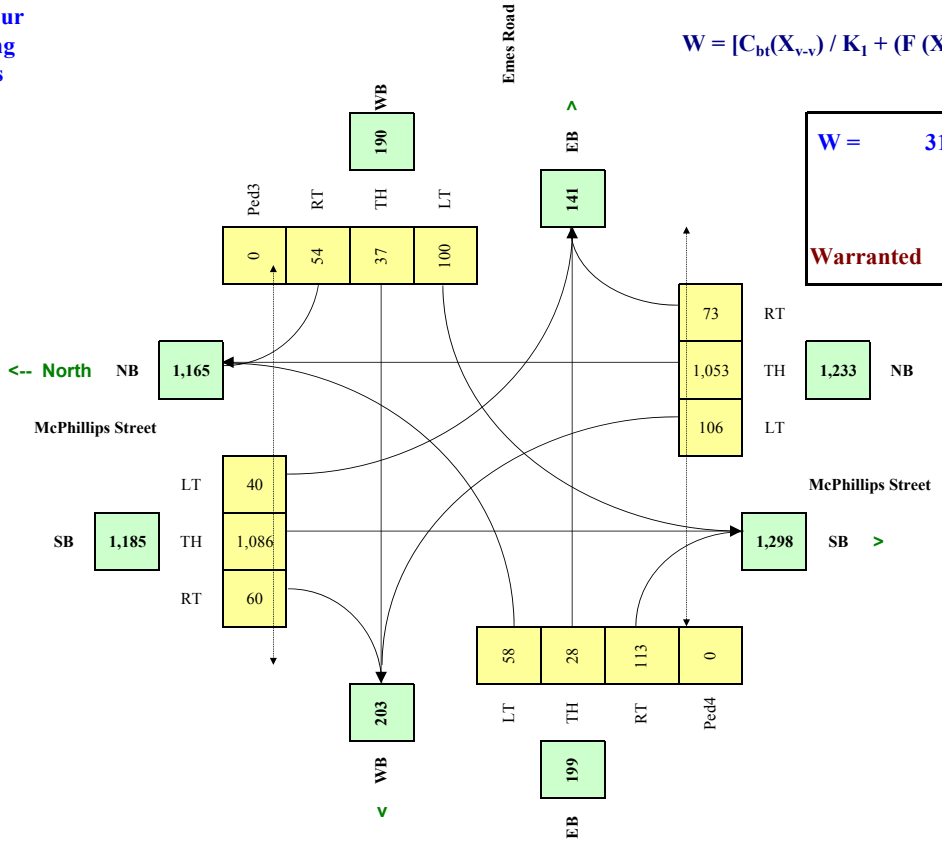
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	4.9%	n	10.0
Emes Road	EW		12.6%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	267	1226	72	46	2981	200	279	95	138	65	34	120				
8:00 - 9:00																
12:00 - 13:00	283	1427	46	29	1211	80	152	61	88	65	22	255				
13:00 - 14:00																
4:00 - 5:00	88	3667	321	162	2323	79	166	66	95	219	111	302				
5:00 - 6:00																
Total (6-hour peak)	**638**	**6,320**	**439**	**237**	**6,515**	**359**	**597**	**222**	**321**	**349**	**167**	**677**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**106**	**1,053**	**73**	**40**	**1,086**	**60**	**100**	**37**	**54**	**58**	**28**	**113**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	315	315	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Fernbank Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2040 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				640	2
McPhillips Street	SB			1		1		460	2
Fernbank Ave	WB								
Fernbank Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

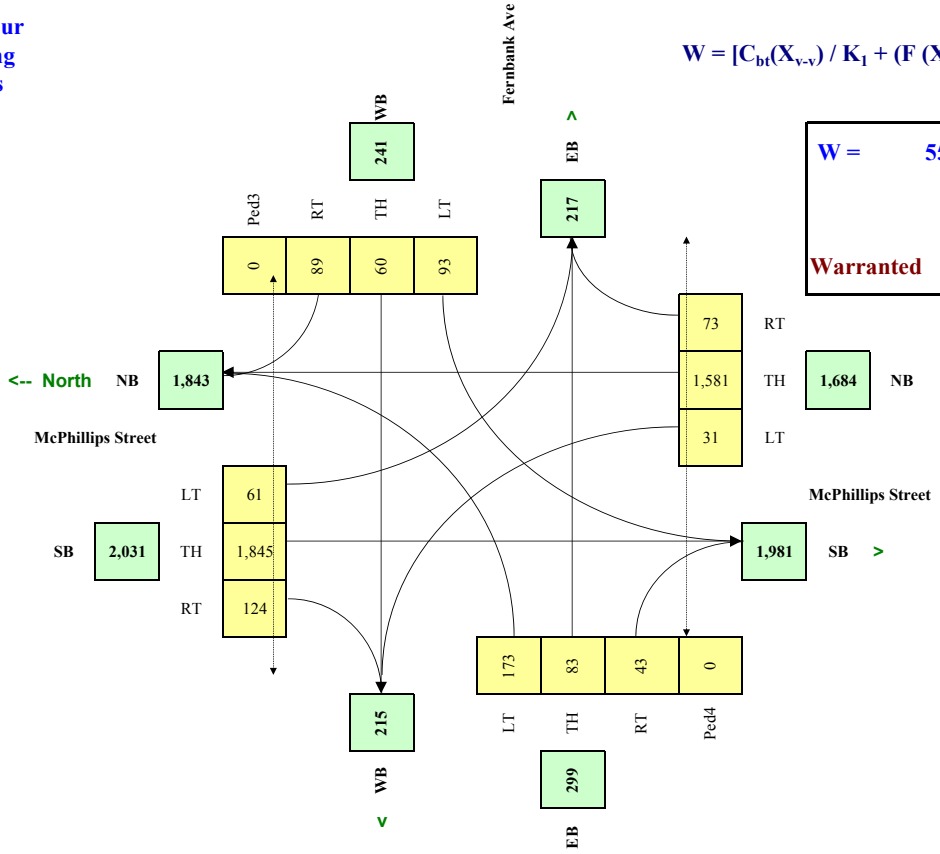
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	5.0%	n	10.0
Fernbank Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	32	2458	95	95	4396	131	226	64	242	452	215	113				
8:00 - 9:00																
11:00 - 12:00	20	1580	61	61	2825	84	145	41	155	290	138	73				
12:00 - 13:00																
16:15 - 17:15	132	5448	280	212	3849	530	185	253	136	296	142	74				
17:15 - 18:15																
Total (6-hour peak)	**184**	**9,486**	**436**	**368**	**11,070**	**745**	**556**	**358**	**533**	**1,038**	**495**	**260**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**31**	**1,581**	**73**	**61**	**1,845**	**124**	**93**	**60**	**89**	**173**	**83**	**43**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	557	557	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Emes Road	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2025 Stage 1 Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		3,350	2
McPhillips Street	SB	1		2			1	2,150	2
Emes Road	WB				1				
Emes Road	EB				1				

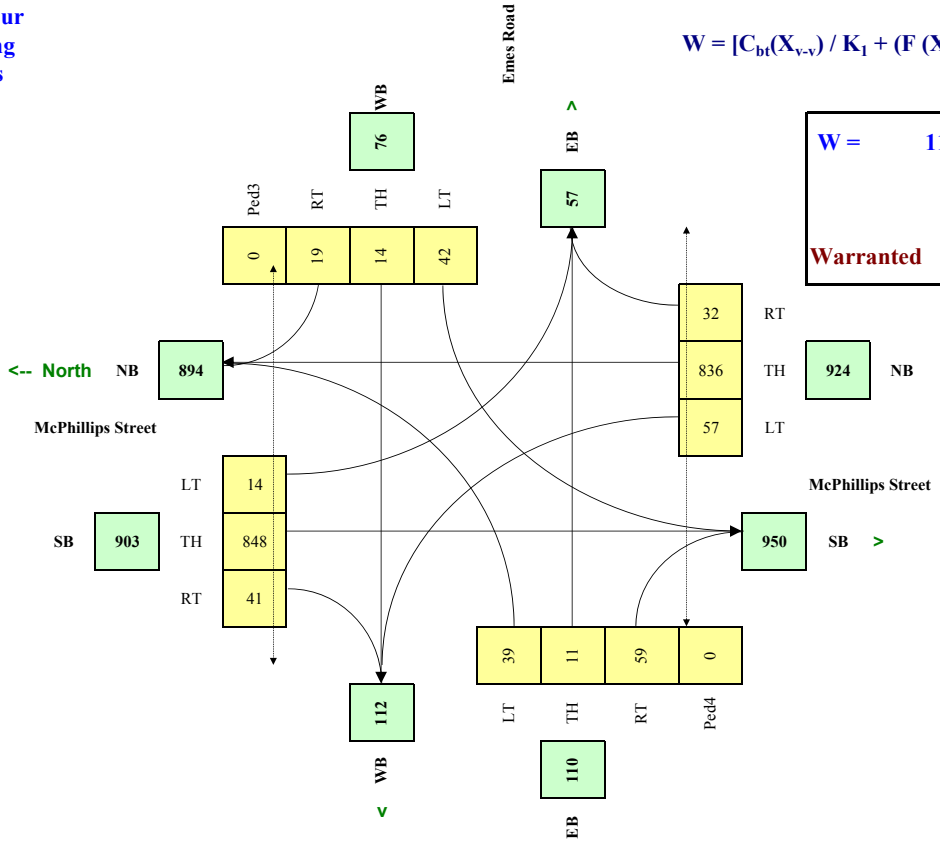
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	4.9%	n	10.0
Emes Road	EW		12.6%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	137	983	28	19	2355	130	123	35	48	51	16	64				
8:00 - 9:00																
12:00 - 13:00	145	1145	18	12	957	52	67	23	31	51	10	136				
13:00 - 14:00																
4:00 - 5:00	59	2887	144	55	1775	62	64	27	35	133	41	156				
5:00 - 6:00																
Total (6-hour peak)	341	5,015	190	86	5,087	244	254	85	114	235	67	356	0	0	0	0
Average (6-hour peak)	57	836	32	14	848	41	42	14	19	39	11	59	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	113	113	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Emes Road	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2035 Stage 2 Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		3,350	2
McPhillips Street	SB	1		2			1	2,150	2
Emes Road	WB				1				
Emes Road	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

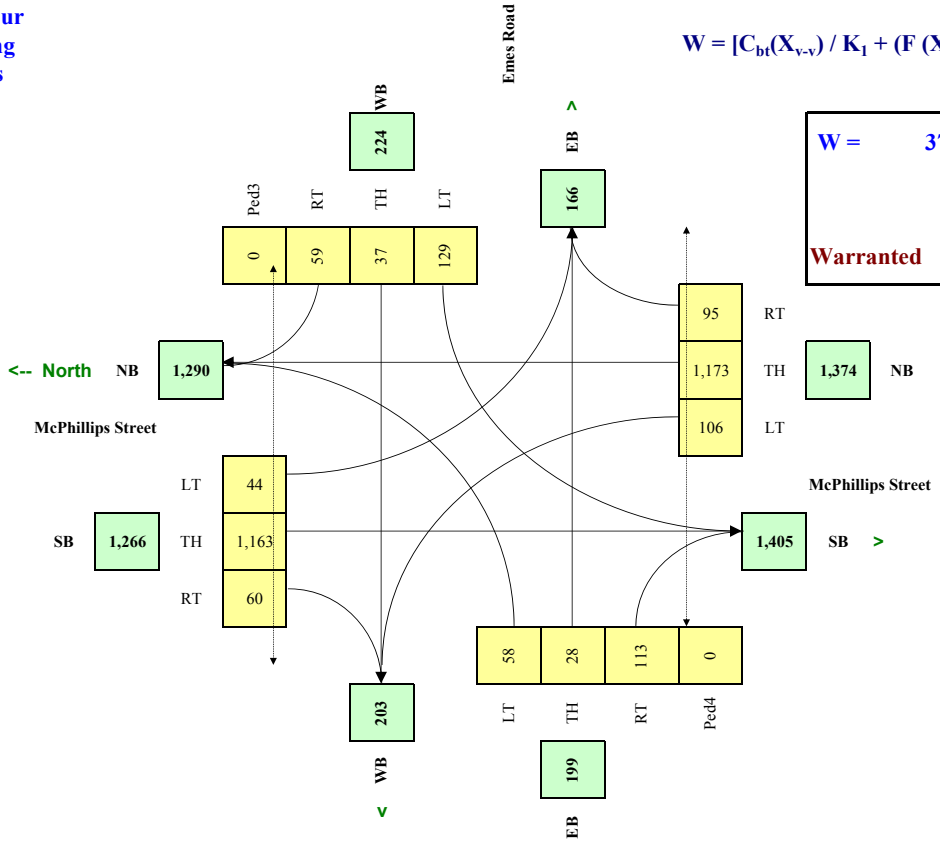
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	4.9%	n	10.0
Emes Road	EW		12.6%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	267	1465	95	51	3100	200	356	95	150	65	34	120				
8:00 - 9:00																
12:00 - 13:00	283	1705	61	33	1259	80	194	61	96	65	22	255				
13:00 - 14:00																
4:00 - 5:00	88	3870	411	177	2619	79	222	66	105	219	111	302				
5:00 - 6:00																
Total (6-hour peak)	**638**	**7,040**	**567**	**261**	**6,978**	**359**	**772**	**222**	**351**	**349**	**167**	**677**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**106**	**1,173**	**95**	**44**	**1,163**	**60**	**129**	**37**	**59**	**58**	**28**	**113**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	379	379	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Fernbank Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2035 Stage 2 Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg	
City:	Winnipeg	
Analysis Date:	2016 Dec 20, Tue	
Count Date:	-	
Date Entry Format:	(yyyy-mm-dd)	

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB			1		1		640	2
McPhillips Street	SB	1		2				460	2
Fernbank Ave	WB				1				
Fernbank Ave	EB								

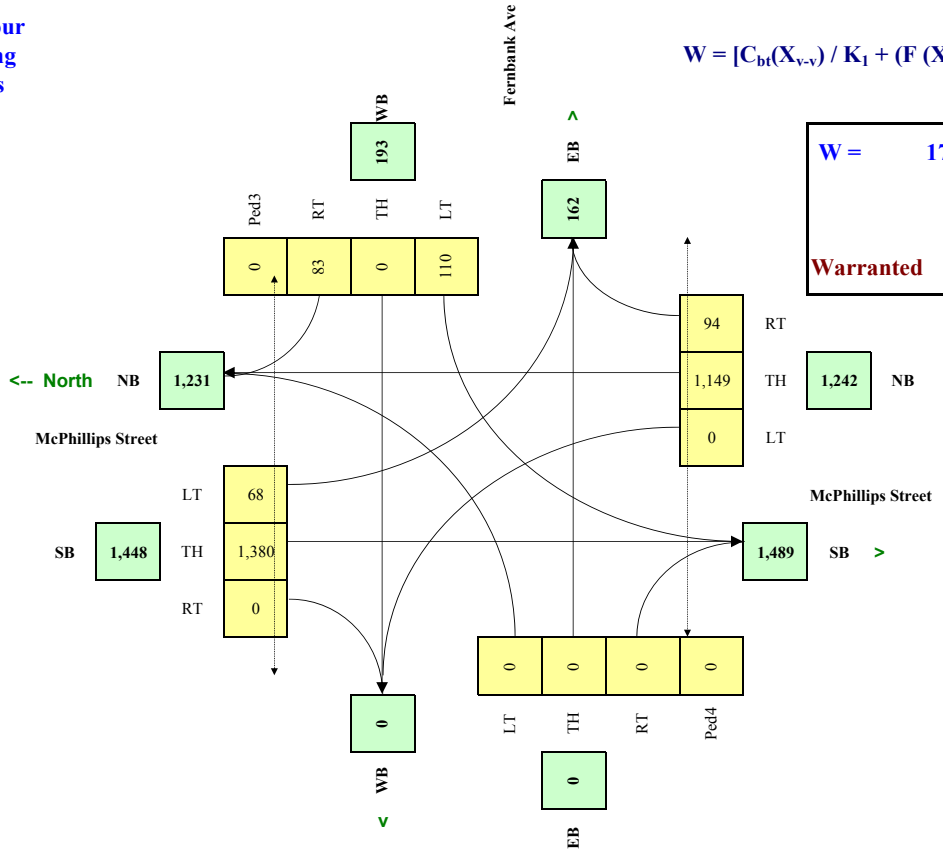
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	90	5.0%	n	10.0
Fernbank Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	1597	129	108	3382	0	236	0	191	0	0	0				
8:00 - 9:00																
12:00 - 13:00	0	1026	83	69	2173	0	152	0	122	0	0	0				
13:00 - 14:00																
4:00 - 5:00	0	4268	349	232	2722	0	271	0	183	0	0	0				
5:00 - 6:00																
Total (6-hour peak)	**0**	**6,891**	**561**	**409**	**8,277**	**0**	**659**	**0**	**496**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**1,149**	**94**	**68**	**1,380**	**0**	**110**	**0**	**83**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	174	174	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2015 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				1,800	2
McPhillips Street	SB			1		1		2,000	2
Balgona Ave	WB								
Balgona Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

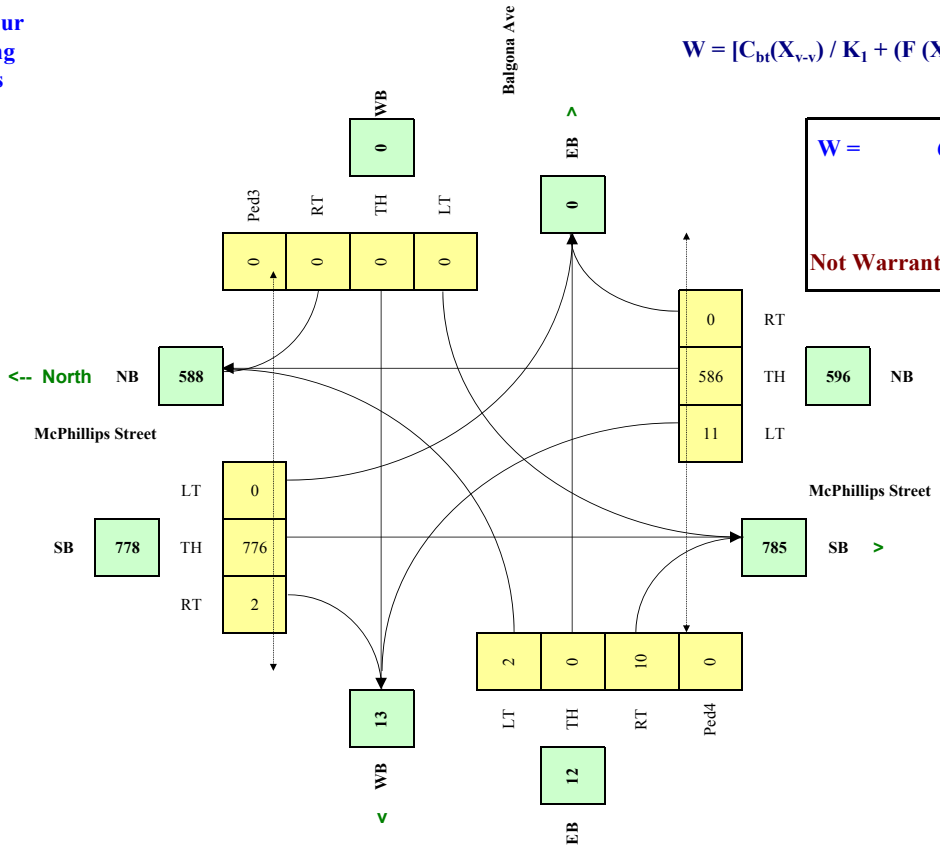
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	20	782	0	0	2142	4	0	0	0	5	0	22				
8:00 - 9:00																
11:00 - 12:00	13	502	0	0	1376	3	0	0	0	3	0	14				
12:00 - 13:00																
16:15 - 17:15	30	2229	0	0	1135	7	0	0	0	6	0	22				
17:15 - 18:15																
Total (6-hour peak)	63	3,513	0	0	4,653	14	0	0	0	14	0	58	0	0	0	0
Average (6-hour peak)	11	586	0	0	776	2	0	0	0	2	0	10	0	0	0	0

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	6	6	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2025 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				1,800	2
McPhillips Street	SB			1		1		1,200	2
Balgona Ave	WB								
Balgona Ave	EB				1				

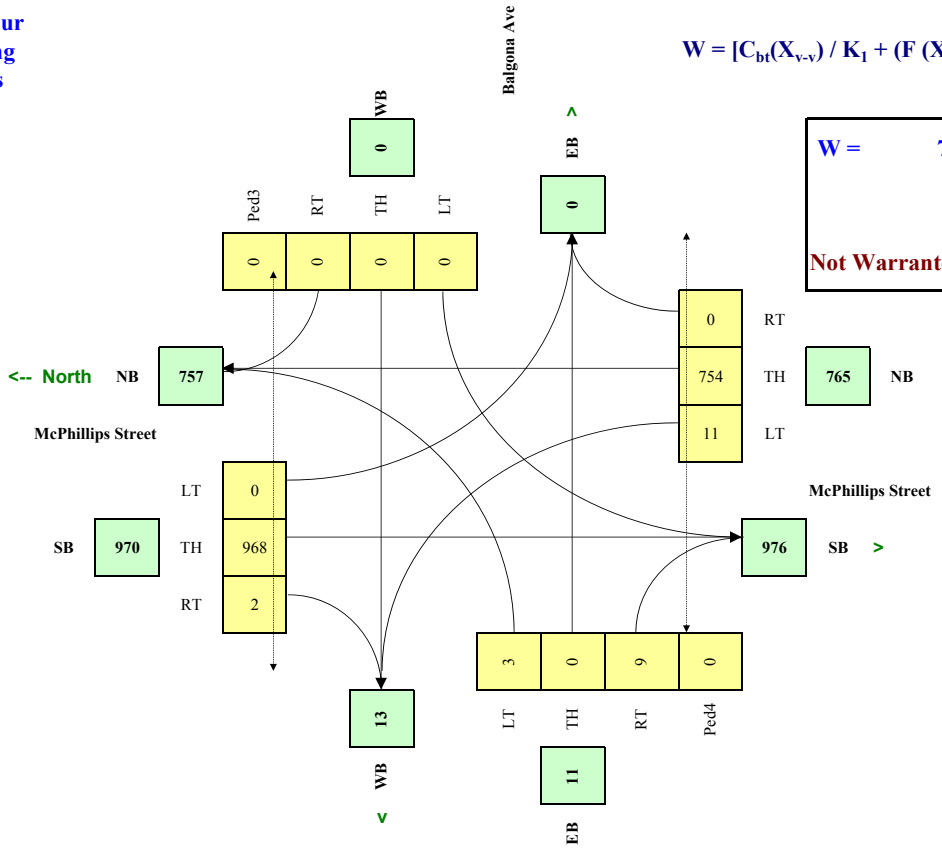
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	20	1051	0	0	2504	4	0	0	0	5	0	20				
8:00 - 9:00																
11:00 - 12:00	13	675	0	0	1609	3	0	0	0	3	0	13				
12:00 - 13:00																
16:15 - 17:15	30	2798	0	0	1693	7	0	0	0	7	0	18				
17:15 - 18:15																
Total (6-hour peak)	**63**	**4,524**	**0**	**0**	**5,806**	**14**	**0**	**0**	**0**	**15**	**0**	**51**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**11**	**754**	**0**	**0**	**968**	**2**	**0**	**0**	**0**	**3**	**0**	**9**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	7	7	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2035 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				1,800	2
McPhillips Street	SB			1		1		1,200	2
Balgona Ave	WB								
Balgona Ave	EB				1				

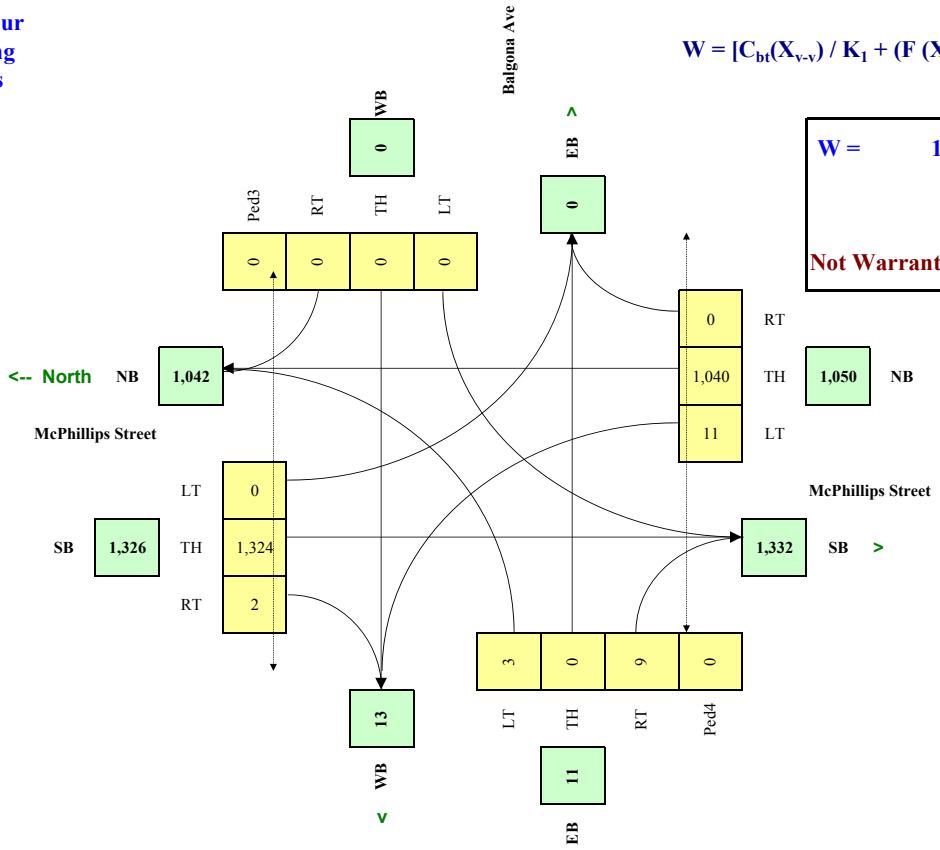
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	20	1523	0	0	3331	4	0	0	0	5	0	20				
8:00 - 9:00																
11:00 - 12:00	13	978	0	0	2140	3	0	0	0	3	0	13				
12:00 - 13:00																
16:15 - 17:15	30	3737	0	0	2471	7	0	0	0	7	0	18				
17:15 - 18:15																
Total (6-hour peak)	**63**	**6,238**	**0**	**0**	**7,942**	**14**	**0**	**0**	**0**	**15**	**0**	**51**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**11**	**1,040**	**0**	**0**	**1,324**	**2**	**0**	**0**	**0**	**3**	**0**	**9**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	10	10	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2035 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				1,800	2
McPhillips Street	SB			1		1		1,200	2
Balgona Ave	WB								
Balgona Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

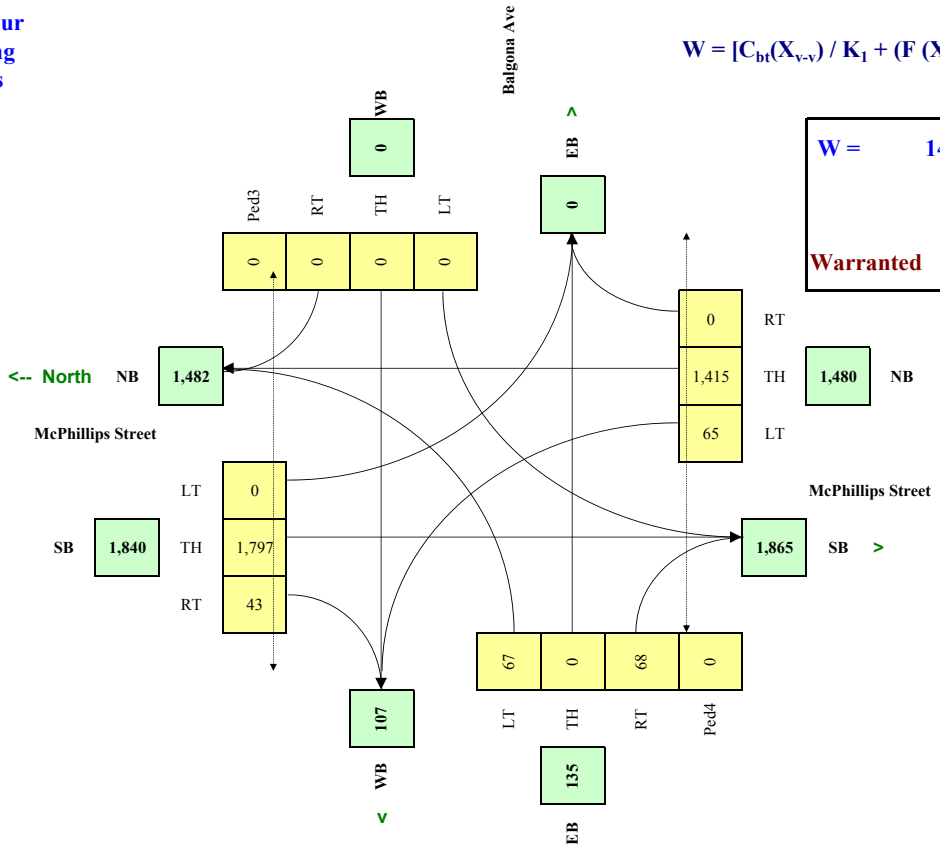
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	94	2202	0	0	4523	60	0	0	0	177	0	180				
8:00 - 9:00																
11:00 - 12:00	61	1413	0	0	2906	45	0	0	0	113	0	116				
12:00 - 13:00																
16:15 - 17:15	234	4876	0	0	3353	150	0	0	0	109	0	113				
17:15 - 18:15																
Total (6-hour peak)	**389**	**8,491**	**0**	**0**	**10,782**	**255**	**0**	**0**	**0**	**399**	**0**	**409**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**65**	**1,415**	**0**	**0**	**1,797**	**43**	**0**	**0**	**0**	**67**	**0**	**68**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	146	146	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2025 Stage 1 Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				1,800	2
McPhillips Street	SB			1		1		1,200	2
Balgona Ave	WB								
Balgona Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

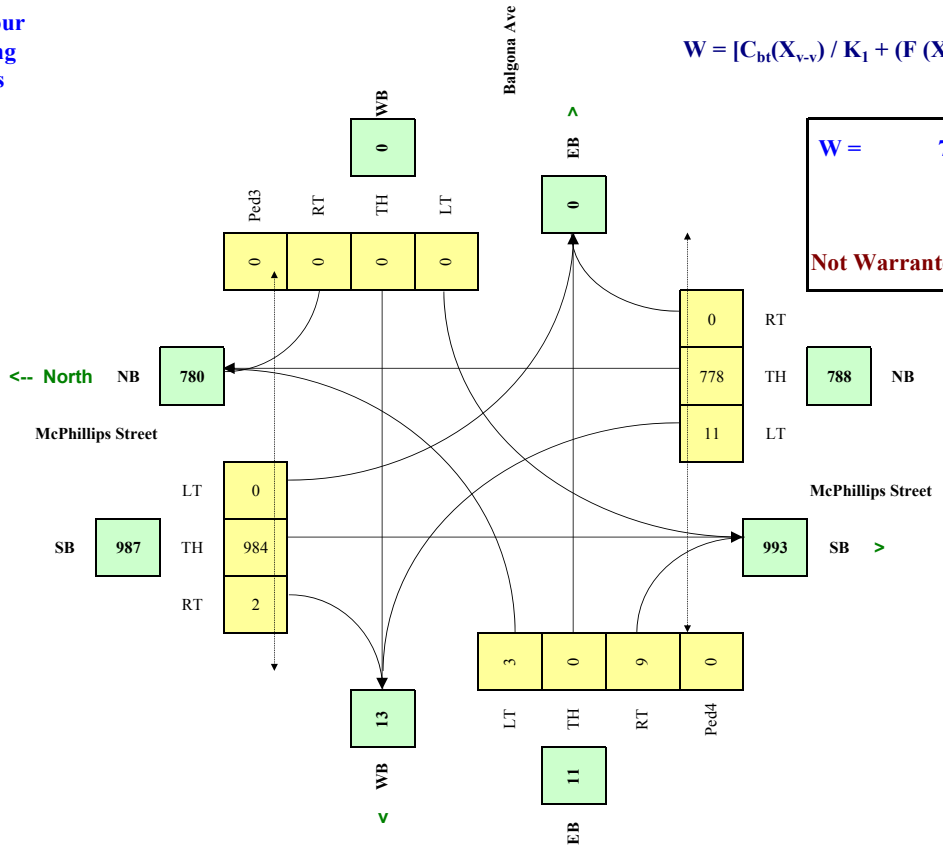
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	20	1115	0	0	2522	4	0	0	0	5	0	20				
8:00 - 9:00																
11:00 - 12:00	13	716	0	0	1620	3	0	0	0	3	0	13				
12:00 - 13:00																
16:15 - 17:15	30	2835	0	0	1763	7	0	0	0	7	0	18				
17:15 - 18:15																
Total (6-hour peak)	**63**	**4,666**	**0**	**0**	**5,905**	**14**	**0**	**0**	**0**	**15**	**0**	**51**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**11**	**778**	**0**	**0**	**984**	**2**	**0**	**0**	**0**	**3**	**0**	**9**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	7	7	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2035 Stage 2 Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				1,800	2
McPhillips Street	SB			1		1		1,200	2
Balgona Ave	WB								
Balgona Ave	EB				1				

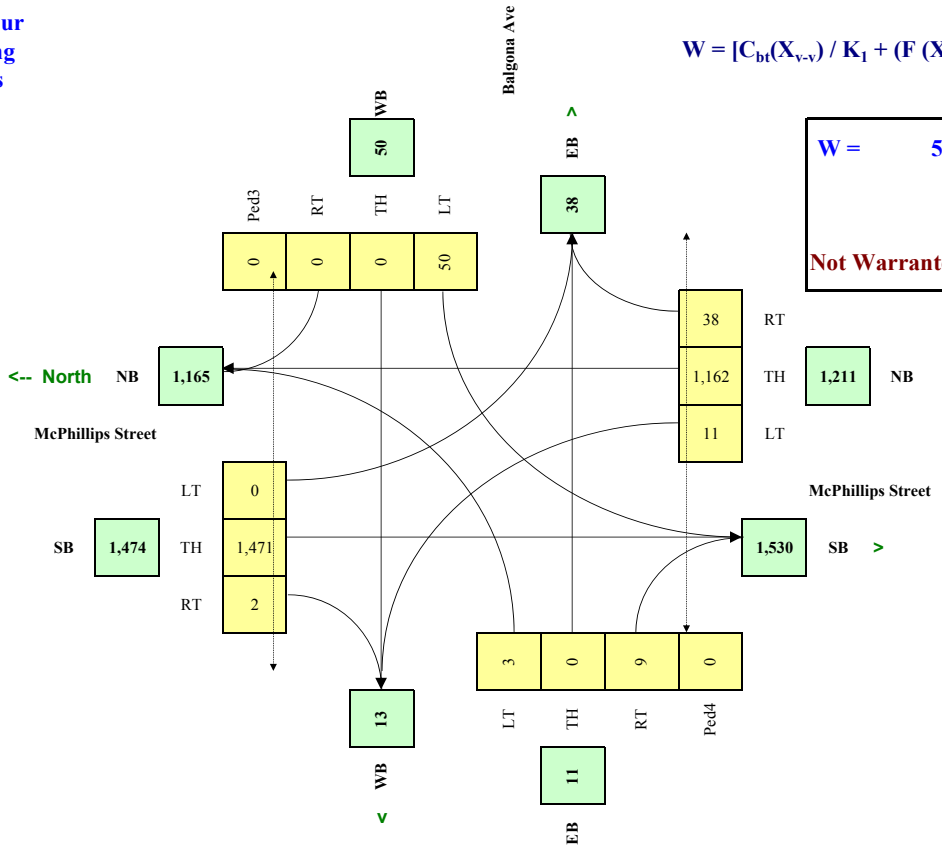
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	20	1717	89	0	3656	4	158	0	0	5	0	20				
8:00 - 9:00																
11:00 - 12:00	13	1102	57	0	2348	3	95	0	0	3	0	13				
12:00 - 13:00																
16:15 - 17:15	30	4154	84	0	2823	7	47	0	0	7	0	18				
17:15 - 18:15																
Total (6-hour peak)	**63**	**6,973**	**230**	**0**	**8,827**	**14**	**300**	**0**	**0**	**15**	**0**	**51**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**11**	**1,162**	**38**	**0**	**1,471**	**2**	**50**	**0**	**0**	**3**	**0**	**9**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	54	54	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Balgona Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2040 Full Build Out
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		2				625	2
McPhillips Street	SB			1		1		1,200	2
Balgona Ave	WB								
Balgona Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

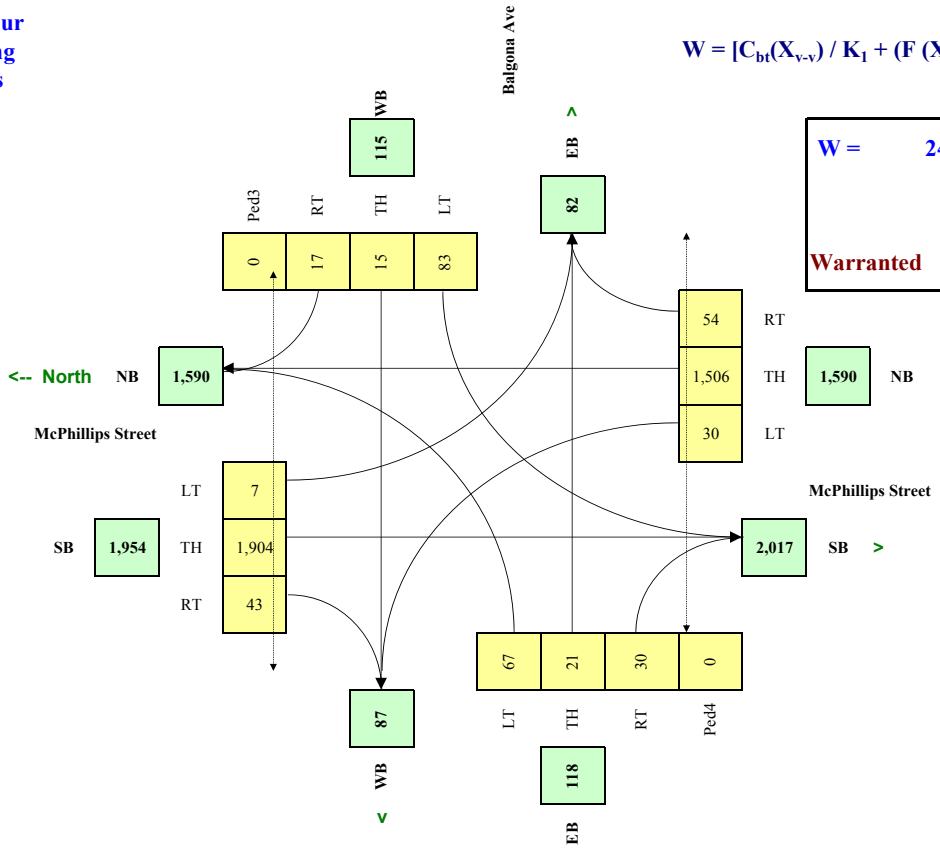
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	n	10.0
Balgona Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	46	2358	104	16	4720	60	265	16	54	177	57	77				
8:00 - 9:00																
11:00 - 12:00	30	1514	66	10	3032	45	159	10	34	113	37	49				
12:00 - 13:00																
16:15 - 17:15	103	5165	152	18	3672	150	75	61	13	109	34	52				
17:15 - 18:15																
Total (6-hour peak)	**179**	**9,037**	**322**	**44**	**11,424**	**255**	**499**	**87**	**101**	**399**	**128**	**178**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**30**	**1,506**	**54**	**7**	**1,904**	**43**	**83**	**15**	**17**	**67**	**21**	**30**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	241	241	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Murray Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2015 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		1,600	2
McPhillips Street	SB	1		1		1		2,000	2
Murray Ave	WB				1				
Murray Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

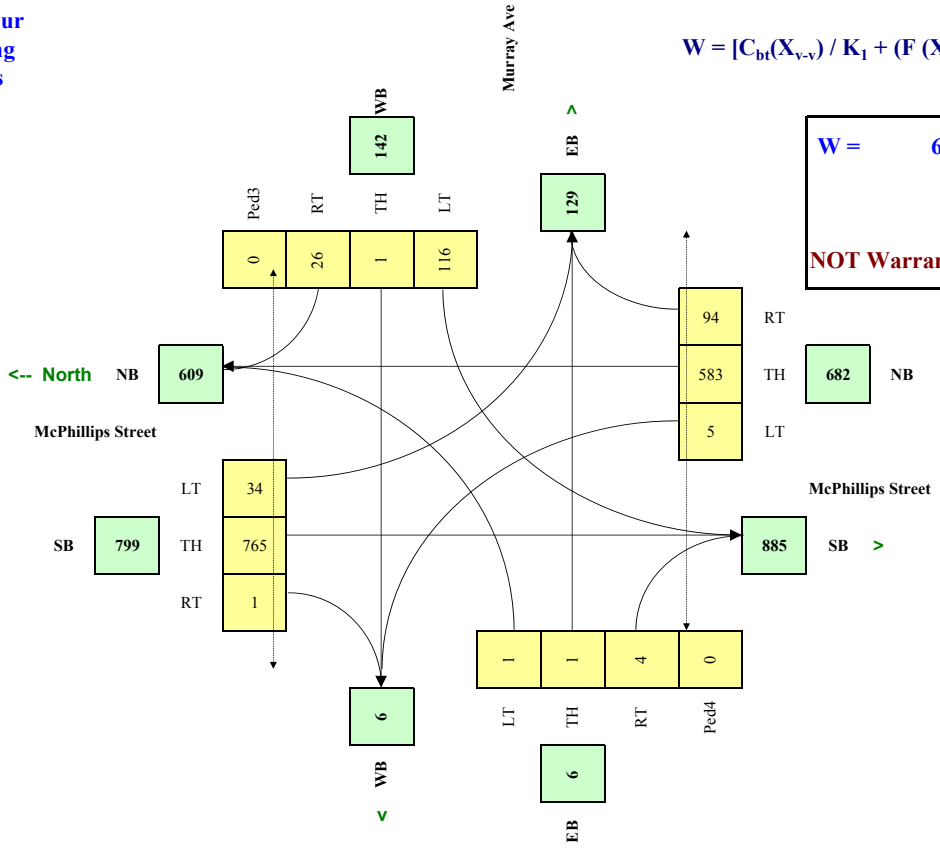
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	y	10.0
Murray Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	8	767	110	78	2112	3	306	1	61	1	1	12				
8:00 - 9:00																
11:00 - 12:00	5	493	71	50	1357	2	197	1	39	1	1	8				
12:00 - 13:00																
16:15 - 17:15	14	2236	385	73	1119	1	194	1	54	4	3	4				
17:15 - 18:15																
Total (6-hour peak)	**27**	**3,496**	**566**	**201**	**4,588**	**6**	**697**	**3**	**154**	**6**	**5**	**24**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**5**	**583**	**94**	**34**	**765**	**1**	**116**	**1**	**26**	**1**	**1**	**4**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	67	67	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Murray Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2025 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		1,600	2
McPhillips Street	SB	1		1		1		1,750	2
Murray Ave	WB				1				
Murray Ave	EB				1				

Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

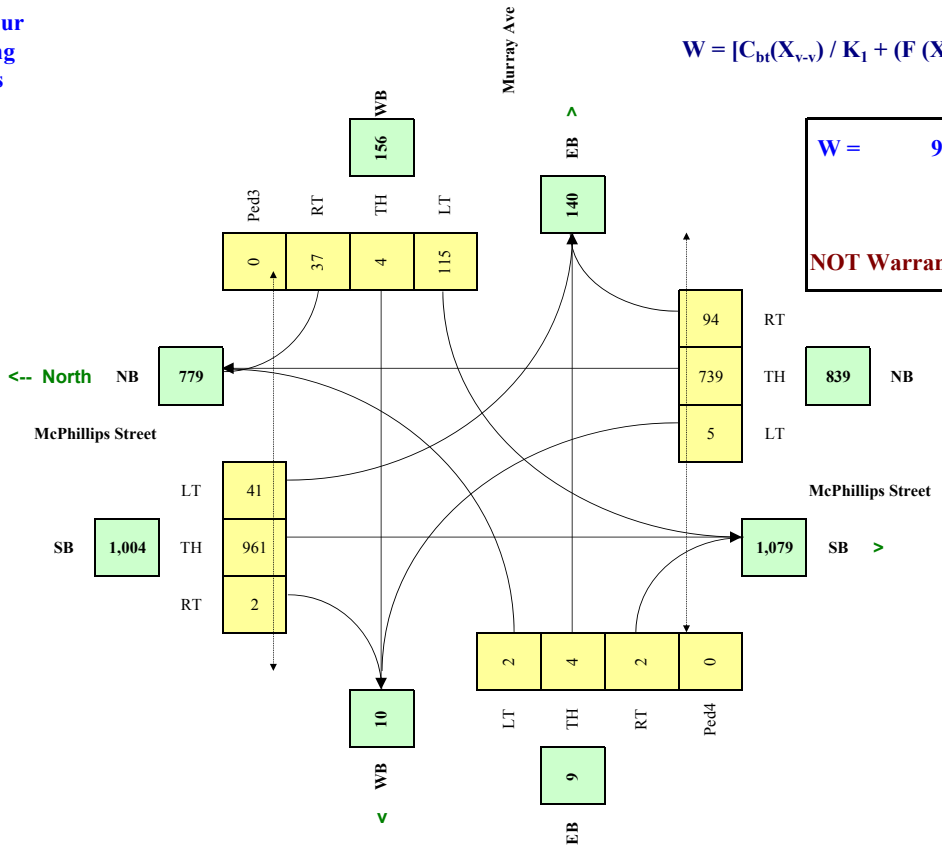
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	y	10.0
Murray Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	11	961	110	91	2530	5	302	7	90	2	9	6				
8:00 - 9:00																
11:00 - 12:00	7	618	71	58	1626	4	194	5	58	1	6	4				
12:00 - 13:00																
16:15 - 17:15	13	2857	385	99	1611	0	194	9	76	8	11	4				
17:15 - 18:15																
Total (6-hour peak)	31	4,436	566	248	5,767	9	690	21	224	11	26	14	0	0	0	0
Average (6-hour peak)	5	739	94	41	961	2	115	4	37	2	4	2	0	0	0	0

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	97	97	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS	Road Authority:	City of Winnipeg
Side Street (name)	Murray Ave	Direction (EW or NS)	EW	City:	Winnipeg
Quadrant / Int #		Comments	2035 Background Scenario	Analysis Date:	2016 Dec 20, Tue
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	-
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		1,600	2
McPhillips Street	SB	1		1		1		1,750	2
Murray Ave	WB				1				
Murray Ave	EB				1				

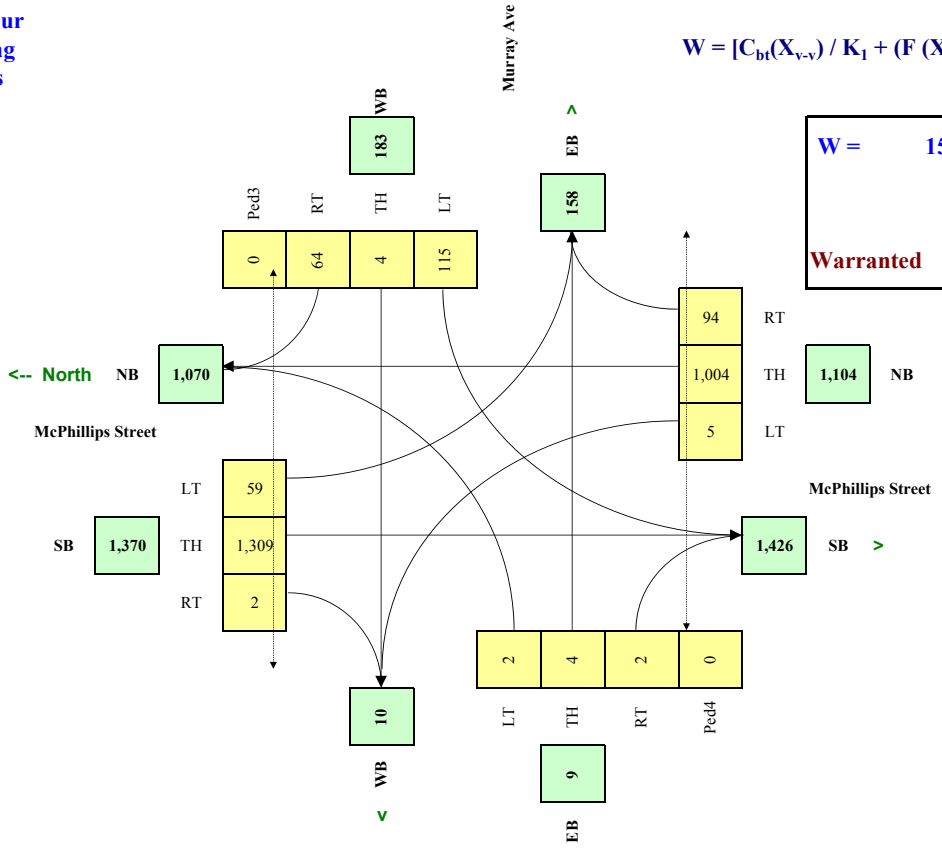
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	y	10.0
Murray Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	11	1347	110	139	3342	5	302	7	174	2	9	6				
8:00 - 9:00																
11:00 - 12:00	7	866	71	89	2147	4	194	5	112	1	6	4				
12:00 - 13:00																
16:15 - 17:15	13	3811	385	128	2363	0	194	9	98	8	11	4				
17:15 - 18:15																
Total (6-hour peak)	**31**	**6,024**	**566**	**356**	**7,852**	**9**	**690**	**21**	**384**	**11**	**26**	**14**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**5**	**1,004**	**94**	**59**	**1,309**	**2**	**115**	**4**	**64**	**2**	**4**	**2**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	159	159	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	McPhillips Street	Direction (EW or NS)	NS
Side Street (name)	Murray Ave	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2025 Stage 1 Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
McPhillips Street	NB	1		1		1		1,600	2
McPhillips Street	SB	1		1		1		1,750	2
Murray Ave	WB				1				
Murray Ave	EB				1				

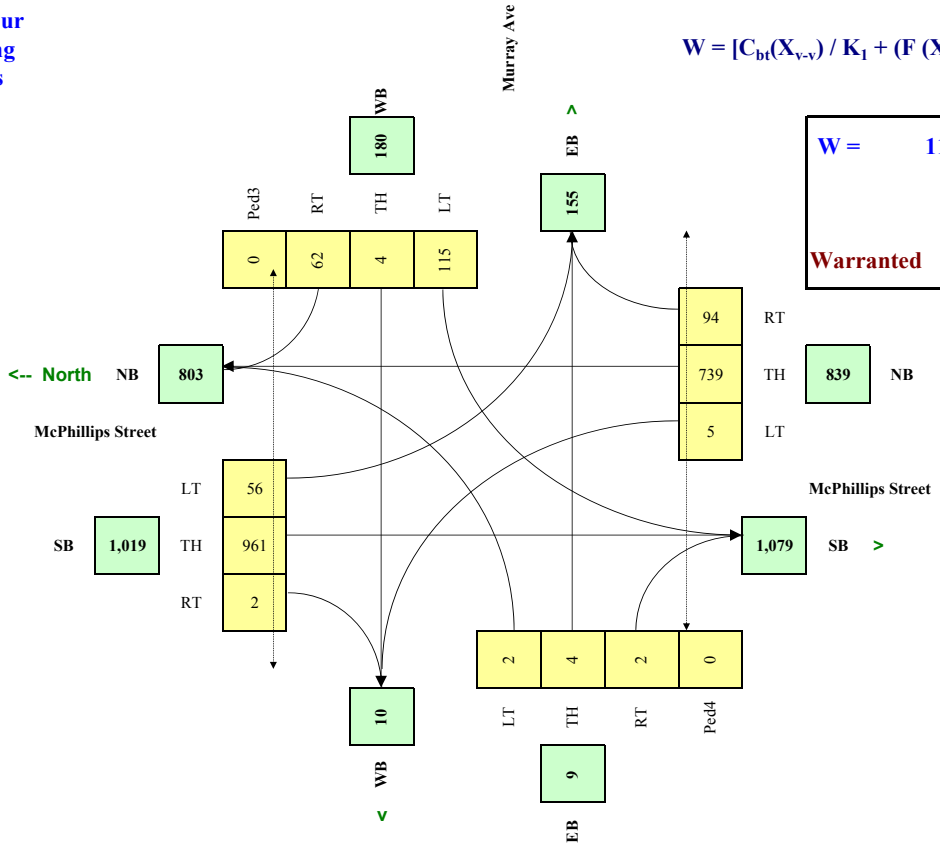
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
McPhillips Street	NS	80	5.0%	y	10.0
Murray Ave	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	11	961	110	110	2530	5	302	7	156	2	9	6				
8:00 - 9:00																
11:00 - 12:00	7	618	71	70	1626	4	194	5	100	1	6	4				
12:00 - 13:00																
16:15 - 17:15	13	2857	385	157	1611	0	194	9	115	8	11	4				
17:15 - 18:15																
Total (6-hour peak)	**31**	**4,436**	**566**	**337**	**5,767**	**9**	**690**	**21**	**371**	**11**	**26**	**14**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**5**	**739**	**94**	**56**	**961**	**2**	**115**	**4**	**62**	**2**	**4**	**2**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	116	116	0
		Veh	*Ped*

Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Murray Ave	Direction (EW or NS)	EW
Side Street (name)	Ferrier Street	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2015 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Murray Ave	WB		1					1,600	1
Murray Ave	EB					1		1,750	1
Ferrier Street	NB				1				
Ferrier Street	SB								

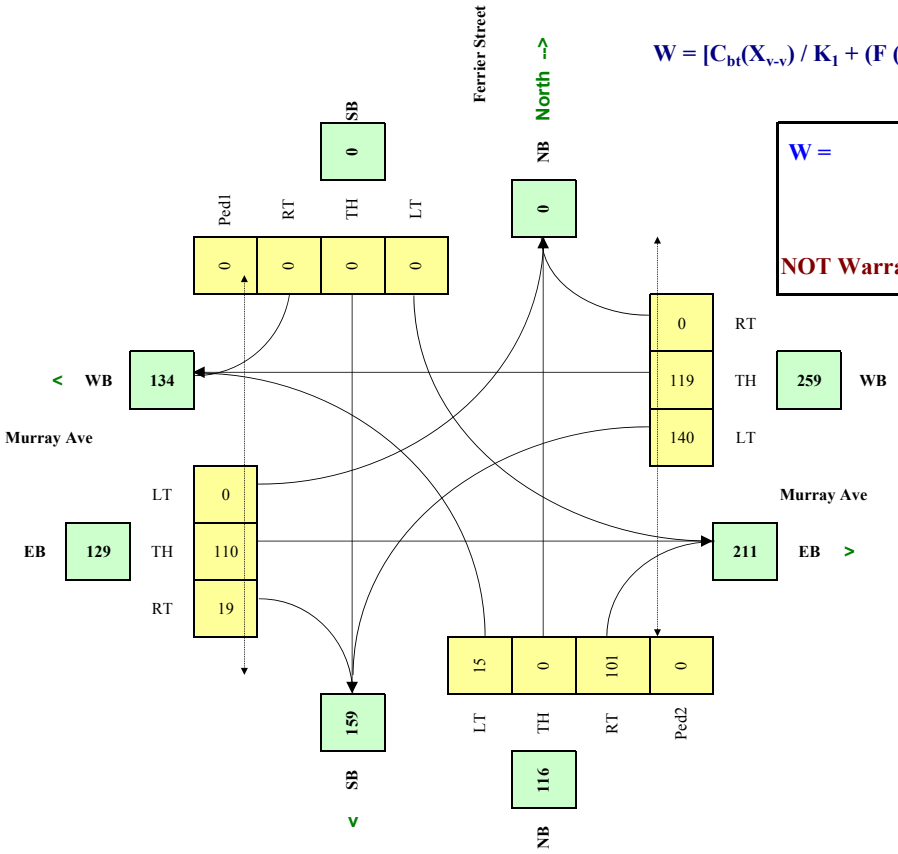
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Murray Ave	EW	50	2.0%	y	0.0
Ferrier Street	NS		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	33	0	106	0	0	0	408	301	0	0	136	49				
8:00 - 9:00																
11:00 - 12:00	21	0	68	0	0	0	262	193	0	0	87	31				
12:00 - 13:00																
16:15 - 17:15	36	0	432	0	0	0	170	217	0	0	436	35				
17:15 - 18:15																
Total (6-hour peak)	**90**	**0**	**606**	**0**	**0**	**0**	**840**	**711**	**0**	**0**	**659**	**115**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**15**	**0**	**101**	**0**	**0**	**0**	**140**	**119**	**0**	**0**	**110**	**19**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	21	21	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Murray Ave	Direction (EW or NS)	EW
Side Street (name)	Ferrier Street	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2025 Background Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Murray Ave	WB		1					1,600	1
Murray Ave	EB					1		1,750	1
Ferrier Street	NB				1				
Ferrier Street	SB								

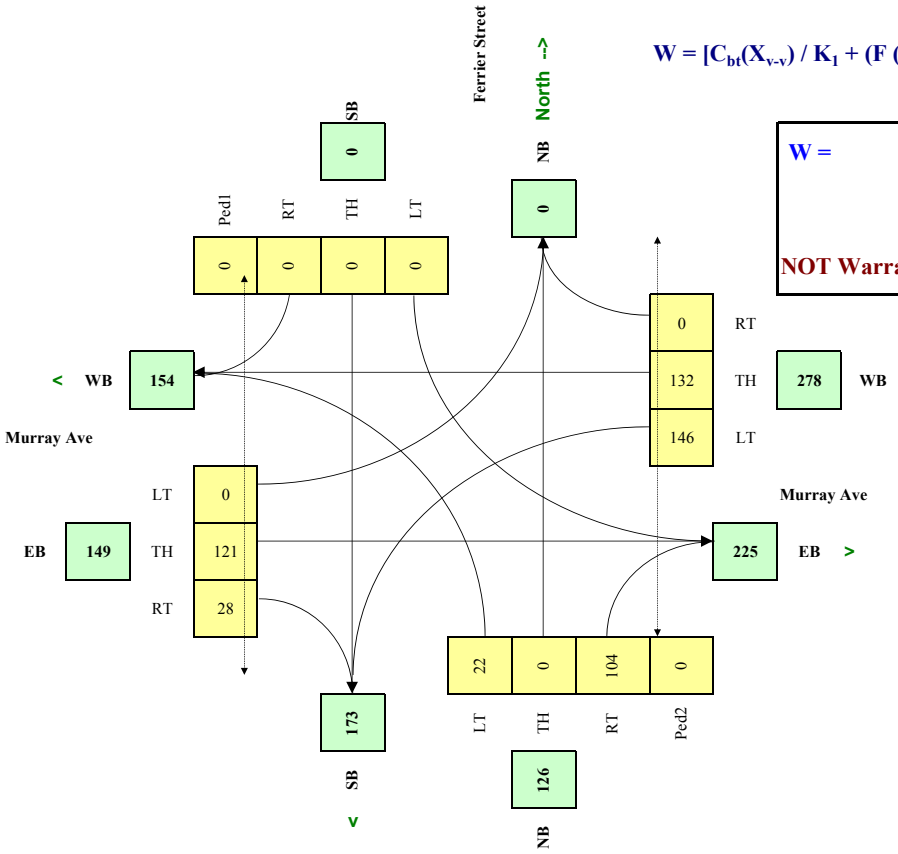
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Murray Ave	EW	50	2.0%	y	0.0
Ferrier Street	NS		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	41	0	110	0	0	0	443	333	0	0	160	72				
8:00 - 9:00																
11:00 - 12:00	26	0	71	0	0	0	284	213	0	0	102	46				
12:00 - 13:00																
16:15 - 17:15	65	0	441	0	0	0	147	248	0	0	465	48				
17:15 - 18:15																
Total (6-hour peak)	**132**	**0**	**622**	**0**	**0**	**0**	**874**	**794**	**0**	**0**	**727**	**166**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**22**	**0**	**104**	**0**	**0**	**0**	**146**	**132**	**0**	**0**	**121**	**28**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	26	26	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Murray Ave	Direction (EW or NS)	EW
Side Street (name)	Ferrier Street	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2035 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Murray Ave	WB		1					1,600	1
Murray Ave	EB					1		1,750	1
Ferrier Street	NB				1				
Ferrier Street	SB								

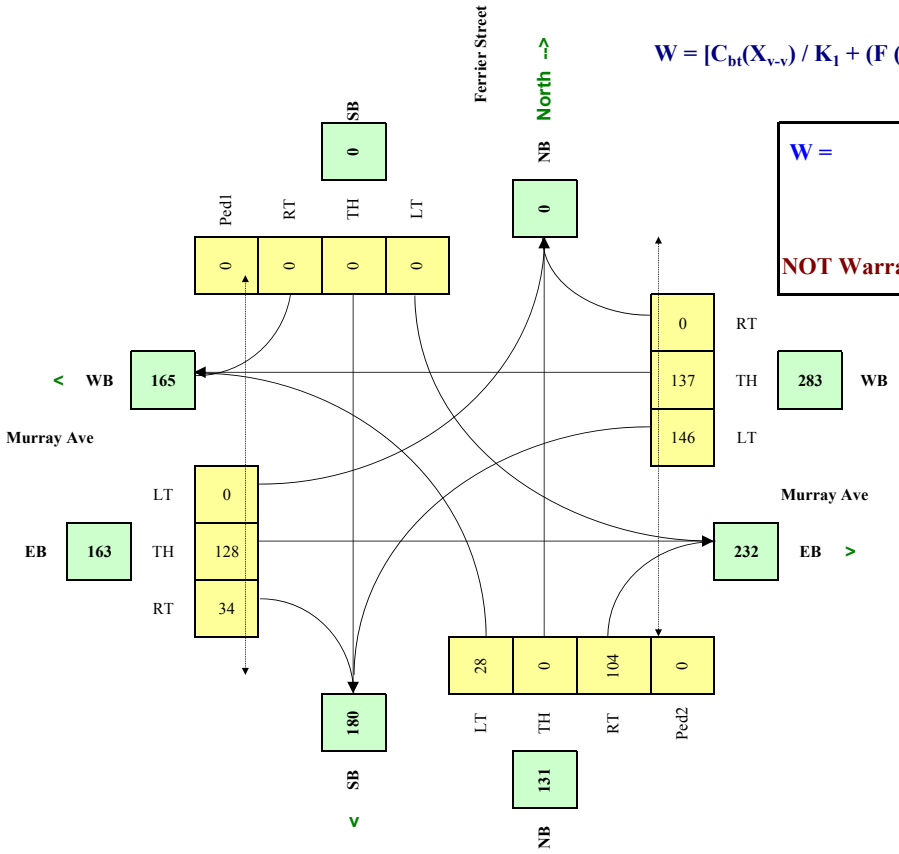
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Murray Ave	EW	50	2.0%	y	0.0
Ferrier Street	NS		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	54	0	110	0	0	0	443	340	0	0	180	90				
8:00 - 9:00																
11:00 - 12:00	35	0	71	0	0	0	284	218	0	0	115	58				
12:00 - 13:00																
16:15 - 17:15	76	0	441	0	0	0	147	266	0	0	475	57				
17:15 - 18:15																
Total (6-hour peak)	**165**	**0**	**622**	**0**	**0**	**0**	**874**	**824**	**0**	**0**	**770**	**205**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**28**	**0**	**104**	**0**	**0**	**0**	**146**	**137**	**0**	**0**	**128**	**34**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	29	29	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Murray Ave	Direction (EW or NS)	EW
Side Street (name)	Ferrier Street	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2040 Background Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Murray Ave	WB		1					1,600	1
Murray Ave	EB					1		1,750	1
Ferrier Street	NB				1				
Ferrier Street	SB								

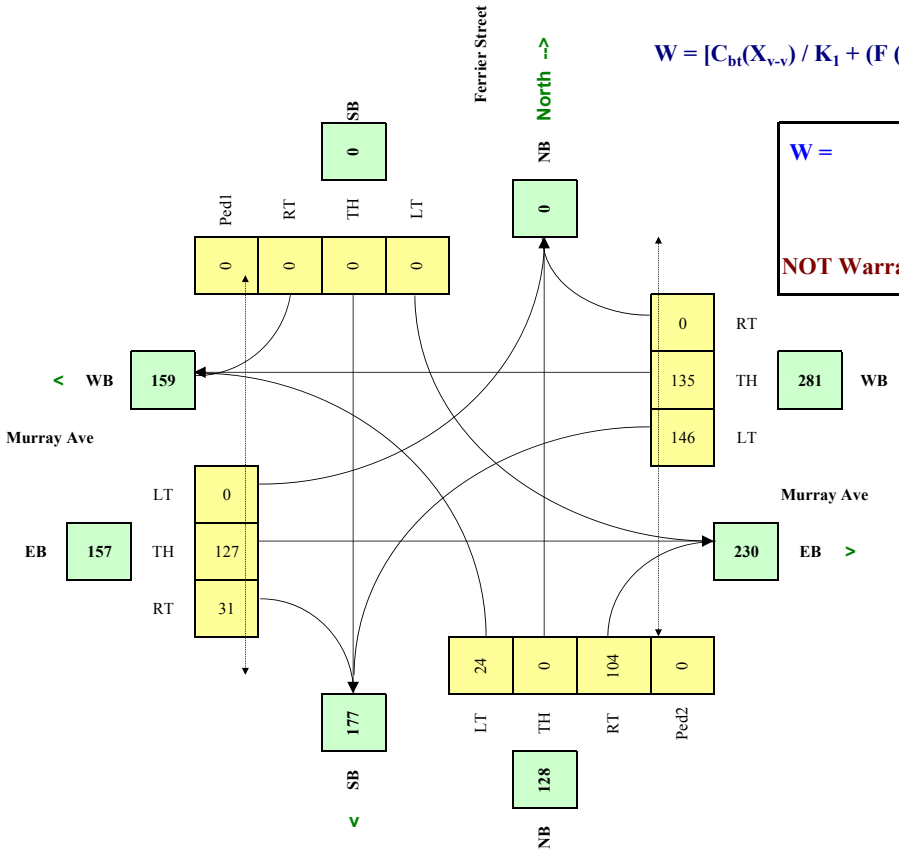
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Murray Ave	EW	50	2.0%	y	0.0
Ferrier Street	NS		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	43	0	110	0	0	0	443	333	0	0	174	80				
8:00 - 9:00																
11:00 - 12:00	27	0	71	0	0	0	284	213	0	0	112	51				
12:00 - 13:00																
16:15 - 17:15	74	0	441	0	0	0	147	265	0	0	473	54				
17:15 - 18:15																
Total (6-hour peak)	**144**	**0**	**622**	**0**	**0**	**0**	**874**	**811**	**0**	**0**	**759**	**185**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**24**	**0**	**104**	**0**	**0**	**0**	**146**	**135**	**0**	**0**	**127**	**31**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	27	27	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Murray Ave	Direction (EW or NS)	EW
Side Street (name)	Ferrier Street	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2025 Stage 1 Scenario
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Murray Ave	WB		1					1,600	1
Murray Ave	EB					1		1,750	1
Ferrier Street	NB				1				
Ferrier Street	SB								

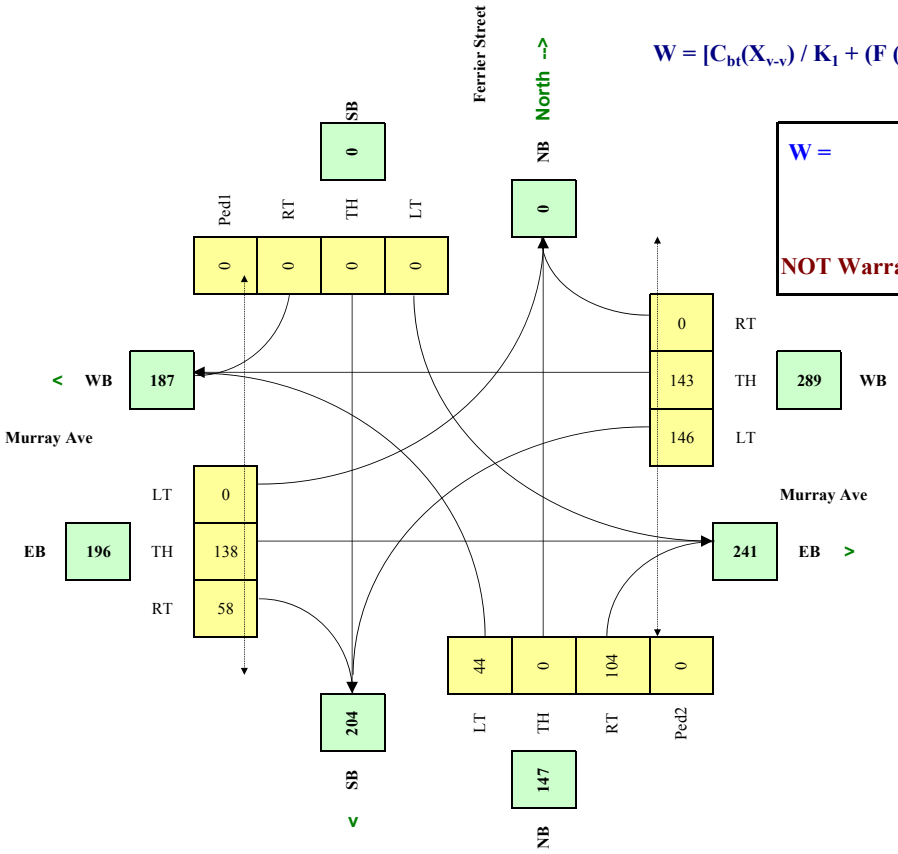
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Murray Ave	EW	50	2.0%	y	0.0
Ferrier Street	NS		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	64	0	110	0	0	0	443	344	0	0	203	150				
8:00 - 9:00																
11:00 - 12:00	41	0	71	0	0	0	284	220	0	0	130	96				
12:00 - 13:00																
16:15 - 17:15	157	0	441	0	0	0	147	296	0	0	492	103				
17:15 - 18:15																
Total (6-hour peak)	**262**	**0**	**622**	**0**	**0**	**0**	**874**	**860**	**0**	**0**	**825**	**349**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**44**	**0**	**104**	**0**	**0**	**0**	**146**	**143**	**0**	**0**	**138**	**58**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	37	37	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

City of Winnipeg Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	Murray Ave	Direction (EW or NS)	EW
Side Street (name)	Ferrier Street	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2035 Stage 2 Scenario

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	City of Winnipeg
City:	Winnipeg
Analysis Date:	2016 Dec 20, Tue
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Murray Ave	WB		1					1,600	1
Murray Ave	EB					1		1,750	1
Ferrier Street	NB				1				
Ferrier Street	SB								

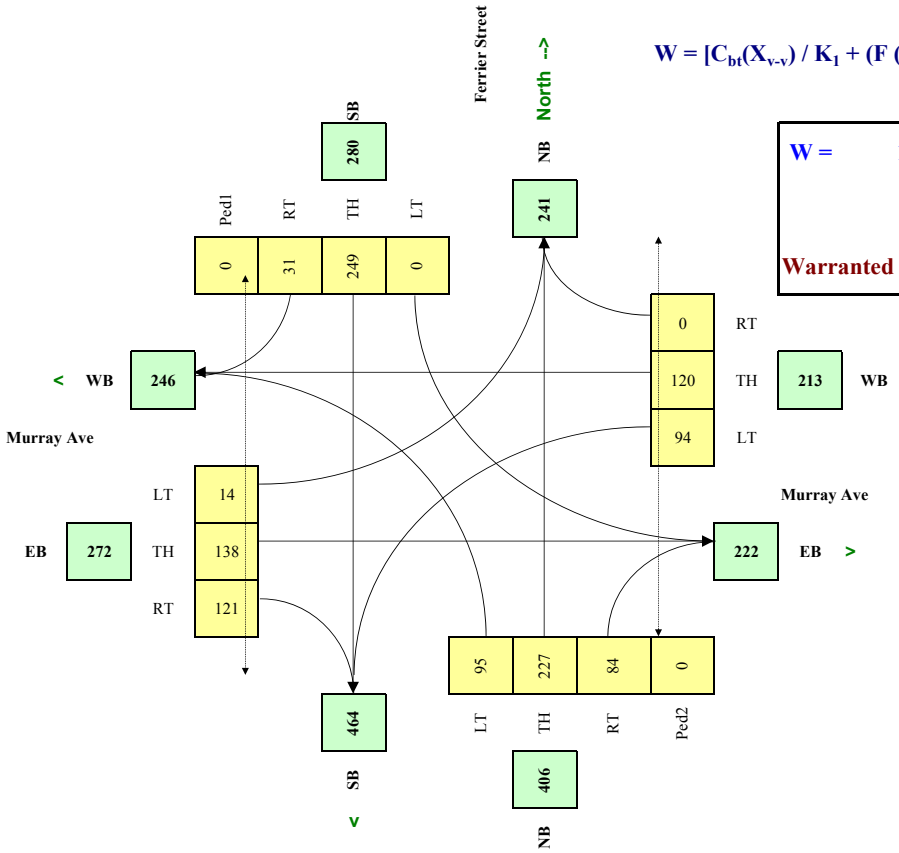
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	700,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Murray Ave	EW	50	2.0%	y	0.0
Ferrier Street	NS		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	116	253	118	0	644	72	296	274	0	21	205	296				
8:00 - 9:00																
11:00 - 12:00	74	162	76	0	413	46	190	175	0	14	131	190				
12:00 - 13:00																
16:15 - 17:15	380	947	311	0	438	67	75	270	0	46	490	239				
17:15 - 18:15																
Total (6-hour peak)	**570**	**1,362**	**505**	**0**	**1,495**	**185**	**561**	**719**	**0**	**81**	**826**	**725**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**95**	**227**	**84**	**0**	**249**	**31**	**94**	**120**	**0**	**14**	**138**	**121**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	182	182	0
		Veh	*Ped*

Warranted

RESET SHEET



Biological Inventory – Land Holdings in NW Winnipeg

Scientific Findings

– Draft report submitted to Ladco Company Limited –

March 2017



NATIVE PLANT SOLUTIONS

Prepared by:

Melissa Mushanski, Jade Raizenne, Lisette Ross

February 2016

Disclaimer

This document has been prepared by Native Plant Solutions for the sole use by Ladco Company Limited. It reflects the finding of a series of biological surveys that make up the Biological Inventory of a Study Area owned by subsidiary companies of Ladco Company Limited. Neither this document nor any of its contents may be used by a third party without prior written consent from Ladco Company Limited and Native Plant Solutions.

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Executive Summary

In 2016 a biological inventory was conducted on land owned by subsidiary companies of Ladco Company Limited and on public City of Winnipeg ROW (the "Study Area"), within an area of Winnipeg referred to as Precinct G. The intent of this report is to provide information that will help guide future development within the Study Area and to help inform design processes in a manner that seeks to capitalize on existing environmental assets and minimize adverse environmental effects where feasible. A series of biological field surveys were designed to target specific groups of organisms that occur within the Study Area including amphibian, breeding bird and vegetation. From these surveys, an understanding of the specific habitats and the role that they play in supporting species was developed.

Five main land cover types were identified within the Study Area: cultivated farm land, grassland, wetland, riparian forest, and willow marsh. The wetland area was dominated by weedy or invasive plant species, including narrow leaf cattail (*Typha angustifolia*), Canada thistle (*Cirsium arvense*), green foxtail (*Setaria viridis*) and reed canary grass (*Phalaris arundinacea*). While this area was heavily influenced by non-native and invasive species, the habitat supports certain amphibian and bird species. The wetlands are present today because of anthropogenic alterations to the regional drainage network that has led to the persistent pooling of water in historically cultivated lands. As a result, the larger semi-permanent wetlands ceased being farmed between 1997-2002 based on aerial photos and Google Earth Imagery. Small, intermittent wetland areas in the Study Area were farmed as recently as 2004 (DigitalGlobe 2016).

The riparian forest was of interest to the City of Winnipeg, identified as Site 345 by the City Naturalist Services. The presence of trees provides habitat to woodland and tree nesting bird species, as well as amphibian species that use woody debris for overwintering. The understory community was dominated by weedy or invasive species including smooth brome (*Bromus inemis*), reed canary grass, Kentucky blue grass (*Poa pratensis*) and Canada thistle. The common native plants of interest were tree species which include Manitoba maple (*Acer negundo*), trembling aspen (*Populus tremuloides*), and cottonwood (*Populus deltoids*). The trees grow primarily around pockets of wet areas rather than as dense forest stands. The majority of the trees were small to mid-size with the exception of a stand of mature cottonwood trees along the north-western edge of the riparian forest habitat (see Appendix A).

Grassland habitat was also present in the Study Area, and is inhabited by both native and non-native plant species. While native plants had a high coverage, the majority of the quadrats consisted of a mix of bare ground and invasive/weedy species. The most common native plant species were western willow aster (*Symphotrichum lanceolatum* var. *hesperium*), flat-top goldenrod (*Euthamia graminifolia*) and prairie cordgrass (*Spartina pectinata*). Invasive or weedy species included purple loosestrife (*Lythrum salicaria*), broadleaf plantain (*Plantago major*) and common sowthistle (*Sonchus oleraceus*).

In total, 91 plant species, 45 bird species (including incidental observations) and 3 frog species were detected during the biological inventory. No federally protected species (those listed as threatened or endangered under the Species at Risk Act) were detected. Leopard frogs, a species of 'special concern' under the SARA, were detected as well as Bobolinks, which are identified as 'threatened' by the COSEWIC. Migratory bird nesting activity was observed during the surveys.

Most of the species detected require more than one of the habitat types listed above. Overall the quality of habitat provided in the Study Area was poor due to high coverage of weedy and invasive vegetation. Since the majority of habitats within the Study Area are of lower quality it is recommended that higher quality habitat be created rather than preserving smaller tracts of poor quality habitat. One avenue for incorporating higher quality wetlands, grasslands and forested habitats is to incorporate naturalized stormwater wetlands, in addition to native grass uplands and treed areas.

Introduction

The Study Area occurs within an area that is designated for development in Winnipeg known as Precinct G. Precinct G is a new community in Our Winnipeg Complete Communities. A precinct planning process is underway. The entire Precinct G area is approximately 800 acres (Figure 1). The Study Area, which consists of approximately 400 acres (Figure 1), is owned by subsidiary companies of Ladco Company Limited and includes a City of Winnipeg ROW. The Study Area is intended for primarily residential development, with limited commercial development, public reserve land, land drainage and possibly a school site. The Study Area is bordered to the west by McPhillips Street/McGregor Street ROW, to the north by a decommissioned landfill and active snow dump, on the east by a Canadian Pacific rail line, and to the south by the ownership limit of Ladco Company Limited lands (Figure 1).

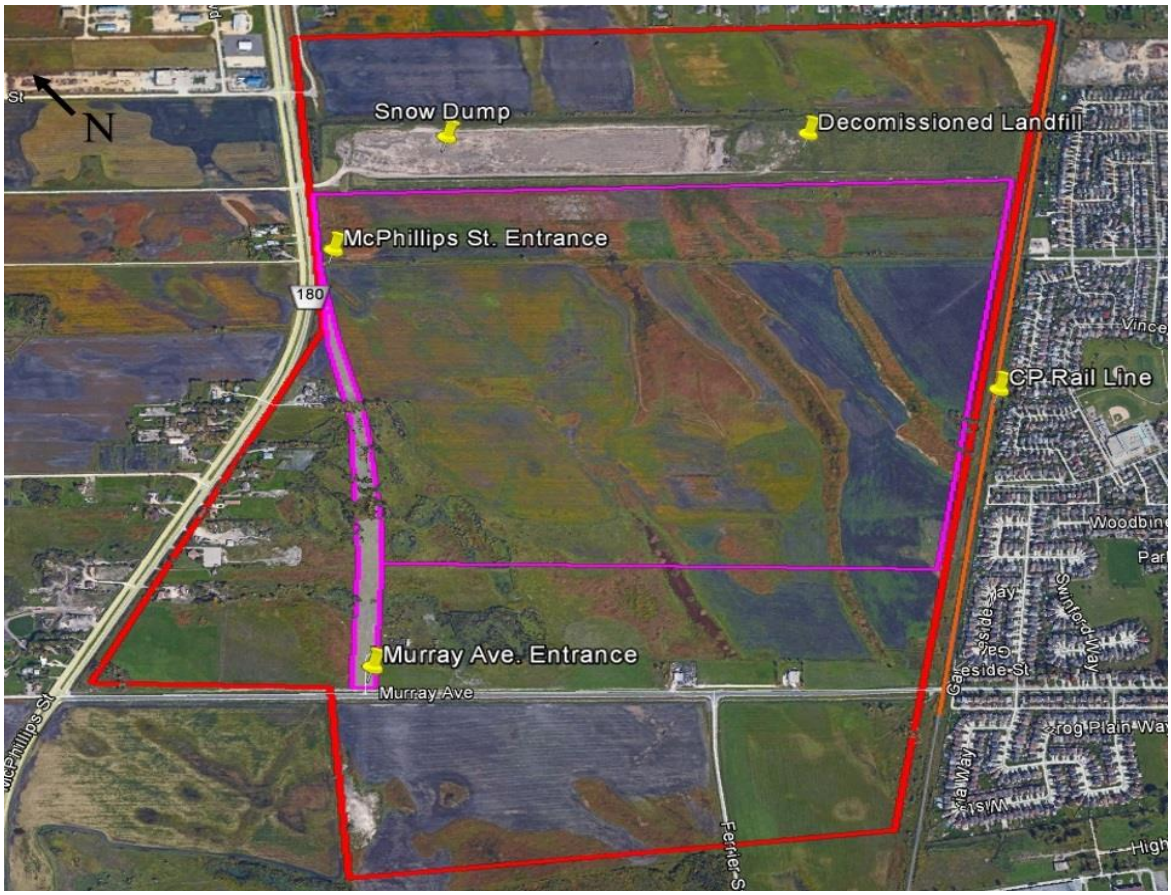

Figure 1. Map of Precinct G. The red line represents the limits of Precinct G. The purple line represents the Study Area surveyed for the biological inventory with the City of Winnipeg ROW shaded white.

An initial desktop assessment indicated that the area consists of primarilty agricultural lands, and habitats including wetlands, non-native grassland, willow marsh, and riparian forest. Native Plant Solutions (NPS) was contracted by Ladco Company Limited in April 2016 to provide recommendations for a biological inventory of the area to capture data on the fauna and flora, as well as data on the composition and structure of Study Area habitats. An in-depth biological inventory was proposed. Surveys commenced in the spring and continued through the summer of 2016.

The Intent of Biological Inventories

Biological inventories are conducted to provide information on the flora and fauna of the area. The overall objective of the biological inventory was to develop a better understanding of the local flora and fauna within the Study Area and how these communities are structured within the available habitats. Not only can these inventories identify areas of high biodiversity, or uniqueness, the inventory also captures more rigorous data on the variables that support biological productivity within the area. Inventory findings can then be used to help inform landscape and development decisions so that potential adverse environmental effects may be lessened, and sensitive habitats or species protected, or supported, in the community designs.

Field Inventories

The field studies conducted were designed to target specific groups of organisms that commonly occur in areas similar to the Study Area as per the initial desktop assessment. Field surveys were scheduled to occur during times when detection of the flora and fauna of interest were most probable (Table 1). A vegetation inventory and spring flowering plant survey were conducted to identify the plant communities present. Breeding bird surveys were conducted to identify and understand the bird community present. An amphibian survey was held in the spring, in addition to incidental mammal observations throughout all surveys. Each set of surveys were performed at times most suited to capturing the best data. Different methods of data collection were used depending on the survey in question. The survey locations were structured throughout the Study Area in order to best capture the biodiversity of the area and to identify the potential habitat use of each of the species surveyed. The information that follows provides a summary of findings for the surveys on the communities listed above.

Table 1. Survey timelines for the biological inventory.

Survey Type	April	May	June	July	Time of Day	# of Site Visits
Amphibian Call					Sunset	4
Breeding/Song Bird Call					Sunrise	4
Spring Flowering Plant					Daylight hrs.	1
General Vegetation					Daylight hrs.	1
Mammal Observations						Throughout
TOTAL VISITS						10

Vegetation Inventory

Summary

Native Plant Solutions (NPS) conducted two vegetation surveys to determine the vegetation composition and diversity and to evaluate the habitat type and quality across the Study Area. This information also creates a baseline for understanding the structure of the bird, amphibian and mammal communities within the Study Area. The two vegetation surveys conducted were the spring flowering survey and a comprehensive vegetation inventory in mid-summer.

The spring flowering survey was conducted on June 13th, 2016. This survey was designed to detect spring flowering plants at the height of their blooming period. The survey included nine transects that captured the main habitat types present in the Study Area (Figure 2). NPS surveyors walked each transect line and recorded all flowering plant species within 10 m of the transect line.

The vegetation inventory looked at plant species within 1m^2 quadrats (5m^2 when in forest areas). Transects were spaced at least 100 m apart along the nine designated transects. No quadrats were

located in existing agricultural lands. Quadrats in forested areas surveyed the diameter at breast height (DBH) and % canopy cover of all trees, in addition to species presence and coverage. In total 26 quadrats were surveyed for the vegetation inventory (Figure 2).



Figure 2. Study Area map depicting colour coded habitat zones. The purple line indicates the footprint of the Study Area. Red lines represent spring flowering survey transects, while gray circles indicate the location of summer vegetation inventory quadrats.

Study Area Habitats

The wetland areas contained 34 different plant species; 22 native and 12 introduced or weedy species (Table 2). While more native species were present than introduced or weedy species in wetland habitats, the weedy species covered a larger area when present (50% weedy, 44% native). The most common plant species observed in quadrats was narrowleaf cattail (*Typha angustafolia*). Narrowleaf cattail is an introduced species from Europe to North American and can be very invasive once introduced into wet areas, where it thrives. Within some individual quadrats narrowleaf cattail covered 50-75% of the surveyed area. Other common introduced species included Canada thistle (*Cirsium arvense*), green foxtail (*Setaria virdis*), and the aggressive reed canary grass (*Phalaris arundinacea*). Common native species included common spike rush (*Eleocharis palustris*), American sloughgrass (*Beckmannia syzigachne*), and beaked sedge (*Carex rostrate*).

Analysis of historical imagery of the Study Area shows that the wetlands and willow marsh currently present exist on historically cultivated/farmed lands as far back as at least 1948. The 1968 imagery depicts that the Study Area was almost entirely cultivated, with very few low lying areas holding water. Evidence of constructed drainage works can be seen in 1988. Anthropogenic changes to regional drainage, including overland flow from the City's snow dump, has allowed wetlands to develop into the present, intermittent hydrological state observed now (Appendix C).

Grassland areas contained 34 different plant species; 24 native and 10 introduced species (Table 2). Native species tended to have a higher coverage in each quadrat (45%) while introduced and weedy species had a lower coverage (17%). Grassland areas were dominated by various species of asters (*Symphotrichum* sp. and *Aster* sp.), a flowering plant. The most commonly observed being the Western willow aster (*Symphotrichum lanceolatum* var. *hesperium*). Flat-top goldenrod (*Euthamia graminifolia)* and Prairie cordgrass (*Spartina pectinata*) were also observed in high abundance, having 50-60% coverage in the quadrats they were found in. Introduced and weedy plant species were commonly present in grassland quadrats including foxtail barley (*Hordeum jubatum*), common plantain (*Plantago major*), and sow thistle (*Sonchus oleraceus)*. Purple loosestrife (*Lythrum salicaria*) had the highest percent coverage of all introduced and weedy plant species with 17% coverage in the quadrats it was found in.

The riparian forest consisted of 25 plant species; 18 native and 7 introduced species (Table 2). On average weedy and introduced plant species covered 64% of the quadrats. This was higher than the coverage of native plant species within the quadrats at 53%. Introduced plant species of this habitat included smooth brome (*Bromus inermis*), reed canary grass, Kentucky bluegrass and Canada thistle. Reed canary grass had the highest percent coverage (90%), as did smooth brome (80%). The most common and abundant native plant species were trees, including Manitoba maple and trembling aspen. While the overall coverage in the riparian forest was <50%, balsam poplar (*Populus balsamifera*) and arrowleaf coltsfoot (*Petasites frigidus* var. *sagittatus*) had a high coverage (100% and 95% respectively) in the one transect that they were detected in. Within this land cover type, we also identified common tree species and their diameter at breast height. The most common tree species within the Study Area included Manitoba maple and trembling aspen. A bluff of mature cottonwood trees were also present along the eastern edge of the riparian forest habitat. Seven shrub species were also identified, with two of the 7 shrubs being introduced species. These included European buckthorn (*Rhamnus cathartica*) and caragana (*Caragana arborescens*). Manitoba maple trees had an average diameter at breast height (DBH) of 16.3 cm while trembling aspen had a DBH of 14.3 cm. The largest tree sampled was a cottonwood, with a DBH of 42 cm suggesting it is much more mature than the other tree species present. The cottonwood bluff, as located on the map in Appendix A, was made up of several trees that were of a similar size. The size and maturity of these trees increases the nesting niches available for birds and allows for the presence of excess woody debris which is used by small mammals and amphibians. Historical aerial photos of the cottonwood stand show that in 1948 this area had no trees and had farm infrastructure present (Appendix C). The trees appear to be a shelterbelt planted between 1948 and 1968, in which the trees are visible (Appendix C). The trees surrounds buildings that were present until 2011 (DigitalGlobe 2016). All tree stands tended to have a grassy understory dominated by weedy species such as Kentucky bluegrass, Canada thistle and smooth brome.

The willow marsh areas were made up of 16 plant species; 9 native species and 7 introduced species (Table 2). On average weedy species had a higher percent cover (i.e., 95%) than the native species present (i.e., 77%). The most abundant introduced plant species included Kentucky bluegrass (60% cover) and alsike clover (*Trifolium hybridum*) (5% cover). Wolf willow (*Elaeagnus commutate*) and smooth aster (*Aster laevis*) (95% cover and 35% cover respectively)

were the most abundant native species found in the willow marsh areas, however each of these plant species were only detected in one quadrat. Willow (*Salix* sp.) species were found along each transect however no quadrats surveyed contained willow species.

Table 2. Plant species observed during the vegetation inventory in August 2016[A].

Common Name	Scientific Name	Habitat	Origin	Life History	Growth Form	Weed?
Alfalfa	Medicago sativa	WM	I	P	F	Y
Alsike Clover	*Trifolium hybridum*	G/W/WM	I	A/B	F	Y
American Vetch	*Vicia americana*	G/RF/WM	N	N	F	N
Arrowleaf Coltsfoot	*Petasites frigidus* var. *sagittatus*	RF	N	P	F	N
Awned Wheatgrass	*Elymus trachycaulus subsecundus*	G	N	P	G	N
Balsam Poplar	*Populus balsamifera*	RF	N	P	T	N
Baltic Rush	*Juncus balticus*	G	N	P	G	N
Beaked Sedge	*Carex utriculata*	W	N	P	G	N
Broadleaf Cattail	*Typha latifolia*	W	N	P	G	N
Canada Fleabane	*Erigeron canadensis*	G/W	N	A	F	N
Canada Thistle	*Cirsium arvense*	G	I	P	F	Y
Caragana	Caragana arborescens	RF	I	P	S	Y
Common Spike Rush	*Eleocharis palustris*	W	N	P	G	N
Prairie Cordgrass	*Spartina pectinata*	G	N	P	G	N
Cottonwood	*Populus deltoides*	G/RF	N	P	T	N
Curled Dock	*Rumex crispus*	G/W	I	P	F	Y
Currant	*Ribes triste*	RF/WM	N	P	S	N
Dandelion	*Taraxacum officinale*	G/W/WM	I	P	F	Y
Duckweed	*Lemna minor*	W/RF	N	P	F	N
European buckthorn	Rhamnus cathartica	RF	I	P	T	Y
Evening Primrose	*Oenothera biennis*	G	N	B	F	N
Flat-top Goldenrod	*Euthamia graminifolia*	G	N	P	F	N
Foxtail Barley	*Hordeum jubatum*	G/W	N	P	G	Y
Giant Bur Reed	*Sparganium eurycarpum*	W	N	P	G	N

Table 2 (con't)

Green Foxtail	*Setaria viridis*	W	I	A	G	Y
Groundsel	*Senecio congestus*	G	N	A	F	N
Hawthorne	*Crataegus sp.*	RF	N	P	T	N
Kentucky Bluegrass	*Poa pratensis*	W/WM/RF	I	P	G	Y
Knotted Rush	*Juncus nodosus*	G	N	P	F	N
Macoun's Buttercup	*Ranunculus macounii*	RF	N	A/P	F	N
Manitoba Maple	*Acer negundo*	RF	N	P	T	N
Many-flowered Aster	*Symphyotrichum ericoides*	G/W	N	P	F	N
Narrowleaf Cattail	*Typha angustifolia*	G/W	I	P	G	Y
Needle Spike Rush	*Eleocharis acicularis*	W	N	P	G	N
Northern Wheat Grass	*Agropyron dasytachyum*	G/W/WM	N	P	G	N
Pincherry	Prunus pensylvanica	RF	N	P	T	N
Common Plantain	*Plantago major*	G/W	I	P	F	Y
Purple Loosestrife	*Lythrum salicaria*	G/W	I	P	F	Y
Red Osier Dogwood	*Cornus sericea*	RF	N	P	S	N
Redtop	*Agrostis rubra*	G/W	I	P	G	Y
Reed Canary Grass	*Phalaris arundinacea*	W/RF	I	P	G	Y
Seaside Arrowgrass	*Triglochin maritima*	W	N	P	G	N
Shore Buttercup	*Ranunculus cymbalaria*	G/W	N	P	F	N
Silverweed	*Argentina anserina*	G/RF	N	P	F	N
Slender Wheatgrass	*Elymus trachycaulus*	G/W/WM	N	P	G	N
American Sloughgrass	*Beckmannia syzigachne*	G/W	N	P	G	N
Small flowered buttercup	*Ranunculus abortivus*	G	N	P	F	N
Small-flowered White Aster	*Symphyotrichum racemosum*	G/WM	N	P	F	N
Smooth Aster	*Symphyotrichum laeve*	G/WM	N	P	F	N
Smooth Brome	*Bromus inermis*	G/RF	I	P	G	Y
Softstem Bulrush	*Schoenoplectus tabernaemontani*	W	N	P	G	N
Common Sowthistle	*Sonchus arvensis*	G/W/WM/RF	I	P	F	N

Table 2 (con't)

Stiff Sunflower	*Helianthus pauciflorus*	G	N	P	F	N
Ticklegrass	*Agrostis scabra*	G	N	P	G	N
Timothy grass	*Phleum pratense*	WM	I	P	G	Y
Trembling Aspen	Populus tremuloides	RF	N	P	T	N
Tufted Loosestrife	*Lythrum thyrsiflora*	W	N	P	F	N
Water Horehound	*Lycopus americanus*	G/W	N	P	F	N
Water Parsnip	*Sium suave*	W	N	P	F	N
Water Plantain	*Alsima plantago-aquatica*	W	N	P	F	N
Western Willow Aster	*Symphyotrichum lanceolatum* var. *hesperium*	G/W/WM	N	P	F	N
Wheat Sedge	*Carex atherodes*	RF	N	P	G	N
Wild Mint	*Mentha arvense*	W	N	P	F	N
Wild raspberry	*Rubus idaeus*	RF	N	P	S	N
Wild rose	Rosa woodsii	RF	N	P	S	N
Wolf Willow	*Elaeagnus comutata*	WM	N	P	S	N

[A] Habitat: G=grassland, W=wetland, RF=riparian forest, WM=willow marsh. Origin: I=introduced, N=native. Life History: A=annual, P=perennial, B=biennial. Growth form: T=tree, S=shrub, G=graminoid, N=non-vascular. Weed?: Y=yes, N=no.

Amphibian Inventory

Summary

Beginning April 27th 2016 amphibian surveys were conducted once weekly for four weeks, totaling 4 surveys. Four locations were surveyed in the Study Area during each survey, with each location being approximately 500-m apart (Figure 3). The four locations were selected to efficiently and effectively survey all land cover types without double counting individuals. Five minute call surveys were conducted at each location between 7 and 10 p.m. Five minute survey length is a standard length that helps to ensure higher detection of species while limiting chances of double counting individuals. It also ensures that survey effort was consistent at all locations (i.e., that higher abundance is not due to more time spent observing). Three different frog species were identified throughout all of the surveys including boreal chorus frogs (*Pseudacris maculata*), leopard frogs (*Rana pipiens*), and one wood frog (*Rana sylvatica*).

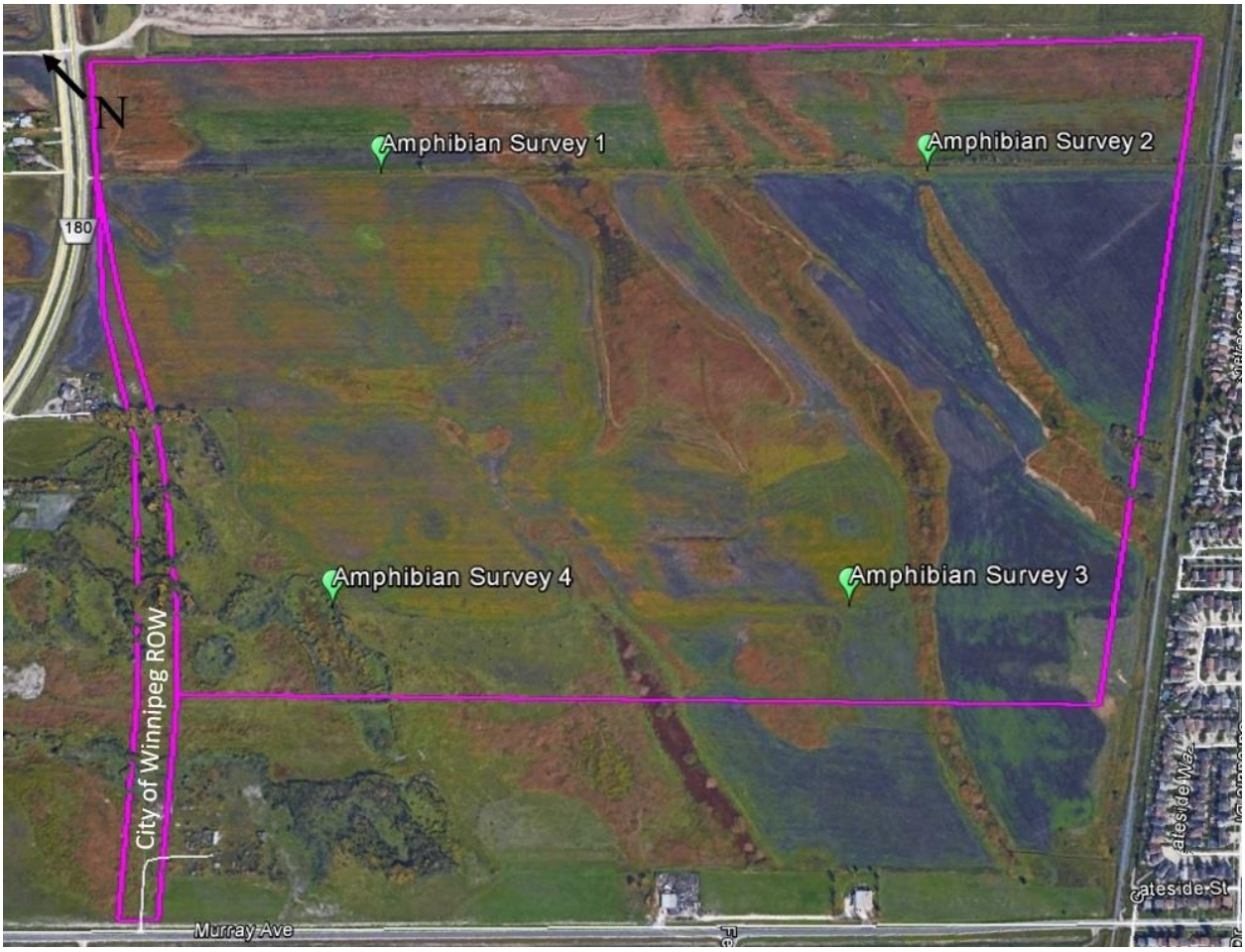

Figure 3. Amphibian survey locations in the Study Area.

Boreal chorus frogs were the most commonly detected amphibian species throughout all surveys. They were heard in all surveys at every location. Detections peaked in the 2nd and 3rd surveys with detection estimates ranging from 4-20 individuals. In location 1, the calls were rated with a call index of 3, meaning high numbers of overlapping calls were made, making it impossible to distinguish individuals. Leopard frogs were detected in much smaller numbers (1-2) at survey locations 1 and 4. They were detected consistently in survey location 4 during all four surveys. Location 4 is made up of wetland areas, dominated by willow and aspen. Only one wood frog was detected during the first survey at survey location 2, with no detections in the subsequent surveys.

Survey location 1 had the highest abundance of frogs for all but one survey. This area was composed of non-native grassland and cultivated land divided by a small man-made drainage ditch with limited tree and shrub species. A variety of resources are available to amphibians at this location with the presence of water, grassland and woody vegetation making it ideal for frog species. All other locations had similar abundances of frogs that were much lower than what was heard at survey location 1.

Species Overview

Boreal Chorus Frog

Boreal chorus frogs, the most common species found in the Study Area, are found in moist forests and grassland habitats, or along the edge of any wet areas or wetland habitats (Oulette et al. 2009). They are rarely found in dry forest habitat, or in brackish waters. From mid-April to early June these frogs will congregate at small ponds, under the cover of vegetation. They will lay eggs attached to the underside of aquatic vegetation which will hatch and transform into frogs by late-June to early-July. Frogs will not reach full maturity for 1-2 years. During the summer frogs will move away from water but become uncommon in habitats >20 m from water (Oulette et al. 2009). Adults overwinter by hibernating under logs, rocks or underground in terrestrial habitat. Their abundance is positively related to vegetative cover and stream density in their habitats (Shulse 2011).

Northern Leopard Frog

Northern leopard frogs are associated with forests, open areas or edge habitats. They prefer dense vegetation for cover, thermoregulation (i.e., a mechanism that enables amphibians to regulate their body temperature) and foraging (Blomquist and Hunter Jr. 2009). They will move upland to forage when it is warmer. Northern leopard frogs hunt for food mostly at night and use thick vegetation for cover during the day. Leopard frogs breed early in the spring and prefer to lay their eggs in vernal pools (i.e., temporary pools of water) that hold water until the end of June. They can also breed in deeper ponds as long as they are fishless. Eggs take roughly 70 days to mature; however, they can overwinter as tadpoles and develop into adults the following spring. Leopard frogs are unique to other species in that they overwinter on the bottom of large fishless ponds (Germaine and Hays 2009).

Wood Frog

Wood frogs prefer wooded areas, but can survive in meadow habitats (Regosin et al. 2003). They will spend the majority of their life in terrestrial habitats, moving upwards of 1000 m away from waterbodies (Vasconcelos and Calhoun 2004). However, during breeding season they lay eggs in vernal pools that hold water until the end of June (Vasconcelos and Calhoun 2004). They most often hibernate under forest leaf litter near shallow ponds where they will breed the following spring (Regosin et al. 2003).

Breeding Bird Inventory

Summary

Breeding bird surveys are important for identifying the diversity and abundance of birds using an area. Not only can it indicate what species are present but it also lets observers identify what habitat types different groups of birds (e.g., waterfowl, raptors, blackbirds, etc.) are using. These surveys also give important indications of the ability of a habitat to sustain high species diversity.

Surveys were conducted between June 9th and June 29th, 2016. Seven locations were surveyed once each week. The surveys consisted of a 1 minute period of silence, followed by a five-minute observation period to detect birds by sight and by vocalizations. The seven locations were selected

in order to best survey the entire study area and all land cover types. A five minute observation period is standard practice when surveying birds. It allows for a higher probability of detecting all species present while limiting chances of double counting individuals. It also ensures that survey effort was consistent at all locations. Surveys were only conducted under favourable weather conditions (i.e., wind speeds <20 km/h and no precipitation) to ensure the highest probability of detection.

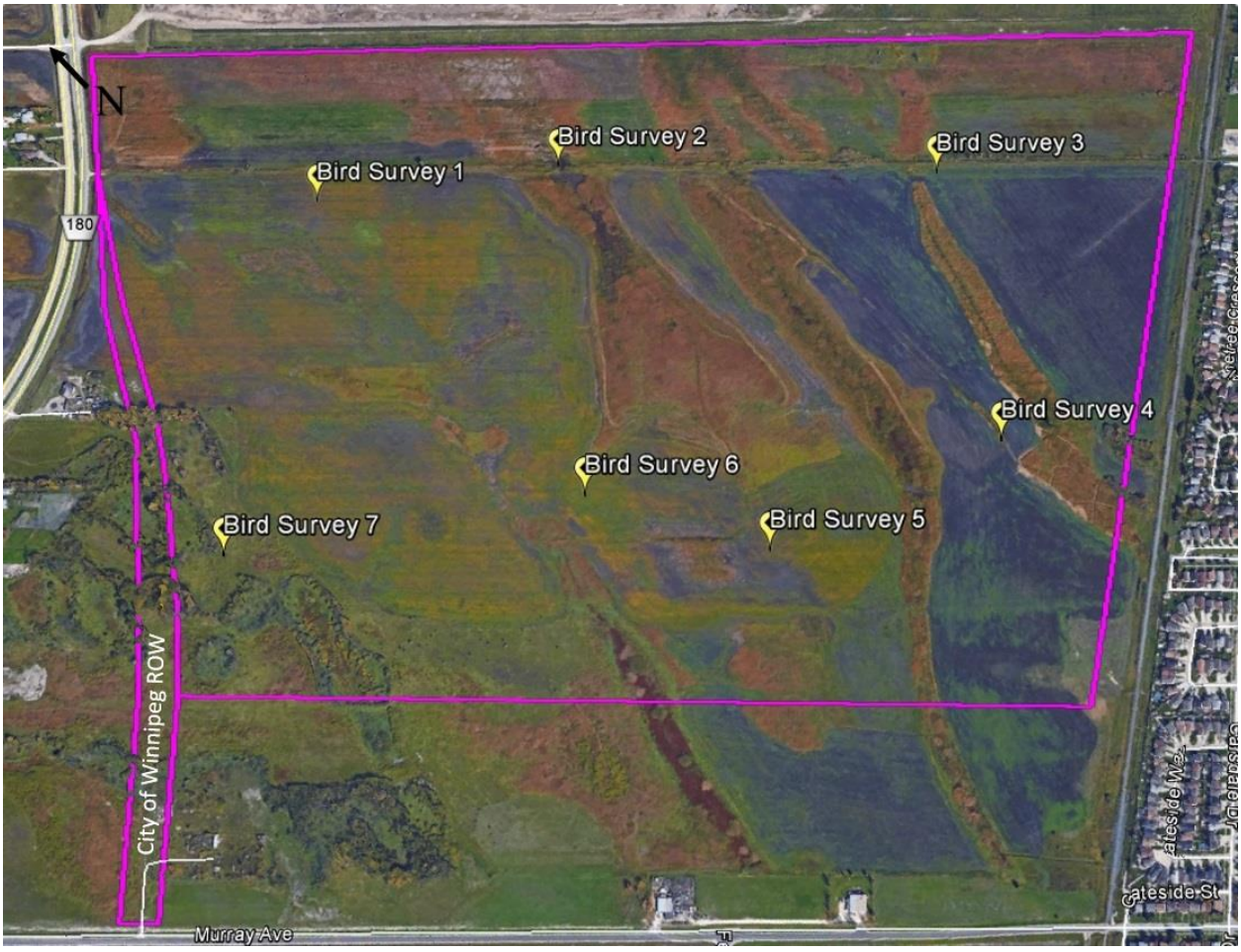

Figure 4. Breeding bird survey locations in the Study Area.

A total of 885 individual birds were detected during the breeding bird surveys (Table 3). This consisted of 36 species identified by sight and sound. Additionally, 314 birds consisting of 40 species were detected by sight and sound incidentally during other surveys (amphibian surveys or vegetation surveys) (Appendix D). Incidental detections contributed 9 new species to the total species detected in the Study Area. The most common bird species detected were the red-winged blackbird (n=275) followed by sedge wren (n=104) and savannah sparrow (n=74) (Table 3). The

most common species observed incidentally were the red-winged black bird (n=127), mallard (n=20) and clay-colored sparrow (n=13) (Appendix D). The incidental observations are important for gaining a complete inventory of species found in the Study Area. However these observations cannot be linked to standard survey locations and some habitats may be over represented or under-represented. Therefore incidental observations are not used to gain insight on the abundance of individuals, but are used to provide valuable information on species presence in the Study Area.

Each survey location had two to three habitat types available to birds (i.e., wetland, willow marsh, riparian forest, grassland and cultivated land), making it difficult to determine exactly which aspect of the survey location birds were using. American robins, a woodland bird species, was only found in survey locations containing riparian forest habitat. American goldfinches and yellow warblers, two species that are shrub nesting species, were only detected where willow marsh habitat was found. All other species used multiple habitat types.

During the breeding bird surveys location 4 had the highest abundance of individual birds (n=163), followed by location 3 (n=162). These two habitats are a mixture of cattail dominated wetlands, non-native grassland and either cultivated land (location 4) or riparian forest (location 3). The lowest abundance (n=92) was found at location 7. Species richness was highest on location 3 (n=20), and lowest on location 4 (n=14). Location 7, with the lowest abundance was a mixture of riparian forest, willow marsh and cultivated land.

A species of interest was detected in the Study Area. Bobolinks (*Dolichonyx oryzivorus*), a grassland obligate species and rare urban resident were observed, including territorial and mating displays. This species is listed as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), however, it is not federally protected under the Species at Risk Act (SARA). Additionally, nesting activity was also noted in the area including a red-tailed hawk (*Buteo jamaicensis*) nest, mallard (*Anas platyrhynchos*), and red-winged black birds (*Agelaius phoeniceus*). The regional nesting period for Winnipeg, as set by Environment Canada, is late-April to late-August. During this period birds are more susceptible to disturbances due to the high energy depends of breeding and rearing offspring. It is also prohibited to disturb or destroy the nests or eggs of migratory birds which includes the above mentioned mallard.

Table 3. Species detected during breeding bird surveys.

Common Name	Latin Name	Observations
American crow	*Corvus brachyrhynchos*	7
American goldfinch	*Spinus tristis*	11
American robin	*Turdus migratorius*	2
Brown-headed cowbird	*Molothrus ater*	4
Blue-winged teal	*Anas discolor*	1
Bobolink	*Dolychonynx oryzivorus*	6
Brewer's blackbird	*Euphagus cyanocephalus*	23
Canada goose	*Branta canadensis*	33
Clay-colored sparrow	*Spizella pallida*	42
Common grackle	*Quiscalus quiscula*	35
Common yellowthroat	*Geothlypis trichas*	44
European starling	*Sturnus vulgaris*	5
Killdeer	*Charadrius vociferus*	14
LeConte's sparrow	*Ammodramus leconteii*	9
Lesser scaup	*Aythya affinis*	2
Mallard	*Anas platyrhynchos*	15
Marsh wren	*Cistothorus palustris*	40
Mourning dove	*Zenaida macroura*	6
Northern pintail	*Anas acuta*	2
Northern shoveler	*Anas clypeata*	3
Ring-billed gull	*Larus delawarensis*	2
Rock pigeon	*Columba livia*	9
Red-tailed hawk	*Buteo jamaicensis*	5
Red-winged blackbird	*Agelaius phoeniceus*	275
Sandhill crane	*Grus canadensis*	3
Savannah sparrow	*Passerculus sandwichensis*	74
Sedge wren	*Cistothorus platensis*	104
Sora Rail	*Porzana carolina*	26
Song sparrow	*Melospiza melodia*	8
Tree swallow	*Tachycineta bicolor*	2
Vesper sparrow	*Pooecetes gramineus*	2
Warbling vireo	*Vireo gilvus*	5
Western meadowlark	*Sturnella neglecta*	12
Wilson's snipe	*Gallinago delicata*	3
Yellow warbler	*Setophaga petechia*	7
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	44

Habitat Importance to Avian Communities

Bird species can often be associated with specific habitat types, in turn linking population trends to the availability of certain habitats (McNicoll 2003, Taylor 2003). Throughout the history of Manitoba, development and alteration have directly impacted the composition of bird communities in the province (McNicoll 2003, Taylor 2003). Reversely, developed areas have created habitat for advantageous bird species to thrive in without competition from native species that decline in developed areas (Staniforth 2003).

Mammal Inventory

Summary

Mammals are a valuable part of an ecosystem. The variety of species that comprise this group can be broad and occupy diverse niches, acting as both predator and prey. Many urban mammals are often small and conspicuous in their environment. However they can impact urban areas, often coming into conflict with humans via property damage, vehicle collisions, or disease transmission. By understanding what mammal species exist within the Study Area efforts can be made to mitigate these effects.

Mammal data was collected incidentally during all site visits. Observations included species and numbers, as well as evidence of animal presence such as tracks, feces, beds and trails. During the biological inventory, observations of white tailed deer (n=5) and deer beds/trails as well as observations of small rodents (species unknown) and rabbit droppings (species unknown) occurred. White-tailed deer observations were made in areas that were a mixture of grassland and forest habitat.

Species Overview

<u>White-tailed Deer</u>

White-tailed deer are the most widely distributed large mammal in North America. By nature they are generalists, being able to adapt and thrive in a variety of habitats, including human altered landscapes such as urban centers (McCance 2009). Urban centres provide refuge from hunting pressure and predators for white-tailed deer, reducing their mortality (McCance 2009). They are

considered an edge species, preferring a mixture of habitat types such as grasslands or cultivated lands for foraging and forests for shelter (McCance 2009). They will typically bed in sheltered areas of tall grass or woody areas and move into open habitat to feed at dawn and dusk (Forsyth 1999). Treed habitat is important for shelter from the elements. During the winter season deer select for adequate shelter areas over areas of higher quality food (Goulden 1981).

Study Conclusions

The data collected during the biological inventory surveys indicate not only the species that inhabit the area, but the quality of the habitat as well. Overall the quality of the land cover types surveyed in the Study Area were of poor quality, dominated in most locations by weedy and invasive species. While low quality habitat does provide some resources for wildlife, they have not evolved with these introduced plant species and are likely using it because higher quality habitat is not available in the vicinity. Second to agricultural land, wetland habitat comprised the majority of the Study Area. The highest abundance of birds were found at survey locations with wetlands present. Frog densities were also higher in areas where the habitat included wet components. Despite being comprised of a majority of non-native plant species, the lack of suitable nearby natural habitat has resulted in an abundance of species using these altered wetlands. It is noted, however, that the wetlands present in the Study Area were not evident until drainage patterns were altered starting in the late 1980's. Prior to this, the Study Area consisted almost entirely of cultivated agricultural land.

All habitat types were used to varying degrees by wildlife in the Study Area. Most species that were detected require multiple habitat types to sustain them throughout different aspects of their survival strategies. For example a mallard female will nest in grassland habitat but forage for food in a nearby wetland. They require both habitats in order to meet their resource requirements to reproduce and survive. Some species also use different habitats based on the season. The three frog species detected in the Study Area require small fishless ponds for breeding and grassland or forest habitat for overwintering. In order to maintain biodiversity and the ecosystem as a whole, multiple habitats would need to be maintained or replaced.

No federally protected species (i.e., those listed as threatened or endangered under the Species at Risk Act) were detected during the Biological Inventory. Observations of leopard frogs, a species of 'special concern' under the SARA, were made. Bobolinks were detected which are not listed under SARA, but are identified as 'threatened' by the COSEWIC. The relative concern for this species' populations are greater in the eastern provinces of Canada, and less so in Manitoba.

Some bird species detected during surveys and incidental observations were migratory birds, making use of the Study Area during early spring and fall as a stopover location to exploit food and cover resources. Resident birds, mammals and amphibians use this area as breeding habitat during the spring and summer months. This critical period spans from April to August and during this time period, species have a higher susceptibility to disturbances because of high energy inputs into breeding and rearing young. Destruction of nests during this critical period, especially later in the season can lead to species being unable to reproduce which in the long term may affect population numbers.

The existing level of biodiversity within the area should be addressed at a community level in order to best understand its complexity. All species are interconnected in a web, therefore conservation of one will conserve others. For example, the conservation of leopard frog habitat, including both wetland, grassland and woodland will benefit all species using these habitats as well as predators of these species. Being mindful of proper connectivity between representative habitat types during planning phases for development makes it possible to promote and maintain the biological diversity that currently exists.

Study Recommendations

The knowledge of habitat types and wildlife use accumulated through the biological inventory can be used to aid in minimizing adverse environmental effects where possible. The findings of the wildlife inventories suggest that multiple habitat types present on the landscape creates the most ideal habitat to support the wildlife community (i.e., amphibians and birds). Incorporating wetland, grassland and treed habitat into a development can create niches for a wide variety of birds. Habitat creation can also provide both breeding, foraging and overwintering habitat for frog species inhabiting the Study Area. Maintaining diverse natural spaces within a development also adds an aesthetic value for residents as well as opportunities for recreational use by the community. Since the majority of habitats within the Study Area are of lower quality based on the high presence

of invasive and weedy vegetation cover, it would be better to create high quality habitat rather than preserving smaller tracts of poor quality lands.

One avenue to incorporate high quality wetland, grassland and forest habitat would be to incorporate naturalized stormwater wetlands adjacent to native grass uplands and treed areas. A naturalized stormwater wetland differs from traditional stormwater ponds in that it reflects a natural wetland by incorporating multiple vegetation zones; open water, deep marsh, and wet meadow. Native wetland and upland vegetation would be used by a variety of bird and amphibian communities. Frogs and birds have evolved with native vegetation, which provides better nesting, cover and food resources than introduced species.

Forest habitat can also be incorporated through the addition of tree and shrub species to the riparian area of the pond, or by capitalizing on the existing resources within the area by locating naturalized stormwater wetlands in close proximity to existing tree stands. This would create connectivity between the three habitats making it ideal for seasonal movement of wildlife species. The stand of large mature cottonwoods (*Populus deltoids*) on the north-west edge of the Study Area would support higher biodiversity because of the larger tree size (Appendix A). The larger canopy supports more nesting species and provides opportunities for cavity nesting birds.

Mitigation

All construction activities affecting natural habitats should be conducted outside of critical breeding seasons. In accordance with the Migratory Birds Convention Act, 1994, disturbance or destruction of nests or eggs of migratory birds is prohibited. The majority of species detected are migratory species and therefore are protected during breeding season under this act. The regional nesting period for Winnipeg, as set by Environment Canada, is late-April to late-August. Development in accordance to this standard will lessen the impact on all wildlife species.

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Appendix A. Location of Cottonwood Tree Stand



Figure A-1. Map of the Study Area showing the location of the mature cottonwood tree stand in white.

Appendix B. Plant Species List

Table B-1. Species detected during the spring flowering plant survey[A].

Common Name	Scientific Name	Origin	Weed?	Observed in Vegetation Surveys?
Alkali bulrush	*Bolboschoenus maritimus*	N	N	N
Alsike clover	*Trifolium hybridum*	I	Y	N
American vetch	*Vicia americana*	N	N	Y
Awlfruit sedge	*Carex stipata*	N	N	N
Balsam groundsel	*Packera paupercula*	N	N	N
Baltic rush	*Junctus balticus*	N	N	Y
Beb's willow	*Salix bebbiana*	N	N	N
Black medic	*Medicago lupulin*	I	Y	N
Canada anemone	*Anemone canadensis*	N	N	N
Canada thistle	*Circium arvense*	I	Y	Y
Caragana	*Caragana arborescens*	I	Y	Y
Common blue-eyed grass	*Sisyrinchium montanum*	N	N	N
Common Spike Rush	*Eleocharis palustris*	N	N	Y
Curly dock	*Rumex crispus*	I	Y	Y
Dandelion	*Taraxacum officinale*	I	Y	Y
Dwarf milkweed	*Asclepias ovalifolia*	N	N	N
Foxtail Barley	*Hordeum jubatum*	N	Y	Y
Green bulrush	*Scirpus atrovirens*	N	N	N
Hardstem bulrush	*Schoenoplectus acutus*	N	N	N
Heart leaf alexander	*Zizia aptera*	N	N	N
Hybrid Cattail	*Typha x glauca*	I	Y	Y
Kentucky blue grass	*Poa pratensis*	I	Y	Y
Leafy spurge	*Euphorbia esula*	I	Y	N
Macoun's Buttercup	*Ranunculus macounii*	N	N	Y
Manitoba Maple	*Acer negundo*	N	N	Y
Philidelphia fleabane	*Erigeron philadelphicus*	N	N	N
Pretty milk vetch	*Astragalus eucosmus*	N	N	N
Prickly rose	*Rosa acicularis*	N	N	N
Purple Loosestrife	*Lythrum salicaria*	I	Y	Y
Quack grass	*Elymus repens*	I	Y	N
Red clover	*Trifolium pratense*	I	Y	N
Red Osier Dogwood	*Cornus sericea*	N	N	Y
Reed Canary Grass	*Phalaris arundinacea*	I	Y	Y
Rough cinquefoil	*Potentilla norvegica*	I	Y	N
Sandbar willow	*Salix exigua*	N	N	N

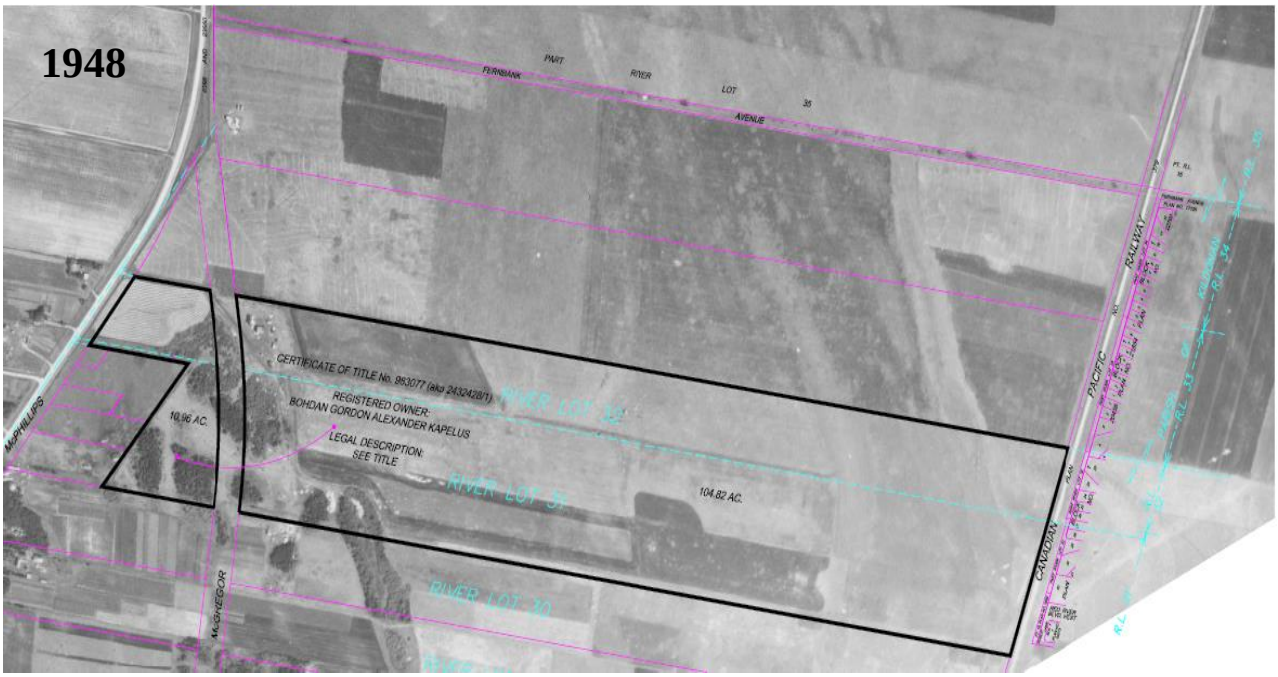
Table B-1 (con't)

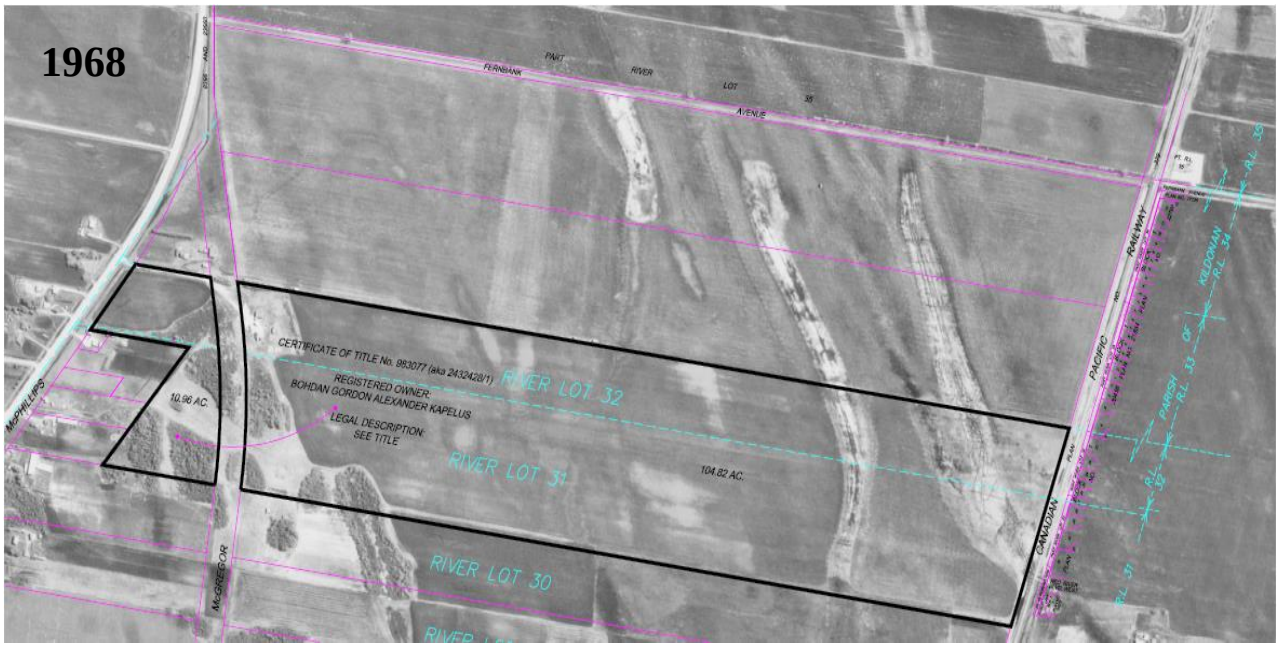
Seaside Arrowgrass	*Triglochin maritima*	N	N	Y
Shepherd's purse	*Capsella bursa-pastoris*	I	Y	N
Shore Buttercup	*Ranunculus cymbalaria*	N	N	Y
Silverweed	*Argentina anserina*	N	N	Y
Slender Wheatgrass	*Elymus trachycaulus*	N	N	Y
Slough Grass	*Beckmannia syzigachne*	N	N	Y
Small flowered buttercup	*Ranunculus abortivus*	N	N	Y
Smooth Brome	*Bromus inermis*	I	Y	Y
Soft Stem Bulrush	*Schoenoplectus tabernaemontani*	N	N	Y
Swamp milkweed	*Asclepias incarnata*	N	N	Y
Tickle grass	*Agrostis scabra*	N	N	Y
Timothy grass	*Phleum pratense*	I	Y	Y
Trembling aspen	*Populus tremuloides*	N	N	Y
Tufted Loosestrife	*Lythrum thyrsiflora*	N	N	Y
Veiny meadow rue	*Thalictrum venulosum*	N	N	N
Water sedge	*Carex atherodes*	N	N	N
Western snowberry	*Symphoricarpos occidentalis*	N	N	N
Wild mustard	*Sisymbrium officinale*	I	Y	N
Wild plum	*Prunus americana*	N	N	N
Wild raspberry	*Rubus idaeus*	N	N	N
Yellow sweet clover	*Melilotus officinalis*	I	Y	N

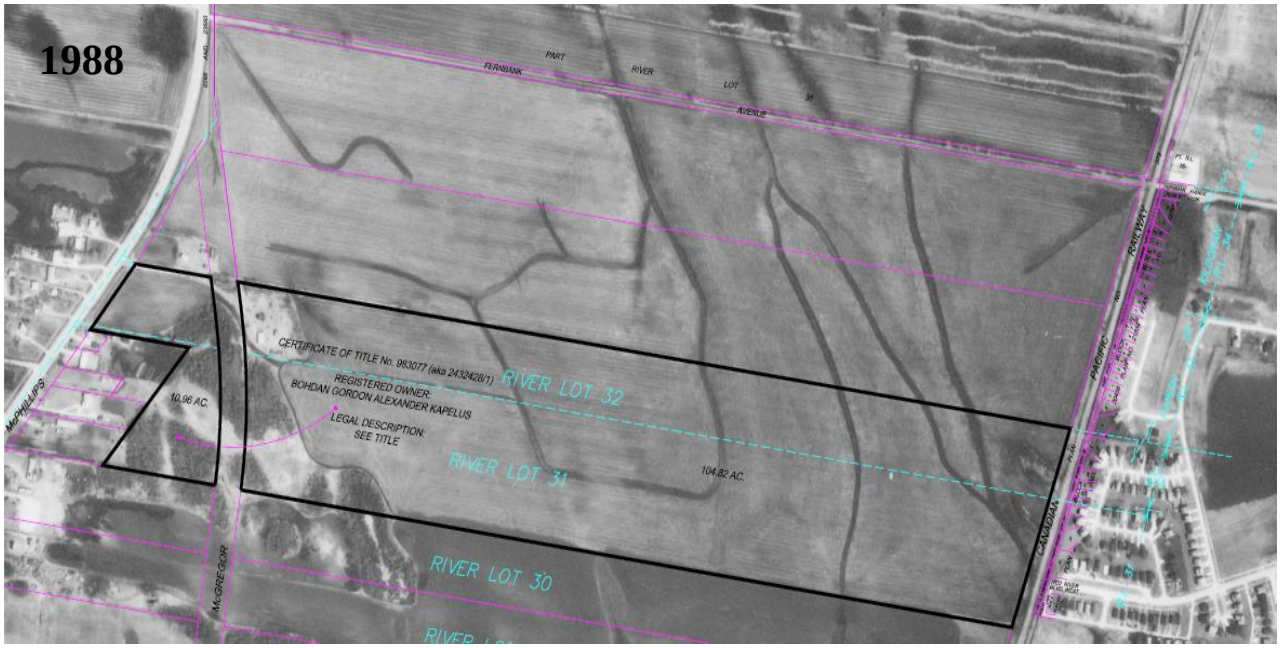
[A] Origin: I=introduced, N=native. Weed?: Y=yes, N=no.

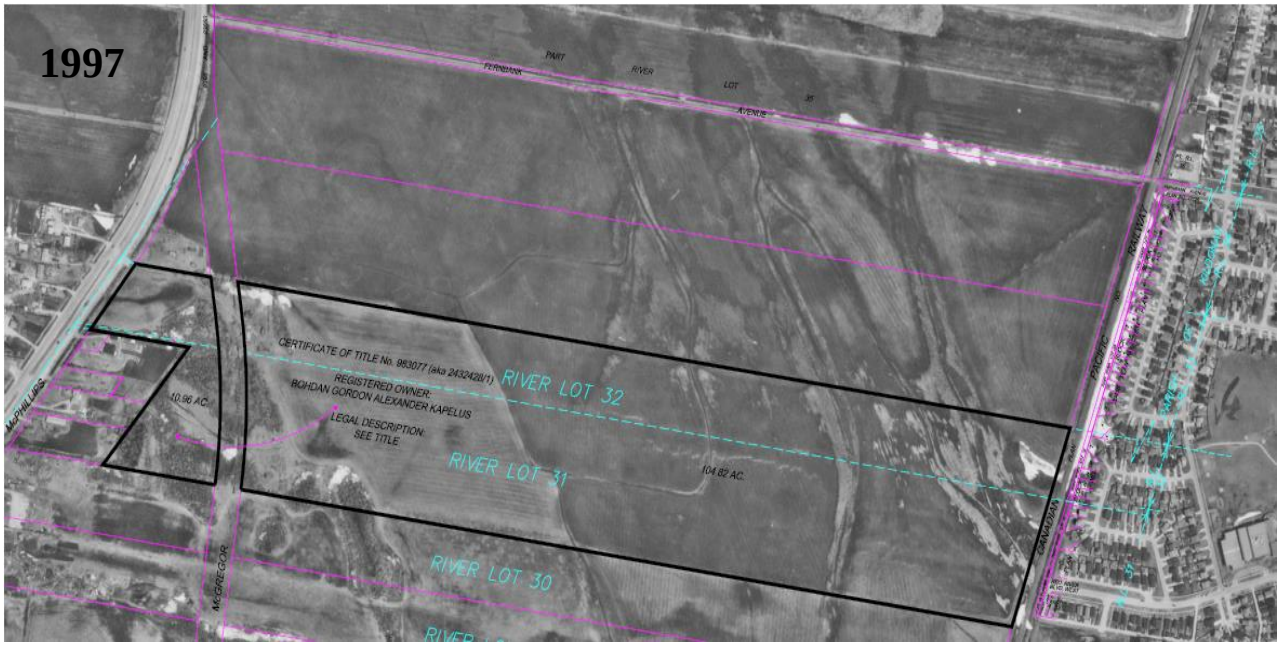
Appendix C. Aerial Imagery

Figure C-1. Historical imagery of Study Area depicting changes in wetland presence between 1948-1997**.**






1988
PART
RIVER
LOT
35
FERNDALE
AVENUE
CERTIFICATE OF TITLE No. 983077 (aka 2432428/1)
REGISTERED OWNER:
BOHDAN GORDON ALEXANDER KAPELUS
LEGAL DESCRIPTION:
SEE TITLE
RIVER LOT 32
RIVER LOT 31
RIVER LOT 30
104.82 AC.
10.96 AC.
McPHILLIPS
McGREGOR
CANADIAN
PACIFIC
RAILWAY


1997
PART
RIVER
LOT
35
FERNDALE
AVENUE
CERTIFICATE OF TITLE No. 983077 (aka 2432428/1)
REGISTERED OWNER:
BOHDAN GORDON ALEXANDER KAPELUS
LEGAL DESCRIPTION:
SEE TITLE
RIVER LOT 32
RIVER LOT 31
RIVER LOT 30
104.82 AC.
10.96 AC.
McPHILLIPS
McGREGOR
CANADIAN
PACIFIC
RAILWAY

Appendix D. Incidental Species Observations

Table D-1. Incidental bird species detected in the Study Area.

Common Name	Latin Name	Observations
Alder flycatcher	*Empidonax alnorum*	1
American bittern	*Botaurus lentiginosus*	1
American crow	*Corvus brachyrhynchos*	3
American robin	*Turdus migratorius*	5
Barn swallow	*Hirundo rustica*	1
Black-capped chickadee	*Poecile atricapillus*	1
Blue-winged teal	*Anas discolor*	3
Bobolink	*Dolychonynx oryzivorus*	4
Brewer's blackbird	*Euphagus cyanocephalus*	5
Brown-headed cowbird	*Molothrus ater*	1
Canada goose	*Branta canadensis*	9
Canvasback	*Aythya valisineria*	2
Clay-colored sparrow	*Spizella pallida*	13
Common grackle	*Quiscalus quiscula*	1
Common yellowthroat	*Geothlypis trichas*	2
Double crested cormorant	*Phalacrocorax auritus*	1
Killdeer	*Charadrius vociferus*	7
LeConte's sparrow	*Ammodramus leconteii*	8
Mallard	*Anas platyrhynchos*	20
Marsh wren	*Cistothorus palustris*	2
Merlin	*Falco columbarius*	2
Mourning dove	*Zenaida macroura*	3
Northern harrier	*Circus cyaneus*	1
Northern shoveler	*Anas clypeata*	9
Palm warbler	*Setophaga palmarum*	1
Red-tailed hawk	*Buteo jamaicensis*	2
Red-winged blackbird	*Agelaius phoeniceus*	127
Rock Pigeon	*Columba livia*	6
Savannah sparrow	*Passerculus sandwichensis*	4
Sedge wren	*Cistothorus platensis*	4
Song sparrow	*Melospiza melodia*	6
Sora Rail	*Porzana carolina*	11
Tree sparrow	*Tachycineta bicolor*	9
Warbling vireo	*Vireo gilvus*	3
Western meadowlark	*Sturnella neglecta*	10
Wilson's snipe	*Gallinago delicata*	10
Wood duck	*Aix sponsa*	3

Table D-1 (con't)

Yellow warbler	*Setophaga petechia*	12
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	1

Appendix E. Photos of the Land Cover Types in the Study Area



Figure E-1. Example of existing wetland habitat.





Figure E-2. Example of grassland habitat.





Figure E-3. Example of the riparian forest/forest habitat.



Figure E-4. Example of the willow marsh habitat.