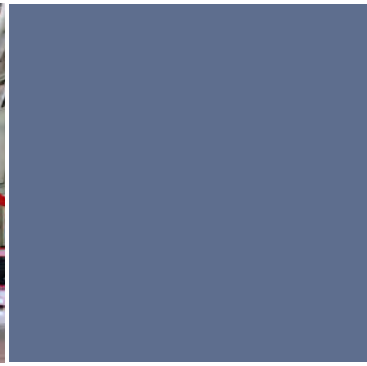




Josephburg Road North Industrial Outline Plan

Accepted Copy

January 2022

Submitted by:

In association with:

Submitted to:



Josephburg Road North Industrial Outline Plan

Prepared for



For



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In association with



January 2022

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1.0

EXECUTIVE SUMMARY

The Josephburg Road North Industrial Outline Plan has been prepared on behalf of Fort Industrial Estates Ltd. for the development of industrial land within the City of Fort Saskatchewan. The Outline Plan provides the context and development details for a portion of land which comprises 605 hectares. The subject area is located in the northeast portion of the City bounded by Highway 15, Township Road 550 and Range Road 220.

The purpose of the Josephburg Road North Industrial Outline Plan is to address development issues such as land use, environmental assessment, and transportation circulation as well as utility servicing to provide the framework to guide future medium industrial development on a comprehensively planned basis. It takes full advantage of its location along the Highway 15 corridor and its close proximity to other adjacent medium and heavy industrial uses, and Alberta's Industrial Heartland.

Figure 7—Development Concept shows a conceptual layout for the Plan area but it must be noted that the Development Concept is not intended as a detailed subdivision layout nor is it representative of the number and size of industrial parcels to be subdivided. Industrial land uses are proposed for the entire Plan area in the form of Medium Industrial land use districts. Parcels not belonging to Fort Industrial Estates Ltd. have also been included in the Plan boundary to ensure that adjacent lands are integrated and developed comprehensively. Prior to redistricting and subdivision, further detailed planning of these lands will be required.

Municipal Reserve (MR), as provided for in the *Municipal Government Act*, is anticipated up to a maximum of 10% of the total subdivision area minus any Environmental Reserve (ER) and may be provided by dedicating land contribution or cash-in-lieu.

Figures 9 and 10 – Water and Sanitary Servicing illustrate that servicing will be provided to a full urban buildout for the western portions of the site (west of Range Road 221). For the remainder of the plan area, servicing will be provided at a reduced level of service.

Figure 13 – Staging outlines the proposed phasing for development of the plan area. Infrastructure servicing will be extended into these lands from the west to east.

In order to provide for all potential industrial development opportunities, the phasing is influenced by preferred lot sizes and location requirements. As such, the number of lots, the size of lots, and the location of each phase will be confirmed at detailed subdivision and engineering.



2.0

INTRODUCTION

2.1 Purpose

The Josephburg Road North Industrial Outline Plan has been prepared on behalf of Fort Industrial Estates Ltd. for a proposed land development within the City of Fort Saskatchewan. The Outline Plan provides the context and development details for a portion of land which comprises 605 ha. The subject area is located in the northeast portion of the City bounded by Highway 15, Township Road 550 and Range Road 220.

The purpose of the Josephburg Road North Industrial Outline Plan is to address development issues such as land use, environmental assessment, and transportation circulation as well as utility servicing to provide the framework to guide development within the Plan area. The Outline Plan includes the following sections:

- existing and proposed land uses;
- traffic impact analysis with appropriate road standards and access locations into the plan area;
- municipal servicing systems including water, sanitary sewer and stormwater management; and
- lotting and staging plan;

The Outline Plan includes an overview of policies and guiding principles for the ongoing development of the Josephburg Road North Industrial area, including how Fort Saskatchewan will plan future land use, economic development, transportation linkages, environmentally sensitive areas and utility servicing for the ongoing development of this area.

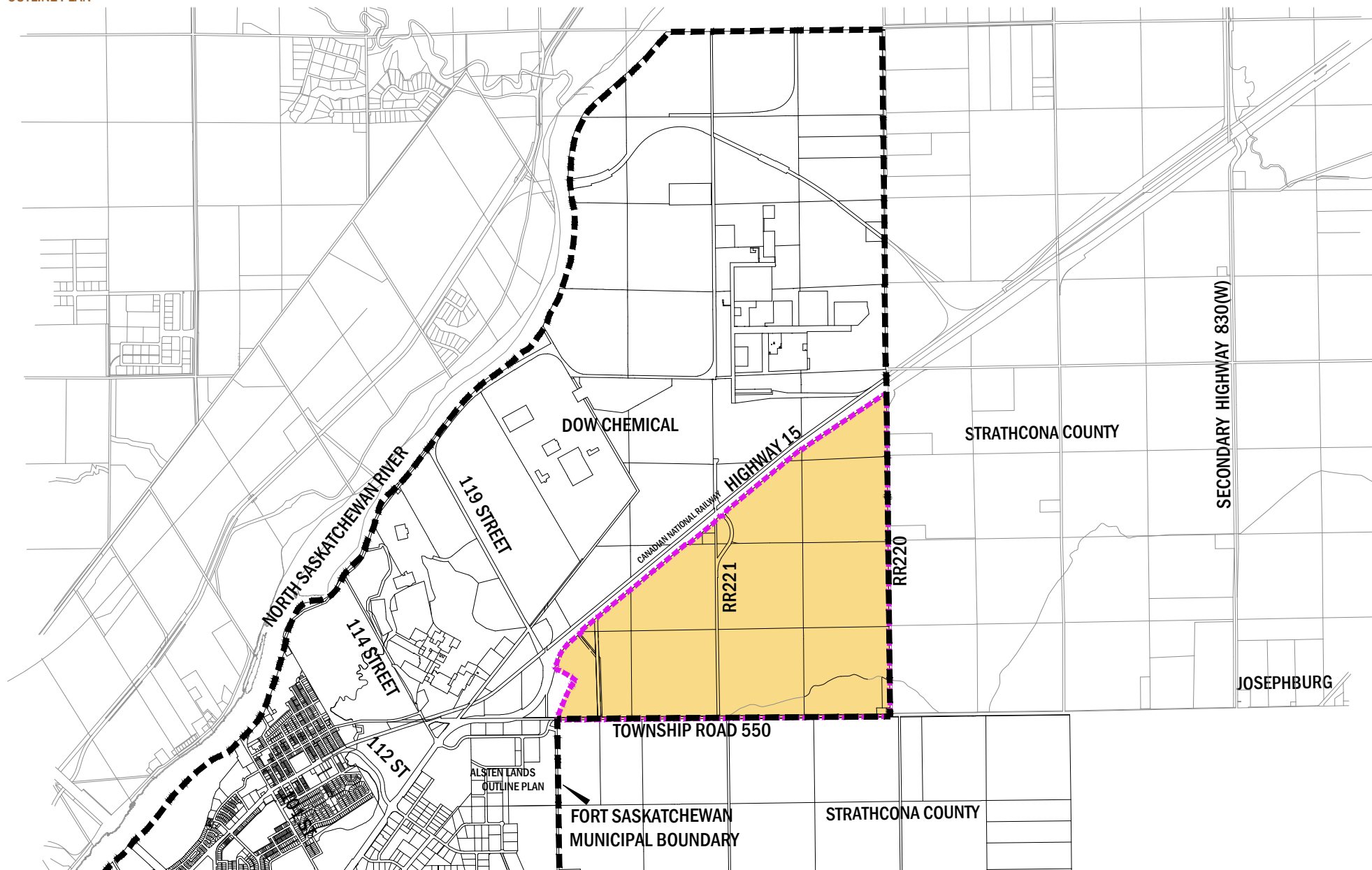
2.2 Definition of Plan Area and Location

The Plan area covers approximately 605 ha and is located within the municipal boundaries of the City of Fort Saskatchewan as shown in *Figure 1—Location*. Contained within the area is the entire Section 1-55-22-4 and portions of Section 2-55-22-4 and Section 12-55-22-4. The Plan area boundaries are as follows:

Northern Boundary:	Highway 15
Eastern Boundary:	Range Road 220 (Strathcona County)
Western Boundary:	Highway 15
Southern Boundary:	Township Road 550

2.3 Land Ownership

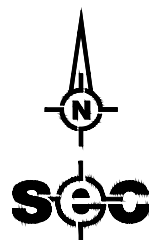
Most of the parcels within the Plan area are not subdivided (i.e. full quarter sections) or have been severed by the Highway 15 right-of-way or the existing drainage ditch in the southeast portion of the Plan area. Three smaller parcels (ranging from 0.5 ha to 5 ha) are registered in the southeast corner of the plan area, and are currently titled to other private landowners. Most of the land in the Plan is held by private developers, while a private landowner currently owns approximately 2½ quarter sections adjacent to Range Road 220. At the intersection of Highway 15 and Range Road 221, across from Dow Chemical, 60 acres in the south half of SW 12-55-22-4 quarter section belongs to ENGIE Fabricom (formerly Cofely Fabricom) with an industrial subdivision already in place. For legal description and gross area of each legal parcel, refer to *Figure 2—Land Ownership and Appendix A—Land Ownership*.



LEGEND

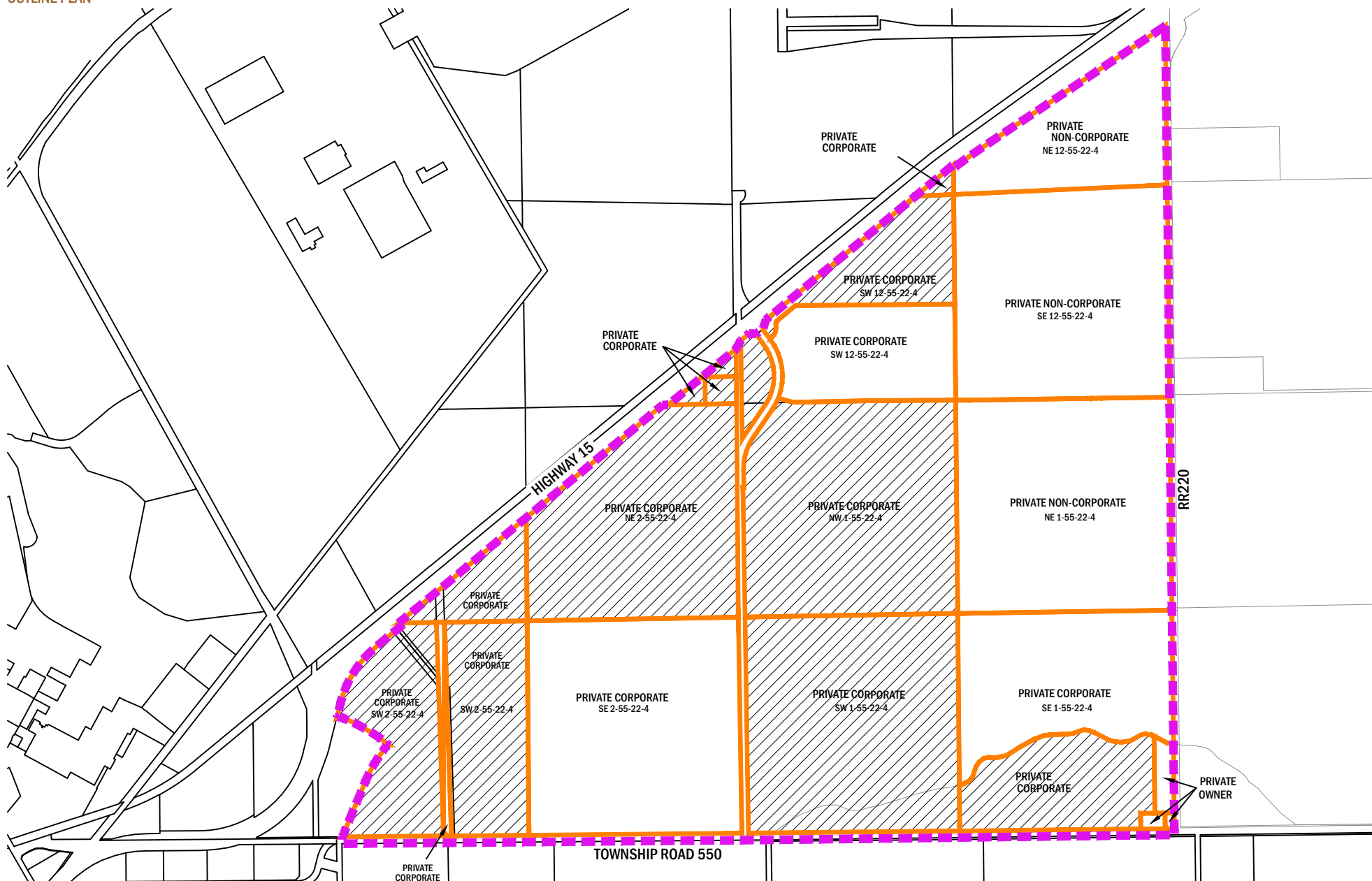
- Outline Plan Area
- Outline Plan Boundary
- Fort Saskatchewan Municipal Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



LOCATION

0 0.5 1 km scale 1:50,000



LEGEND



Fort Industrial Estates Ltd. Ownership

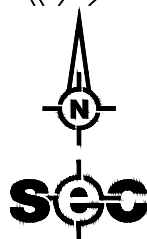


Ownership Boundary



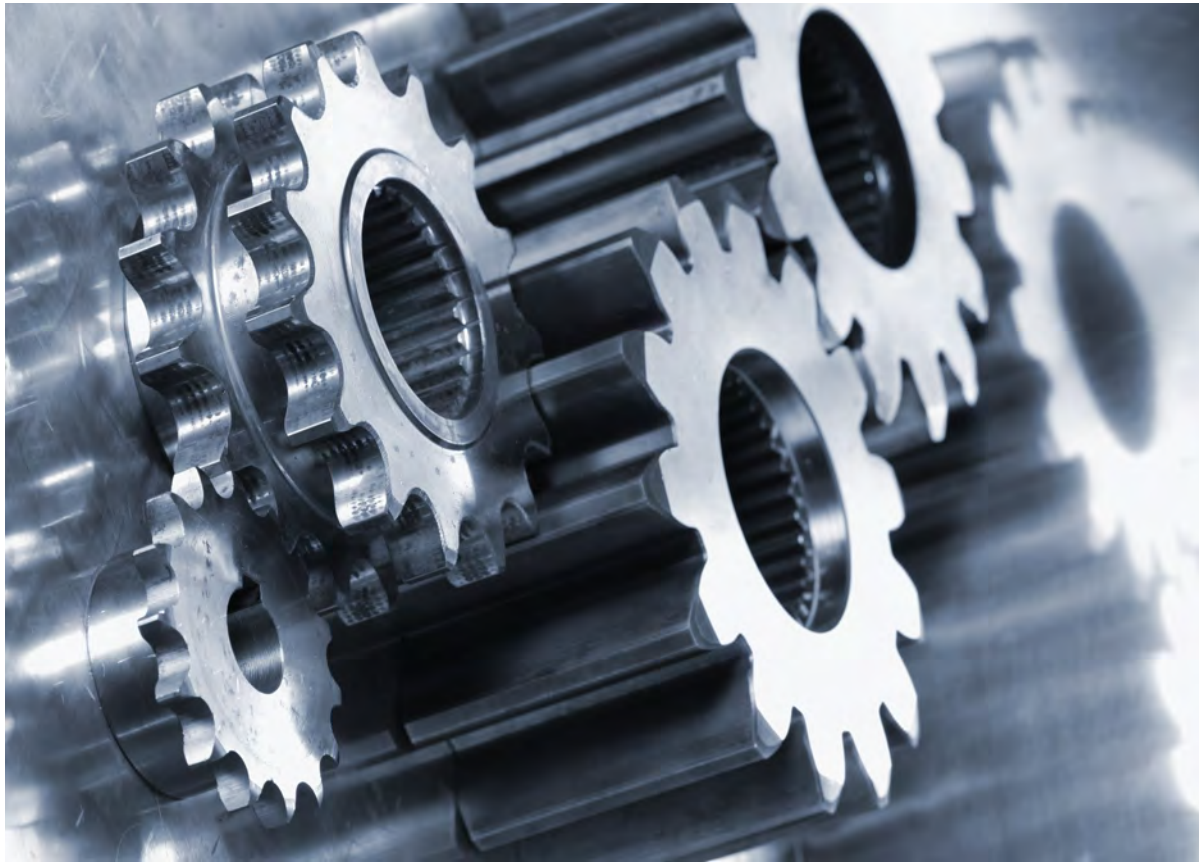
Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



LAND OWNERSHIP

0 200 400 m scale 1:20,000



3.0

3.0

PLANNING POLICY CONTEXT

3.1 City of Fort Saskatchewan Community Sustainability Plan (CSP)

The *Community Sustainability Plan* provides a high-level strategic vision to guide all decision-making in Fort Saskatchewan towards a sustainable future. This Outline Plan will be submitted to the City of Fort Saskatchewan for approval and compliance with the CSP.

3.2 City of Fort Saskatchewan Municipal Development Plan (MDP) Bylaw C16-10

The Municipal Development Plan is a high-level policy document that provides overall direction for land development in the City of Fort Saskatchewan. This Outline Plan will be submitted to the City of Fort Saskatchewan for approval and compliance with the MDP.

This Outline Plan adheres to the *Fort Saskatchewan Municipal Development Plan* through the following policies:

Section 6.0	<i>The Future Land Use Plan (Map 3), which identifies the overall growth management strategy for the City of Fort Saskatchewan, designates the Outline Plan Area as Light and Medium Industrial.</i>
Section 6.8.8	<i>Ensure that developments mitigate visual impacts from public roads.</i>
Section 6.8.18	<i>Ensure that Light and Medium Industrial uses meet current industrial Risk standards and guidelines.</i>
Section 8.4.1	<i>Use the Transportation Master Plan as a reference to ensure that adequate rights-of-way are preserved and incorporated into future development areas.</i>
Section 11.4.2	<i>Maximize retention of stormwater or require enhancement to natural wetlands where possible to ensure a high quality of stormwater effluent.</i>

3.3 Josephburg Road North Industrial Area Structure Plan (ASP) Bylaw C9-15

The Outline Plan follows the same boundary as the *Josephburg Road North Industrial Area Structure Plan (ASP)*. Specifically, the ASP provides guidance for the future growth of industrial development within the City of Fort Saskatchewan.

Objective	Area Structure Plan Policy	Implementation
4.2.1 <i>To provide for light and medium industrial land that will be available to meet the diverse needs of prospective industries.</i>	4.2.1(a) <i>Lands in the ASP designated for medium industrial development will be accommodated through application of the IM—Medium Industrial Districts.</i>	
	4.2.1(c) <i>To provide industrial and business opportunities to serve the employment needs of the Industrial Heartland, the City of Fort Saskatchewan and the Capital.</i>	4.2.1(c) <i>Uses which are permitted within the existing IM—Medium Industrial Districts will be applied.</i>
4.2.2 <i>Locate and orient industrial parcels along roadways to take advantage of the high visibility and convenient access opportunities.</i>	4.2.2 <i>To ensure internal roadway circulation increases visibility and provides appropriate access to the industrial parcels.</i>	4.2.2 <i>The internal roadway circulation pattern will be refined and confirmed at the Outline Plan, rezoning and subdivision phases with regards to the development and staging pattern and logical extension of infrastructure, and may require the completion of detailed Transportation Impact Assessment.</i>
4.2.5 <i>To apply an appropriate buffer width to protect the existing drainage course from encroaching industrial development.</i>	4.2.5 <i>Development shall be intended primarily for uses that are complimentary to heavy industrial land uses in proximity, with secondary emphasis on limited highway commercial uses.</i>	4.2.5 <i>Development shall comply with the IM—Medium Industrial Districts of the Land Use Bylaw.</i>

The *Land Use Concept* of the *Josephburg Road North Industrial Area Structure Plan* (ASP Figure 5), which illustrates a conceptual land use and development framework for more detailed Outline Plans, designates the Josephburg Outline Plan area as Medium Industrial.

3.4 Alberta Industrial Heartland Area Structure Plan (ASP) Bylaw C19-00

The *Alberta industrial Heartland Area Structure Plan* guides future industrial growth in the City of Fort Saskatchewan and complements similar area structure plans prepared by neighbouring partner municipalities in Alberta's Industrial Heartland including Strathcona County that borders the east and south boundary of this Outline Plan, Sturgeon County and Lamont County. The Outline Plan complies with the Alberta Industrial Heartland (AIH) ASP. The AIH ASP designation is Medium Industry Policy Area. Some of the guidelines in the ASP include:

- Section 2.3.1.2
- *Planning, design and development of [...] site to optimize the conservation of heat and water, and to minimize the production of noise and light*
 - *Maintenance of the environmental characteristics indigenous to the area (e.g. planting materials, wildlife habitat, topography) in the planning, design, development and reclamation of the site*
- Section 2.4.2 *Medium Industrial Activities:*
- *Located across Highway 15 from portions of Dow [...], this area will accommodate medium industrial activities that could support the activities associated with the heavy industrial activities throughout the Heartland*
 - *Access to and from Highway 15 will be centralized in one or two intersections*
- Section 2.6 *Sewage Management*
- *Existing and new industry and commercial development will be encouraged to connect with the City of Fort Saskatchewan's oversized collection system for industrial and domestic sewage, and to the Capital Region sewage system*
- Storm Water Management*
- *As new developments [...] are being attracted to the area, increased attention will be given to developing and implementing innovative means to manage storm water runoff and ultimate discharge into the North Saskatchewan River*

3.5 City of Fort Saskatchewan Land Use Bylaw (LUB) C10-13

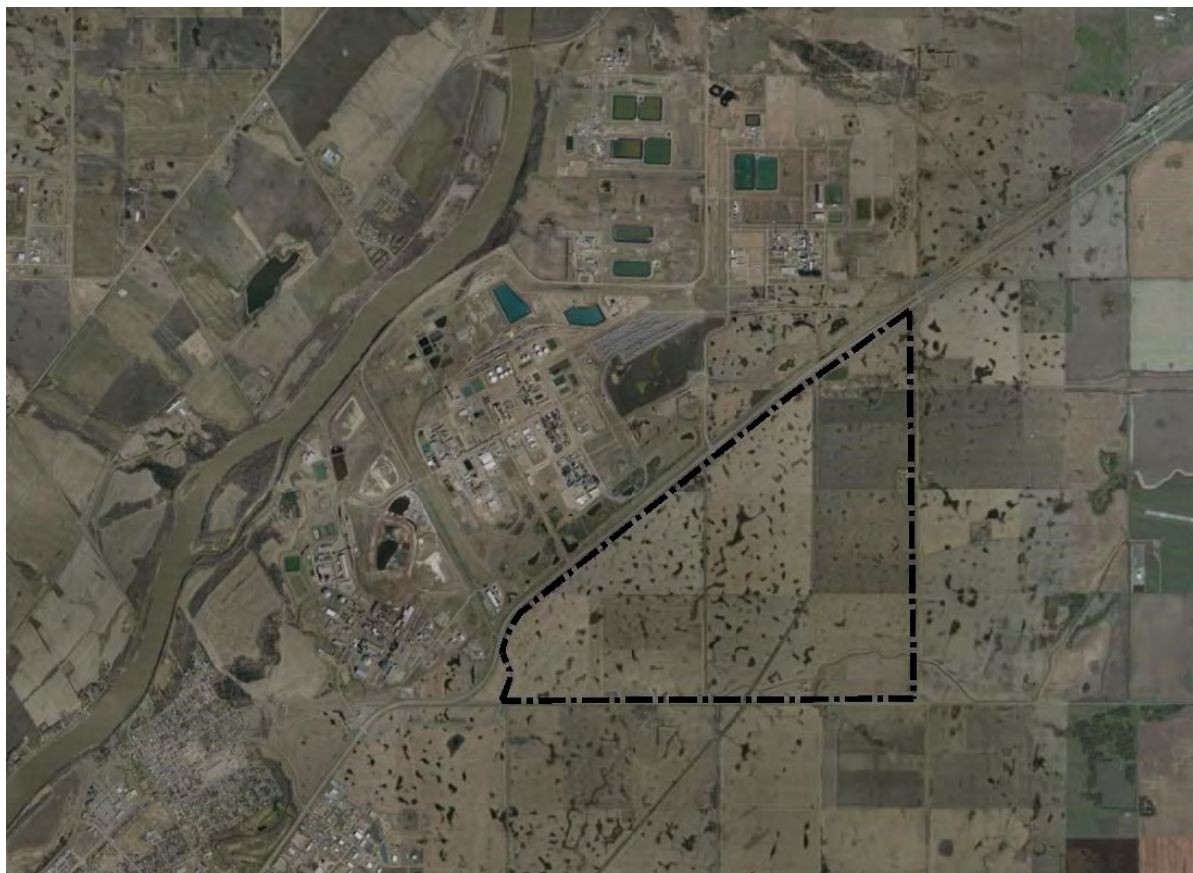
The *City of Fort Saskatchewan Land Use Bylaw* regulates land uses within the City. The existing Land Use District is *IR-Industrial Reserve District*. However, the lands are currently cultivated for agricultural purposes. Hence, this land development will require compliance and / or amendments to meet approvals. Required subdivision and redistricting applications will be submitted to the City of Fort Saskatchewan.

Additionally, a portion of the plan area adjacent to Highway 15 is covered by the Highway 15 Vicinity Overlay as shown in *Figure 7—Development Concept*. The purpose of the Overlay is to “provide for limited highway commercial uses adjacent to Highway 15”.

3.6 Capital Region Board (CRB) Policies

The *Capital Region 10-Year Provincial Highways Plan* (a follow-up on the Capital Region Integrated Growth Management Plan Report) recognizes the Province’s priorities with respect to Capital Region improvements. Within and in proximity to the Plan area, the Provincial Highways Plan outlines the following improvements that directly or indirectly impact the Outline Plan area:

- Intersection upgrade at the Highway 15 / Range Road 220 intersection;
- The Fort Saskatchewan by-pass highway, consisting of a new 4-lane roadway and two (2) new interchanges; one at the south end of the City intersecting with Highway 21 and another at the intersection of the proposed by-pass with Highway 15 and Secondary Highway 830 east of the City.



4.0

SITE CONTEXT AND DEVELOPMENT CONSIDERATIONS

4.1 Site Description and Constraints

4.1.1 Topography

As shown in *Figure 3—Natural Constraints*, the topography of the land within the Plan area is primarily flat, with gradual sloping from east to west. The highest point is at an elevation of 631.1m, while the lowest elevation is 624.1m. The maximum elevation difference across the entire Plan area is approximately 7.0m.

4.1.2 Soils

Soils in the Plan area are well drained, with the exception of the small wetland areas in the centre and in southwest portions of the Plan area which contain soils characteristic of wetland ecosystems.

4.1.3 Vegetation

The majority of land within the Plan area has been cleared of vegetation and is under cultivation. However, there are several low-lying areas loosely scattered throughout the Plan area and a large tree stand along the boundary of NE 12-55-22-4 and SE 12-55-22-4. The existing tree stand contains healthy mature balsam poplar with a thick willow understory and a meadow-like interior

consisting of reed canary grass. Another smaller treed area is located along the drainage area at the north eastern corner of SE 2-55-22-4. This willow thicket predominantly consists of willow shrubs and mixed grasses.

4.2 Existing Land Uses

The existing land is currently used for the cultivation of agricultural products with a few permanent structures. As seen on *Figure 4—Development Constraints*, there is some existing residential land use with five existing dwellings present within the Plan area, each on separately titled parcels. As well as the dwellings, each parcel also has associated outbuildings including grain silos, workshops, garages. Two of the dwellings have direct access to Range Road 220 and the other three from Township Road 550.

4.2.1 Built Infrastructure

Several pipeline right-of-ways (ROWs) traverse the Plan area. As seen in *Figure 4—Development Constraints*, there are 7 distinct pipeline right-of-ways, that contain a total of 22 separate pipelines, as summarized in *Table 1—Pipeline Information Summary* and *Table 2 - Utility Right of Way Information Summary*.

Pipeline corridor “A” is located in the extreme southwest corner of the Plan area and is an ATCO Gas and Pipelines Ltd natural gas pipeline right-of-ways with an approximate 15m wide ROW. It contains three operating natural gas pipelines.

Pipeline corridor “B” extends along the south boundary of the Plan area is another ATCO Gas and Pipelines Ltd 6m wide natural gas pipeline right-of-way. It contains two operating natural gas pipelines.

Pipeline corridor “C” in the southwest corner of the Outline Plan belongs to Keyera Energy Ltd and contains three operating high pressure pipelines within a ROW that varies in width from 6m to 18m.

The largest pipeline right-of-way (approximately 66m) (identified as “D” and “E”) extends from the south central part of the Plan area towards the northeast edge of the plan boundary (32m) with a portion diverging towards the north (48m). This major right-of-way, containing products under extremely high pressure, has pipelines belonging to Nova Chemicals, BP Canada Energy Company, Alberta Ethane Development Company, Suncor, Praxair, Shell Canada and Access Pipeline.

Pipeline corridor “F” is a BP Canada Energy Company 18m right-of-way and contains two operating high pressure pipelines, within the north portion of the Plan area. The right-of-way enters from the east of Range Road 220, bends towards the north and crosses over Highway 15.

Lastly, pipeline corridor “G” contains one operating Praxair high pressure pipeline with a 5m right-of-way is located in the south west corner of the Plan area.

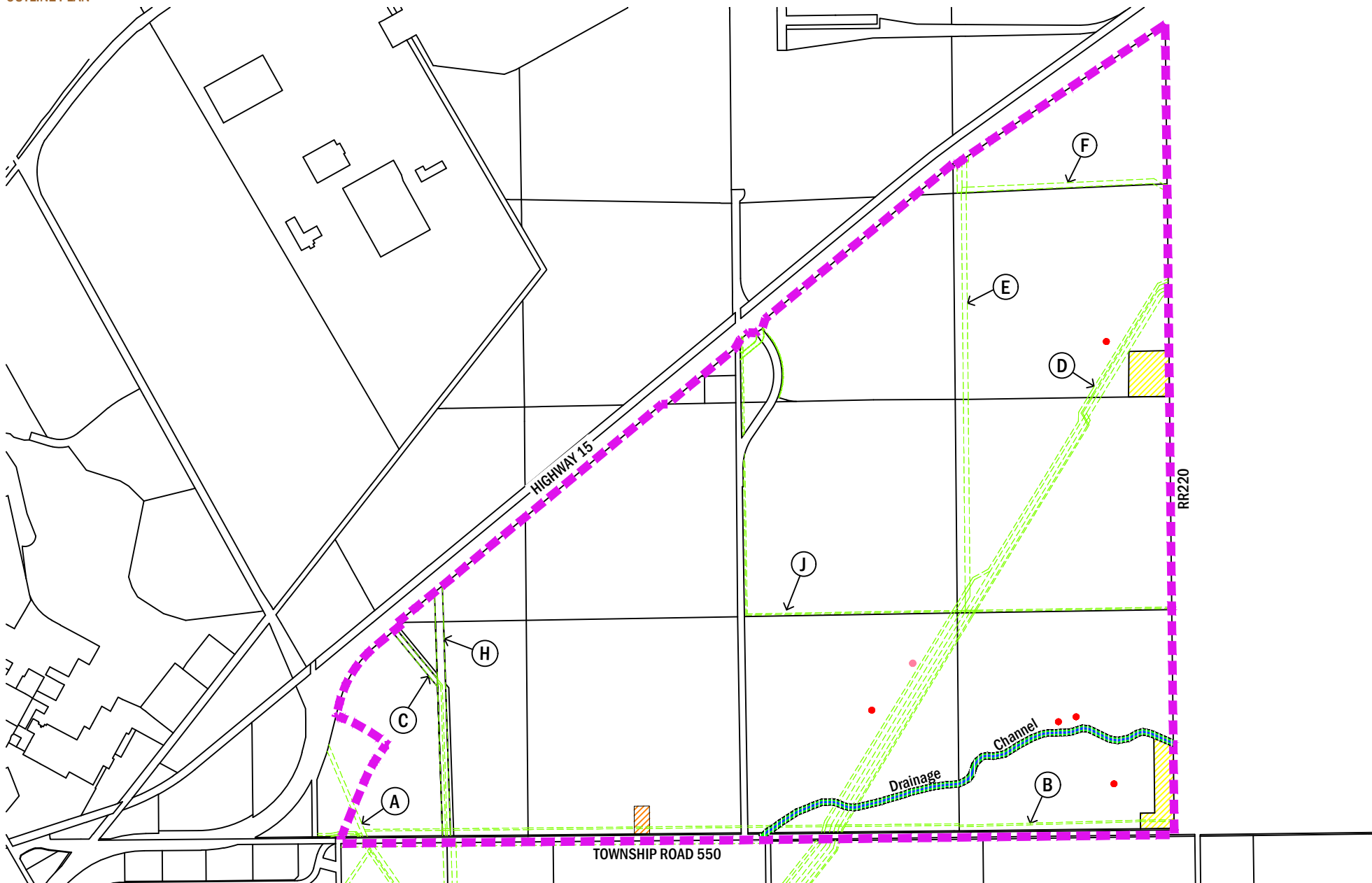
There are also two existing powerline right-of-ways within the southwestern portion of the Outline Plan area. Powerline right-of-way “H” is situated within a 35m wide corridor and contains a series of 2 parallel above ground transmission towers. The second powerline right-of-way, identified as “I” is an underground powerline contained within a 9.2m wide right-of-way.

Right-of-way “J” is an existing buried, telephone cable within a 5m right-of-way.



- Outline Plan Boundary

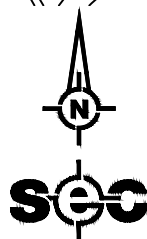
FIGURE 3



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- | | | | | | |
|-----|---------------------------------|--|------------------------------|--|-----------------------|
| (J) | Reference Letter (Tables 1 & 2) | | Environmental Reserve Buffer | | Abandoned Well |
| | Existing Right of Way | | Agricultural Use | | Active Well |
| | Drainage Channel | | Residential Use | | Outline Plan Boundary |

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



DEVELOPMENT CONSTRAINTS

0 200 400 m
scale 1:20,000

225-17015-02-PRF004.DWG
Jjurinic August 18, 2021

FIGURE 4

Table 1 - Pipeline Information Summary

License #	Licensee	Status / Substance	Operating Pressure (kPa)	Utility Right-of-Way Plan	Reference ID (Figure 4)
1826-59	ATCO Gas and Pipelines (South)	Abandoned/Natural Gas	0		
4932-1	ATCO Gas and Pipelines (South)	Operating / Natural Gas	4,450	Gasline R/W 4729HW	Pipeline Corridor "A"
1826-61	ATCO Gas and Pipelines (South)	Operating / Natural Gas	3,450		
1826-24	ATCO Gas and Pipelines (South)	Operating / Natural Gas	3,450		
9453-1	ATCO Gas and Pipelines (South)	Operating / Natural Gas	3,450	Gas Pipeline R/W 3014KS	Pipeline Corridor "B"
1826-25	ATCO Gas and Pipelines (South)	Operating / Natural Gas	3,450		
8594-6	Keyera Energy Ltd	Operating / High Vapour Pressure Products	4,960	Products Pipeline R/W 1913TR	Pipeline Corridor "C"
8478-6	Keyera Energy Ltd	Operating / High Vapour Pressure Products	6,230		
8588-7	Keyera Energy Ltd	Operating / High Vapour Pressure Products	4,930		
34335-1	Suncor Energy Inc	Operating / Carbon Dioxide	7,290	Pipeline R/W 952/5272; Petroleum Products Pipeline R/W 822/1189; Oil Pipeline R/W 3859NY	Pipeline Corridor "D"
27896-3	Praxair Canada Inc	Operating / Miscellaneous Gases	6,800		
19780-23	Shell Canada Ltd	Operating / Low Vapour Pressure Products	9,930		
19780-4	Shell Canada Ltd	Operating / Low Vapour Pressure Products	9,930		
46674-30	Access Pipeline Inc	To be constructed / Low Vapour Pressure Products	9,930		
43179-1	Nova Chemicals Corp.	Operating / High Vapour Pressure Products	9,930	Oil Pipeline R/W 5278TR; Gas Pipeline R/W 792 2504	Pipeline Corridor "E"
14763-36	Nova Chemicals Corp.	Operating / High Vapour Pressure Products	9,930		
9570-1	BP Canada Energy Company	Operating / High Vapour Pressure Products	9,930		
13023-16	AB Ethane Development Company	Operating / High Vapour Pressure Products	9,930		
16967-1	Nova Chemicals Corp	Operating / High Vapour Pressure Products	9,930		

License #	Licensee	Status / Substance	Operating Pressure (kPa)	Utility Right-of-Way Plan	Map Reference ID
22037-1	BP Canada Energy Company	Operating / High Vapour Pressure Products	9,930	Light Hydrocarbons Liquids	Pipeline Corridor "F"
9570-11	BP Canada Energy Company	Operating / Low Vapour Pressure Products	9,930	Pipeline R/W 5053TR	
27896-2	Praxair Canada Inc	Operating / High Vapour Pressure Products	6,800	Pipeline R/W 952 1455	Pipeline Corridor "G"

Table 2 - Utility Right of Way Information Summary

Owner	Utility Right of Way	Map Reference ID
Altalink Management	Powerline Right of Way 6661KS	Pipeline Corridor "H"
Altalink Management	Powerline Right of Way 1110RS	Pipeline Corridor
Alberta Government Telephones	Buried Cable Right of Way	Pipeline Corridor

There is one abandoned well located in the S.W. 1/4 Sec 1-55-22-4 and 6 active well sites, one in S.E. 1/4 Sec 12-55-22-4, three in S.E. 1/4 Sec 1-55-22-4, one in S.W. 1/4 Sec 1-55-22-4 and one in N.W. 1/4 Sec 2-55-22-4. Prior to development within the vicinity of an abandoned well site, the location and access requirements for the well site shall be accommodated. The Alberta Energy Regulator administers minimum development setbacks which must be maintained from any energy facility.

4.2.1.1 Pipeline Setbacks And Areas Of Interest

There are areas of interest to consider when development is proposed near or adjacent to pipelines. The first area is the pipeline right-of-way. Development shall maintain the minimum Alberta Energy Regulator (AER) setback from pipelines. This setback shall apply from the property line of the proposed development to the pipeline right-of-way. In most cases, a minimum setback for adjacent development should be the edge of the pipeline right-of-way, or as determined by AER.

The second area is a consultation zone based on the class location design criteria found in Canadian Standards Association CSA Z662: Oil and Gas Pipeline Systems (CSA Z662). This area covers an area extending 200 metres perpendicular to either side of the centerline of a pipeline. The 200-metre consultation area may be greater if a high-vapour-pressure pipeline or a sour gas pipeline has an associated setback or emergency response planning zone that extends beyond 200 metres from the pipeline centreline.

Upon referral of a development application, AER will determine the appropriate setback. AER categorizes sour gas facilities into four hazard levels based on release volumes for pipelines, and hydrogen sulphide (H₂S) content. There are predetermined setback distances for each level of sour gas facility. Once the appropriate level has been established for the subject pipeline, AER will then examine the types of developments in the vicinity and how people typically use the general area.

AER may designate an area on either side of the pipeline, beyond its right-of-way, where pathways, park areas, roadway and other crossings, and commercial industrial outdoor storage may be considered acceptable. Subdivision design shall accommodate the continued transport and maintenance needs of the oil and gas company while minimizing the impact on adjacent development. This should include the provision for temporary emergency access while pipelines are still active.

4.2.2.2 Josephburg Aerodrome

Warren Thomas (Josephburg) Aerodrome may impact development in the Josephburg Road North area. Although the aerodrome is within Strathcona County, a portion of the eastern ASP area is affected by the take-off/approach surface of the runway. Therefore, it should be recognized that the aerodrome may influence the height and type of development permitted within the Plan area.

Sections 9.1 A – Airport and 9.2 AO -Airport Vicinity Protection Overlay of the Strathcona County Land Use Bylaw 6-2015, provide direction with respect to restrictions to land use, buildings and structures in areas in proximity to the aerodrome to ensure continuing flight safety and air navigation.

Development which may cause dangerous conditions that would interfere with safety for aircraft landing or taking off should not be allowed. Those conditions include:

- Excessive discharge of toxic, noxious or other particulate matter into the atmosphere.
- Radiation or interference by the use of electronic equipment such as industrial x-ray, diathermy equipment, or equipment for commercial purposes that causes electrical interference with navigational signals or radio communications.
- Fire and explosive hazards.
- Accumulation of any material or waste edible by or attractive to birds.
- Glare or lighting that interferes with lights necessary for aircraft landing or take-off.

In addition, the maximum height for any use or development including all equipment, shall not penetrate the surfaces as shown on *Figure 5 – Josephburg Aerodrome Limitation Surfaces*. The City should notify Strathcona County of any development permit application within the area affected by the take-off/approach surface of the runway.

4.2.2 Existing Access and Surrounding Road Network

The Plan area is bound on the north and west by Highway 15, a four lane divided urban expressway. It is of note that Highway 15 is part of the provincially designated high load corridor system. Access to the Highway from the subject lands is currently from three separate intersections located at Range Roads 220, 221 and Township Road 550.

Township Road 550 runs east-west along the south boundary of the Plan area and is constructed as an improved, two lane rural road. Township Road 550 is under the City of Fort Saskatchewan's municipal jurisdiction. West of the Plan area, Township Road 550 bends to the south before extending to the west as 88 Avenue and intersecting Highway 15. East of the Plan area, the roadway extends to Range Road 220 (and beyond). Range Road 220 is an unimproved two lane roadway that runs north-south along the east boundary of the Plan area. Range Road 220 is under the jurisdiction of Strathcona County.

The only roadway internal to the Plan area is Range Road 221 (also known as 125 Street) which runs north-south through the middle of the Plan area. In the vicinity of Highway 15, Range Road 221 has been realigned and has been constructed to intersect Highway 15 perpendicularly and provide better sight lines along the intersection approach. The remainder of Range Road 221 is currently constructed as an unimproved two lane rural roadway. For a summary of the rationale associated with the design, refer to *Appendix G – Highway 15/125 Street Intersection Review Technical Memorandum*.

4.3 Surrounding Land Uses

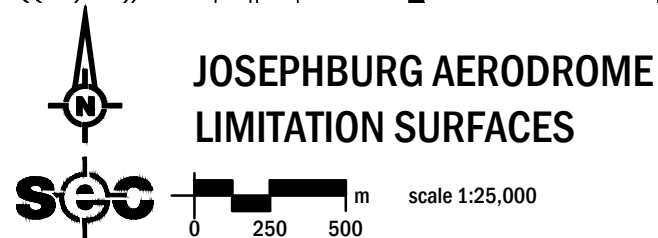
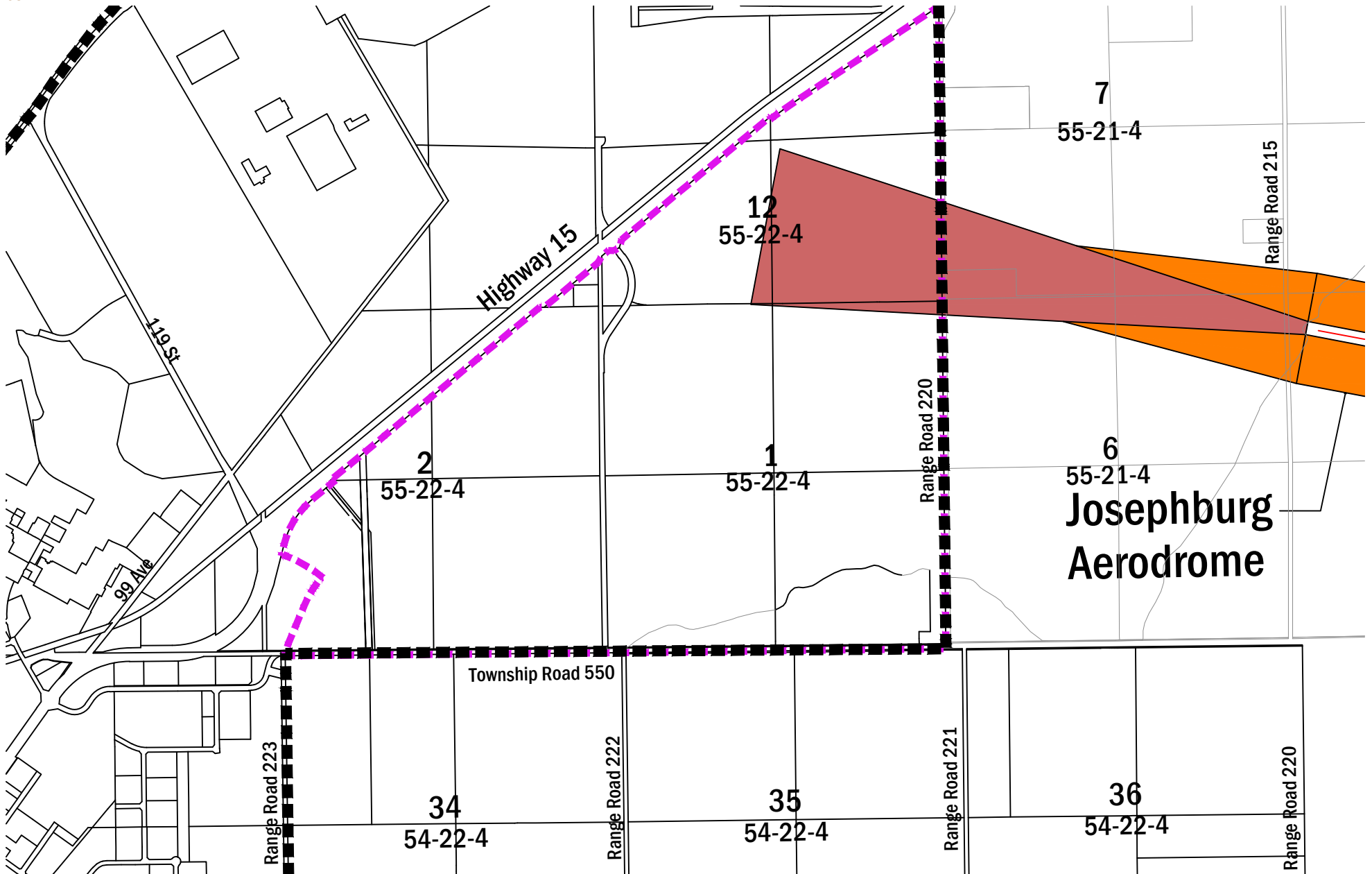
The Plan area shares boundaries with Strathcona County with adjacent land uses to the east and south falling within the jurisdiction of Strathcona County, while land uses to the north and west are within the City of Fort Saskatchewan.

As shown in *Figure 6—Adjacent Existing and Proposed Land Use*, lands to the east and south are being actively cultivated for agriculture with five (5) existing farmsteads directly adjacent to the Plan area with access to either Range Road 220 or Josephburg Road. Heavy industrial uses are located to the north and west of the Plan area. These uses are petro-chemical industries and include multi-national firms such as Dow Chemical Canada Inc., Agrium Inc. and Sherrit International. These industries cover a large area of land area accessed from Highway 15.

The *Alsten Lands Outline Plan area* (approved in 2007) is located to the southwest of the Plan area and contains a mixture of light and medium industrial lands on parcels ranging from 1.0 ha to 5.0 ha in area.

4.4 Background Studies

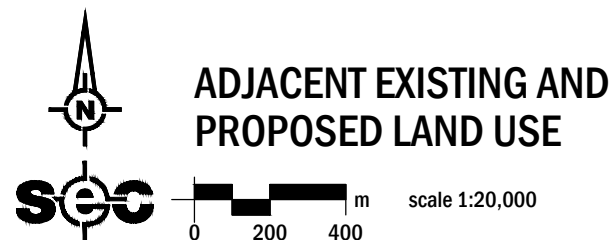
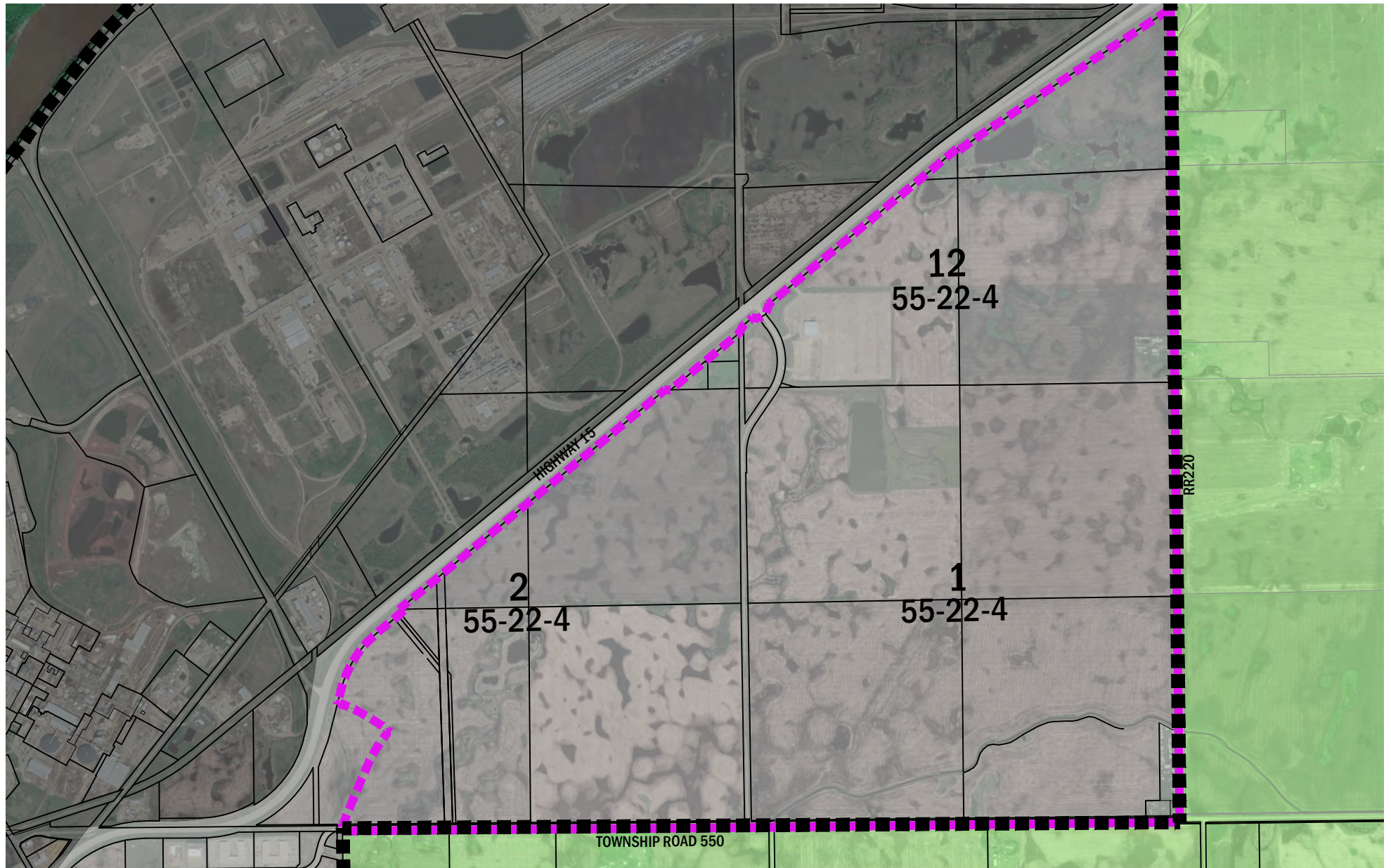
Background studies were undertaken to assess site suitability. Josephburg Road North Industrial Area Structure Plan Transportation Impact Assessment (*Appendix F*) will continue to serve as the transportation planning document for the Plan area. Findings and recommendations of each study are summarized below.



LEGEND

- Runway
- Transitional Surface
- Takeoff/Approach surface
- Fort Saskatchewan Municipal Boundary
- Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



LEGEND

- Heavy Industrial
- Light/Medium Industrial
- Agricultural

- Fort Saskatchewan Municipal Boundary
- Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN

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FIGURE 6

4.4.1 Geotechnical Evaluation

In March 2014, Parkland Geo completed a Geotechnical Evaluation for lands including lands within S.W. 1/4 Sec 12-55-22-4 and N.W. 1/4 Sec 1-55-22-4. The scope of this report is to determine the existing soil conditions and assess the suitability of the subject lands for industrial development. The report outlines various guidelines and recommendations to follow when constructing new roads, storm ponds and building foundations, while no significant barriers to construction were identified. A Geotechnical Evaluation for the remainder of the lands will occur at a further stage of development.

The report concludes that from a geotechnical perspective, the site soil conditions are favourable for the proposed development. Measures and options have been recommended to ensure that the most suitable constructions and material types are used for the lands.

4.4.2 Biophysical Assessment

In November 2007, Ecomark completed a Biophysical Assessment for lands including SW-, SE-, and NE-2-55-22-4, SW-12-55-22-4 and SW-, and NW-1-55-22-4. The objectives of the assessment included: conducting a biophysical assessment of all natural features in the study area, assessing the impacts that may result from the proposed development, providing protections and mitigation recommendations, identifying cumulative and residual impacts, and providing advice with regard to final design, regulatory requirements, implementation of project development and operational monitoring. The report draws a number of conclusions. An unnamed creek exists on site, which likely only contains run-off during snowmelt and heavy rain events; however, the creek is important to the management of stormwater. Two seasonal and one semi-permanent wetlands exist on site. These are also important to the management of stormwater and provide wildlife habitat; it is recommended that these landscape features are retained where practical or are otherwise replaced with a constructed wetland area. A Biophysical Assessment for the remainder of the lands will occur at a further stage of development.

4.4.3 Historical Resources Overview

The *Alberta Historical Resources Act* legislates land-based development proposals that may impact historic resources, including archaeological, paleontological, historic sites or structure(s) and Aboriginal traditional use sites. The *Act* ensures that historic resources are managed in an orderly manner allowing for their preservation, study, interpretation and promotion. The *Act* applies to all developments in Alberta on both public and private lands, requiring developers to conduct studies on potential impacts development may have on historical resources. These studies are carefully evaluated during the planning stages of development proposals.

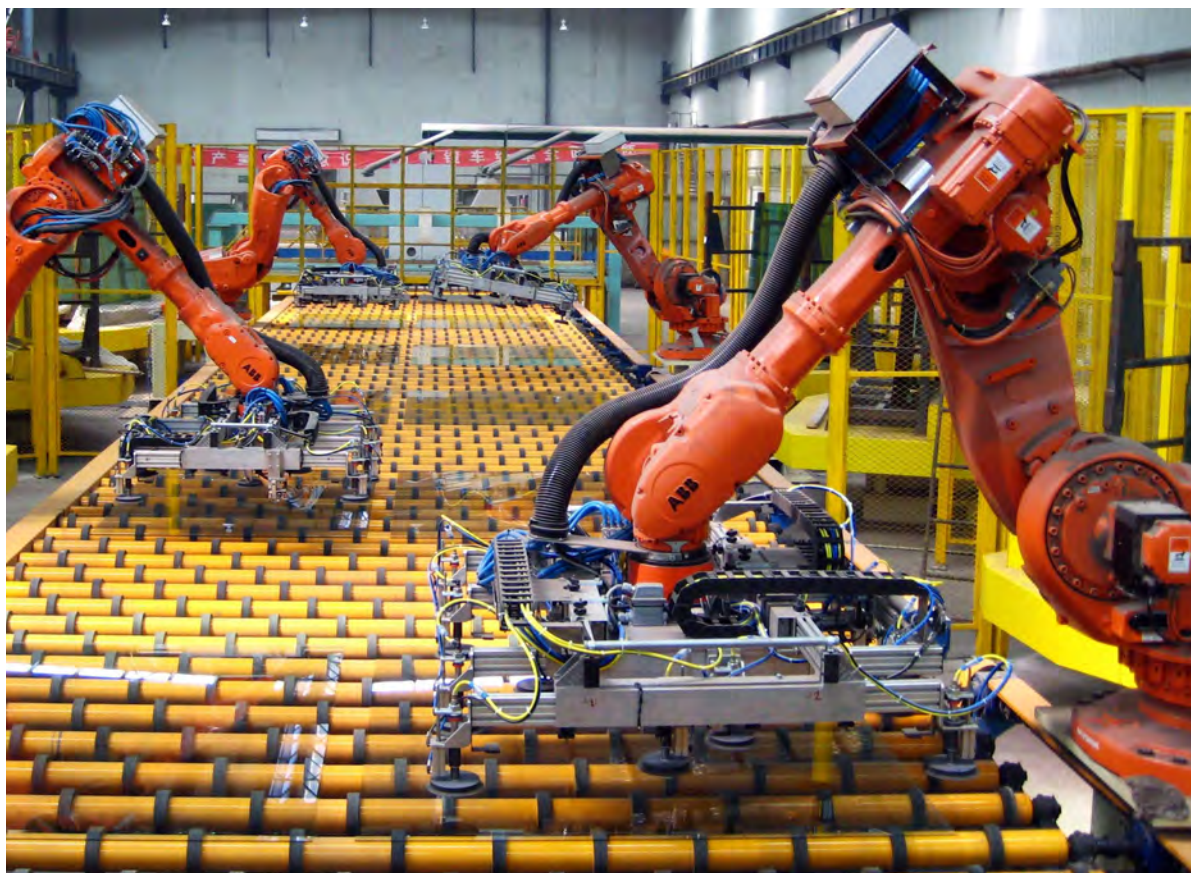
Historical Resources Clearance through Alberta Culture and Tourism was applied for on July 16, 2015. Clearance was granted on July 21, 2015 and can be found in *Appendix B*. Section 31 of the *Act* still requires that anyone who discovers an historic resource during the course of development activities must notify the province immediately for direction and appropriate action.

4.5 Further Ecological Assessment

A site reconnaissance conducted in summer 2008 identified a total of three (3) wetlands (defined as having standing water and/or the presence of hydrophilic vegetation) and one drainage course on site. The wetlands are low lying elevations and are absent of distinct hydrophilic vegetation. This suggests that the primary function of these wetland features is surficial runoff storage. As such these wetland areas have been incorporated into the overall stormwater management system for the plan area., as shown on *Figure 11—Stormwater Management*.

The drainage course, a tributary of Ross Creek, runs from the east of the SE 1/4 1-55-22-4 to the southwest corner of the SW 1/4 1-55-22-4, and has been evident on the landscape since 1949. The channel appears to be a natural creek, which has been heavily modified over time. The historical air photo review indicates that the drainage channel likely contains water during parts of the year. Consistent with Section 4.6.4 of the City of Fort Saskatchewan Land Use Bylaw No. C10-13, buildings or structures proposed adjacent to the drainage channel shall be “setback a minimum of 12.0m (39.4ft) from the top of the bank, where the top of the bank is less than 6.0m (19.7ft) high”. The required setback may be increased or decreased based on a geotechnical analysis provided as part of a subdivision or development permit application. All or part of the area within the setback may be required to be dedicated as Environmental Reserve (ER) or Environmental Reserve Easement in accordance with Section 664 of the Municipal Government Act (MGA).

Provincial approval is required for the alteration of wetlands as proposed in this Outline Plan. As such, findings and recommendations outlined in the environmental reports contained in Appendices C and D should be updated and confirmed through future subdivision applications.



5.0

GUIDING PRINCIPLES AND OBJECTIVES FOR DEVELOPMENT

5.1 Vision

The Josephburg Road North Industrial Outline Plan seeks to provide a framework for future medium industrial development on a comprehensively planned basis. It takes full advantage of its location along the Highway 15 corridor and its close proximity to other adjacent medium and heavy industrial uses and Alberta's Industrial Heartland.

5.2 Guiding Principles

The following principles recognize the vision of, and are based on, the *City of Fort Saskatchewan Community Sustainability Plan*, *Municipal Development Plan* and the *Josephburg Road North Industrial Area Structure Plan*.

Principle 1: **Industrial Development**

Future industrial growth within the Plan area will be guided in a way that is sustainable and makes optimal use of existing services, is attractive to new investment, and complementary to the existing surrounding heavy industry and agriculture uses and important site elements.

Principle 2: **Medium Industrial - Highway 15 Vicinity Overlay**

Provide for opportunities for limited commercial oriented land uses, adjacent to Highway 15, which are compatible and complementary to heavy industrial development in proximity to the Plan.

Principle 3: **Utility Right of Ways**

Existing utility pipeline right-of-ways, transmission lines and other right-of-ways will be incorporated into the future development fabric and joint use will be encouraged in order to ensure their integrity and minimize adverse visual and environmental impact.

Principle 4: **Environmental Management**

Environmentally conscious development practices will be pursued and necessary measures will be taken in order to protect elements deemed to be of environmental significance.

Principle 5: **Transportation**

An effective and functional road layout that maximizes the Plan area's prime location adjacent to Highway 15, supports industrial development and protects adequate land area for anticipated major transportation improvements at the Highway 15 / Range Road 220 intersection.

Principle 6: **Sustainable Development Practices**

Sustainable development practices that allow for high levels of environmental and economic performance will be promoted.

Principle 7: **Municipal Servicing**

Municipal utility services will be provided as indicated in the Josephburg Road North Industrial Area ASP and will be extended congruent to future growth.

Principle 8: **Highway 15 Corridor Design Guidelines**

A high standard of design and aesthetics will be promoted for development along Highway 15 given the Plan area's importance as a gateway to the City of Fort Saskatchewan and the Alberta's Industrial Heartland.

Principle 9: **Risk Management**

A Risk Management Framework that prohibits land uses within the Plan area incompatible with hazardous land uses located on lands in adjacent industrial areas will be adopted.

5.3 Guiding Objectives

Objective: *5.3.1 To provide medium industrial land uses that will meet the diverse needs of prospective industries*

Implementation: 5.3.1(a) A variety of lot sizes have been accommodated allowing for flexibility in the types of uses and industries while aligning with the *Land Use Bylaw* and the *Josephburg Road North ASP*.

Objective:: *5.3.2 To ensure that all development is orderly and contiguous, and provides for proper access to each new lot created in the future.*

Implementation: 5.3.2(a) Development is required to be contiguous to ensure best use and effective extension of municipal services.

5.3.2(b) All new lots created through the subdivision will have municipal frontage.

Objective: ***5.3.3 To encourage industrial land uses that support the Alberta's Industrial Heartland, are complementary and compatible with Heavy Industry and have adequate infrastructure to meet current and future industrial needs***

Implementation: 5.3.3(a) Development shall be intended primarily for medium industrial land uses that are complimentary to heavy industrial land uses in proximity, with secondary emphasis on limited highway commercial uses. This will create an appropriate transition of land uses from heavy industrial to agricultural.

Objective: ***5.3.4 To provide opportunities for limited commercial oriented land uses immediately adjacent to Highway 15.***

Implementation: 5.3.4(a) Commercial oriented development will only be considered within the area identified as "Highway 15 Vicinity Overlay", and shall not exceed approximately ten percent (10%) of the gross developable area. Development shall comply with the Highway 15 Vicinity Overlay of the Land Use Bylaw and to the satisfaction of the City of Fort Saskatchewan.

5.3.4 (b) Land uses shall be of the type that does not employ a significant number of people, and the type and intensity of commercial uses must be compatible with heavy industry. They must be designed and operated to minimize the risk associated with the continued operation of these heavy industrial facilities.

5.3.4 (c) Encouraging land uses that provide complimentary services for the medium and heavy industrial land uses in the area to address local industrial workers. These may include uses such as vehicle wash and service station.

Objective: ***5.3.5 To implement risk management procedures to ensure that commercial oriented development does not restrict the operation or expansion of heavy industrial uses in proximity to the plan area.***

Implementation: 5.3.5(a) Appropriate safety measures may be required for new buildings in the plan area to ensure that the operation or expansion of adjacent heavy industrial uses will not be compromised by commercial oriented uses.

5.3.5(b) Risk Assessments may be required for any commercial oriented developments to ensure a calculated risk equal to or lower than the 1 x 10⁻⁵ risk criteria at the 1.5km distance, as required by the City of Fort Saskatchewan (Major Industrial Accidents Council of Canada, MIACC).

5.3.5(c) Shall be designed with the principles of Shelter in Place.

Objective: ***5.3.6 To protect pipeline and utility right-of-ways from encroachment by abutting uses.***

Implementation: 5.3.6(a) Utility right-of-ways will be incorporated into development sites and protected by easement, as a requirement of subdivision approval.

5.3.6(b) Major utility rights-of-ways not already owned by the operator will be dedicated to the City as public utility lots, as a requirement of subdivision approval.

Objective:	<i>5.3.7 To create appropriate buffers between operating pipelines and industrial uses.</i>
Implementation:	5.3.7(a) The minimum setback shall be in accordance with the guidelines of Alberta Energy Regulator and relevant regulations specified in the <i>Land Use Bylaw</i>. 5.3.7(b) In order to allow for future expansion of the pipelines, providing all bylaw requirements are met, new buildings shall be located as far from the pipelines as possible.
Objective:	<i>5.3.8 To encourage the retention, incorporation and enhancement of sustainable wetland areas into the ASP.</i>
Implementation:	5.3.8(a) Development shall incorporate wetland areas, where feasible, into the stormwater management system, thereby reducing infrastructure and servicing costs.
Objective:	<i>5.3.9 To protect the existing treed area in the north-east corner of the plan area.</i>
Implementation:	5.3.9(a) The tree stand is anticipated to be dedicated to the City of Fort Saskatchewan through Municipal Reserve dedication, which will be achieved as a condition of subdivision of the affected lands.
Objective:	<i>5.3.10 Take 10% of the Gross Developable Area to be subdivided in the form of municipal reserve land or cash in lieu.</i>
Implementation:	5.3.10(a) The amount, form (land or cash) and location of municipal reserves shall be confirmed through subdivision applications and to the satisfaction of the City of Fort Saskatchewan.
Objective:	<i>5.3.11 To protect land adjacent to the Highway 15 / Range Road 220 intersection for future right-of-way requirements for short-term intersection improvements and long-term construction of an interchange.</i>
Implementation:	5.3.11(a) The alignment and construction of the intersection improvements shall be determined in consultation with the City of Fort Saskatchewan, Strathcona County and Alberta Transportation. 5.3.11(b) The landowner or his/her representative shall consult with the City of Fort Saskatchewan, Alberta Transportation and Strathcona County in determining when the interchange is required and the amount of land needed.
Objective:	<i>5.3.12 Ensure noise resulting from heavy traffic and along major roadways is taken into consideration and addressed where necessary.</i>
Implementation:	5.3.12(a) Appropriate landscaping, berming and fencing, as required by the <i>Land Use Bylaw</i> , shall be provided along Township Road 550 or Range Road 220 to provide for visual and noise attenuation.

Objective: ***5.3.13 Ensure roadways are built to a standard acceptable to the City of Fort Saskatchewan's Development Guidelines and Engineering Standards.***

Implementation: 5.3.13(a) Roadway standards and right-of-ways, both urban and rural, have been determined during the preparation of the Outline Plan. Further detail will be required as part of the subdivision conditions.

Objective: ***5.3.14 To ensure that suitable contributions are made, be they financial or physical, to shared infrastructure within each servicing basin, so as to accommodate the ultimate servicing concepts as outlined within the ASP.***

Implementation: 5.3.14(a) Proponents of a subdivision, shall accommodate the ultimate servicing requirements by providing for suitable rights-of-way, and contributing to the overall construction of the system by either constructing municipal infrastructure, or contributing financially, through a municipal levy, for the future installation of municipal infrastructure.

5.3.14(b) Development within the plan area west of Range Road 221 shall be fully serviced; while development within the plan area east of Range Road 221 shall have a reduced level of servicing. Areas subject to a reduced level of servicing are to be served by a trickle water feed and a low pressure sanitary system. Fire protection will be provided via dry hydrants connected to suitably sized stormwater management facilities.

5.3.14(c) A combination of overland storm drainage conveyance and underground systems will be utilized. Engineering design reports will guide the location and extent of overland conveyance, as well as that of the underground system. Underground systems may be utilized within the plan area subject to the Highway 15 Overlay; while a combination of overland conveyance and underground systems may be used for the remainder of the lands.

5.3.14(d) Should the end user desire a level of service in conformance with the ultimate servicing plan, and proposed Outline Plan, they shall provide suitable design drawings to the City and construct the infrastructure to City standards.

Objective: ***5.3.15 All shallow utility infrastructure required to provide service to development will be located underground, unless otherwise directed by the City of Fort Saskatchewan.***

Implementation: 5.3.15(a) Underground shallow utility services will be extended as deep servicing is extended and executed through the associated servicing agreements

Objective: ***5.3.16 Development in the Vicinity of the Strathcona Airport in the City of Fort Saskatchewan shall ensure that development do not negatively impact existing airport operations and any future plans for expansion (See Figure 5—Josephburg Aerodrome Limitation Surfaces).***

Implementation: 5.3.16(a) Development Permit applications within the area affected by the take off and approach surface are to be referred to Strathcona County.

Objective: ***5.3.17 Provide for a flexible servicing and phasing scheme having regard for the economical and efficient extension of City services and utilities.***

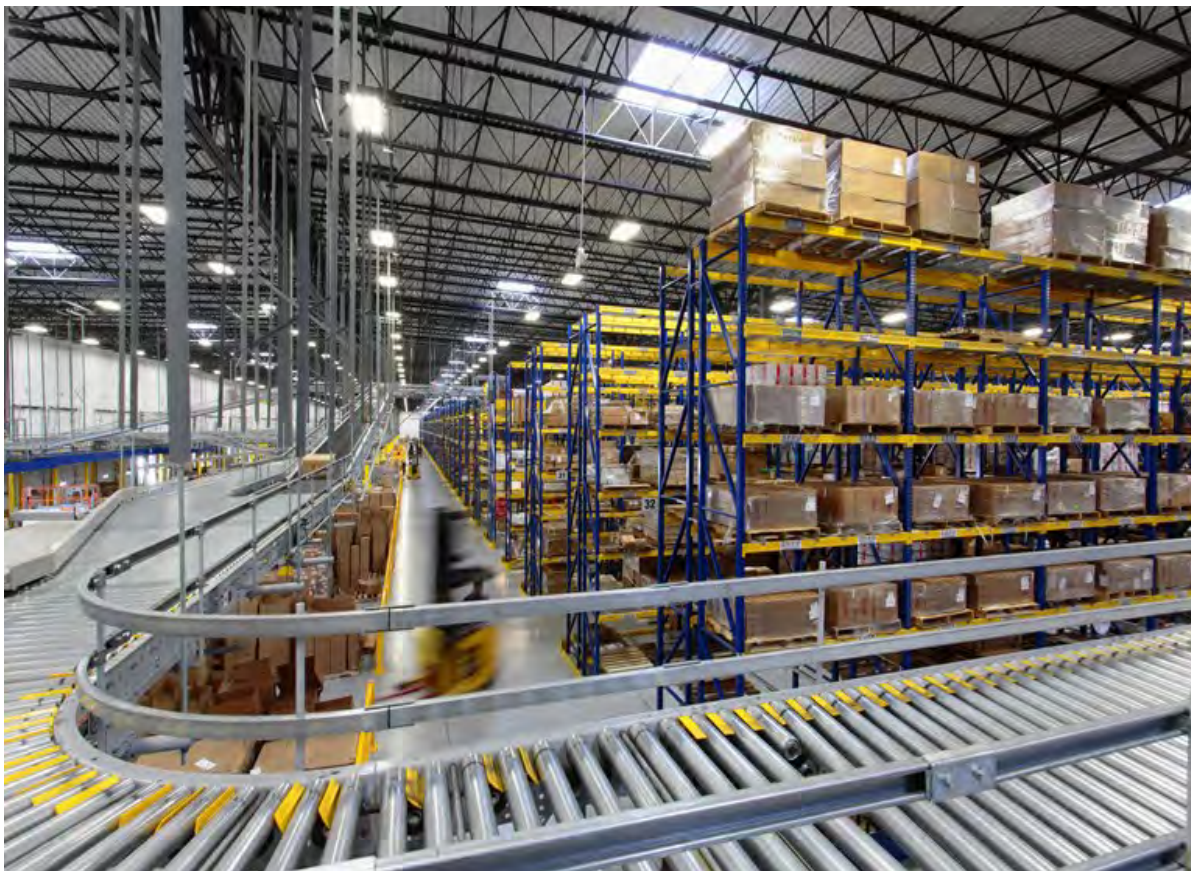
Implementation: 5.3.17(a) Development and servicing should occur sequentially, through the extension of storm, sanitary and water systems; flexibility in the sequence of development and servicing shall be accommodated where warranted by the proponent of a subdivision and where supported by the City.

Objective: ***5.3.18 To Utilize stormwater management facilities to provide water for fire protection purposes.***

Implementation: 5.3.18(a) A system of dry hydrants, connected to suitably sized stormwater management facilities, shall be required as part of any development, and shall be in accordance with the Outline Plan and Engineering Detailed Design approved by the City.

Objective: ***5.3.19 To encourage the joint use of utility pipeline right-of-ways, transmission lines and other utility right-of-ways.***

Implementation: 5.3.19(a) Have multi use pipeline / utility right-of-ways to accommodate oil, natural gas and product pipelines, utilities such as electrical transmission lines and communications infrastructure. Pipeline and utility companies shall be notified during the subdivision application and development review process.



6.0

LAND USE AND DEVELOPMENT CONCEPT

This Outline Plan provides the framework to guide development of industrial and ancillary uses (such as stormwater management) in this area.

Figure 7—Development Concept shows a conceptual layout for the Plan area but it must be noted that the Development Concept is not intended as a detailed subdivision layout nor is it representative of the number and size of industrial parcels to be subdivided. Land use district boundaries and subdivision plans will generally follow the Development Concept for the Josephburg Road North Industrial Outline Plan.

Municipal Reserve (MR), as provided for in the *Alberta Municipal Government Act*, is anticipated up to a maximum of 10% of the total subdivision area minus any Environmental Reserve (ER) and may be provided by dedicating up land contribution or cash-in-lieu. The disposition of Municipal Reserves will be addressed at the detailed subdivision stage.

6.1 Land Use Layout

The Development Concept is proposed to be compatible with existing industrial and agricultural uses surrounding the Plan area and presents a conceptual land use plan that complies with the overarching policy documents covering the area.

On July 15, 2015, City of Fort Saskatchewan Council adopted an amendment to the *Josephburg Road North Industrial ASP*. The development concept approved within this amendment designates the majority of the Plan area as Medium Industrial, with the Highway 15 Vicinity Overlay covering the portion of the Plan area with exposure to Highway 15.

Six (6) stormwater management facilities are distributed through the Plan area to take advantage of existing topography and to provide sufficient stormwater management. Servicing will be provided to a full urban standard with water, sanitary and sewer mains subject to the Medium Density – Highway 15 Vicinity Overlay, with full water and sanitary servicing provided to the remainder of the area west of 125 Street (Range Road 221). For the remainder of the plan area east of 125 Street, servicing shall be provided at reduced level of service, such as trickle water service and low pressure sanitary sewers.

Public collector roads are included to provide transportation and access for the Plan area and to connect to the wider transportation network. Various all-directional accesses are proposed on each of the roadways that abut the Plan area. Conceptual lotting is provided for illustrative purposes only to demonstrate how subdivisions may be configured (*Figure 12—Preliminary Lotting Plan*). The land use statistics for the Development Concept are outlined in *Table 3 – Land Use Statistics*.

6.2 Land Use

Industrial land uses are proposed for the entire Plan area in the form of Medium Industrial land use districts. The designation allows for industrial uses, permitted and discretionary, from the *City of Fort Saskatchewan Land Use Bylaw C10-13* for the districting within the Plan area.

6.2.1 Medium Industrial

Medium industrial use makes up approximately 444 ha of the site with a portion of the Medium Industrial use along the southwest section of the site being within the Highway 15 Vicinity Overlay (approximately 70 ha) as shown on *Figure 7—Development Concept*. All development within this District will adhere to *City of Fort Saskatchewan Land Use Bylaw*.

Medium industrial lands are situated as a buffer between the existing heavy industrial development north of Highway 15 and the agricultural lands to the south and east, within Strathcona County's boundaries. The Land Use Bylaw currently specifies a minimum parcel size of 0.4 ha (1.0 ac) for medium industrial development. Conceptual lotting and parcel sizes are as indicated in *Figure 12—Preliminary Lotting Plan*. These lot configurations are for illustrative purposes only and a detailed layout will be determined at the subdivision stage.

This buffer zone accommodating medium industrial can support heavy industrial activities throughout the Heartland area. Some example of activities that can be located on these lands include heavy industrial and agricultural equipment sales, rentals and repairs, laboratories, temporary indoor storage, contracting services, vehicle repair, service stations, commercial composting facility, recycle depot and greenhouses/nurseries.

6.2.2 Highway 15 Vicinity Overlay

In addition to the zoning in place, a portion of the Plan area adjacent to Highway 15 is subject to the Highway 15 Vicinity Overlay. The purpose of the Overlay is to provide for limited highway commercial uses adjacent to Highway 15 as shown in *Figure 7—Development Concept*. The lands

subject to this Overlay may permit uses that differ from those traditionally found in medium industrial areas. These may include uses such as vehicle wash and service station. These use types would require good visibility and accessibility to Highway 15. It must be noted that, as per the *Land Use Bylaw C10-13*, any vehicle-oriented use that may result in overnight stays or

accommodation and drive through services will not be permitted within the area of this overlay. Some other considerations in the selection of appropriate uses include ensuring they are of the type that does not employ a significant number of people, and the type and intensity of commercial uses must be compatible with heavy industry and must be designed and operated to minimize the risk associated with the continued operation of these heavy industrial facilities.

Table 3 - Land Use Statistics

6.3 Interface with Non-Industrial Land Uses

	Area (ha)	% of GDA
GROSS AREA	596.4	
*Highway 15/Range Road 220 Interchange Right-of-Way	15.2	
Pipeline & Utility Rights-of-Way	23.0	
Environmental Reserve (Public Utility Lot/Drainage Channel)	3.8	
Sub-total	42.0	
GROSS DEVELOPABLE AREA	554.4	100.0%
Stormwater Management Facility	49.7	9.0%
Industrial Roadways	35.7	6.4%
Municipal Reserve	20.4	3.7%
Sub-total	105.8	
NET DEVELOPABLE AREA	448.6	80.9%
Medium Industrial	413.6	74.6%
Medium Industrial – Highway 15 Vicinity Overlay	35.0	6.3%
	448.6	80.9%

*Area is approximate. Exact area and extent of land required for the interchange to be determined in conjunction with Alberta Transportation, Strathcona County, and the City of Fort Saskatchewan prior to the approval of an Outline Plan for the adjacent lands.

** Exact MR area to be confirmed at time of detailed Outline Plan submission. Balance of MR owing to be provided as cash-in lieu, unless the City determines through the Outline Plan stages that smaller park areas are required.

The Plan area is bounded by Highway 15, Range Road 220 and Township Road 550. Existing agricultural uses are present east of Range Road 220 and south of Township Road 550, within Strathcona County's boundary. Adjacent use to the north of Highway 15 is heavy industrial with companies such as Sherritt International Corporation and Dow Chemical Company occupying large area of lands. Residential uses, the downtown and other general urban areas are found further to the southwest of the Plan area, separated by a large open space buffer. There do not appear to be any land use conflicts.

6.4 Landscaping Requirements

Appropriate landscaping will be provided as a buffer between industrial uses and any on-site and adjacent residential uses, as required by the Land Use Bylaw.



NOTE: EXACT LOCATIONS OF MUNICIPAL RESERVE,
STORMWATER PONDS AND MEDIUM INDUSTRIAL
LOTS TO BE DETERMINED AT TIME OF SUBDIVISION

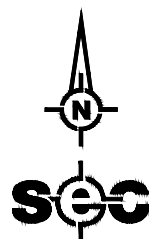
LEGEND

- Medium Industrial
- Highway 15 Vicinity Overlay
- Future Road Right of Way

- Municipal Reserve
- Environmental Reserve
- Stormwater Management Facility

- Pipeline/Utility Corridor
- Potential Interchange
- Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



DEVELOPMENT CONCEPT

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FIGURE 7





7.0

OPEN SPACE AND PARK
RESERVE

No parks, recreation facilities or trail systems currently exist or are proposed for the Plan area. A review of the need to provide a multi-use trail network within the Josephburg Road North Outline Plan was completed as part of the preparation of the Outline Plan. It was found that no multi-use trail network was identified within the *City of Fort Saskatchewan Recreation, Culture and Parks Master Plan*, prepared by RC Strategies, EDA Collaborative, ATB Architecture and the University of Alberta Population Research Lab in 2008. There is also no connectivity to the City's overall trail network. Given the nature of the medium industrial uses proposed for the site and lack of residential, hotel and motel uses, it is anticipated that few if any employees or customers would use the multi-use trail system. While a comprehensive multi-use trail system may not be warranted, provisions for active transportation modes may be considered to be accommodated within the roads carriage way.

As required by the Municipal Government Act (MGA), 10% of the total subdivision area minus any Environmental Reserve (ER) is to be dedicated in the form of Municipal Reserve (MR) land or cash-in-lieu. In this development, 20.4 ha is chosen to be dedicated as MR with the remaining amount as cash-in-lieu. The disposition of Municipal Reserves will be confirmed at the detailed subdivision stage. Land dedicated as MR and ER are illustrated in *Figure 7—Development Concept*. The treed area and the creek indicated in Figure 7 is anticipated to be dedicated to the City of Fort Saskatchewan for environmental conservation.

Two Municipal Reserve parcels are located in the southwest plan area to create relief through a topsoil stockpile which will ultimately become a dense tree stand and carbon sink. Tree species, such as aspen, willow or poplar, that populate quickly will be used so that the site becomes denser through time. Little to no maintenance will be required as this site will be designed to discourage public use and will not be accessible to the local workers or public given the risk factor. The exact size, amount and types of trees required will be confirmed through detailed design at the development permit stage.



8.0

TRANSPORTATION
CONCEPT

8.1 Transportation Network

The proposed transportation network aligns with the transportation goals of the *Josephburg Road North Industrial Area Structure Plan*. The proposed circulation pattern provides for the safe and efficient movement of traffic throughout the Plan area and beyond. The road carriage way is sufficient to accommodate the potential for all active modes of transportation. *Figure 8—Transportation* shows both the external and internal transportation network.

8.2 Roadway Network

The Plan identifies the location of three (3) major all-directional access points into the Plan area from Highway 15. The southern most access is proposed at the intersection of the future re-aligned Township Road 550 and 119 Street. The second access is located at the existing location across from the main gate of Dow Chemical Canada Ltd., while the third access is at the intersection of the future realigned Range Road 221 and northerly access to the Dow site. Each of these all-directional access points occurs at existing intersection locations, and will provide the main access routes to the Plan area.

8.2.1 Regional Network Accessibility

Figure 8—Transportation shows both the external and internal transportation network.

Highway 15

Highway 15 is a four lane divided urban expressway with a concrete median separating opposite traffic for the majority of its length adjacent to the Plan area. The Highway is the main transportation route into Fort Saskatchewan from the north, intersecting with Highway 21 within the City limits. At the Highway 21 / Highway 15 junction, Highway 15 continues to the northeast, serving as a major transportation route to the Industrial Heartland. Three (3) intersections on Highway 15 in the vicinity of the Plan area are signalized: Highway 15 / Township Road 550 (88 Avenue); Highway 15 / Dow Chemical main gate access road; and Highway 15 / 125 Street. The Highway 15 / Range Road 220 intersection is currently stop-controlled along the minor approaches. Highway 15 is designated as a dangerous goods route in proximity to the Plan area.

Township Road 550

Township Road 550 is currently a paved two-lane roadway constructed to a rural cross-section standard roadway. Township Road 550 runs east-west along the south boundary of the Plan area. The roadway is designated as an arterial road in the MDP.

Range Road 220

Range Road 220 runs north-south along the east boundary of the Plan area. The road is a two-lane partially paved roadway that is constructed to a rural cross-section standard.

8.2.2 Access to Highway Network and External Road System

The Plan identifies the location of three (3) major all-directional access points into the Plan area from Highway 15:

- 119 Street – 119 Street represents the extension of Township Road 550 to the north and west through the southwest portion of the Plan area to Highway 15;
- Future Local Road Access – A future local road is proposed to be developed as the south leg of the Dow Chemical Main Gate access road intersection with Highway 15;
- 125 Street – The realignment of 125 Street immediately south of Highway 15 is anticipated to improve intersection operations (particularly for movements on the south approach) and provide better sight lines to the intersection (*Appendix G*).

The Plan also identifies the site of a potential interchange, a fourth access point into the Plan area from Highway 15:

- Range Road 220 – The Highway 15 / Range Road 220 intersection has been identified as a candidate intersection to be upgraded to an interchange .

The extension of 119 Street to Highway 15 adds a new fourth leg to the intersection. Each of these remaining all-directional access points occurs at existing intersection locations, and will provide the main access routes to the Plan area.



NOTE: ROAD NETWORK IS PRELIMINARY AND
SUBJECT TO CHANGE.

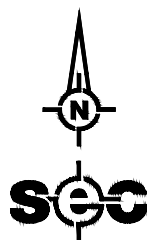
LEGEND

- Local Road (21.5m)
- Collector Road (23.0m)
- Major Collector Road (23.0m)

- Existing Highway (Hwy 15)
- Existing Country/Future Arterial Road
- Arterial Road Realignment
- ▨ Existing Township/Range Road - to be closed

- Potential Interchange
- All Directional Access
- Future Road Right of Way
- Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



TRANSPORTATION
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FIGURE 8

In addition to accesses to the Plan area on Highway 15, the area is also planned to be accessible via Range Road 220 and Township Road 550. The Development Concept proposes three area access intersections on Township Road 550 between Highway 15 and Range Road 220. As per Section 4.6.1 and 4.11.4 of the *Josephburg Road North Industrial ASP*, Strathcona County will be consulted regarding all access points from the Plan area roads onto Range Road 220 and Township Road 550, to the west and south of the Plan area. The ASP Implementation policy states that County road improvement or access matters must be resolved to the satisfaction of both parties prior to any new development proposals being accepted within the Plan area.

8.2.3 Future Roadway Network

Fort Saskatchewan By-Pass:

The *Capital Region 10-Year Provincial Highways Plan*, a follow up on the Capital Region Integrated Growth Management Plan Report, was released by the Alberta Government to the public in August 2008. The proposed Fort Saskatchewan by-pass south of the Plan area presents opportunities to access the southern part of the Plan area.

8.2.4 Internal Road System

125 Street runs north-south as the spine through the middle of the plan area. It will be repurposed as a major collector road. A collector road is planned to be developed parallel to Highway 15 on the west portion of the plan area to maximize lots visible from the highway. Roads in the east portion of the plan area generally follow the alignments of pipeline ROWs.

Given there may be industrial end-users with substantial land requirements, the local and collector road alignments may be adjusted accordingly to provide only the amount of public road necessary to service proposed subdivision(s). Roadway standards will comply with the City of Fort Saskatchewan roadway standards and to the satisfaction of the City of Fort Saskatchewan.

8.2.5 Noise Attenuation Measures

Land uses fronting and/or backing onto Highway 15, Township Road 550 or Range Road 220 will provide appropriate landscaping, berms and/or other enhancements (such as strategic building orientation) to assist in minimizing traffic noise disruption.

8.3 Roadway Staging

The development of roads in the Plan area is anticipated to follow the logical sequence of development and is subject to review and approval by the City of Fort Saskatchewan. Only road(s) dedicated within subdivision application(s), as part of individual stages, will be constructed. The road layout is subject to change at the detailed subdivision and engineering design stage. Details including road standards and roadway levies will be determined at that time.

9.0

MUNICIPAL SERVICING
CONCEPT

A Pre-Design Report accompanies the Josephburg Road North Industrial Outline Plan and describes the requirements and location of servicing infrastructure including water servicing, sanitary servicing, stormwater management, and shallow utilities.

As summarized in the *Josephburg Road North Industrial Area Structure Plan*, “servicing required for the development of the ASP lands will be paid for and constructed either by the developer, or by the City upon satisfactory collection of municipal levies”. Servicing will be provided to the IM Medium Industrial District and Highway 15 Vicinity Overlay, with full water and sanitary servicing provided to the area west of 125 Street (Range Road 221). For the remainder of the plan area east of 125 Street, servicing shall be provided at reduced level of service, such as trickle water service and low pressure sanitary sewers. On-site servicing may be considered where the deep utilities have not yet been extended to the specific area being developed. On-site services would include water cisterns and sewer holding tanks with pump-outs. The consideration for on-site servicing will be reviewed on a case-by-case basis, at the discretion of the City.

An analysis of the water servicing, sanitary sewer, and stormwater servicing requirements for the plan area was conducted in accordance with requirements. The conceptual servicing plans are identified in *Figures 9 - 11 – Water Servicing, Sanitary Services and Stormwater Management* which set the framework of utilities that are needed to provide required fire service and demand capacity throughout the plan area. The design of the stormwater management system was done in accordance with the *Alberta Water Act*, the *Alberta Stormwater Management Guidelines* and the directions provided in the *Municipal Development Plan*.

The 2006 *City of Fort Saskatchewan Conceptual Servicing Study Final Report* provided a conceptual level servicing for these lands in conjunction with the *Alsten Lands Outline Plan* to the south-west. In 2013/2014 the initial water, sanitary and stormwater servicing concepts for the plan area were reviewed and alternate servicing concepts, blending full and reduced servicing levels were prepared. Further, more detailed technical reports will be required through subsequent stages of development (i.e. Subdivision, Detailed Engineering Design etc.) in order to adequately address the provision of water, sanitary and stormwater services.

9.1 Water Servicing

Figure 9– Water Servicing depicts the preliminary water servicing for the Outline Plan Area. The City has recently installed a 450m watermain which has tied into the Alsten Lands waterline, east of the Heartland Buildings on Josephburg Road. This 450mm trunk will be the main feed into the Outline Plan Area.

As detailed in *Figure 9– Water Servicing*, the waterline will generally follow the roadway alignments as they are developed, which will be looped as required to provide required pressures and redundancy. *Figure 6* provides preliminary line sizing & alignments, which will be confirmed at the detailed design stage via a water network analysis.

As indicated in the *Josephburg Road North Industrial ASP*, the 450mm and 400mm watermains will support the fire flows in the majority of the Outline Plan Area west of Range Road 221 (also known as 125 Street). The October 2014 *City of Fort Saskatchewan Josephburg Road North Industrial Water Modelling Study - Update Technical Memorandum* identifies that the plan area west of Range Road 221 can be fully serviced. As a result of limited capacity, the lands to the east of Range Road 221 will be serviced by a 150mm waterline to provide potable water only. On-site water cisterns may be considered where the water mains have not yet been extended to the specific area being developed. The consideration for on-site servicing will be reviewed on a case-by-case basis, at the discretion of the City.

9.2 Sanitary Servicing

Figure 10– Sanitary Services depicts the preliminary sanitary servicing for the Outline Plan Area.

As detailed in *Figure 10– Sanitary Services*, the sewer line will generally follow the roadway alignments as they are developed. Preliminary line sizing, alignments & flow direction will be confirmed at the detailed design stages as development progresses.



LEGEND

----- Existing Right of Way

— 300mm Water Line

— 450mm Water Line

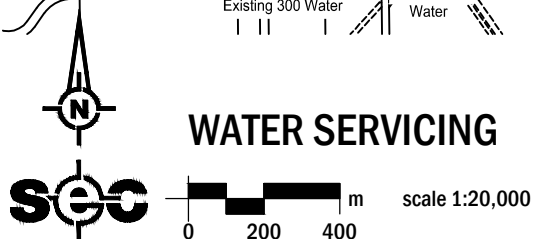
--- Outline Plan Boundary

— 150mm Water Line

— 400mm Water Line

▨ Fully Served

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



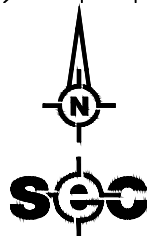


LEGEND

- Existing Right of Way
- Proposed Offsite Forcemain
- ⊗ Proposed Sanitary Lift Station

- ▨ Fully Served
- ▶ Proposed Full Service Sanitary Gravity Sewer
- - - - Proposed 150mm Sanitary Low Pressure Sewer
- ▬▬▬ Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



SANITARY SERVICES

0 200 400 m scale 1:20,000

As depicted in the *Josephburg Road North Industrial ASP*, all sanitary flows in the City of Fort Saskatchewan are directed to the Alberta Capital Region Wastewater Commission (ACRWC) pumping station and siphon located over 2 km west of the Outline Plan, along River Road and north of 104 Street.

As shown on *Figure 10– Sanitary Services*, all of the sanitary flows are conceptually directed to a proposed lift station located at the 119 Street and Highway 15 intersection, which will pump flows via forcemain to the existing sanitary sewer system in the Eastgate Business Park. The existing system downstream will be able to accommodate the additional flows, as detailed in the *Josephburg Road North Industrial ASP*, via an existing 1200mm trunk sewer at the intersection of Highway 15 and 112 Street.

A proposed full service sanitary gravity sewer main will network through the Outline Plan Area west of Range Road 221. The proposed developments east of Range Road 221 will be serviced with a proposed 150mm sanitary low pressure sewer system which will connect to the full service sanitary gravity sewer system at two locations on Range Road 221. On-site sanitary holding tanks may be considered where the sanitary mains have not yet been extended to the specific area being developed. The consideration for on-site servicing will be reviewed on a case-by-case basis, at the discretion of the City.

The overall sanitary system & configuration will be further reviewed at the detailed design stages of development.

9.3 Stormwater Management

Figure 11– Stormwater Management depicts the preliminary stormwater servicing for the Outline Plan Area.

As described in the ASP, a heavily modified, minor tributary of Ross Creek (in the south-eastern part of the plan, crossing to the south side of Township Road 550) forms the principal drainage feature through the plan area. The east side of the plan area slopes from 630m in the west to 626m near the middle. The west half is very flat with an elevation of approximately 626m. Runoff in the west flows away from the high point in all directions whereas to the north runoff collects in a depression. The runoff to the east and south is ultimately collected in a ditch that runs along the south side of Township Road 550. This ditch carries flows west to a tributary of Ross Creek. The runoff on the east half of the plan area collects in the low lying areas, however under large rainfall events, the runoff would be directed to the ditch to the south and eventually into the tributary of Ross Creek.

Sameng Inc. completed the *Josephburg Road North Industrial Stormwater Management Concept* in October 2011, which is included in Appendix H. The stormwater management for the Outline Plan will include six (6) stormwater management facilities (SWMF) spread throughout the area as shown in *Figure 11 – Stormwater Management*.

Stormwater will be conveyed via overland and piping to the stormwater facilities, where the flows will be contained and released at pre-development flows.

Two of the SWMF's will discharge into the tributary of Ross Creek, which is on the southeast portion of the area. Two of the SWMF's, in the northeast of the Outline Plan, will discharge into a stormwater trunk which will network through the plan area before heading south down Range Road 221, then west along Josephburg Road (Township Road 550) where the remaining two SWMF will also discharge into this trunk. This storm trunk will continue west until it connects to the Alsten Lands stormwater system.

The Sameng report details the discharges and how the ponds will act in series to convey stormwater.

The SWMF's will be sized in order to supply fire water for future development within the portion of the plan area serviced by a trickle water system and not fully serviced by municipal water services. The SWMF will be outfitted with a dry hydrant system, acceptable to the City of Fort Saskatchewan.

Three wetland areas have been identified within the plan area. Although these wetland areas have been heavily modified over time, they are deemed to have low ecological value and retain water only on an intermittent basis, their incorporation into the proposed development as stormwater management facilities may be a desirable means with which to retain the wetlands on the landscape, given the proposed industrial development. As also noted in the *ASP*, development would require regulatory approvals or compensation under the *Water Act*, *Public Lands Act* and *Environmental Protection Act*.

9.4 Shallow Utilities

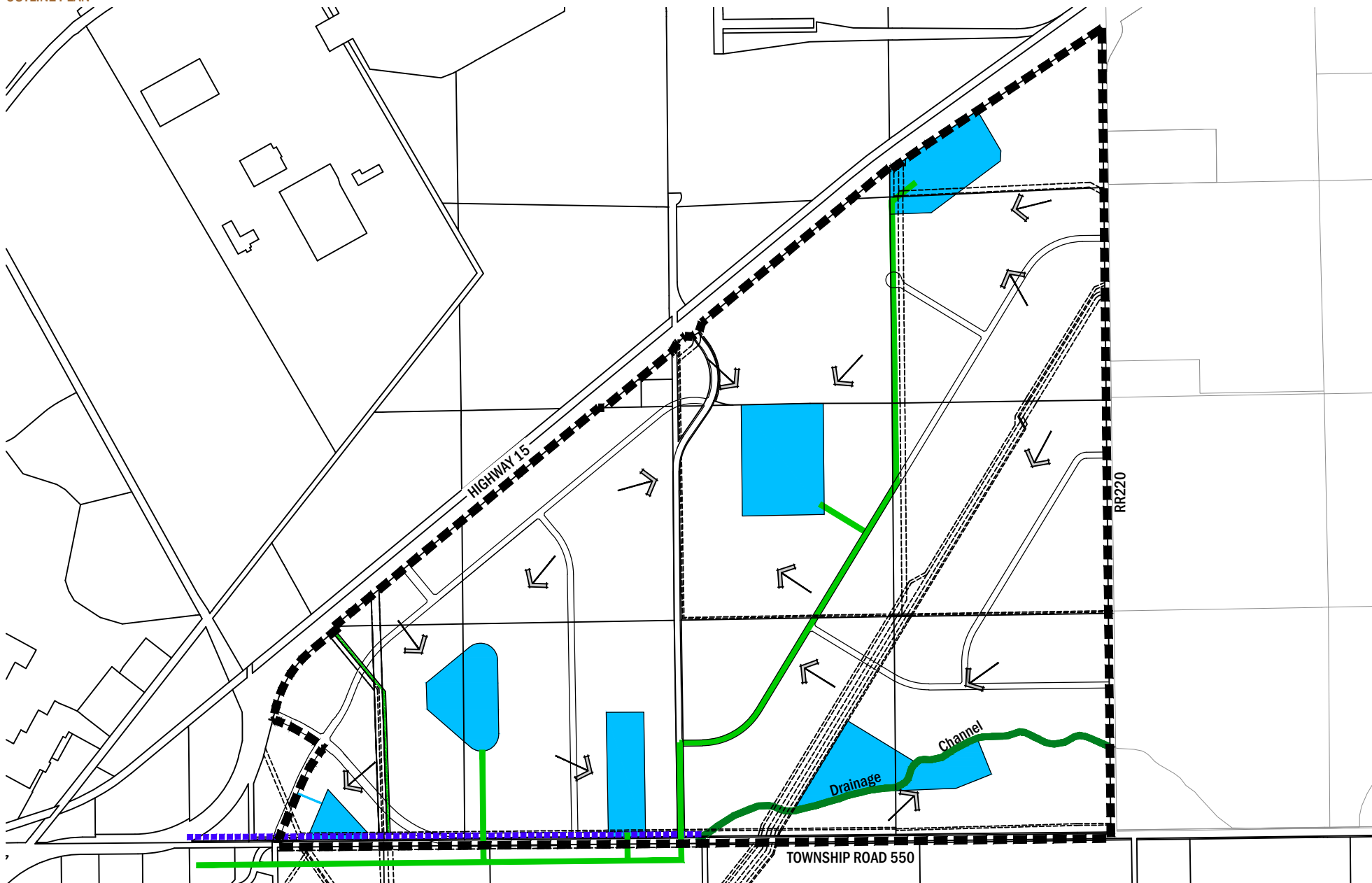
Shallow utilities will be extended into the plan in accordance with the requirements of the individual utilities company and service providers.

Alignments for the shallow utilities will be provided through the road right-of-ways or easements as required.

9.5 Pipeline / Utility Right-of-Ways

In recognition of the proximity of the plan area to heavy industry and the existing pipeline and utility right-of-ways within the plan area, utility companies shall be notified during the Outline Plan, subdivision application and development review process. Cooperation and communications with these companies will provide the pipeline companies with the ability to adequately plan their long term infrastructure and land right-of-way requirements, while integrating with the land uses proposed within the plan area.

They provide information on location, design, and size requirements for municipal services. Further review and details will be provided as the subdivision and detailed engineering design processes are pursued.



LEGEND

----- Existing Right of Way

■ Josephburg Stream

----- North Josephburg Drainage Ditch

■ Stormwater Management Facility

— Storm Trunk

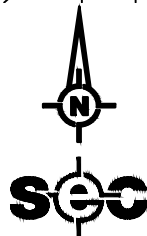
— Future Storm Ditch

→ Existing Direction of Flow

■ Outline Plan Boundary

STORMWATER MANAGEMENT

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



0 200 400 m
scale 1:20,000

225-17015-02-PRF011.DWG
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FIGURE 11

9.6 Emergency Services

The City of Fort Saskatchewan's Disaster Services Agency provides fire and disaster services to the Plan area, while emergency medical services are provided by Alberta Health Services. The Plan area is covered by the City's Fire Hall at the intersection of Highway 15 and 101 Street (approximately 2 miles southwest from the Plan area). Two fully equipped ambulances are also located at the main fire station to provide emergency medical services to the City.

Also, Strathcona County's Heartland Hall (Station #4) is located approximately 2 miles northeast of the Plan area along Highway 15. This station provides full-time protection for heavy industry in the area, with advanced industrial level fire and dangerous goods support.

The RCMP provides police services to the City of Fort Saskatchewan from the central station located west of Highway 15 and 99 Avenue. Additionally, Heartland Hall also serves as a satellite office for the RCMP, special constables and bylaw officers working in north Strathcona County.

9.7 Risk Assessment Framework

The City of Fort Saskatchewan retained the services of Doug McCutcheon and Associates, Consulting to undertake an Industrial Risk Assessment (IRA) for the Plan area in 2009. Uses within the Plan area are potentially impaired by heavy industrial activity from companies in the vicinity including Sherritt Gordon, Marsulex, Shell Canada and Dow Chemical. The IRA provides a breakdown of the probability of an industrial accident occurring in proximity to the Plan area and concludes that these values are within an acceptable level of risk based upon the Major Industrial Accidents Council of Canada (MIACC) criteria for risk based land use planning. Sound design, collection of leaks, fire protection systems, operational procedures, emergency planning and other activities will serve to effectively manage risk to an acceptable level. Based on the circumstances, Emergency Officials will let residents know if Sheltering-in-Place is appropriate, or if an evacuation is required.

The IRA concludes that there is an opportunity to incorporate a limited amount of highway commercial uses within the 0 km to 1.5 km risk contour as regulated through the Highway 15 Vicinity Overlay. Should uses such as office buildings be incorporated into this Overlay, safety measures such as HVAC control and isolation of systems using monitors to initiate shutdown, windows that cannot open, and doors capable of sealing tightly, should be part of the building design in order to provide an effective means of sheltering in place should a toxic release happen.



10.0

PHASING AND IMPLEMENTATION CONCEPT

10.1 Development Phasing

Figure 13 – Staging outlines the proposed phasing for development of the plan area. Infrastructure servicing will be extended into these lands from west to east, which is also the general direction of the proposed phasing. Economic conditions, market demands and the logical and cost-effective extension of roadways, municipal services and other infrastructure will determine the detailed phasing at subdivision and development. If, as a result of the detailed phasing, the need to construct services and other municipal infrastructure in advance of the logical phasing of development is proposed, review will be required by the City provided the developer finances the required costs.

In order to provide for all potential industrial development opportunities, the phasing is influenced by preferred lot sizes and location requirements. As such, the number of lots, the size of lots, and the location of each phase will be confirmed at detailed subdivision and engineering. Timing of development will depend upon market conditions. Historically light industrial development in Fort Saskatchewan is approximately six (6) hectares per year, therefore full buildout could take a few decades.

10.2 Redistricting and Subdivision

Redistricting and subdivision applications that conform to this Outline Plan will be undertaken as required to the satisfaction of the City of Fort Saskatchewan in conformance with the *Land Use Bylaw* and *Municipal Development Plan*, from IR - Industrial Reserve to IM - Medium Industrial.



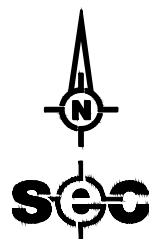
LEGEND

- Medium Industrial
- Highway 15 Vicinity Overlay
- Future Road Right of Way

- Municipal Reserve
- Environmental Reserve
- Stormwater Management Facility

- Pipeline/Utility Corridor
- Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN

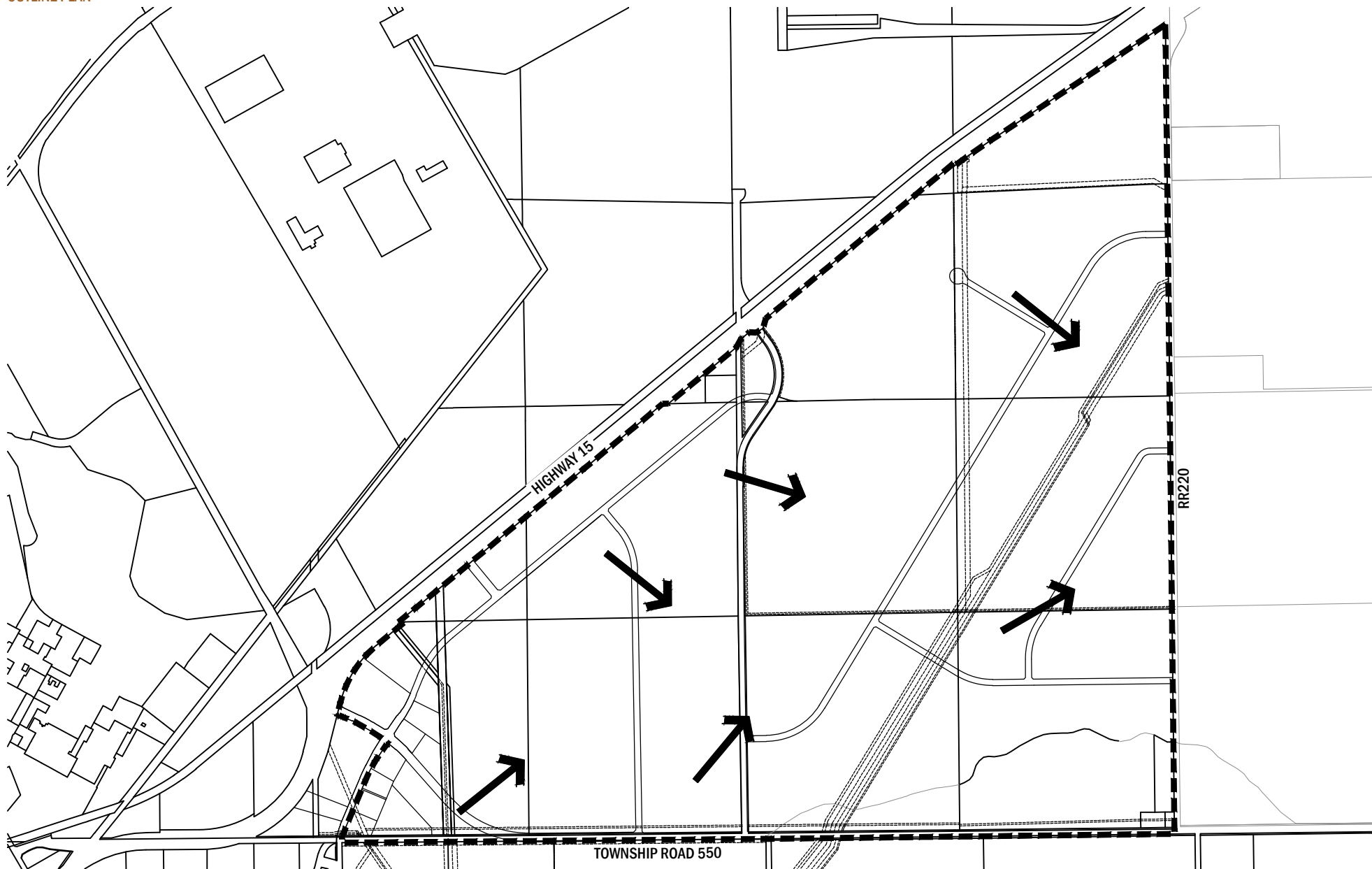


PRELIMINARY LOTTING

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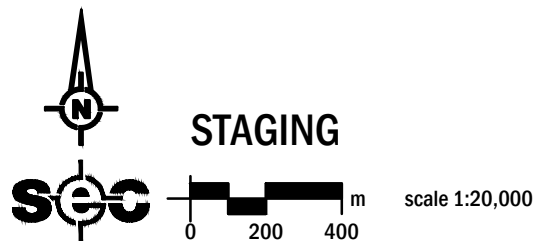
FIGURE 12



LEGEND

-  Staging Direction
-  Outline Plan Boundary

JOSEPHBURG ROAD NORTH INDUSTRIAL OUTLINE PLAN
CITY OF FORT SASKATCHEWAN



Capital Region Integrated Growth Management Plan Project Team, *Capital Region Integrated Growth Management Plan*, 2007

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City of Fort Saskatchewan, *City of Fort Saskatchewan Land Use Bylaw C10-13*, 2015

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Doug McCutcheon and Associates Consulting, *City of Fort Saskatchewan Industrial Risk Assessment Final Report*, March 2009

Durrance Projects Ltd; Trans America Group; Ecomark Ltd; Associated Engineering Ltd; & BK Hydrology Services, *Alsten Lands Outline Plan*, 2007

Municipal Program Development Branch, Environmental Sciences Division, Environmental Service, *Alberta Stormwater Management Guidelines*, 1999

Province of Alberta, *Environmental Protection Act Revised Statutes of Alberta 2000 Chapter E-12*, 2014

Province of Alberta, *Historical Resources Act Revised Statutes of Alberta 2000 Chapter H-9*, 2013

Province of Alberta, *Municipal Government Act (MGA) (Revised Statues of Alberta, 2000, Chapter M-26)*.

Province of Alberta, *Public Lands Act Revised Statutes of Alberta 2000 Chapter P-40*, 2014

Province of Alberta, *Water Act Revised Statutes of Alberta 2000 Chapter W-3*, 2014

Scheffer Andrew Ltd., *Josephburg Road North Area Structure Plan Bylaw C9-15*, 2015





APPENDIX A

Land Ownership





	Titled Owner	Legal Description	Area (ha)
1	Private Corporate	Lot 1, Block 1, Plan 082 0100	1.79
2	Private Corporate	SW ¼ 2-55-22-W4M	54.93
3	Private Corporate	SE ¼ 2-55-22-W4M	65.20
4	Private Corporate	SW ¼ 1-55-22-W4M	65.89
5	Private Corporate	SE ¼ 1-55-22-W4M	40.44
6	Private Corporate	Lot 1, Plan 952 2270	23.49
7	Private Non-Corporate	SE ¼ 1-55-22-W4M	2.02
8	Private Non-Corporate	SE ¼ 12-55-22-W4M	64.7
9	Private Non-Corporate	NE ¼ 12-55-22-W4M	28.48
10	Private Corporate	Pt of Lot 1, Plan 912 2507	0.82
11	Private Corporate	SW ¼ 12-55-22-W4M	20.4
12	Private Corporate	NW & NE ¼ 2-55-22-W4M	62.9
13	Private Corporate	NW ¼ 1-55-22-W4M	64.7
14	Private Non-Corporate	NE ¼ 1-55-22-W4M	64.7
15	Private Corporate	Power Line ROW OT, Plan 110 RS	2.48
16	Private Non-Corporate	SE ¼ 1-55-22-W4M	0.54
17	Private Non-Corporate	SE ¼ 1-55-22-W4M	0.20
18	Private Corporate	Lot A, Plan 590 KS	1.01
19	Private Corporate	Lot B, Plan 590 KS	1.21
20	Private Corporate	Lot C, Plan 590 KS	0.92
		TOTAL	566.82

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APPENDIX B

Historical Resources Application



Historic Resources Application

Activity Administration

Date Received: July 16, 2015

HRA Number: 4835-15-0095-001

Project Category: Subdivisions (4835)

Application Purpose: ☒ Requesting HRA Approval / Requirements

Lands Affected ☒ All New Lands

Project Type: ☒ Industrial Subdivision
☒ Area Structure Plan / Outline Plan
 Approximate Project Area (ha) 590 hectares

Project Name: North East Fort Industrial Outline Plan

Additional Name(s):

Key Contact:	Mr. Armin A Preiksaitis	Affiliation:	ParioPlan Inc.
Address:	605, 10080 Jasper Ave	City / Province:	Edmonton, AB
Postal Code:	T5J 1V9	Phone:	(780) 423-6824
E-mail:	armin@parioplan.com	Fax:	() -
		Your File Number:	

Proponent:	Trans America Group	Contact Name:	Bob Horton
Address:	#400, 10240 124 Street	City / Province:	Edmonton, AB
Postal Code:	T5N 3W6	Phone:	(780) 486-3919
E-mail:	horton@transamericagroup.com	Fax:	() -

Proposed Development Area					Land Ownership			
MER	RGE	TWP	SEC	LSD List	FRH	SA	CU	CT
4	22	55	1	1-16	☒	☐	☐	☐
4	22	55	2	1-12,14-16	☒	☐	☐	☐
4	22	55	12	1-11,16	☒	☐	☐	☐

Historical Resources Impact Assessment:

For archaeological resources:

Has a HRIA been conducted? ☐ Yes ☒ No

Permit Number (if applicable):

For palaeontological resource:

Has a HRIA been conducted? ☐ Yes ☒ No

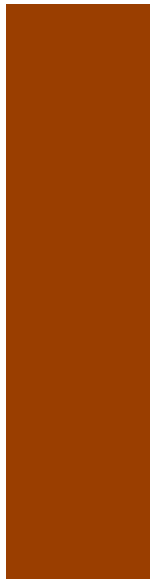
Permit Number (if applicable):

Historical Resources Act approval is granted subject to Section 31, "a person who discovers an historic resource in the course of making an excavation for a purpose other than for the purpose of seeking historic resources shall forthwith notify the Minister of the discovery." The chance discovery of historical resources is to be reported to the contacts identified within the Listing of Historic Resources.



July 21, 2015

Date



APPENDIX C

Biophysical Environmental Assessment and Wetland Compensation Plan





BIOPHYSICAL ENVIRONMENTAL ASSESSMENT AND WETLAND COMPENSATION PLAN

**PROPOSED LAND DEVELOPMENT PLAN,
FORT N.E. INDUSTRIAL
IN FORT SASKATCHEWAN, ALBERTA
(W12-55-22-W4M, NW1-55-22-W4M)**



BIOPHYSICAL ENVIRONMENTAL ASSESSMENT AND WETLAND COMPENSATION PLAN

PROPOSED LAND DEVELOPMENT PLAN, FORT N.E. INDUSTRIAL IN FORT SASKATCHEWAN, ALBERTA (W12-55-22-W4M, NW1-55-22-W4M)

Submitted to:

BOB HORTON
OF
TRANS AMERICA GROUP
EDMONTON, ALBERTA

AND

GLEN KENNEDY
OF
PRISM ENGINEERING
EDMONTON, ALBERTA

Submitted by:

K. L. WALKER-MAKOWECKI
K. THOMPSON &
S. CONRAD

OF

ENVIROMAK INC.
ENVIRONMENTAL MANAGEMENT
CONSULTANTS

EDMONTON, ALBERTA

May 30, 2014

TRACKING TABLE OF DOCUMENT REVISIONS

Document Revision Date	Name of Document	Initials of Editor/Author
May 27, 2014	14-05 Fort NE Industrial NW1&W12-55-22-W4M DRAFT Biophysical Report 140527ktkm	klw-m
May 28, 2014	14-05 Fort NE Industrial NW1&W12-55-22-W4M DRAFT Biophysical Report 140528ktkm	klw-m
May 30, 2014	14-05 Fort NE Industrial NW1&W12-55-22-W4M Biophysical Report 140530km	klw-m

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1.0 INTRODUCTION AND BACKGROUND

Trans America Group and Prism Engineering Inc. are developing a property as part of the Fort N.E. Industrial Development, southeast of Highway 15 and east of Range Road 221 (125 street) within Fort Saskatchewan, Alberta. The proposed development will be located within W12-55-22-W4M and NW1-55-22-W4M. The property totals approximately 111.3ha (275ac) of land and contains 67 wetlands of differing classes, dispersed amongst a cultivated field.

A biophysical environmental assessment was conducted for the proposed development by EnviroMak Inc. Environmental Management Consultants on behalf of Trans America Group and Prism Engineering Inc. The following provides a description of some biophysical parameters of specific features associated with the development property site. Additionally, some possible environmental protection opportunities to consider in developing the final development plan are suggested.

2.0 OBJECTIVES

The purpose of the biophysical assessment and wetland compensation plan is to determine if there are any specific environmental features that would influence the industrial development proposed for the Fort N.E. Industrial Development in W12-55-22-W4M and NW1-55-22-W4M.

EnviroMak Inc. Environmental Management Consultants overall objectives were to complete a biophysical assessment and an environmental affects assessment of the aquatic and terrestrial resources and to develop mitigation measures intended to meet the approval of the regulatory agencies for the management of the Fort N.E Industrial Development in W12-55-22-W4M and NW1-55-22-W4M. The specific objectives of this assessment were:

- To conduct a biophysical assessment of the wetlands, waterbodies and watercourses and other natural features present in the study area;
- To assess the potential environmental effects and impacts that may result from the proposed development;
- To provide environmental protection and compensation and mitigation recommendations that minimize or eliminate impacts and monitors the health of the aquatic and terrestrial ecosystem;
- To identify cumulative and residual impacts and their significance; and
- To provide advice with regard to final design, regulatory requirements and approvals, implementation of project development and operational monitoring.

3.0 STUDY AREA

The study area for this biophysical assessment includes 111.3ha (275ac) of developable land. The primary use of landscape is agricultural cultivated field with several wetlands dispersed throughout, and a small area of vegetation near Highway 15. The study area is located within Fort Saskatchewan, Alberta (Figure 3.1) and includes the entirety of NW1-55-22-W4M (64.7ha; 160ac), a large part of SW12-55-22-W4M (46.5ha; 113ac) and a smaller part of NW12-55-22-W4M (0.81ha; 2.00ac). The immediate area of the study area is on private lands (Fort Industrial Estates). Highway 15 and Range Road 221 border the north and west sides of the property, while agriculture development surrounds the property to the east and south.

This study area is part of the overall Josephburg Road North Industrial Area Structure Plan (ASP) (Appendix 14.3) which covers numerous sections within Fort Saskatchewan. This biophysical assessment focused on a portion of that ASP area, within the privately owned sections W12-55-22-W4M and NW1-55-22-W4M (Figure 3.1).

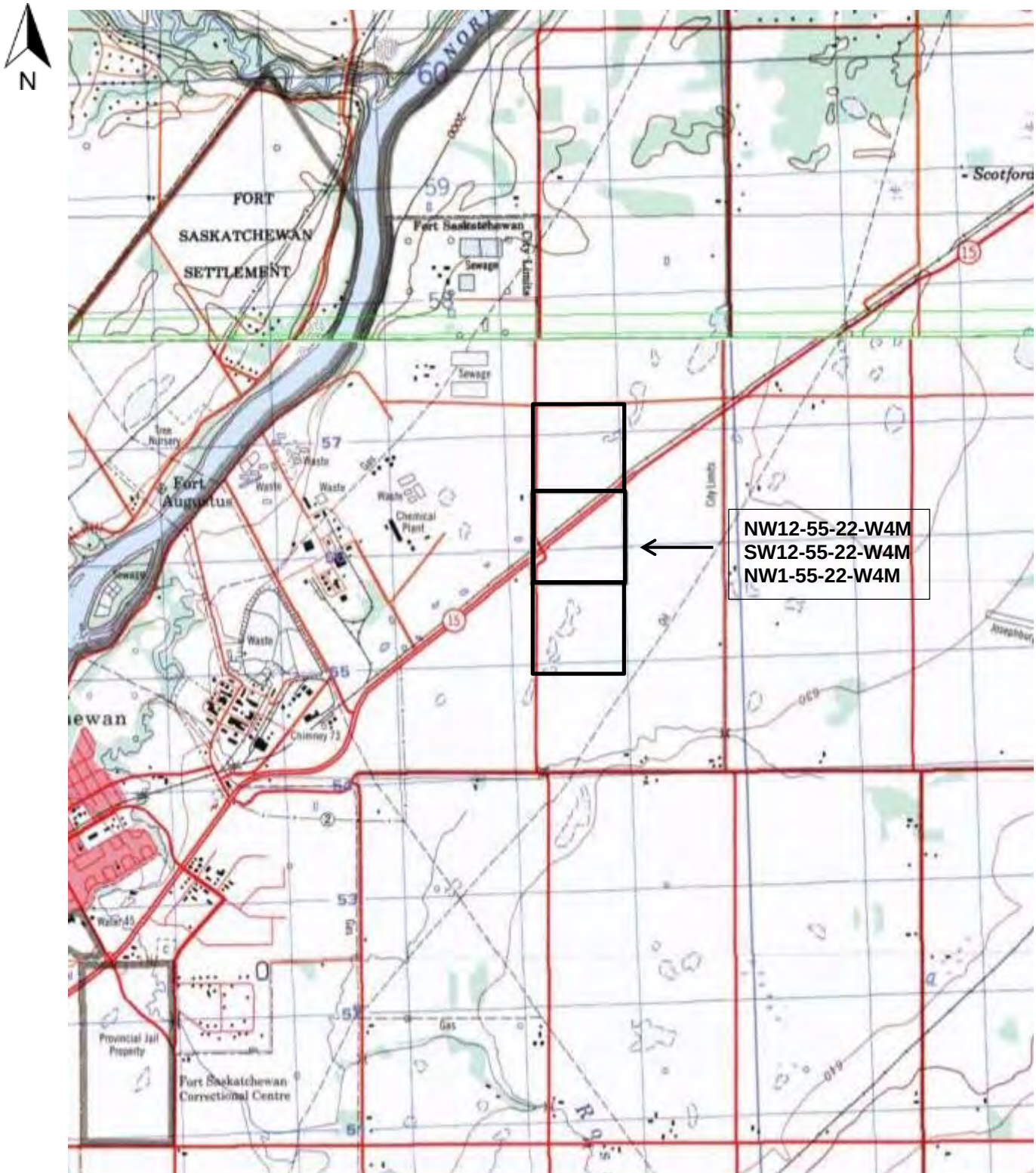


Figure 3.1. Quarter sections encompassing study area for the Fort N.E. Industrial Development at W12-55-22-W4M and NW1-55-22-W4M. (1:50,000 scale Etopo NTS Map, 83H11, 2000).

4.0 STUDY METHODS

This biophysical environmental assessment was supported by information that provided the basic site description information, construction specifications, existing biological information, field assessment/survey/truthing and overall assessment.

The desktop existing information review included as available and applicable map and aerial photography interpretation and comparative examination, ground level photograph examination, existing database queries, previous study, geotechnical and engineering design/evaluation and environmental report research and interviews with landowners/stakeholders/regulators/proponent/others.

Valued ecosystem components (VECs) were identified from existing information including consideration of Elements-At-Risk which were collected from a variety of sources. Elements-At-Risk include plants and animals considered at risk due to being restricted to a small portion of their former range or extent based on a combination of Alberta Conservation Information Management System (ACIMS 2013) tracking and watch lists, federal endangered species lists (COSEWIC 2010), provincial at risk and may be at risk species list (AESRD 2010), Fish and Wildlife Management Information System (FWMIS 2014) and other sources.

The land architect and/or engineering survey and design data were reviewed and considered in the environmental assessment as applicable and available.

A comprehensive field survey of the location was undertaken on May 1, May 2 and May 12, 2014 by qualified biologists. The biophysical field survey generally includes a foot level survey of perimeter and intersecting transects throughout the property with the purpose of identifying environmentally significant areas, key habitats and unique, rare, endangered and/or protected natural features and VECs.

Generally and with regard to field assessment methodology of wetland areas, in the Green Areas of Alberta, the Canadian Wetland Classification System (National Wetlands Working Group 1997) is applied while in the White Areas the Stewart and Kantrud Wetland Classification System (1971) is used as part of the biophysical field assessment.

Existing information and results of the field survey were considered in the overall interpretation and assessment of environmental effects and recommendations for mitigation and monitoring.

5.0 EXISTING INFORMATION REVIEW

5.1 Ecoregion, Soils and Topography

The property (W12-55-22-W4M, NW1-55-22-W4M) is located in the Aspen-Parkland Ecoregion (Strong and Leggat, 1992) (Table 5.1).

The area is in the Thick Black Soil Zone of central and east-central Alberta (Soil Correlation Area 10, Pedocan Land Evaluation Ltd. 1993). The area is dominated by Chernozemic soils with significant Solonetzic and other salt-affected soils. Gleysolic soils occurred in depressional areas (Pedocan 1993).

According to the Alberta Geological Survey web maps (2009), the site does not fall within a sand or gravel deposit with aggregate resource potential. The Quantification of Aggregate Minerals in Alberta Map produced by EnviroMak Inc. (2000) shows historic private land aggregate extraction pits located at or near the property.

5.2 Environmentally Significant Areas

The Government of Alberta Environmentally Significant Areas Map (2009) identified this area to be located near a nationally significant area, the North Saskatchewan River (720). The North Saskatchewan River is approximately 2.5km away from project boundary. The property does not contain any ecological reserves or special wildlife projects. A data search around the site in Alberta Conservation Information Management System (ACIMS) online system did not identify any recorded occurrences of elements on tracking lists (Online ACIMS Database 2013).

Table 5.1. General location descriptors of proposed Fort N.E. Industrial Development in Fort Saskatchewan in W12-55-22-W4M and NW1-55-22-W4M.

Descriptor	Specific Location
Legal Land Description	W12-55-22-W4M NW1-55-22-W4M
¹ Soil Correlation Area	SC 10
² Ecoregion	Aspen Parkland
Watershed (River Basin)	North Saskatchewan River Basin
General Location in Basin	Middle
Municipality	City of Fort Saskatchewan
Alberta Land Use Area (Green or White)	White
³ Environmentally Significant Area	Approximately 2.5km from Nationally Significant Area 720
Nearest Town/City	Fort Saskatchewan
⁴ UTM	12U 358478E 5955677N
⁴ Latitude/Longitude	53°43'49.69"N 113° 8'43.52"W

¹ Pedocan Land Evaluation 1993

² Strong & Leggat 1992

³ ACIMS Map 2009 ⁴Google Earth Pro 2013

5.3 Climate

Climate data was gathered from Environment Canada (2013) which maintains a weather station at Fort Saskatchewan, Alberta. Fort Saskatchewan temperature averages 2.9 °C annually; the July mean is 16.7°C, and; the January mean is -13.5 °C. Mean annual precipitation is 460mm; rainfall averages 355mm and snowfall averages 105cm.

5.4 Agriculture

According to the capability classification (1:250,000 scale Canada Land Inventory Soil Capability for Agriculture), the majority of W12-55-22-W4M and NW1-55-22-W4M is classified as Class 2D. Class 2 indicates soils that have moderate limitations for crop use. Additionally, this area is identified as subclass D, which states that this area has undesirable soil structure and low permeability (1:250,000 scale Canada Land Inventory Soil Capability for Agriculture).

The growing season lasts approximately 180 – 185 days (Pedocan Land Evaluation 1993). Agroclimate is 2H (slight heat limitations). Growing season is P-PE= -150 to -250mm and snow cover persists throughout the winter (Pedocan 1993).

5.5 Watershed Characteristics

The property at W12-55-22-W4M and NW1-55-22-W4M is located in the middle of the North Saskatchewan River Basin. The nearest fish-bearing water bodies are Ross Creek and the North Saskatchewan River (Ecomark Ltd. 2007). The property contains 27 Class I wetlands, 27 Class II Wetlands, 9 Class III Wetland, and 2 Class IV wetlands. Additionally two wetlands were classified Class II-III. A total of 67 wetlands were observed in May 2014.

The Class IV wetland in NW1-55-22-W4M (Figure 6.2c) identified in May 2014 by EnviroMak Inc. had been previously assessed during an Ecomark Ltd. September 2007 field inspection. At that time, Ecomark Ltd. (2007) had classified this wetland as a Class III seasonal wetland based on the Stewart and Kantrud Wetland Classification System (Ecomark Ltd. 2007). During this assessment the wetland lacked surface inlets and outlets and had been heavily impacted by agricultural development (Ecomark Ltd. 2007). Through aerial photograph review, the wetland appears to drain southwest toward a group of willow (*Salix sp.*), but agricultural development has removed any evidence that the wetland is linked to the regional drainage system (Ecomark Ltd. 2007). The wetland did not contain water during the 2007 inspection but has potential to provide suitable seasonal habitat for wildlife (Ecomark Ltd. 2007).

5.6 Existing Fisheries Information

Existing information contained on the AESRD Fish and Wildlife Management Information System (FWMIS) did not identify the presence of any fish species within a 2km radius of this location (FWMIS Internet Mapping Framework 2013). A site assessment in September 2007 confirmed that the property contained no suitable habitat for fish, and that the nearest fish bearing water bodies are Ross Creek and the North Saskatchewan River (Ecomark Ltd. 2007).

5.7 Existing Wildlife Information

Searches of the Fish and Wildlife Management Information System (FWMIS) and the Alberta Conservation Information Management System (ACIMS) databases identify Canadian Toad (*Bufo hemiophrys*), Peregrine Falcon (*Falco peregrinus*) and Swainson's Hawk (*Buteo swainsoni*) within a 2km radius of this location (FWMIS 2014).

Alberta Government files classify the Canadian Toad as "May Be at Risk" (AESRD Alberta Species at Risk 2010). Committee on the Status of Endangered Wildlife in Canada (2013) lists the Canadian Toad as "Not at Risk" (COSEWIC Canadian Species at Risk 2013).

Alberta Government files classify the Peregrine Falcon as "At Risk" (AESRD Alberta Species at Risk 2010). Committee on the Status of Endangered Wildlife in Canada (2013) lists the Peregrine Falcon as "Special Concern" (COSEWIC Canadian Species at Risk 2013).

Alberta Government files classify Swainson's Hawk as "Sensitive" (AESRD Alberta Species at Risk 2010). Committee on the Status of Endangered Wildlife in Canada (2013) did not have Swainson's hawk on record (COSEWIC Canadian Species at Risk 2013).

Table 5.2. Species of concern which have been identified within a 2km radius of W12-22-55-W4M and NW1-55-22-W4M according to the Fish and Wildlife Management Information System (FWMIS) and the Alberta Conservation Information Management System (ACIMS).

Common Name	Scientific Name	Provincial Status ¹	Federal Status ²
Canadian Toad	<i>Bufo hemiophrys</i>	May Be at Risk	Not at Risk
Peregrine Falcon	<i>Falco peregrinus</i>	At Risk	Special Concern
Swainson's Hawk	<i>Buteo swainsoni</i>	Sensitive	No Record

¹ AESRD 2011 – check website at <http://esrd.alberta.ca/fish-wildlife/species-at-risk/wild-species-status-search.aspx>

² COSEWIC 2014– check website at http://www.cosewic.gc.ca/eng/sct1/searchform_e.cfm

During the September 25, 2007 site inspection, Song Sparrows (*Melospiza melodia*), Black-billed Magpie (*Pica hudsonia*), American Crow (*Corvus brachyrhynchos*), Ruffed Grouse (*Bonasa umbellus*), and Red-tailed Hawk (*Buteo jamicensis*) were observed on the subject property, and additional signs of coyote (*Canis latrans*), red fox (*Vulpes vulpes*), moose (*Alces alces*), deer (*Odocoileus* spp.) muskrat (*Ondatra zibethicus*) and weasel (*Mustela* spp.) were noted (Ecomark Ltd. 2007).

5.8 Historical Aerial Photograph Interpretation and Comparative Review

Aerial photographs of the area were interpreted and compared in order to determine the historical land use of the area, as well as the presence of any significant features (particular focus on wetlands) throughout the years (Appendix 14.2). The aerial photography was obtained from Alberta Environment and Sustainable Resource Development (AESRD) and Google Earth Pro. The aerial photograph review spanned the years 1978 to 2013.

A descriptive summary of historical aerial photography is provided below in Table 5.3. The AESRD historical aerial photographs from 1978, 1996 and 2008, and Google Earth Pro 2005, 2010, 2011, 2012 and 2013 aerial images are provided in Appendix 14.3.

Table 5.3. Historical aerial photograph interpretation summary for 111.3ha in W12-55-22-W4M and NW1-55-22-W4M for various years between 1978 and 2013 (Aerial Photographs in Appendix 14.2).

Year	Month	Description
1978	N/A	▪ Hwy 15 Present to the northwest of the property ▪ Range Road 221 (125st) does not appear to have been established ▪ Land being used for agricultural purposes ▪ Large Class IV Wetland visible at NW1-55-22-W4M ▪ Large Class IV wetland visible in north east corner at W12-55-22-W4M ▪ Few depressional areas indicating lower class wetlands
1996	September or October	▪ Range Road 221 (125st) development to the northwest ▪ Land being used for agricultural purposes; cultivation present ▪ Few wetlands with standing water present ▪ Large Class IV wetland visible at NW1-55-22-W4M ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M
2005	April	▪ Pipeline Utility Corridor¹ present to the east and south ▪ Range Road 221 (125st) clearly established ▪ Land being used for agricultural purposes ▪ Abundant wetlands with standing water present ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M
2008	October	▪ Large Class IV wetland visible at NW1-55-22-W4M ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M ▪ Land being used for agricultural purposes ▪ Few wetlands visible
2010	April	▪ Minor snow cover ▪ Large Class IV wetland visible at NW1-55-22-W4M ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M ▪ Land being used for agricultural purposes; cultivation visible ▪ Few wetlands visible
2011	July	▪ Numerous wetlands visible ▪ Some connectivity between wetlands ▪ Large Class IV wetland visible at NW1-55-22-W4M ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M
2012	August	▪ Large Class IV wetland visible at NW1-55-22-W4M ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M ▪ Several depressional areas ▪ Land being used for agricultural purposes; cultivation visible
2013	October	▪ Large Class IV wetland visible at NW1-55-22-W4M ▪ Large Class IV Wetland visible in north east corner at W12-55-22-W4M ▪ Several depressional areas ▪ Land being used for agricultural purposes; cultivation visible

1-Prism Engineering Tentative Plan showing a proposed subdivision of SW12-55-22-W4M

6.0 FIELD ASSESSMENT RESULTS

6.1 *Field Assessment Details*

Site visits were conducted on May 1, May 2, and May 12, 2014. The assessments focused on valued ecosystem components (VECs) including watercourses, wetlands, vegetation, wildlife, fish, fish habitat, hydrology and other physical features as were present.

The morphometric features of the area are described (Figure 6.2, Figure 6.1a-6.1c, Tables 6.1a-6.6, Photographs in Appendix 14.1 and 14.2; Site Development Plan in Appendix 14.3).

The assessments were conducted during sunny conditions with an air temperature of 8°C on May 2, 2014 and 16°C on May 1, 2014 and May 12, 2014. There was no precipitation at the time of the assessment.

6.2 *Morphometric Features*

The property is within City of Fort Saskatchewan and is located southeast of Highway 15 and east of Range Road 221 (125st) in Fort Saskatchewan. The study area borders agricultural development, and has a total land area of approximately 111.3ha (275ac) of potentially developable area.

The analyses of the morphometric landscape features of the overall area has been divided into three parcels for the purposes of development planning including: North Parcel, Central Parcel and South Parcel (Figure 6.1).

The study area lies within the White Area of Alberta, and as such, wetlands are classified through the Stewart and Kantrud Classification System. Wetland surface area (Acres; Ha) and Percent of Landscape (%) are summarized in Tables 6.1a-6.1c and Figures 6.1a-6.1c.



Figure 6.1. October 2013 Google Earth aerial of Fort N.E. Industrial Development area in W12-55-22-W4M and NW1-55-22-W4M; North Parcel outlined in white, Central Parcel outlined in green, South Parcel outlined in yellow (Google Earth Pro 2014).

6.2.1 North Parcel

The North Parcel (Table 6.1a, Figures 6.1a and 6.2a) totals 18.21ha of developable land. Wetlands formed 2.62ha (27.1%) of this area and the remainder of the north parcel is 15.59ha (72.9%) of cultivated field. Class I wetlands account for 0.71ha (3.90%) of the total north area, Class II wetlands account for 0.99ha (5.44%), Class III wetlands account for 0.67ha (3.68%), and Class IV wetlands account for 2.56ha (14.1%).

Table 6.1a. Landscape and vegetation coverage of the North Parcel in Fort Saskatchewan in W12-55-22-W4M.

Landscape Type		Surface Area (Acres)	Surface Area (Ha)	Percent of Landscape (%)
Wetlands	Wetland #1 (Class IV)	6.32	2.56	14.0
	Wetland #2 (Class I)	0.22	0.09	0.5
	Wetland #3 (Class I)	0.22	0.09	0.5
	Wetland #4 (Class I)	0.15	0.06	0.3
	Wetland #5 (Class II)	0.30	0.12	0.7
	Wetland #6 (Class I)	0.12	0.05	0.3
	Wetland #7 (Class II)	0.36	0.15	0.8
	Wetland #8 (Class III)	0.99	0.40	2.20
	Wetland #9 (Class I)	0.52	0.21	1.20
	Wetland #10 (Class II)	0.15	0.06	0.3
	Wetland #11 (Class III)	0.67	0.27	1.5
	Wetland #12 (Class II)	0.15	0.06	0.3
	Wetland #13 (Class I)	0.04	0.02	0.08
	Wetland #14 (Class II)	0.29	0.12	0.6
	Wetland #15 (Class I)	0.44	0.18	1.0
	Wetland #16 (Class I)	0.02	0.01	0.04
	Wetland #17 (Class II)	0.99	0.40	2.2
	Wetland #18 (Class II)	0.21	0.08	0.5
	Wetland Subtotal	12.16	4.93	27.1
	Class II and above Wetlands Subtotal	10.43	4.93	27.1
Cultivated Field		32.8	14.27	72.9
Total		45.0	18.21	100

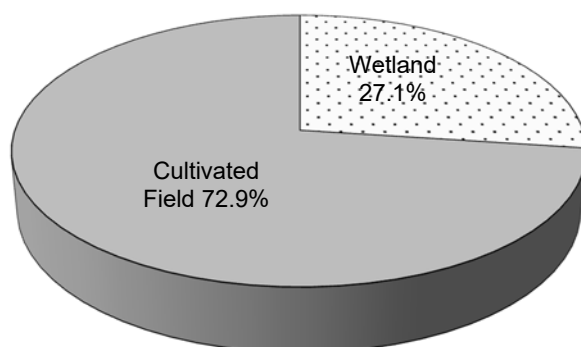


Figure 6.2a. Landscape use (%) of the North Parcel in Fort Saskatchewan in W12-55-22-W4M.



Figure 6.1a. October 2013 Google Earth aerial of Fort N.E. Industrial Development North Parcel area in W12-55-22-W4M; Class I wetlands shaded in blue, Class II wetlands shaded in dark green, Class III wetlands shaded in yellow, Class IV wetlands shaded in purple (Google Earth Pro 2014).

6.2.2 Central Parcel

The Central Parcel (Table 6.1b, Figures 6.1b and 6.2b) totals 24.3ha of developable land, 2.27ha (9.34%) of which is wetlands, 0.35ha (1.43%) that is treed vegetation (predominately Aspen), and the remainder is 21.7ha (89.3%) cultivated field. Class I wetlands account for 0.99ha (4.07%) of the Central parcel, Class II wetlands account for 0.86ha (3.54%) and Class III wetlands account for 0.42ha (1.73%). There are no Class IV wetlands in the Central Parcel.

Table 6.1b. Landscape and vegetation coverage of the Central Parcel in Fort Saskatchewan in W12-55-22-W4M.

Landscape Type		Surface Area (Acres)	Surface Area (Ha)	Percent of Landscape (%)
Wetlands	Wetland #26 (Class I)	1.22	0.49	2.03
	Wetland #27 (Class I)	0.09	0.04	0.15
	Wetland #28 (Class I)	0.022	0.009	0.04
	Wetland #29 (Class II)	0.45	0.18	0.75
	Wetland #30 (Class I)	0.52	0.21	0.87
	Wetland #31 (Class I)	0.19	0.08	0.32
	Wetland #32 (Class II)	1.03	0.42	1.72
	Wetland #33 (Class II)	0.65	0.26	1.08
	Wetland #34 (Class I)	0.21	0.08	0.35
	Wetland #35 (Class I)	0.11	0.04	0.18
	Wetland #36 (Class I)	0.02	0.008	0.03
	Wetland #37 (Class III)	0.25	0.10	0.42
	Wetland #38 (Class I)	0.02	0.008	0.03
	Wetland #39 (Class III)	0.78	0.32	1.3
	Wetland #40 (Class I)	0.04	0.02	0.07
	Wetland Subtotal	5.60	2.27	9.34
	Class II and above Wetlands Subtotal	3.16	1.28	5.27
Cultivated Field		53.5	21.7	89.3
Treed Vegetation (Predominately Aspen)		0.86	0.35	1.44
Total		60.0	24.3	100

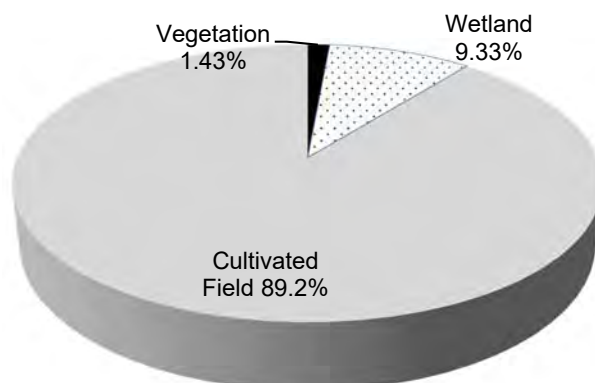


Figure 6.2b. Landscape use (%) of the Central Parcel in Fort Saskatchewan in W12-55-22-W4M



Figure 6.1b. October 2013 Google Earth aerial of Fort N.E. Industrial Development Central Parcel area in SW12-55-22-W4M; Class I wetlands shaded in blue, Class II wetlands shaded in green, Class III wetlands shaded in yellow (Google Earth Pro 2014).

6.2.3 South Parcel

The South Parcel (Table 6.1c, Figures 6.1c and 6.2c) totals 68.9ha of developable land. The wetlands in this area comprise 6.87ha (9.97%) of the area, and the remainder is 61.3ha (89.0%) cultivated field, except for a small portion (0.77ha, 1.12%) in the northwest corner which contains infrastructure (125 ST). Class I wetlands account for 0.56ha (0.81%) of the South Parcel, Class II wetlands account for 2.34ha (3.40%), Class III wetlands account for 0.77ha (1.12%), and Class IV wetlands account for 2.99 (4.34%). Wetlands assessed as Class II-III account for 0.21ha (0.30%).

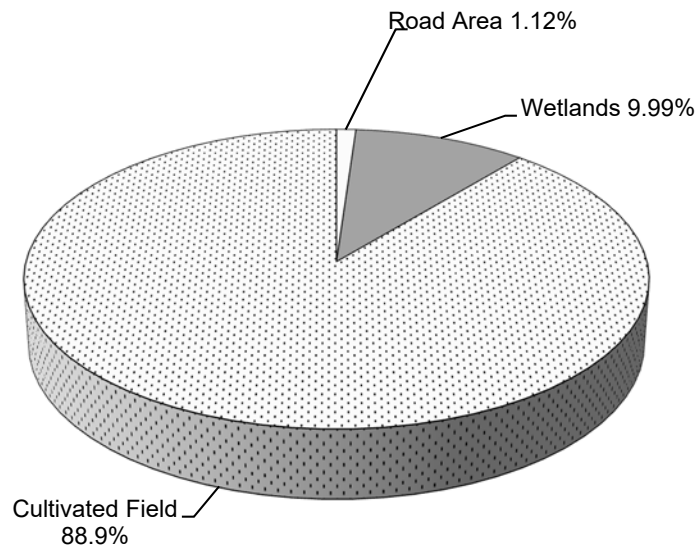


Figure 6.2c. Landscape use (%) of the South Parcel in Fort Saskatchewan in NW1-55-22-W4M and SW12-55-22-W4M.

Table 6.1c. Landscape and vegetation coverage of the South Parcel in Fort Saskatchewan in W12-55-22-W4M.

Landscape Type		Surface Area (Acres)	Surface Area (Ha)	Percent of Landscape (%)
Wetlands	Wetland #19 (Class II)	1.11	0.45	0.65
	Wetland #20 (Class III)	0.19	0.07	0.11
	Wetland #21 (Class III)	0.48	0.19	0.28
	Wetland #22 (Class I)	0.07	0.02	0.04
	Wetland #23 (Class III)	0.25	0.10	0.15
	Wetland #24 (Class II)	0.30	0.12	0.18
	Wetland #25 (Class II)	0.54	0.22	0.32
	Wetland #41 (Class I)	0.78	0.32	0.46
	Wetland #42 (Class II)	0.22	0.09	0.13
	Wetland #43 (Class II)	0.19	0.08	0.11
	Wetland #44 (Class II)	0.55	0.22	0.32
	Wetland #45 (Class II)	0.21	0.08	0.12
	Wetland #46 (Class II)	0.31	0.15	0.18
	Wetland #47 (Class II)	0.37	0.15	0.22
	Wetland #48 (Class II-III)	0.42	0.17	0.25
	Wetland #49 (Class IV)	7.38	2.990	4.34
	Wetland #50 (Class I)	0.15	0.06	0.09
	Wetland #51 (Class II)	0.09	0.04	0.05
	Wetland #52 (Class II-III)	0.11	0.04	0.06
	Wetland #53 (Class I)	0.06	0.02	0.04
	Wetland #54 (Class I)	0.05	0.02	0.03
	Wetland #55 (Class II)	0.05	0.02	0.03
	Wetland #56 (Class I)	0.11	0.04	0.06
	Wetland #57 (Class II)	0.52	0.21	0.31
	Wetland #58 (Class III)	0.74	0.29	0.44
	Wetland #59 (Class III)	0.30	0.12	0.18
	Wetland #60 (Class II)	0.15	0.06	0.09
	Wetland #61 (Class II)	0.26	0.11	0.15
	Wetland #62 (Class II)	0.17	0.07	0.10
	Wetland #63 (Class I)	0.04	0.02	0.02
	Wetland #64 (Class II)	0.43	0.17	0.25
	Wetland #65 (Class II)	0.17	0.09	0.10
	Wetland #66 (Class I)	0.15	0.06	0.09
	Wetland #67 (Class II)	0.017	0.007	0.01
	Wetland Subtotal	16.9	6.88	9.99
	Class II and above Wetlands Subtotal	15.5	6.31	9.13
Cultivated Field		151.2	61.2	88.9
Development/Road Area		1.90	0.77	1.12
Total		170	68.9	100

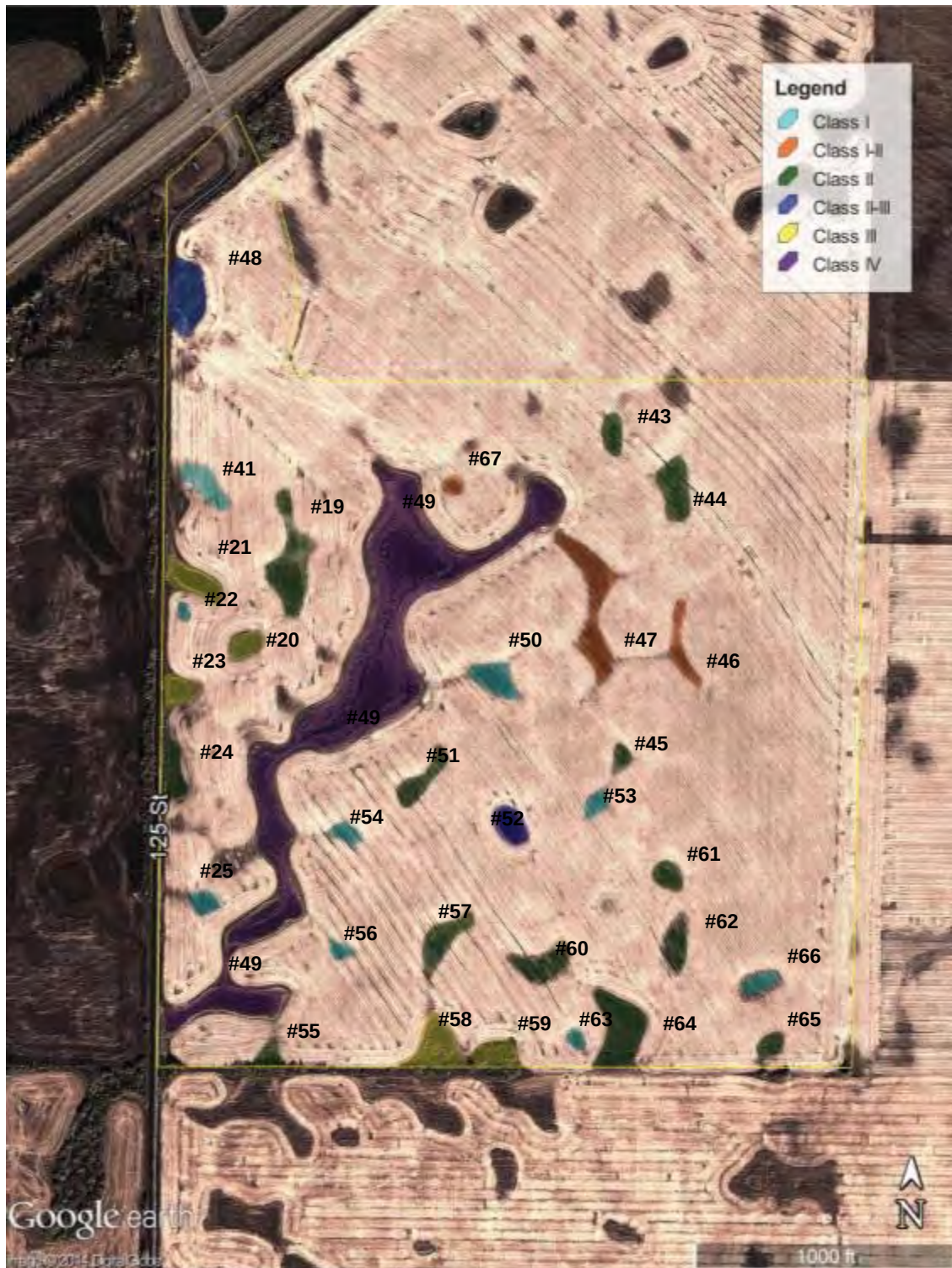


Figure 6.1c. October 2013 Google Earth aerial of Fort N.E. Industrial Development South Parcel area in SW12-55-22-W4M and NW1-55-22-W4M; Class I wetlands shaded in light blue, Class II wetlands shaded in green and orange, Class II-III wetlands shaded in dark blue, Class III wetlands shaded in yellow, Class IV wetland shaded in purple (Google Earth Pro 2014).

6.3 Vegetation Features

The study area contained several species of aquatic and terrestrial vegetation including: Aquatic grasses (*Panicum* sp.), cattail (*Typha latifolia*), common duckweed (*Lemna minor*), filamentous green algae (*Cladophora* sp.), mint (*Mentha* sp.), moss (*Drepanocladus* sp.), rush (*Juncus* sp.) sedge (*Carex* spp.), slough grass (*Beckmannia syzigachne*), trembling aspen (*Populus tremuloides*), and willow (*Salix* sp.) (Table 6.2).

The small area of vegetation (0.35ha; 1.43%) in the Central Parcel contained a stand of trembling aspen that constitutes potential nesting habitat.

No rare plants were observed during the spring site assessments conducted by EnviroMak Inc. nor during the fall assessment conducted by Ecomark Ltd. (2007).

Table 6.2. Vegetation types associated with a property in Fort N.E. Industrial in W12-55-22-W4M and NW1-55-22-W4M in May 2014.

Area	Common Name	Scientific Name
North Parcel	Cattail	<i>Typha latifolia</i>
	Sedge	<i>Carex</i> spp.
	Willow	<i>Salix</i> sp.
	Slough Grass	<i>Beckmannia syzigachne</i>
Central Parcel	Cattail	<i>Typha latifolia</i>
	Sedge	<i>Carex</i> spp.
	Common duckweed	<i>Lemnoideae</i>
	Slough Grass	<i>Beckmannia syzigachne</i>
	Trembling Aspen	<i>Populus tremuloides</i>
	Filamentous Green Algae	<i>Cladophora</i> sp.
	Mint	<i>Mentha</i>
South Parcel	Aquatic grasses	<i>Panicum</i> sp.
	Reed Canary Grass	<i>Phalaris arundinacea</i>
	Cattail	<i>Typha latifolia</i>
	Moss	<i>Drepanocladus</i> sp.
	Rush	<i>Juncus</i> sp.
	Sedge	<i>Carex</i> spp.
	Slough Grass	<i>Beckmannia syzigachne</i>
	Willow	<i>Salix</i> sp.

Table 6.3. Vegetation types observed at Fort N.E. Industrial Development in NW1-55-22-W4M in September 2007¹.

Area	Common Name	Scientific Name
Class III Wetland ¹ (Class IV Wetland) ²	Cattail	<i>Typha latifolia</i>
	Reed canary grass	<i>Phalaris arundinacea</i>
	Slough grass	<i>Beckmannia syzigachne</i>
	Fowl mana grass	<i>Glyceria striata</i>
	Fescue	<i>Festuca</i> spp.
	Brome	<i>Bromus</i> spp.
	Foxtail Barley	<i>Hordem jubatum</i>
	Fireweed	<i>Epilobrium angustifolium</i>
	Mixed sedges	<i>Carex</i> spp.

1- Ecomark Ltd. 2007

6.4 Fish and Fish Habitat Features

Ross Creek and the North Saskatchewan River are located southwest of the overall property and are the nearest fish-bearing water bodies according to Daryl Watters, Fisheries Biologist with Alberta Sustainable Resource Development (Ecomark Ltd. 2007). The 2007 site inspection performed by Ecomark Ltd. determined that no suitable fish habitat was present on or near the subject property (Ecomark Ltd. 2007).

No fish habitat was identified during the May 2014 field assessment conducted by EnviroMak.

6.5 Wetland Features

The study area within W12-55-22-W4M and NW1-55-22-W4M was within the designated White Area of Alberta. As such, the acceptable classification system for this area at the time of this assessment is the Stewart and Kantrud Classification System (1971).

Based on the Stewart and Kantrud Classification System, the property contains 27 Class I wetlands, 27 Class II wetlands, 9 Class III wetlands and 2 Class IV wetlands. Additionally two wetlands were classified in a transitional state between Class II-III. A total of 67 wetlands were observed in May 2014.

A detailed listing of wetlands and classifications is provided for in Section 6.2.

6.6 Wildlife Features

During the site visits on May 1, May 2 and May 12, 2014, several species of birds were observed including: American coot (*Fulica americana*), American Crow (*Corvus brachyrhynchos*), American Robin (*Turdus migratorius*), American Widgeon (*Anas americana*), Blue-winged teal (*Anas discors*), Bonaparte's Gull (*Larus philadelphia*), Canada Goose (*Branta canadensis*), Common Goldeneye (*Bucephala clangula*), Horned Grebe (*Podiceps auritus*), Mallard (*Anas platyrhynchos*), Northern Shoveler (*Anas clypeata*), Redwing Blackbird (*Agelaius phoeniceus*), Ring-billed Gull (*Larus delawarensis*), Savannah Sparrow (*Passerculus sandwichensis*), Song Sparrow (*Melospiza melodia*), and Swainson's Hawk (*Buteo swainsoni*) (Table 6.4). In addition to these species Black-billed Magpie (*Pica hudsonia*), Ruffed Grouse (*bonasa umbellus*) and Red-tailed Hawk (*buteo jamaicensis*) were observed during the Ecomark Ltd. 2007 site inspection.

Boreal chorus frog (*Pseudacris triseriata*) and wood frog (*Rana sylvatica*) were the only two species of amphibians encountered during the May, 2014 field assessment.

Table 6.4. Wildlife and/or wildlife signs observed at the Fort N.E. Industrial Development in Fort Saskatchewan at W12-55-22-W4M and NW1-55-22-W4M in May 2014.

Common Name	Scientific Name
American Coot	<i>Fulica americana</i>
American Crow	<i>Corvus brachyrhynchos</i>
American Robin	<i>Turdus migratorius</i>
American Widgeon	<i>Anas americana</i>
Blue-winged Teal	<i>Anas discors</i>
Bonaparte's Gull	<i>Larus philadelphia</i>
Canada Goose	<i>Branta canadensis</i>
Boreal Chorus Frog	<i>Pseudacris triseriata</i>
Common Goldeneye	<i>Bucephala clangula</i>
Horned Grebe	<i>Podiceps auritus</i>
Mallard	<i>Anas platyrhynchos</i>
Northern Shoveler	<i>Anas clypeata</i>
Redwing Blackbird	<i>Agelaius phoeniceus</i>
Ring-billed Gull	<i>Larus delawarensis</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Song Sparrow	<i>Melospiza melodia</i>
Swainson's Hawk	<i>Buteo swainsoni</i>
Wood Frog	<i>Rana sylvatica</i>

6.7 Land Ownership Status

The title of the beds and shores of all naturally occurring rivers, streams, watercourses and lakes is vested in the Crown in right of Alberta (as per Section 3 (1) of the Public Lands Act).

In examining the historical aerial photographs (1978, 1996, 2005, 2008, 2010, 2011, 2013, and 2013), the 1:50,000 NTS maps, Fish and Wildlife Management Information Systems (2014), as well as the site visit, it appears that both Class IV wetlands are naturally occurring wetlands. As such, it is possible that the Crown would lay claim over both of these Class IV Wetlands.

A request to AESRD Water Boundaries to review the ownership of the wetlands within the development area was submitted on March 4, 2014 and at the time of drafting this report a response had not yet been received.

7.0 BYLAWS AND AREA STRUCTURE PLANS

7.1 *City of Fort Saskatchewan Land Use Bylaw No. C10-13*

The purpose of this bylaw is to regulate the use and development of lands and buildings within the City of Fort Saskatchewan.

As per Section 4.6.4, buildings shall be a minimum of 12.0m from the top of the water body bank, where the bank is less than 6.0m in height. It was noted that none of the wetlands within the project area had a defined bank (K. Bourgeois, per. comm.). Additionally, Section 4.6.7 states that vegetation within 35.0m of a water body shall not be removed if the removal of that vegetation will have a negative impact on those water bodies. Section 7.4 describes the need for industrial sites to include a minimum of one tree for each 3.0m of lot width planted adjacent to the public roadway frontage.

Additionally, as per Section 4.14, no storage or activity may be undertaken which, in the opinion of the Development Authority, constitutes a danger or annoyance to persons on the site, on a public property, or on a site adjacent to it. Section 4.15 describes the need to conform to all applicable local, provincial and federal air and water quality regulations and standards. These include: regulating odour, dust, fumes and gases which are noxious, toxic or corrosive, suspended solid or liquid particles; regulating erosion and sedimentation, storm drainage and runoff control, solid wastes and hazardous substances.

It is noted in the Josephburg Road North Industrial Area Structure Plan (2011) that the entire area is currently zoned as Industrial Reserve, but is agricultural and presently under cultivation. The district is “intended to reserve those areas of the municipality which are rural in character or land use but intended for future development until such time as a subdivision plan has been accepted in principle or approved for other specific uses not permitted in this district”. Lands that are adjacent to, but not within, the plan area and are within the City of Fort Saskatchewan are currently zoned as Light Industrial, Medium Industrial or Heavy Industrial (Josephburg ASP 2011).

7.2 *Josephburg Road North Industrial Area Structure Plan 2011*

The Josephburg Road North Industrial Area Structure Plan (2011) identifies the Class IV wetland in NW1-55-22-W4M to be an intermittent body of water. The 2011 ASP suggests that because of the impact that agriculture has had on this wetland, the wetland has low ecological value and would serve as a surficial run-off storage feature. The Class IV wetland in the north east corner of W12-55-22-W4M was described as a “Tree Stand” in the Josephburg Road Industrial ASP (2011). The tree stand has been deemed to be sustainable and permanent feature on the landscape and the 2011 ASP recommends that it be retained.

8.0 POTENTIAL ENVIRONMENTAL EFFECTS

The industrial development may cause alterations to the existing landscape in W12-55-22-W4M and NW1-55-22-W4M. Environmental effects on those landscapes may occur with the removal of the vegetation and alteration of the morphometry of the existing landscape. The development of infrastructure, buildings, parking lots, storm drainage systems, trails, sewage disposal facilities, waste disposal facilities and other anthropogenic developments (required and/or desired) in subdivision developments results in changes to natural landscapes. The current landscape remains mostly undeveloped, and retains numerous natural features. The nature and extent of the new subdivision development has been assessed according to the current development plan. The proposed development plan (current at the time of the drafting of this report) is provided in Appendix 14.7.

Some potential environmental effects that are noted, observed and measured from urban-like developments along watercourses, riparian areas, and in upland natural areas include but are not limited to:

1. Sedimentation from infrastructure, land clearing and construction activities;
2. Nutrient enrichment of eutrophic waters from fertilizer use;
3. Reduced water quality from enrichment or contaminants such as herbicides;
4. Direct wildlife mortalities (i.e. destruction of migratory birds);
5. Alteration, disruption and destruction of wildlife habitat due to use;
6. Altered wildlife habitats in upland and riparian areas due to clearing vegetation;
7. Increased disturbance of watercourse areas due to increased anthropogenic activity including potential alteration, disruption and/or destruction of potential forage and sport fish feeding, migratory and spawning habitat;
8. Inadequate instream flow needs;
9. Restricted fish passage;
10. Tree stand alteration and reduction of habitat for tree dependent species;
11. Encroachment of water surface areas thus reducing water-based environmental values, and altering historical drainage patterns;
12. Contaminant spills; and
13. Cumulative effects.

This specific project may alter the environment in the following manner.

- Treed areas may be altered through clearing, stripping, and grading activities.
- Wetlands may be altered/eliminated.

9.0 MITIGATION MEASURES

To address the potential effects that may occur on the aquatic ecosystem of the wetlands, watercourses, and surrounding terrestrial ecosystem as a result of land development activities, some mitigation, compensation and restoration strategies could be considered and/or may be required. Should changes to the engineering design and the construction plan be implemented then these measures should be reassessed and adjusted as necessary to ensure that all applicable potential effects have been mitigated.

9.1 *Surface Water Changes and Watercourse Alteration*

Release of surface water is a concern of the City of Fort Saskatchewan and Alberta Environment and Sustainable Resource Development (AESRD). Accordingly, the water quality and quantity will have to meet municipal, provincial and federal requirements for release of water into this watershed should release of water from the wetland dewatering be required.

Erosion and sediment control measures should be deployed and monitoring should be conducted to ensure the integrity of water quality in offsite areas. Any water being released into the environment must meet the standards of the Alberta Surface Water Quality Guidelines (1999, Draft 2013).

Further, a stormwater management plan is normally required for approval by AESRD.

No fish and/or fish habitat values were found on the property, and, as such, regulatory approvals associated with such aquatic resource alteration are not required.

9.2 *Wetland Alteration*

The elimination of the existing wetlands will be addressed with possible compensation of wetlands provisions under Alberta Government Policy and the Water Act. Since the wetlands that may be eliminated are classified within the White Area of the Province of Alberta, there will be need for compensation or application for regulatory approval for the elimination and/or alteration of all wetlands classified as Class II or greater. Various options for compensation are available including financial compensation coordinated through Alberta Environment and Sustainable Resource Development. If the wetlands are to be eliminated according to the development plan, a compensation plan would be required (Section 10.0).

9.3 *Construction Timing*

Scheduling of construction timing is recommended to minimize harmful effects on migratory nesting birds or other wildlife denning or nesting sites. The current timing window for construction restricts the removal of natural vegetation during the period from April 1 to August 31 unless there is an assessment of the landscape for nesting birds providing contrasting recommendations. Numerous bird species, most notably owls, nest within trees in Alberta outside of this timing window and in order to protect those species not covered under the Migratory Birds Convention Act it is recommended that nest assessments for owls at applicable sites are conducted prior to tree removal beginning on approximately February 15. As well,

prior to the alteration of natural vegetation, applicable landscapes should be surveyed for Canada geese nesting beginning on approximately March 20. As such, if construction is to occur from February 15 to August 31, a migratory bird survey should be conducted prior to clearing of vegetation and eliminating of wetlands, riparian areas and/or watercourses.

9.4 Construction Footprint

Minimizing the construction footprint is encouraged so as to minimize environmental effects on the adjacent natural landscapes.

9.5 Erosion and Sediment Control

Erosion and sediment control planning should be addressed for the construction and post-construction periods. Best Management Practices to minimize potential environmental effects such as those provided in the Erosion and Sediment Control Manual (Alberta Transportation 2011) or The City of Edmonton Erosion and Sedimentation Control Guide or municipal based relevant documentation or bylaws should be adhered to. Construction contractors may provide formal Erosion and Sediment Control Plans to the proponent for review prior to construction.

9.6 Revegetation

Re-vegetation of areas should follow requirements outlined by the City of Fort Saskatchewan Bylaw Land Use Bylaw C10-13 and the Alberta Transportation Design Bulletin No. 25 (Alberta Transportation 2005) for Central Parkland (Zone 5) which provides the following acceptable species for revegetation:

- Slender Wheat Grass, *Bromus anomalus* 25%
- Northern Wheat Grass, *Agropyron dasystachyum* 10%
- Fringed Brome (1), *Bromus ciliatus* 15%
- Green Needle Grass, *Stipa viridula* 15%
- Canada Wildrye, *Elymus canadensis* 10%
- Indian Rice Grass, *Orzyopsis hymenoides* 10%
- Nuttall's Alkali Grass, *Puccinellia nuttalliana* 10%
- Western Wheat Grass, *Agropyron smithii* 5%

Section 7.1 provides details of vegetation requirements associated with the bylaw.

9.7 Noxious Weeds

If prohibited noxious and/or noxious weeds are encountered during pre-construction or construction, they should be identified as such. If prohibited noxious and/or noxious weeds are present, the owner is to contact the Agriculture Fieldman to discuss control strategies. The local municipality has the legislative power to upgrade the status of a weed listed in the Act. Currently there are 46 species of prohibited noxious weeds and 29 species of noxious weeds listed in the Act.

No noxious weeds were identified within the study area during the site survey. However, as the area is cleared and opened up for development, it is likely that weeds may be introduced. If noxious weeds are observed, they should be controlled and/or removed as part of the Weed Control Act and as per the direction of the local Alberta Agricultural fieldperson.

10.0 WETLAND COMPENSATION PLAN

The area to be impacted by the current development is outlined in a summary plan in Appendix 14.7. It includes the following specific areas further identified and quantified on the summary plan:

- Roadway Construction Area
- Cofley Modyard Area
- Stormwater Pond & Topsoil and Clay Storage Area

The wetlands associated with these specific areas are identified in the summary plan in Appendix 14.7. Total wetland areas requiring compensation for alteration include:

- Roadway Construction Area, 0 ha
- Cofley Modyard, 1.1 ha
- Stormwater Pond & Topsoil and Clay Storage Area, 1.04 ha

Total wetland area requiring compensation, 2.14 ha

The development is unable to avoid these particular wetlands present. As such, two options were developed and are presented as possible compensation considerations for the elimination of the wetlands on this property.

Option 1. Compensation via Wetland Restoration Agency (Ducks Unlimited Canada)

This option provides financial compensation for altered wetlands through Ducks Unlimited Canada, an approved wetland restoration agency, to undertake wetland restoration as per their mandate with the Provincial government.

This option indicates that compensation should include all classes of wetlands (excluding repeatedly disturbed Class I wetlands and treed muskegs at this time) with all wetlands being treated equally with regard to compensation costs. The costs have been established on the basis of construction and securement of the lands and these costs are variable within the province and are updated periodically by the wetland restoration agency. For this project within the City of Fort Saskatchewan, the restoration costs amount to \$19,000/ha (C. Bishop, per. comm. 2014).

This option expects a 3:1 compensation rate for all the classes being altered.

Option 2. Wetland Replacement/Development

This option involves the construction of wetlands by the proponent that would replace those that are being altered. Depending upon the nature of the alteration being either an elimination versus an encroachment as well as the type of compensation, a plan could create a wetland at a minimum of a 3:1 ratio of the wetland being altered. The replacement objective is intended to create at a minimum three times the amount of

wetland that is being altered. This option may also be combined with a financial component that could result in a compensation plan that includes both financial and development aspects.

Proposed Selected Wetland Replacement Option

The proponent has selected the financial compensation option via a wetland restoration agency (Option 1).

As such, this wetland compensation option would pay Ducks Unlimited Canada \$121,980 plus GST as applicable based on an elimination of 6.42 ha (2.14 ha x 3) of wetland for the development area. Ducks Unlimited does not wish to debate quantities that are to be required and will only provide advice when requested (C. Bishop, per. comm. 2014).

The mandatory compensation expected by Alberta Environment is the 3:1 ratio (as indicated by Alberta Environment and Sustainable Resource Development personnel).

The Alberta Water Act Application Form, associated Alberta Environment and Sustainable Resources Development Wetland Impact Assessment Form and wetland classification system information have been attached in appendices 14.4, 14.5 and 14.6.

11.0 CONCLUSIONS AND RECOMMENDATIONS

The biophysical environmental assessment results in the following summarized findings.

1. The biophysical assessment was conducted for approximately 111.3 ha of land within W12-55-22-W4M and NW1-55-22-W4M.
2. The study area consists predominately of wetlands and cultivated agricultural fields.
3. A total of 67 wetlands were identified, classified and quantified within the study area.
4. The map and aerial photograph interpretation, watershed characteristics and the aquatic vegetation suggest that the Class IV wetland in NW1-55-22-W4M drains south toward a stand of willows, but does not drain into larger watercourses (Ross Creek or the North Saskatchewan River).
5. The Class IV wetland in the north east corner of SW12-55-22-W4M appears to be connected to a large wetland in NE12-55-22-W4M although it is bisected by a pipeline/utility corridor.
6. Approximately 42.5 ha of the study area is proposed for immediate development. The area consists of the Cofley Modyard, Roadway Construction Area and the Stormwater Pond & Topsoil and Clay Storage Areas. 2.14 ha of Class II, III and IV wetland areas (9 wetlands, 1 wetland encroachment) requiring compensation are associated with these development areas.

As such, the financial compensation rate for this area would be \$19,000/ha at a required 3:1 compensation rate for a total of \$121,980 plus GST compensation for the elimination of 6.42 ha (2.14 ha x 3) of Class II or greater wetlands.

The encroachment on the Class IV wetland compensation plan is not expected to impact the remaining functioning Class IV wetland area. A request to Water Boundaries, Alberta Public Lands was initiated in February 2014 to determine if the crown were to lay claim to this wetland area. At this time, a response has not yet been received. If the crown were to lay claim to the bed and shore of this wetland, additional regulatory approvals may be required from Public Lands.

7. The potential presence of amphibians may require mitigation to address effects during alteration/construction. During the spring assessment conducted on June 20, 2013, no rare or endangered organisms were observed, although Boreal Chorus Frogs and Wood Frogs were observed.
8. Noxious weeds were not observed during the field survey. If noxious weeds are observed, they should be controlled and/or removed as part of the Weed Control Act and as per the direction of the local Alberta Agricultural fieldperson.

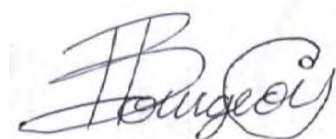
9. If natural habitats are to be cleared or disrupted, the Migratory Birds Convention Act must be addressed. Nesting birds are protected and hence, clearing of such lands must either avoid the nesting period (March 15-August 31) or have the area surveyed by a qualified biologist who would certify that such birds are not present in the areas to be cleared. If owls or other early nesters are known to be present in the area, on and after February 15, the location should be surveyed for their presence prior to clearing.
10. The release of water to offsite surface waters will require communication with the City of Fort Saskatchewan and AESRD with regard to storm water requirements and management under the Water Act.
11. To ensure that limited effects result from this development, some mitigation measures should be incorporated into the project construction plan as outlined in Section 9.0. These mitigation measures should be reassessed in the event that changes are made to the engineering design details.

12.0 LIMITATIONS AND CLOSURE

In conducting the assessment and rendering our conclusions, EnviroMak gives the benefit of its best judgment based on its experience and in accordance with generally accepted professional standards for this type of assessment in present time. This report was submitted with the best information to date and on the information provided. This report has been prepared for the exclusive use of the proponent/client. Any use which any other third party makes of this report, or any reliance on or decisions to be made on it, are the responsibility of such third parties. EnviroMak accepts no responsibility for damages, if any, suffered by any other third party as a result of decisions made or actions based on this report.

Please contact EnviroMak Inc. by telephone at (780) 425-2461 (office) or email to info@enviromak.com with any questions or concerns.

Sincerely,



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Attachments: Bibliography and Appendices

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14.0 APPENDICES

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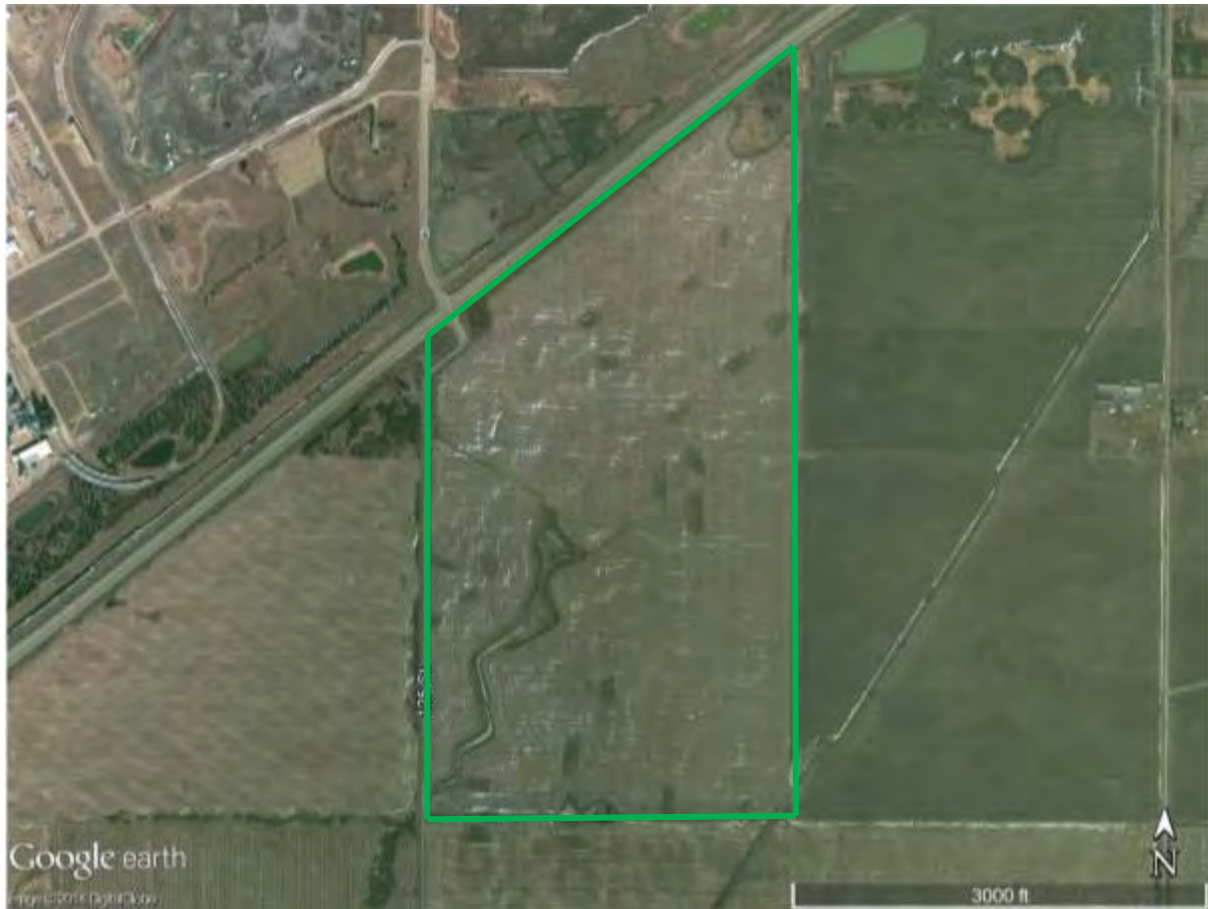


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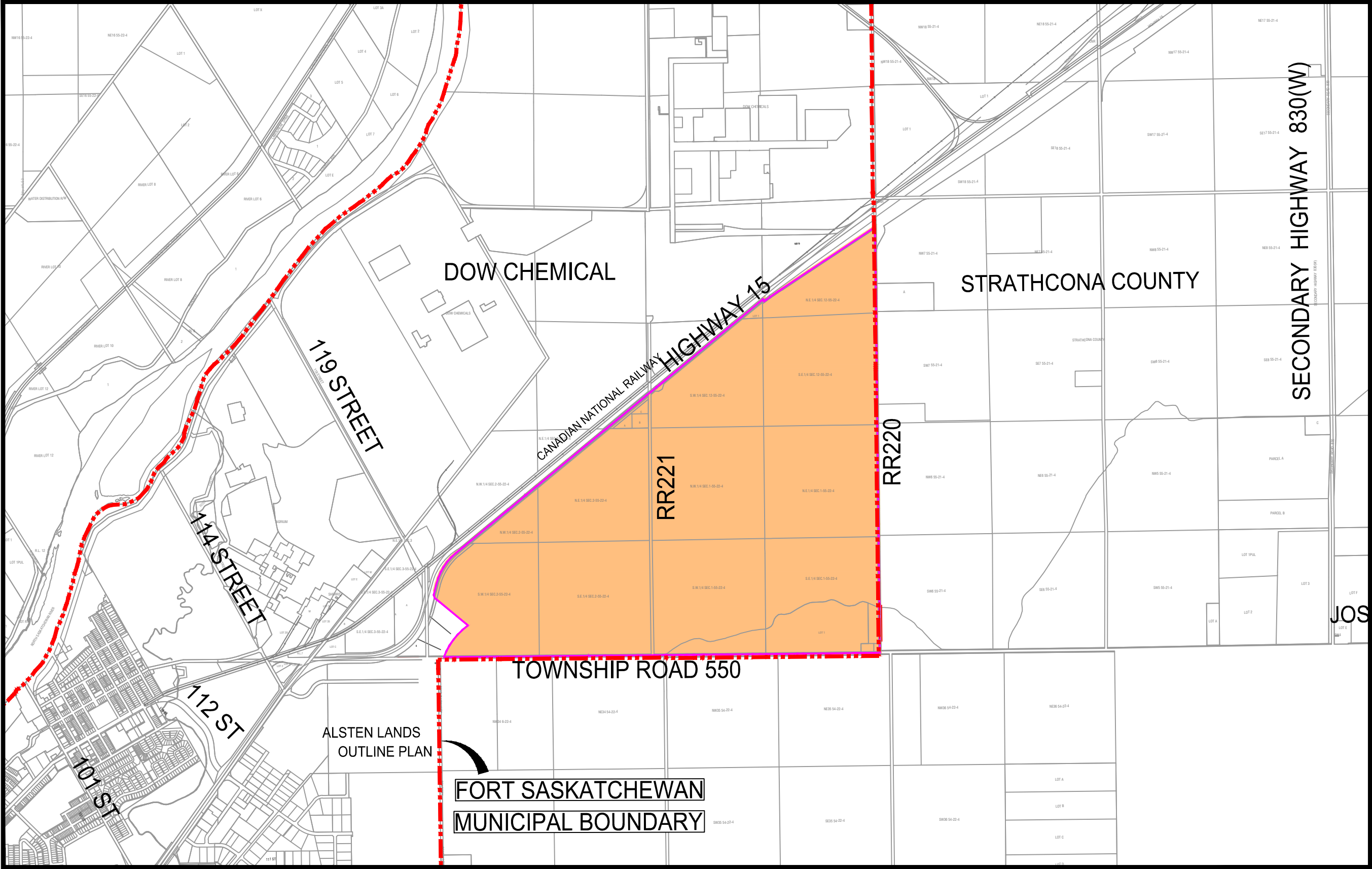
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14.3 Josephburg Road North Industrial Area Structure Plan

Figure 1.0
Plan Area



Josephburg Road North Industrial Area Structure Plan Bylaw C13-09

14.4 Alberta Water Act Application

Attached as a separate document/file.

14.5 Wetland Impact Assessment Form (Provincial Wetland Restoration/ Compensation Guide, Alberta Environment 2007)

Prepared by: EnviroMak Inc. Date of assessment: May 30, 2014

Wetland Characteristics

Water body name (if applicable): Unnamed Wetlands **Please see environmental report for details.**

Wetland area: 0.09 hectares – Location: NW1-55-22-W4M
Wetland area: 0.08 hectares – Location: NW1-55-22-W4M
Wetland area: 0.22 hectares – Location: NW1-55-22-W4M
Wetland area: 0.15 hectares – Location: NW1-55-22-W4M
Wetland area: 0.15 hectares – Location: NW1-55-22-W4M
Wetland area: 0.35 hectares – Location: NW1-55-22-W4M
Wetland area: 0.06 hectares – Location: NW1-55-22-W4M
Wetland area: 0.18 hectares – Location: NW1-55-22-W4M
Wetland area: 0.32 hectares – Location: SW12-55-22-W4M
Wetland area: 0.49 hectares – Location: SW12-55-22-W4M
Wetland area: 0.04 hectares – Location: SW12-55-22-W4M
Wetland area: 0.009 hectares – Location: SW12-55-22-W4M
Wetland area: 0.21 hectares – Location: SW12-55-22-W4M
Wetland area: 0.08 hectares – Location: SW12-55-22-W4M
Wetland area: 0.42 hectares – Location: SW12-55-22-W4M
Wetland area: 0.26 hectares – Location: SW12-55-22-W4M
Wetland area: 0.08 hectares – Location: SW12-55-22-W4M
Wetland area: 0.04 hectares – Location: SW12-55-22-W4M
Wetland area: 0.008 hectares – Location: SW12-55-22-W4M
Wetland area: 0.10 hectares – Location: SW12-55-22-W4M
Wetland area: 0.008 hectares – Location: SW12-55-22-W4M
Wetland area: 0.32 hectares – Location: SW12-55-22-W4M
Wetland area: 0.02 hectares – Location: SW12-55-22-W4M

Contributing drainage area: Unknown

Water Survey of Canada sub basin code: North Saskatchewan River Basin

*Note: The QWAES shall classify the wetland(s) by using **either** the Cowardin or Stewart and Kantrud Wetland Classification Systems.*

Cowardin Wetland Classification

Major class: _____ -
Sub class: _____ -
Water regime: _____ -
Water chemistry: _____ -

Stewart and Kantrud Wetland Classification

Class I Ephemeral ponds: 13 Class I Impacted Wetlands (Previously cultivated)
Class II Temporary ponds: 7 Class II Wetlands
Class III Seasonal ponds and lakes: 2 Class III Wetlands
Class IV Semi-permanent ponds and lakes: 1 Class IV Wetland (partial disturbance)
Class V Permanent ponds and lakes: _____
Class VI Alkali ponds and lakes: _____ -
Class VII Fen (alkaline bog) ponds: _____ -

Please see report for more details.

Riparian Area

Type: See Report Avg. width See Report m Total area 3.685 hectares

Surrounding land use: Natural x
Cropland X
Hay
Pasture
Industrial x
Residential
Other See report for additional details

Referenced site photos attached: Yes x No See report

Historical aerial photos attached: Yes x No

Site Observations

Waterfowl: Yes
Wetland dependent wildlife: yes
Fauna: no

Rare or endangered species: no

Other: _____

Wetland Function (Benefits):

Proposed Development:

Location and proposed development plan:

(Insert or attach a development plan drawing) – Please see report appendices and figures.

Development Description: Industrial development

Avoid impacts? Yes , if No X (Why?) Majority of wetland areas cannot be avoided—see report. Greater part of Class IV wetland is to be avoided

Minimize impacts? Yes , if No x (Why?) Change in land use expected

Wetland loss compensation? **See report**

Compensation Proposal: Please see report, appendices and figures. The thirteen Class I wetlands (total area 1.545ha) show historical disturbance through agricultural practice and should not require compensation.

14.6 Summary of Stewart and Kantrud (1971) Wetland Classification System

The Stewart and Kantrud (1971) system classifies wetland type based on seven vegetation zones that can be identified by characteristic species, evidence of salinity and the presence and depth of water:

- Wetland low prairie:** periodically flooded in spring but predominately a transition zone between upland and saturated zones, dominated by sedges and upland grasses, with snowberry and rose shrubs.
- Wet meadow:** rapidly drained, with periodic spring flooding; dominated by grasses, sedge and rushes.
- Shallow marsh:** retains water for much of the spring and early summer, dry by fall; depending on water depth, will have normal emergent vegetation, an open-water phase at high flood, natural drawdown emergent phase, and after prolonged dry periods, a drawdown bare-soil period.
- Deep marsh:** maintains surface water through spring and summer, frequently retaining water through fall and winter; in drought years, a drawdown phase and a natural drawdown emergent phase are present, otherwise both a normal emergent and an open-water phase with submerged aquatic plants are evident.
- Permanent open water:** found in ponds and lakes with stable water levels; submerged aquatic plants only.
- Intermittent alkali zone:** highly saline shallow water and salt flats; no emergent plants, and few submerged aquatic species.
- Fen (alkaline bog) zone:** surface water may be lacking, or may be present as seeps; mats of emergent vegetation (sedges, rushes).

Table A. Summary of wetland classification (Stewart and Kantrud 1971).

Class	Class Name	Deepest Vegetation Zone
Class I	Ephemeral Pond	Wetland-low prairie zone
Class II	Temporary Pond	Wet meadow zone
Class III	Seasonal Pond or Lake	Shallow-marsh zone
Class IV	Semi-permanent Pond or Lake	Deep-marsh zone
Class V	Permanent pond or Lake	Permanent open water zone
Class VI	Alkali Pond or Lake	Intermittent alkali zone
Class VII	Fen (Alkaline bog) Pond	Fen zone

14.7 Development Plan



ROADWAY CONSTRUCTION AREAS	WETLAND I.D.	ACTUAL WETLAND AREA (ha)	PROPOSED COMPENSATION AREA (ha)
CLASS I	29	0.18	0
CLASS I	41	0.32	0
	TOTAL	0.5	0



	CLASS I
	CLASS I-II
	CLASS II
	CLASS II-III
	CLASS III
	CLASS IV
	CONSTRUCTION BOUNDARY
	SWMF POND CONSTRUCTION BOUNDARY
	TOPSOIL AND CLAY STORAGE BOUNDARY
	COFLEY MOD YARD DEVELOPMENT BOUNDARY

[illegible]



APPENDIX D

Biophysical Assessment



Biophysical Assessment

**SW-, SE-, and NE-2-55-22-W4M; SW-12-55-22-W4M; and
NW- and SW-1-55-22-W4M
Fort Saskatchewan, Alberta**



For:

**Ms. Michaela Murray of
Durrance Projects Ltd.**

REVISION INDEX

ECOMARK Project No.: DURPR-07509-50577-0					
A	November 2, 2007	Issue for Review	AH	JMB	MP
Rev	Date	Description	Prepared	Checked	Approved



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LETTER OF TRANSMITTAL

November 2, 2007

Our Project Number: DURPR-07509-50577-0

Ms. Michaela Murray
Durrance Projects Ltd.
102, 10630 – 172 Street
Edmonton, Alberta, T5S 1H8

Dear Ms. Murray

**Re: Biophysical Assessment
SW-, SE-, and NE-2-55-22-W4M; SW-12-55-22-W4M; and NW- and SW-1-55-22-W4M
Fort Saskatchewan, Alberta**

We are pleased to present the above referenced Biophysical Assessment Report (Report) for you and Strathcona County's benefit and use in assessing the environmental integrity of the property known as SW-, SE-, and NE-2-55-22-W4M; SW-12-55-22-W4M; and NW- and SW-1-55-22-W4M, Fort Saskatchewan, Alberta.

This Report is based on a field reconnaissance, and records review, including Alberta Natural Heritage Information Centre (ANHIC), Access Natural History Database maintained by the Federation of Alberta Naturalists (FAM), Fish and Wildlife Management Information System (FWMIS), and Federal Species at Risk Act and Provincial Species at Risk Program, Soil Surveys, and Regional Groundwater Assessments.

The opinions expressed in this Report are solely those of Ecomark Ltd. This Report is furnished in our capacity as consultants to Durrance Projects Ltd. (Client) for the project described in this Report and do not necessarily reflect the viewpoint of the Client. The Report is written for the benefit and use of the Client only and may only be relied upon by the Client in connection with the Biophysical Assessment. Conditions assessed are valid to the date of visual assessment and limited by the information that was shared by the third parties involved. Liability is limited to the invoiced amount for the Report. This Report shall be valid for one month following the date of the Report. While every effort was made to confirm that the data collected from third parties is factual, complete and accurate, Ecomark Ltd. makes no guarantees or warranties whatsoever with respect to such data.

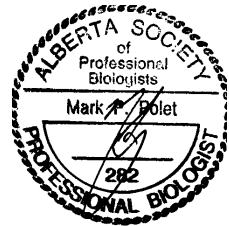
Yours sincerely,



Alicia Hamm, P. Biol.



Mark Polet, P. Biol.



Professional Seal

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1 Introduction

1.1 Scope

At the request of Ms. Michaela Murray of Durrance Projects Ltd., Ecomark Ltd. was retained to perform a biophysical assessment of the property known as SW-, SE-, and NE-2-55-22-W4M; SW-12-55-22-W4M; and NW- and SW-1-55-22-W4M, Fort Saskatchewan, Alberta. This assessment contains a records review, which includes:

- a) Alberta Natural Heritage Information Centre (ANHIC)
- b) Fish and Wildlife Management Information System (FWMIS)
- c) Federal *Species at Risk Act* and Provincial *Species at Risk Program*
- d) Soil Survey of Edmonton
- e) Regional Groundwater Assessment

This assessment also includes a field inspection, personal communications and conservation recommendations.

The property was inspected September 25, 2007.

1.2 Development Project Description

The City of Fort Saskatchewan presently zones the subject property as Industrial Reserve – Holding District (I-R) land use. It is proposed that the subject property be developed into a large industrial centre with four stormwater management ponds (Durrance, 2006).

2 Discussion

2.1 Study Area

2.1.1 Location

The subject property is located in SW-, SE-, and NE-2-55-22-W4M; SW-12-55-22-W4M; and NW- and SW-1-55-22-W4M, Fort Saskatchewan, Alberta. The total area of the site is nearly 960 acres (388.5 hectares). The property is presently used as cultivated, agricultural land, with the exception of some low-lying wet areas, hedgerows and an unnamed creek at the southeastern corner of the subject property.

Highway 15 runs along the northwestern boundary of the subject property and Township Road 550 runs along the southern boundary of the subject property. The DOW Chemical Industrial Complex is immediately north of Highway 15. The other surrounding properties are cultivated, agricultural land.

2.1.2 Climate and Physiographic Description

The subject property is located in the Central Parkland subregion of Alberta. Trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*) are common tree species in this subregion. The mean annual temperature for the Central Parkland subregion is 2 degrees Celsius. The average temperature between May and September is 13 degrees Celsius. The frost-free period is approximately 95 days. The mean annual precipitation in this subregion is between 350 millimeters and 450 millimeters. The majority of the precipitation accumulates between May and September (NRC, 2006).

2.2 Approach and Assessment Methods

A field inspection of the subject property was conducted September 25, 2007 and involved collecting vegetation information including dominant tree, dominant shrub and dominant grass species throughout the subject property. The field inspection focused on areas where productive and critical habitats were expected to occur. Evidence of wildlife (visual and wildlife tracks) was also detected on the subject property.

3 Assessment Results

3.1 Historical Air Photos

Air photos from 1950 to 2004 were observed using a stereoscope.

❖ 1950 AS132 #54 (1:40,000)

Subject Property: The subject property was predominately agricultural land with hedgerows at the quarter section boundaries. There were several farm buildings and an unnamed creek running through the southern half of SW-1-55-22-W4M. There were also buildings located at the southern portion of SE-2-55-22-W4M. There were wetland areas located in the northeast corner of SW-12-55-22-W4M; in the centre of NW-1-55-22-W4M; and the northeast corner of SE-2-55-22-W4M.

Surrounding Properties: The surrounding properties were agricultural land with a forested area directly north of Highway 15. There was a farmyard located in the quarter section directly south of SE-2-55-22-W4M.

❖ 1962 AS871 #125 (1:31,680)

Subject Property: There were several unidentified structures at the northern portion of NE-2-55-22-W4M. There were also several low-lying wet areas throughout the subject property.

Surrounding Properties: The DOW Chemical Industrial Complex was under development.

❖ 1967 AS978 #197 (1:31,680)

Subject Property: There were two driveways and several buildings located directly north of NE-2-55-22-W4M.

Surrounding Properties: Parts of the forested area north of Highway 15 were removed for further development of the DOW Chemical Industrial Complex.

❖ 1972 AS1207 #151 (1:31,680)

Subject Property: There was shrubbery located along a drainage area at the northeast corner of SE-2-55-22-W4M and a man-made drainage area from Highway 15 across the western half of SW-2-55-22-W4M. The wetland area in NW-1-55-22-W4M was partially cultivated.

Surrounding Properties: There were no significant changes to the surrounding properties.

❖ 1976 AS1547 #289 (1:20,000)

Subject Property: The wetland area in NW-1-55-22-W4M was cultivated agricultural land.

Surrounding Properties: There were no significant changes to the surrounding properties.

❖ 1981 AS2399 #64 (1:25,000)

Subject Property: There were three dominant wetland areas on the subject property including the northeast corner of SW-12-55-22-W4M, the centre of NW-1-55-22-W4M and the northeast corner of SE-2-55-22-W4M. The shrubbery located along the drainage area at the northeast corner of SE-2-55-22-W4M expanded into a willow thicket.

Surrounding Properties: There were no significant changes to the surrounding properties.

❖ 1985 AS3229 #51 (1:25,000)

Subject Property: There was a visible hedgerow along Range Road 221. The wetland area at SW-12-55-22-W4M appeared to be part of a larger wetland complex directly east of the subject property.

Surrounding Properties: The DOW Chemical Industrial Complex expanded.

❖ 1992 AS4261 #044 (1:20,000)

Subject Property: The wetlands at NW-1-55-22-W4M and SW-2-55-22-W4M were cultivated agricultural land. Only the wetland area at SW-12-55-22-W4M appeared to contain water and wetland vegetation. The buildings were

removed north of NE-2-55-22-W4M and the site was overgrown with trees and shrubbery.

Surrounding Properties: There were no significant changes the surrounding properties.

❖ 1996 AS4742 #6 (1:20,000)

Subject Property: The wetland area at NW-1-55-22-W4M appeared to drain towards the willow thicket at the northeast corner of SE-2-55-22-W4M. The wetland area at SW-2-55-22-W4M contained very little water and was partially cultivated.

Surrounding Properties: There were no significant changes the surrounding properties.

❖ 2001 ED2001-2 #80 (1:20,000)

Subject Property: The wetland areas at SW-12-55-22-W4M and SW-2-55-22-W4M appeared dry. The wetland area at NW-1-55-22-W4M was cultivated agricultural land.

Surrounding Properties: There were no significant changes the surrounding properties.

❖ 2004 AS5301 #148 (1:20,000)

Subject Property: The wetland areas at SW-12-55-22-W4M, SW-2-55-22-W4M and NW-1-55-22-W4M appeared dry.

Surrounding Properties: There were no significant changes the surrounding properties.

3.2 Field Reconnaissance, Sampling and Surveys

The field inspection identified five vegetative features that occurred on or near the subject property that may be affected by development of the subject property. The features included an unnamed creek at the southern half of SW-1-55-22-W4M, three seasonal and semi-permanent wetland areas, hedgerows along quarter section boundaries, a willow thicket at the northeast corner of SE-2-55-22-W4M and agricultural land.

The unnamed creek at the southern half of SW-1-55-22-W4M ran from the quarter section east of the subject property into the drainage ditch along Township Road 550. The unnamed creek was dry at the time of inspection and likely only contains water following snowmelt and following heavy rain events.

The field inspection identified two seasonal wetland areas located at the centre of NW-1-55-22-W4M and the northeast corner of SE-2-55-22-W4M. The wetland areas were located in topographically defined depressions and consisted of a wetland-low-prairie zone, wet-meadow zone and a shallow-marsh zone. At the time of inspection, the shallow-marsh zones were exposed mudflats. Based on the Stewart and Kantrud Wetland

Classification System, these wetland areas are classified as Class III seasonal wetland areas (Stewart and Kantrud, 1971). The wetland area at NW-1-55-22-W4M, in contrast, appeared to lack surface inlets and outlets. The amount of water in both wetland areas is related to the amount of surface flow into the wetland areas and water losses by evaporation (NWWG, 1997). Both wetland areas were heavily impacted by agricultural development.

The wetland area at SW-12-55-22-W4M was part of a larger wetland complex located in the quarter section east of the subject property. The wetland area on subject property was dry and consisted of bare ground, restricted weeds, and mixed grasses. There was a permanent-open-water zone located in the quarter section directly east of the subject property. Based on the Stewart and Kantrud Wetland Classification System, this wetland area is classified as a Class IV semi-permanent wetland area (Stewart and Kantrud, 1971).

The air photo review indicated that the sizes of the seasonal and semi-permanent wetland areas on the subject property varied over time. The average size of the wetland areas on the subject property is summarized in Table 1.

Table 1: Vegetative Features on the Subject Property

ID	Wetland Type	Wetland Class	Location	Average Size	
				Acres	Hectares
W1	Seasonal	Class III	SW-2-55-22-W4M	6.96	2.82
W2	Seasonal	Class III	NW-1-55-22-W4M	10.18	4.12
W3	Semi-Permanent	Class IV	SW-12-55-22-W4M	6.75	2.73

The hedgerows along the quarter section boundaries were composed of trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*) and shrubbery. The willow thicket located along the drainage area at the northeastern corner of SE-2-55-22-W4M predominately consisted of willow shrubs (*Salix* spp.) and mixed grasses. The air photo review indicates that the average size of the hedgerows is 6.60 hectares (16.30 acres). All other areas were cultivated, agricultural land.

3.3 Topography

The subject property is flat to gently undulating, with minor variations in elevation throughout the subject property. Topography varies between 580 and 780 meters above sea level in the region, generally sloping downwards towards the North Saskatchewan River. The subject property is approximately 620 meters above sea level (hcl, 2001).

3.4 Geology

3.4.1 Surface Geology

The surface deposits on the subject property are glaciolacustrine sediments deposited by a large pre-glacial lake known as Lake Edmonton. The deposits generally consist of sand, silt and clay with minor pockets of coarse sands and gravels (Alberta Research, 1972).

3.4.2 Bedrock Geology

The bedrock geology on the subject property is of the Late Cretaceous stage. The bedrock is of the Oldman Formation; the upper part of the Belly River Group. The formation has a maximum thickness of 120 meters and consists of continental deposits, sandstone, siltstone, shale and coal (hcl, 2001).

3.5 Hydrology

3.5.1 Surface Water

There were several low-lying areas on the subject property that consisted of bare soil, canola crop, slough grass (*Beckmannia syzigachne*) and Canada thistle (*Cirsium arvense*). These low-lying areas likely contained water following snowmelt and thus were not seeded in spring due to wet soil conditions.

The field inspection also identified a man-made drainage area along the western portion of SW-2-55-22-W4M. The air photo review indicates that the drainage area was dug out sometime between 1967 and 1972. At the time of inspection, the man-made drainage was dry and contained cattails (*Typha latifolia*), slough grass (*Beckmannia syzigachne*) and fowl manna grass (*Glyceria striata*). Based on the types of vegetation, there is likely enough surface water throughout the growing season in the man-made drainage to promote the growth of aquatic vegetation.

Based on the air photo review, the wetland area at NW-1-55-22-W4M appeared to be drain southwest towards the willow thicket at SE-2-55-22-W4M. Agricultural development throughout the subject property has removed any other evidence that the seasonal and semi-permanent wetland areas, along with the low-lying areas are linked to the regional drainage system.

3.5.2 Groundwater

Groundwater near the subject property typically has total hardness concentrations above 200 milligram per liter and total dissolved solid levels ranging from 165 to 1700 milligram per liter. Data in Strathcona County suggests that groundwater contained in the surficial deposits range from calcium-magnesium bicarbonate or calcium-magnesium sulphate to sodium-bicarbonate or sodium-sulphate type. Groundwaters from both upper

bedrock aquifers and surficial aquifers in the region exceed water quality guidelines for total dissolved solids and sodium concentrations (hcl, 2001).

The Alberta Environment Groundwater System was searched for any registered water wells on the subject property. According to the water well drilling reports, there was record of a domestic water well located at SW-1-55-22-W4M and an industrial water well located at 2-55-22-W4M. It is unknown if the industrial water well is located on the subject property. In the adjoining sections, there was record of an industrial water well located at NW-2-55-22-W4M and a domestic water well located at SE-1-55-22-W4M (Appendix 1).

It appears that the water wells in the immediate area of the subject property were completed in bedrock aquifers. The depths of water wells ranged from 43 meters to 70 meters and the non-pumping static levels ranged from 8 meters to 9 meters below ground surface. According to the lithology description of the water well located in section 2-55-22-W4M, there was clay over sand and gravel, gravelly coal, sandstone, shale and water bearing sandstone (Appendix 1).

3.6 Soil

The subject property is located in the Central Parkland subregion of Alberta. Black and Dark Brown Chernozems commonly occur under grassland vegetation and Dark Gray Chernozems and Luvisolics occur under moister aspen stands. The surficial deposits are generally ground moraine (NRC, 2006).

Soils found on the subject property belong to one of two local soil series: the Malmo silty clay loam, or the Angus Ridge loam. The Angus Ridge loam is an Orthic Black Chernozem developed on glacial till, whereas the Malmo silty clay loam is an Eluviated Black Chernozem developed on slightly saline lacustrine sediments. The underlying tills are sometimes found within one meter of the surface, but it is more often found at depths greater than 1.5 meters. A sand layer may separate the lacustrine clays from the till (Bowser *et al.*, 1962).

Due to the gently undulating topography found on the subject property, the Malmo Series soils are generally found in low-lying areas. The Angus Ridge soils are more commonly found in upland areas (Bowser *et al.*, 1962). Soils found on the subject property are considered medium to high agricultural quality with medium to high water storage capacity (Bowser *et al.*, 1962).

Table 2: Rare Plant Species of Concern Compiled from Alberta Natural Heritage Information Centre (ANHIC)

Common Name	Scientific Name	Provincial Status	Global Status
Aloe-like rigid screw moss	<i>Alonia rigida</i>	S2	G3G5
N/A	<i>Brachythecium acutum</i>	SU	GNRQ
N/A	<i>Brachythecium plumosum</i>	S2	G5
N/A	<i>Conardia compacta</i>	S2	G3G5
Cushion moss	<i>Dicranum ontariense</i>	S1	G4G5
N/A	<i>Entodon concinnus</i>	S2	G4G5
N/A	<i>Entodon schleicheri</i>	S1	G3G5
N/A	<i>Leskea gracilescens</i>	S1	G5
N/A	<i>Leskea obscura</i>	S1	G5
Bladder-cap moss	<i>Physcomitrium hookeri</i>	S1	G2G4
N/A	<i>Rhodobryum ontariense</i>	S2	G5
Flagon-fruited splachnum	<i>Splachnum ampullaceum</i>	S2	G5
N/A	<i>Thuidium philibertii</i>	S1S2	G5
N/A	<i>Bryohaplocladium virginianum</i>	S1	G5
N/A	<i>Physconia isidiigera</i>	S2	G3G4
Starburst lichen	<i>Xanthoria Montana</i>	SNR	
N/A	<i>Phaeophyscia cernohorskyi</i>	S1	G4G5
N/A	<i>Physcia dimidiata</i>	S1	G5?
N/A	<i>Peltigera evansiana</i>	S2S3	G4
Herriot's sagewort	<i>Artemisia tilesii</i>	S2	G5
Flat-topped white aster	<i>Aster umbellatus</i>	S2	G5
False dragonhead	<i>Physostegia ledinghamii</i>	S2	G3?
Long-leaved bluets	<i>Hedyotis longifolia</i>	S2	G4G5
Clammy hedge-hyssop	<i>Gratiola neglecta</i>	S2S3	G5
Crowfoot violet	<i>Viola pedatifida</i>	S2	G5
Back's sedge	<i>Carex backii</i>	S2	G4
N/A	<i>Panicum wilcoxianum</i>	S1	G5
Canadian rice grass	<i>Oryzopsis Canadensis</i>	S1	G5
Field grape fern	<i>Botrychium campestre</i>	S1	G3G4
N/A	<i>Botrychium spathulatum</i>	S2	G3

3.7 Vegetation

The Alberta Natural Heritage Information Centre (ANHIC) was requested to provide information on rare plant occurrences in Twp-55-22-W4M. They report 30 rare plant occurrences in the townships (Table 2). It is unknown whether any of these rare plant species occur on the subject property.

The dominant vegetative species found in the unnamed creek at the southern half of SW-1-55-22-W4M included balsam poplar (*Populus balsamifera*), willow (*Salix* spp.), prickly rose (*Rosa acicularis*), clover (*Trifolium hybridum*), Canada thistle (*Cirsium arvense*), scentless chamomile (*Matricaria maritima*), stinkweed (*Thlaspi arvense*), reed canary grass (*Phalaris arundinacea*), fescue (*Festuca* spp.), Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*) and foxtail barley (*Hordem jubatum*).

The dominant vegetative species found in the seasonal wetland areas included cattails (*Typha latifolia*), reed canary grass (*Phalaris arundinacea*), slough grass (*Beckmannia syzigachne*), fowl manna grass (*Glyceria striata*), fescue (*Festuca* spp.), brome (*Bromus* spp.), foxtail barley (*Hordem jubatum*), fireweed (*Epilobium angustifolium*) and mixed sedges (*Carex* spp.). The dominant vegetative species found in the semi-permanent wetland area at the northeast corner of SW-12-55-22-W4M included Canada thistle (*Cirsium arvense*), clover (*Trifolium hybridum*), alfalfa (*Medicago sativa*), fireweed (*Epilobium angustifolium*), yarrow (*Achillea millefolium*), bluejoint (*Calamagrostis canadensis*) and brome (*Bromus* spp.).

The dominant vegetative species found in the hedgerows and willow thicket included trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), willow (*Salix* spp.), raspberry (*Rubus idaeus*), gooseberry (*Ribes* spp.), stinkweed (*Thlaspi arvense*), Bicknell's geranium (*Geranium bicknellii*), Canada thistle (*Thlaspi arvense*), bluejoint (*Calamagrostis canadensis*) and brome (*Bromus* spp.).

3.8 Wildlife

3.8.1 Birds

Bird occurrence data for the subject property and surrounding areas was requested from the provincial Fish and Wildlife Management Information System (FWMIS) for Twp-55-22-W4M and weaselhead.org. The list of bird occurrences is available in Table 3.

At the time of inspection, song sparrows (*Melospiza melodia*), black-billed magpies (*Pica hudsonia*), American crows (*Corvus brachyrhynchos*), ruffed grouse (*Bonasa umbellus*) and red-tailed hawk (*Buteo jamaicensis*) were observed on the subject property.

Table 3: Potential Bird Species Compiled from Fish and Wildlife Management Information System (FWMIS) and Weaselhead.org

Common Name	Scientific Name	Provincial Status	Federal Status
American white pelican	<i>Pelecanus erythrorhynchos</i>	Sensitive	Not at Risk
Great egret	<i>Ardea alba</i>	Accidental	Not at Risk
Canada goose	<i>Branta canadensis</i>	Secure	Not at Risk
Mallard	<i>Anas platyrhynchos</i>	Secure	Not at Risk
Blue-winged teal	<i>Anas discors</i>	Secure	Not at Risk
Bufflehead	<i>Bucephala albeola</i>	Secure	Not at Risk
Hooded merganser	<i>Lophodytes cucullatus</i>	Secure	Not at Risk
Franklin's gull	<i>Larus pipixcan</i>	Secure	Not at Risk
Peregrine falcon	<i>Falco peregrinus</i>	At Risk	Special Concern
Northern goshawk	<i>Accipiter gentilis</i>	Sensitive	Not at Risk
Cooper's hawk	<i>Accipiter cooperii</i>	Secure	Not at Risk
Swainson's hawk	<i>Buteo swainsoni</i>	Sensitive	Not at Risk
Red-tailed hawk	<i>Buteo jamaicensis</i>	Secure	Not at Risk
Great horned owl	<i>Bubo virginianus</i>	Secure	Not at Risk
Northern saw-whet owl	<i>Aegolius acadicus</i>	Secure	Not at Risk
Short-eared owl	<i>Asio flammeus</i>	May Be At Risk	Special Concern
Long-eared owl	<i>Asio otus</i>	Secure	Not at Risk
Gray partridge	<i>Perdix perdix</i>	Exotic	Not at Risk
Ring-necked pheasant	<i>Phasianus colchicus</i>	Exotic	Not at Risk
Ruffed grouse	<i>Bonasa umbellus</i>	Secure	Not at Risk
Chukar	<i>Alectoris chukar</i>	Exotic	Not at Risk
Greater yellowlegs	<i>Tringa melanoleuca</i>	Secure	Not at Risk
Hairy woodpecker	<i>Picoides villosus</i>	Secure	Not at Risk
Northern flicker	<i>Colaptes auratus</i>	Secure	Not at Risk
Pileated woodpecker	<i>Dryocopus pileatus</i>	Sensitive	Not at Risk
Common raven	<i>Corvus corax</i>	Secure	Not at Risk
American crow	<i>Corvus brachyrhynchos</i>	Secure	Not at Risk
Black-billed magpie	<i>Pica hudsonia</i>	Secure	Not at Risk
Varied thrush	<i>Ixoreus naevius</i>	Secure	Not at Risk
Bohemian waxwing	<i>Bombycilla garrulus</i>	Secure	Not at Risk
Yellow-rumped warbler	<i>Dendroica coronata</i>	Secure	Not at Risk
Red-winged blackbird	<i>Agelaius phoeniceus</i>	Secure	Not at Risk
Purple finch	<i>Carpodacus purpureus</i>	Secure	Not at Risk
House finch	<i>Carpodacus mexicanus</i>	Secure	Not at Risk
Song sparrow	<i>Melospiza melodia</i>	Secure	Not at Risk

3.8.2 Fish

According to Daryl Watters, Fisheries Biologist with Alberta Sustainable Resource Development, there were no current or historical records of fish presence within water bodies on or near the subject property. The nearest fish-bearing water bodies are Ross Creek and the North Saskatchewan River southwest of the subject property (Watters, 2007, Email Comm.). There was no suitable fish habitat detected on or near the subject property.

3.8.3 Reptiles and Amphibians

The provincial Fish and Wildlife Management Information System (FWMIS) were requested to report any occurrence records of reptiles and amphibians for Twp-55-22-W4M. Based on FWMIS occurrence records, species distribution and wildlife status reports, there are seven (7) potential reptile and amphibian species found on or near the subject property (Table 4).

At the time of inspection, there was no evidence of reptiles or amphibians detected on the subject property.

Table 4: Potential Reptile and Amphibian Species Compiled from Species Distribution and Wildlife Status Reports (SRD, 2007)

Common Name	Scientific Name	Provincial Status	Federal Status
Boreal chorus frog	<i>Pseudacris maculata</i>	Secure	Not at Risk
Canadian toad	<i>Bufo hemiophrys</i>	May Be At Risk	Not at Risk
Northern leopard frog	<i>Rana pipiens</i>	At Risk	Special Concern
Red-sided garter snake	<i>Thamnophis sirtalis</i>	Sensitive	Not At Risk
Tiger salamander	<i>Ambystoma tigrinum</i>	Secure	Not At Risk
Western toad	<i>Bufo boreas</i>	Sensitive	Special Concern
Wood frog	<i>Rana sylvatica</i>	Secure	Not At Risk

3.8.4 Invertebrates

There are likely a number of common invertebrates that inhabit the subject property including earthworms, snails, ants, butterflies, moths, grasshoppers, bees and wasps, spiders, ground beetles, caddisflies and mosquitoes (SRD, 2007). Weaselhead.org reports occurrences of Milbert's tortoiseshell (*Nymphalis milberti*), ichneumon wasp family (*Ichneumonidae* family) and aspen leafroller (*Pseudexentera oregonana*) near the subject property (Weaselhead, 2007).

At the time of inspection, there were no specific invertebrate species observed on the subject property.

3.8.5 Mammals

The provincial Fish and Wildlife Management Information System was requested to report any wildlife occurrence records for Twp-55-22-W4M. They did not report any mammal occurrences for the township. Based on species distribution, there are eighteen (18) species that could potentially occur on the subject property (Table 5).

At the time of inspection, evidence of coyote (*Canis latrans*), red fox (*Vulpes vulpes*), moose (*Alces alces*), deer (*Odocoileus* spp.), muskrat (*Ondatra zibethicus*) and weasel (*Mustela* spp.) was detected in the wetland areas on the subject property.

Table 5: Potential Mammal Species on the Subject Property Compiled from Species Distribution and Wildlife Status Reports (SRD, 2007)

Common Name	Scientific Name	Provincial Status	Federal Status
Beaver	<i>Castor canadensis</i>	Secure	Not at Risk
Muskrat	<i>Ondatra zibethicus</i>	Secure	Not at Risk
Porcupine	<i>Erethizon dorsatum</i>	Secure	Not at Risk
Woodchuck	<i>Marmota monax</i>	Secure	Not at Risk
White-tailed jackrabbit	<i>Lepus townsendii</i>	Secure	Not at Risk
Snowshoe hare	<i>Lepus americanus</i>	Secure	Not at Risk
Weasel	<i>Mustela</i> spp.	Secure	Not at Risk
Red squirrel	<i>Tamiasciurus hudsonicus</i>	Secure	Not at Risk
Striped skunk	<i>Mephitis mephitis</i>	Secure	Not at Risk
Coyote	<i>Canis latrans</i>	Secure	Not at Risk
Red fox	<i>Vulpes vulpes</i>	Secure	Not at Risk
Little brown bat	<i>Myotis lucifugus</i>	Secure	Not at Risk
Silver-haired bat	<i>Lasionycteris noctivagans</i>	Secure	Not at Risk
Long-legged bat	<i>Myotis volans</i>	Secure	Not at Risk
Northern long-eared bat	<i>Myotis septentrionalis</i>	May Be At Risk	Not at Risk
Deer spp.	<i>Odocoileus</i> spp.	Secure	Not at Risk
Moose	<i>Alces alces</i>	Secure	Not at Risk
Vole	<i>Microtus</i> spp.	Secure	Not at Risk

3.8.6 Rare, Threatened and Endangered Species

Table 2 identified eleven (11) provincially ranked plant species at risk with fewer than five individuals or occurrences (S1) in the province located in the township. The majority of these S1-ranked plant species were moss and lichen species observed on native sod, steep slopes, forested areas or riparian areas along the North Saskatchewan River (Rintoul, 2007, Email Comm.). Based on these habitat requirements, it is unlikely that any of these S1-ranked species occur on the subject property.

Table 3 identified six (6) bird species of concern that may occur on or near the subject property. Based on the site inspection and species habitat requirements, the short-eared owl (*Asio flammeus*) has the greatest potential of the birds listed to occur on the subject property. The short-eared owl typically occupies areas where prey (*i.e.* voles or lemmings) is abundant and is known to nest on the ground in stubble fields near wetland areas (Clayton, 2000). Although the subject property offers some of these habitat features, it is unlikely that the subject property provides critical, quality habitat for this species.

Table 4 identified four (4) herptile species of concern that may occur on or near the subject property. The wetland areas offer limited habitat for these species because of its lack of connectivity to larger wetland complexes. The semi-permanent wetland area at SW-12-55-22-W4M may offer a potential breeding site for herptile species; however dispersal will likely be unsuccessful.

Table 5 identified the northern long-eared bat (*Myotis septentrionalis*) as the only mammal species provincially listed as “May Be At Risk”. Based on the site inspection and habitat requirements, it is unlikely that the subject property offers any critical habitat features for this species.

4 Discussion

4.1 Creek

The field inspection and air photo review identified an unnamed creek at the southern half of SW-1-55-22-W4M that ran from the quarter section east of the subject property into the drainage ditches along Township Road 550. The unnamed creek was dry at the time of inspection and likely only contains water following snowmelt and following heavy rain events.

The records review and field inspection indicate that the unnamed creek is not suitable fish habitat. Nonetheless, the unnamed creek manages surface drainage, acts as a corridor for wildlife and promotes biological diversity. The unnamed creek is also considered crown land as it has a defined bed and channel. Thus, an Alberta Sustainable Resource Development Public Lands Officers must approve any disruption or alteration of this water feature pursuant to the *Public Lands Act*.

4.2 Wetland Areas

The field inspection and air photo review identified two seasonal wetland areas located at the centre of NW-1-55-22-W4M and the northeast corner of SE-2-55-22-W4M, and one semi-permanent wetland located at the northeast corner of SW-12-55-22-W4M. The wetland areas were situated in topographically defined depressions. The amount of water in these wetland areas was likely related to the amount of surface flow into the wetland areas and water losses by evaporation (NWWG, 1997).

Although the wetland areas on the subject property did not contain any water at the time of inspection, they may provide suitable *seasonal* habitat for wildlife. The field inspection identified evidence of several mammal species in the wetland areas on the subject property. Seasonal and semi-permanent wetland areas are typically diverse in vegetation and are preferred by some nesting bird species. Wetland areas that are repeatedly impacted by agricultural activities like the wetland areas on the subject property, however, often result in the growth of weedy vegetation, which are unappealing to nesting birds (Kantrud and Stewart, 1984).

Amphibians typically prefer permanent and semi-permanent wetland areas that contain water until late summer for breeding habitat (SRD, 2003). Moreover, amphibians rely on unfragmented habitats for dispersal and connectivity to summer feeding areas and overwintering habitat. Agricultural development has removed any evidence that the seasonal and semi-permanent wetland areas are linked to the regional drainage system. Thus, dispersal of amphibian species on the subject property will likely be unsuccessful.

The average sizes of the wetland areas over time are listed in Table 1. Although the wetland areas on the subject property do not provide high quality habitat for wetland dependent wildlife, the water features are naturally occurring wetlands and any loss or development of the seasonal and semi-permanent wetlands will likely require appropriate wetland compensation pursuant to the *Water Act* (AENV, 2007).

4.3 Hedgerows and Willow Thicket

The field inspection identified hedgerows along the quarter section boundaries and a willow thicket at the northeast corner of SE-2-55-22-W4M. The hedgerows consisted of deciduous trees and shrubbery and the willow thicket consisted of willow shrubs and mixed grasses.

Hedgerows can be valuable habitat for birds and small mammals in agricultural and urban areas. Hedgerows promote habitat connectivity for small mammals (Tattersall *et al.*, 2002) and provide habitat for bird species (Macdonald and Johnson, 1995). Studies have shown that the presence of hedgerows in between forested areas can increase growth rates in small mammal populations (Fahrig and Merriam, 1985), as well as provide critical nesting and feeding habitat for songbirds and other bird species that prefer forest edge habitats (Rempel, 2007).

The value of hedgerows to wildlife depends on its age, structure and composition. Mature hedgerows with a variety of woody plant species and heights ranging from two to three meters provide the greatest level of wildlife diversity (Macdonald and Johnson, 1995).

Although, hedgerows promote biological diversity in agricultural areas, there is little ecological difference between hedgerows and small patches of forested areas to wildlife (Tattersall *et al.*, 2002). Hedgerows, willow thickets or small patches of forested areas should be maintained to promote biological diversity in urban settings, where

possible. Removal of forested areas on the subject property should be avoided during bird nesting seasons (April 15 to August 15).

4.4 Agricultural Land

The majority of the subject property was cultivated agricultural land. At the time of inspection, the agricultural land contained barley crop with good growth and no signs of stressed vegetation. There was clover (*Trifolium hybridum*), Canada thistle (*Cirsium arvense*), stinkweed (*Thlaspi arvense*), timothy (*Phleum pratense*) and foxtail barley (*Hordem jubatum*) located along the edges of the cropland. The field inspection also identified several low-lying areas that consisted of bare soil, canola crop and Canada thistle (*Cirsium arvense*). It appeared that the low-lying areas contained water following snowmelt and thus were not seeded in spring due to wet soil conditions.

The former cultivated agricultural land may offer suitable habitat for the crowfoot violet (*Viola pedatifida*) and Herriot's sagewort (*Artemisia tilesii*), as they typically occupy prairie grasslands and open woods (Moss, 1983). However, restricted weeds likely out compete any potential rare plant species that may occur on the subject property. Similarly, the presence of restricted weeds on the subject property and agricultural activity limits its usefulness to wildlife. Although the subject property offers potential habitat for "Sensitive"-listed bird species like the short-eared owl (*Asio flammeus*), it is unlikely that the subject property provides high quality habitat for this species.

5 Conservation Recommendations

The most valuable vegetative features on or near the subject property were the unnamed creek at the southern half of SW-1-55-22-W4M, the three seasonal and semi-permanent wetland areas on the subject property and the hedgerows along the quarter section boundaries and willow thicket at the northeast corner of SE-2-55-22-W4M. The unnamed creek is not expected to be directly impacted by development of the subject property (Durrance, 2006) and should continue to manage surface drainage, act as a wildlife corridor and promote biological diversity on the subject property.

The wetland areas on the subject property were heavily impacted by agricultural development and were not unique or critical wildlife habitat. Nonetheless, there are still benefits in maintaining wetland areas within urban industrial settings. Wetlands maintain biodiversity, provide habitat for migratory birds and waterfowl, filters water resources, acts as storm water retention areas and provide valuable recreational opportunities for the public. For these reasons, it is recommended that the wetland area be retained, where practical or replaced with a constructed wetland area.

Studies have shown that constructed wetland areas can resemble natural occurring wetland areas within ten years following construction (Spieles *et al.*, 2006). The success of constructed wetlands depends on its size, suitability, and connectivity to surrounding habitats (Lehtinen and Galatowitsch, 2001). It is recommended that any impacts to the semi-permanent wetland area at the northeast corner of SW-12-55-22-W4M be avoided, as it is connected to a larger wetland area in the quarter section east of the subject property. If impacts to the seasonal wetland areas cannot be avoided or minimized, the seasonal wetland areas should be replaced with one large naturalized stormwater pond with varying water levels, native wetland vegetation, upland grasses and willow shrubbery. Upland vegetation around the naturalized stormwater pond should compensate for removal of any hedgerows on the subject property.

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- ❖ 1976 Air Photo. AS1547 #289 (1:20,000)
- ❖ 1981 Air Photo. AS2399 #64 (1:25,000)
- ❖ 1985 Air Photo. AS3229 #51 (1:25,000)
- ❖ 1992 Air Photo. AS4261 #44 (1:20,000)
- ❖ 1996 Air Photo. AS4742 #6 (1:20,000)
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Figures

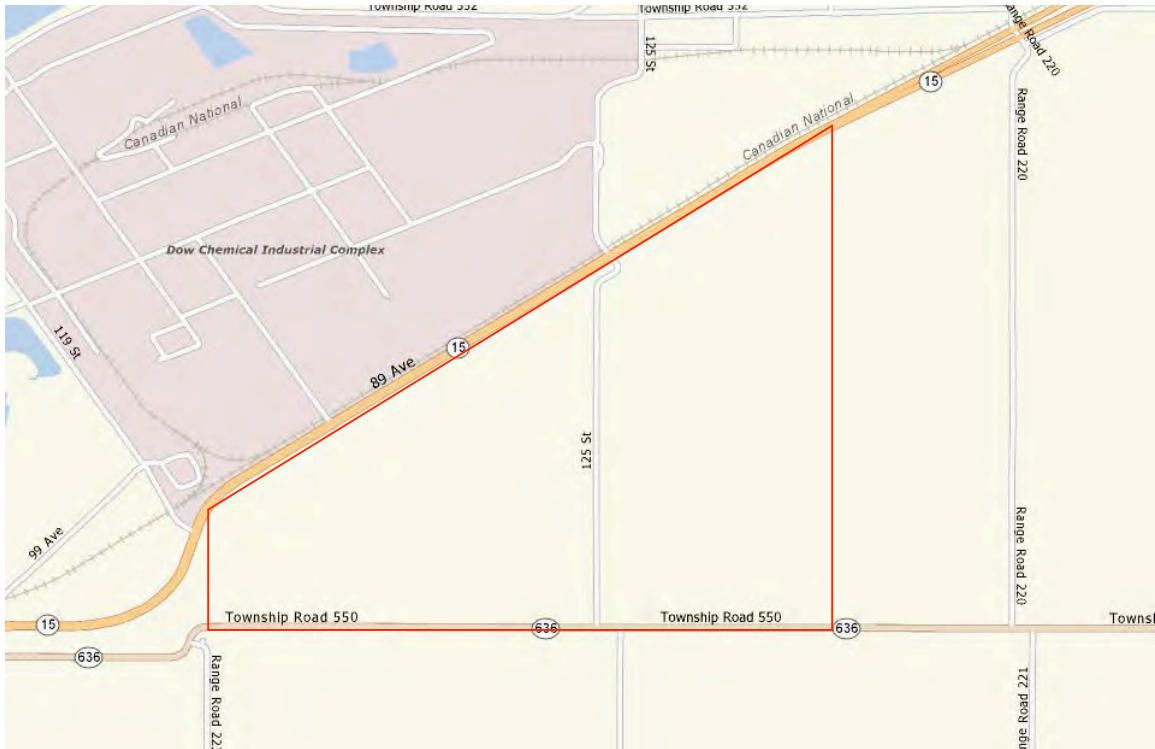
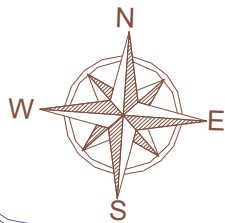
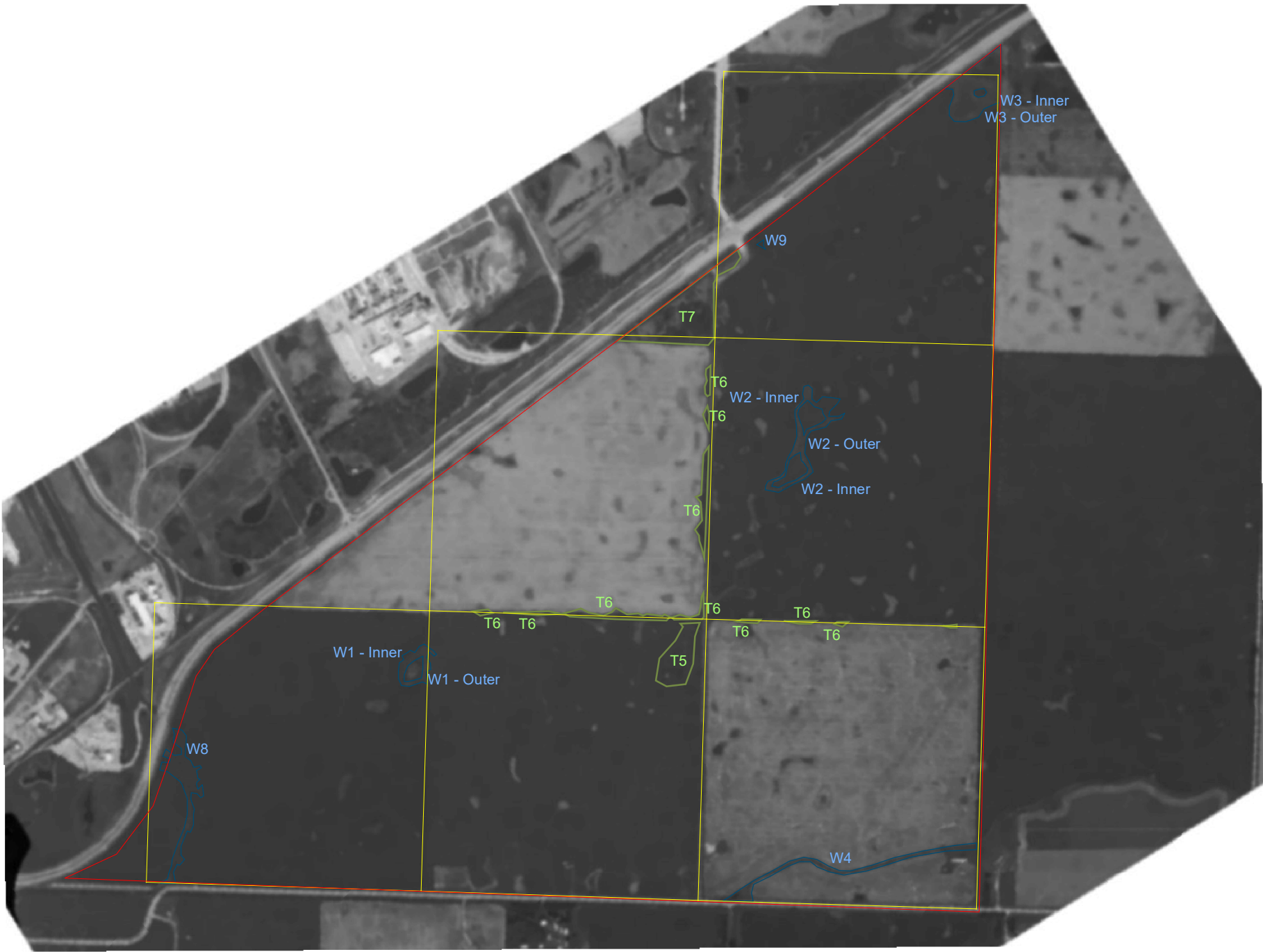


Figure 1: Map of Area (Mapquest, 2007)



REV #	DATE:	DESCRIPTION
1.0	2007-11-01	DRAFT FOR REVIEW

SITE PLAN
FORT SASKATCHEWAN
SHOWING LOCATIONS OF WETLANDS AND TREED AREAS
AIR PHOTO FROM AS5301-B, #148

DRAWN BY: CL
REVIEWED BY: AH
APPROVED BY: AH

ECOMARK Ltd.
Suite 100, 14894 - 121 Avenue NW
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P: (403) 410-3803

PROJECT: DURPR-07509-50577-0

DATE: 2007-11-01

REV 1.0

FIG 2



Figure 3: 1950 Air Photo (AS132 #54)



Figure 4: 1962 Air Photo (AS817 #125)



Figure 5: 1967 Air Photo (AS978 #197)



Figure 6: 1972 Air Photo (AS1207 #151)



Figure 7: 1976 Air Photo (AS1547 #289)



Figure 8: 1981 Air Photo (AS2399 #64)



Figure 9: 1985 Air Photo (AS3229 #51)



Figure 10: 1992 Air Photo (AS4261 #44)



Figure 11: 1996 Air Photo (AS4742 #6)



Figure 12: 2001 Air Photo (ED2001-2 #80)



Figure 13: 2004 Air Photo (AS5301 #148)



Figure 14: Unnamed Creek and Agricultural Land in SW-1-55-22-W4M



Figure 15: Unnamed Creek



Figure 16: Seasonal Wetland at NW-1-55-22-W4M



Figure 17: Seasonal Wetland at SW-2-55-22-W4M



Figure 18: Semi-Permanent Wetland east of SW-12-55-22-W4M



Figure 19: Hedgerow at NE-2-55-22-W4M



Figure 20: Willow Thicket at SE-2-55-22-W4M



Figure 21: Low-lying Area



Figure 22: Man-made Drainage Area

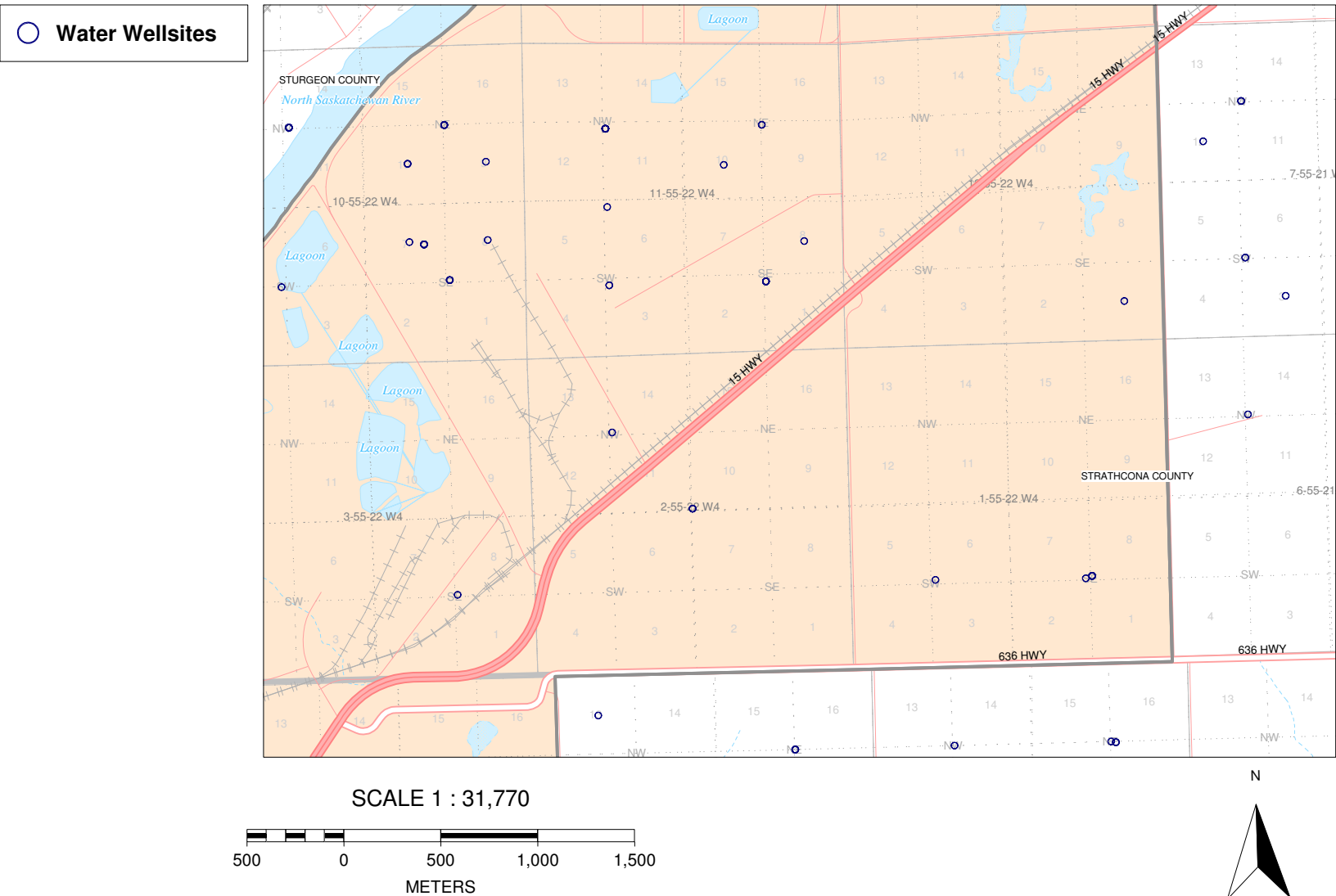


Figure 23: Agricultural Land

Appendices

Appendix 1: Water Well Search

TELUS Geomatics - Alberta Map





Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0261092
 Map Verified: Not Verified
 Date Report: 1978/12/23
 Received:
 Measurements: Imperial

1. Contractor & Well Owner Information			2. Well Location		
Company Name: BIG IRON DRILLING LTD.		Drilling Company Approval No.: 99718	1/4 or Sec Twp Rge West of LSD M 00 02 055 22 4		
Mailing Address: 9803 47 AVE	City or Town: EDMONTON AB CA	Postal Code: T6E 5M7	Location in Quarter 0 FT from Boundary 0 FT from Boundary		
Well Owner's Name: DOW CHEMICALS	Well Location Identifier:		Lot Block Plan		
P.O. Box Number:	Mailing Address: FT SASK	Postal Code:	Well Elev: How Obtain: FT Not Obtain		
City:	Province:	Country:			
3. Drilling Information			6. Well Yield		
Type of Work: New Well	Proposed well use: Industrial		Test Date Start Time: (yyyy/mm/dd): 1978/03/08 11:00 AM		
Reclaimed Well	Anticipated Water Requirements/day 0 Gallons		Test Method: Bailer		
Date Reclaimed:	Materials Used:		Non pumping 25 FT static level:		
Method of Drilling: Unknown	Rate: Gallons Oil Present: No		Rate of water removal: 3 Gallons/Min		
Flowing Well: No			Depth of pump intake: 0 FT		
Gas Present: No			Water level at 140 FT end of pumping:		
4. Formation Log			5. Well Completion		
Depth from ground level (feet)	Lithology Description		Date Started (yyyy/mm/dd): 1978/03/08	Date Completed (yyyy/mm/dd): 1978/03/08	Distance from top of casing to ground level: Inches
15	Clay		Well Depth: 140 FT	Borehole Diameter: 0 Inches	Depth To water level (feet) Elapsed Time
40	Sand & Gravel		Casing Type: Unknown	Liner Type: Unknown	Drawdown Minutes: Sec Recovery
50	Gravelly Coal		Size OD: 5.5 Inches	Size OD: 4.5 Inches	Total Drawdown: 115 FT
75	Sandstone		Wall Thickness: 0 Inches	Wall Thickness: 0 Inches	If water removal was less than 2 hr duration, reason why:
85	Shale		Bottom at: 85 FT	Top: 0 FT Bottom: 0 FT	Recommended pumping rate: 0 Gallons/Min
110	Sandstone		Perforations from: 130 FT to: 140 FT	Perforations Size: 0 Inches x 0 Inches	Recommended pump intake: 120 FT
125	Shale		from: 0 FT to: 0 FT	0 Inches x 0 Inches	Type Pump Installed Pump Type: SUB
135	Shale & Sandstone		from: 0 FT to: 0 FT	0 Inches x 0 Inches	Pump Model: H.P.:
140	Water Bearing Sandstone		from: 0 FT to: 0 FT	0 Inches x 0 Inches	Any further pump test information?
			Perforated by: Unknown		
			Seal: from: 0 FT to: 0 FT		
			Seal: from: 0 FT to: 0 FT		
			Seal: from: 0 FT to: 0 FT		
			Screen Type: Screen ID: 0 Inches from: 0 FT to: 0 FT Slot Size: 0 Inches		
			Screen Type: Screen ID: 0 Inches from: 0 FT to: 0 FT Slot Size: 0 Inches		
			Screen Installation Method:		
			Fittings Top: Bottom:		
			Pack: Grain Size: Amount:		
			Geophysical Log Taken: Retained on Files:		
			Additional Test and/or Pump Data Chemistries taken By Driller: No Held: 0 Documents Held: 1		
			Pitless Adapter Type: Drop Pipe Type: Length: FT Diameter: Inches		
			Comments:		
7. Contractor Certification					
Driller's Name: UNKNOWN DRILLER Certification No.:					

This well was constructed in accordance with the Water
Well regulation of the Alberta Environmental Protection
& Enhancement Act. All information in this report is true.
Signature Yr Mo Day

Report 1 Pump Test 1 page1



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0156872
 Map Verified: Not Verified
 Date Report: 1990/01/25
 Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLER Drilling Company Approval No.: 99999
 Mailing Address: UNKNOWN City or Town: UNKNOWN AB CA Postal Code:
 Well Owner's Name: THEROUX, CHRIS Well Location Identifier:
 P.O. Box Number: 3343 Mailing Address: FORT SASKATCHEWAN Postal Code: T8L 2T3
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 SW 01 055 22 4
 Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan
 Well Elev: FT How Obtain: Not Obtain

3. Drilling Information

Type of Work: Chemistry
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Not Applicable
 Flowing Well: No Rate: Gallons
 Gas Present: Oil Present:

6. Well Yield

Test Date Start Time:
 (yyyy/mm/dd):
 Test Method:
 Non pumping FT
 static level:

4. Formation Log

Depth from ground level (feet)
Lithology Description

5. Well Completion

Date Started(yyyy/mm/dd): Date Completed (yyyy/mm/dd):
 Well Depth: 0 FT Borehole Diameter: 0 Inches
 Casing Type: Liner Type:
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 0 FT
 Perforations from: 0 FT to: 0 FT Perforations Size: 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 Perforated by:
 Seal: from: 0 FT to: 0 FT
 Seal: from: 0 FT to: 0 FT
 Seal: from: 0 FT to: 0 FT
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Installation Method:
 Fittings Top: Bottom:
 Pack: Grain Size: Amount: 0
 Geophysical Log Taken:
 Retained on Files:
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 1 Documents Held: 1
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:
 Comments:

Rate of water removal: Gallons/Min
 Depth of pump intake: FT
 Water level at FT end of pumping:
 Distance from top of casing to ground level: Inches
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes:Sec Recovery

Total Drawdown: FT
 If water removal was less than 2 hr duration, reason why:

Recommended pumping rate: Gallons/Min
 Recommended pump intake: FT
 Type pump installed
 Pump type:
 Pump model:
 H.P.:
 Any further pump test information?

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.:

This well was constructed in accordance with the Water
Well regulation of the Alberta Environmental Protection
& Enhancement Act. All information in this report is true.
Signature Yr Mo Day

Report 1



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 1690074
 Map Verified: Not Verified
 Date Report: 2006/11/24
 Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: SHUMANSKY WATERWELL SERVICES LTD.
 Drilling Company Approval No.: 120054
 Mailing Address: 15956 - 88 ST
 City or Town: EDMONTON AB CA
 Postal Code: T5Z 3J1
 Well Owner's Name: RASMUSSEN, RON
 Well Location Identifier:
 P.O. Box Number:
 Mailing Address: 8202-95A AVE
 Postal Code:
 City: FT SASKATCHEWAN
 Province: AB
 Country: CA

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 SE 01 055 22 4
 Location in Quarter
 FT from N Boundary
 FT from E Boundary
 Lot Block Plan
 Well Elev: FT
 How Obtain: Not Obtain

3. Drilling Information

Type of Work: New Well
 Reclaimed Well
 Date Reclaimed:
 Materials Used: Unknown
 Method of Drilling: Rotary
 Flowing Well: No
 Gas Present: No
 Rate: Gallons
 Oil Present: No
 Proposed well use: Domestic
 Anticipated Water Requirements/day: 500 Gallons

6. Well Yield

Test Date (yyyy/mm/dd): 1999/05/13
 Start Time: 11:00 AM
 Test Method: Bailer & Air
 Non pumping: 31 FT
 static level:

4. Formation Log

Depth from ground level (feet)	Lithology Description
38	Till & Clay
45	Clay
63	Sand & Gravel
95	Shale
97	Sandstone
106	Shale
110	Sandstone
148	Shale
155	Sandstone
158	Shale
168	Sandstone
180	Shale
198	Sandstone

5. Well Completion

Date Started (yyyy/mm/dd): 1999/05/10
 Date Completed (yyyy/mm/dd): 1999/05/13
 Well Depth: 195 FT
 Borehole Diameter: 7.875 Inches
 Casing Type: Plastic
 Liner Type: Plastic
 Size OD: 6 Inches
 Size OD: 5 Inches
 Wall Thickness: 0.187 Inches
 Wall Thickness: 0.25 Inches
 Bottom at: 104 FT
 Top: 95 FT Bottom: 195 FT
 Perforations from: 170 FT to: 190 FT
 Perforations Size: Inches x 0.015 Inches
 from: FT to: FT
 Inches x Inches
 from: FT to: FT
 Inches x Inches
 Perforated by: Machine
 Seal: Bentonite Chips/Tablets
 from: 0 FT to: 104 FT
 Seal: Unknown
 from: FT to: FT
 Seal: Unknown
 from: FT to: FT
 Screen Type: Unknown
 Screen ID: Inches
 from: FT to: FT
 Slot Size: Inches
 Screen Type: Unknown
 Screen ID: Inches
 from: FT to: FT
 Slot Size: Inches
 Screen Installation Method: Unknown
 Fittings
 Top: Unknown Bottom: Unknown
 Pack: Unknown
 Grain Size: Amount: Unknown
 Geophysical Log Taken:
 Retained on Files:
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: Documents Held:
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: FT Diameter: Inches
 Comments:
 BOREHOLE DIAMETER ALSO 6.25"

Rate of water removal: 7 Gallons/Min
 Depth of pump intake: FT
 Water level at end of pumping: 135 FT
 Distance from top of 24 Inches casing to ground level:
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery

0:00	135
1:00	131.9
2:00	129
3:00	126.3
4:00	123.7
5:00	121
6:00	118.5
7:00	116.2
8:00	113.9
9:00	111.9
10:00	109.3
12:00	102.4
14:00	96.7
16:00	92.2
20:00	84.5
25:00	76.9
30:00	70.6
35:00	65.8
40:00	62
50:00	56.2
60:00	52.4
75:00	47.2
90:00	42

Total Drawdown: 104 FT
 If water removal was less than 2 hr duration, reason why:

Recommended pumping rate: 4 Gallons/Min
 Recommended pump intake: 160 FT

7. Contractor Certification

Driller's Name: ERNIE SHUMANSKY
 Certification No.: VAC606

Type Pump Installed
 Pump Type: SUBMERSIBLE
 Pump Model:

Certification NO.: V A60006	H.P.:
This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.	Any further pump test information?
Signature	No
Yr Mo Day	

Report 1 Pump Test 1 page1



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0282100
 Map Verified: Phone
 Date Report: 1984/06/19
 Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: Drilling Company Approval No.:
 MCALLISTER WATERWELLS LTD.
 Mailing Address: City or Town: Postal Code:
 Well Owner's Name: Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 FORT SASK
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 NW 02 055 22 4
 Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan
 Well Elev: How Obtain:
 FT Not Obtain

3. Drilling Information

Type of Work: New Well
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Rotary
 Flowing Well: No
 Gas Present: No
 Rate: Gallons
 Oil Present: No
 Proposed well use:
 Industrial
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date Start Time:
 (yyyy/mm/dd):
 Test Method:
 Non pumping FT
 static level:

4. Formation Log

Depth from ground level (feet)
Lithology Description
 1 Topsoil
 46 Brown Clay
 84 Dry Sand
 120 Sand & Gravel
 170 Gray Shale
 175 Sandstone
 186 Shale
 190 Sandy Shale
 232 Shale

5. Well Completion

Date Started(yyyy/mm/dd): Date Completed (yyyy/mm/dd):
 1984/05/08 1984/05/09
 Well Depth: 232 FT Borehole Diameter: 0 Inches
 Casing Type: Liner Type:
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 0 FT
 Perforations Perforations Size:
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Rate of water removal: Gallons/Min
 Depth of pump intake: FT
 Water level at FT end of pumping:
 Distance from Inches top of casing to ground level:
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes:Sec Recovery

Total Drawdown: FT
 If water removal was less than 2 hr duration, reason why:

Recommended pumping rate: Gallons/Min

Recommended pump intake: FT

Type pump installed
 Pump type:
 Pump model:
 H.P.:
 Any further pump test information?

Perforated by:
 Seal: Bentonite Chips/Tablets
 from: 120 FT to: 122 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Installation Method:
 Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount: 0
 Geophysical Log Taken:
 Retained on Files:
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 1
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:
 Comments:
 DRILLER REPORTS ANODES 1-198', 2-188', 3-178', 4-162', 5-152', 6-142'. COKE BREEZE 50 BAGS.

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.:

This well was constructed in accordance with the Water
Well regulation of the Alberta Environmental Protection
& Enhancement Act. All information in this report is true.
Signature Yr Mo Day

Report 1

Appendix 2: Qualifications and Information Pertaining to the Environmental Consultants

Name of Firm: Ecomark Ltd.

Address: 100 – 14964 – 121A Avenue, Edmonton, Alberta T5V 1A3

Phone: (780) 444–0706

Fax: 1–866–337–8631

Date Established: January 11, 2000

Insurance Coverage:

- ❖ Professional Errors & Omissions - \$2,000,000
- ❖ Commercial General Liability - \$1,000,000
- ❖ WCB Account

Safety Training: All professional staff at Ecomark has appropriate safety training in WHIMS, H₂S Alive, TDG, First Aid and Ground Disturbance Practices.

We excel in assessments, reclamation and remediation, and corporate environmental management. Our experience covers phase 1, 2, and 3 environmental assessments and environmental audits on the widest variety of industrial/commercial and residential properties and companies. We also have extensive facility experience, from scouting potential routes and facilities, through audit of existing facilities, to final reclamation and restoration of disturbed habitats.

One of our key strengths is corporate (government) liability assessments. We evaluate the environmental liability incumbent to a site or sites. We have been relied on by major corporations to place a monetary value on the environmental liability of assets being acquired, disposed of, or maintained.

Our staff provides Ecomark with 28 years of individual professional experience. We have appropriate professional errors and omission (E&O) insurance, contractors general liability (CGL) insurance, and Worker's Compensation. We have also attained Small Employer Certificate of Recognition (SECOR) safety status. A professional biologist, professional chemist, professional engineer, or professional geologist warrants all our work. We do quality, fully warranted assessments that all parties can understand.

Ecomark Ltd. Projects and Experience

Phase 1 Environmental Assessments

Phase 1 environmental assessments throughout Canada

Phase 2 Environmental Assessments

Phase 2 environmental assessments throughout Canada

Tier 2 risk assessments, Airdrie, Sundre, and North Garrington, Alberta

Phase 3 and 4 Environmental Assessments

Oilfields reclamation in Devon, Bonnie Glen and Redwater

Oil lease cleanups

Class 3 railway derailment cleanup and complete railway line abandonment

Diesel spill remediation

Fuel tank removals and cleanups

Underground storage tank remediation

Contaminated soil cleanups

Landfill reclamations

Salt spill weeping tile design and geotechnical assessment

Bioremediation, audit, waste cleanup, and process redesign

Erith River crossings reclamation

Peat bog sewage treatment field reclamation

Grading, cleanup, and reclamation of Mountain Park Loop

Pipeline crossing inspection, creek monitoring, and reclamation

Native grass and forbs species research for boreal forest reclamation

Stabilization of a mineral spring

Mitigation measures and further recommendations for rare native grasslands

Constructed wetland, survey, plan, construction

Wastewater tertiary treatment

Mould Assessments

Mould assessments

Indoor air quality assessments

Assessments – Reports, Acquisition, Habitat, Hazard, Environmental Impact and Others

Corporate environmental acquisition assessments

Chemical/brownfield site assessments

Federal and provincial environmental impact assessments

Health risk impact assessment, Health Board equivalent of an EIA

Environmental compliance audit for health facilities

Commercial environmental audits and technical reviews

Hazard identification assessments for industry, developers, and municipalities

Complete biophysical assessments, including wetland and aquatic assessments

Compost research and field application trials

Nutrient management in intensive livestock operations

Effects on nitrogen leaching in soils with the application of bedding

Effects of phosphogypsum on compost

Waste operations

Route selection and design of river crossings for pipelines

Technology evaluations for secondary off-gas treatment, cement kiln

- Scouting, application, and approvals for linear development projects
- Medicine Lodge Loop environmental assessment
- Environmental field report for Cheviot and Mountain Park Railway
- Stormwater outflow inspection and installation, Atim Creek
- Culvert installation under Atim Creek CN Right-Of-Way
- Aquatic inspection in Athabasca and North Saskatchewan drainages
- Fisheries monitoring studies and research and creek fisheries assessments
- Transalta fish recovery tank for Lake Wabamun
- Dredging impact literature search and sediment survey, Lake Wabamun
- Rare plant studies throughout western Canada, including a study covering 1.8 million hectares in northwestern Saskatchewan, and smaller studies in BC and Alberta
- Technology, composting alternatives, fly ash for road building material

Air, Water, Soil and Biomonitoring

- Groundwater monitoring
- Soil monitoring
- Vegetation, lichen, and agricultural field biomonitoring
- Establishment of biomonitoring plots complete with FCIR and Air Photo interpretation
- Indoor air quality monitoring

Environmental Systems Development

- Landfill design and development
- Establishment of bioremediation, composting, and recycling facilities
- Environmental training module and delivery
- Environmental procedures manual for North American Construction Group
- EUB waste module manual and delivery
- Northern Alberta compost brochure and manual
- Building operator training program waste module
- Habitat restoration and environmental aspects of linear development
- Fisheries training (linear development)
- Cleanup of upstream oilfield sites for World Bank Russia training program
- Training for Alberta Onsite Waste Water training program
- Waste management system development
- Waste module for downstream oilfield operations in Venezuela
- Waste audit report on waste resource management at Northlands Park
- Management of animal bedding from a race track by diversion from landfill and use in composting or incorporation into farm fields
- Compost marketing study for the University of Alberta
- Sewage field testing
- Intensive livestock composting seminar for the County of Lamont
- Assessment of waste dewatering market for Western Canada
- Waste audit and waste minimization implementation
- Development of integrated waste management facility for Fero, Yukon
- Environmental management course, waste management, construction, and operations for Russia World Bank
- Development of waste management facility for Margao, India
- International hazardous waste management pricing survey
- Operational enhancement of community septic system and design of new infiltration field

Establishment of hazardous waste transfer station, including market analysis
Assistance in establishing bioremediation market
Assistance and rewrite of production unit subscription and business plan
Assistance on CADR grinding technology
Assessment of proposals for PCB regulatory framework for Colombia
Historical environmental review for Paintearth Resource Recovery Centre,
Coronation, Alberta
Energy management plan
Development of micropower interconnection on-line manual
Installation of monitoring and demonstration system for solar heating project

Applications, Licenses, and Regulatory Assistance

Facility approval applications
Integrated municipal waste facility Board of Health application
Industrial application for waste handling facilities
Waste management applications
AEUB Guide 58 applications
AEUB Guide 55 support
Water well application for facility water supply system
Redefinition of hazardous waste for Canadian Environmental Protection Act
Assessment of regulations for importation of hauling waste from other countries
Development of the Medicine Hat Waste Management Facility, Petro-Canada
Development of the Paintearth Resource Recovery Centre
Development of commercial land for Wetaskiwin, Alberta

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APPENDIX E

Geotechnical Report



GEOTECHNICAL REPORT PROPOSED INDUSTRIAL SUBDIVISION

**WITHIN SW1/4 - 12 - 55 - 22 - W4M &
NW1/4 - 1 - 55 - 22 - W4M
FORT SASKATCHEWAN, ALBERTA**

PREPARED FOR

TRANSAMERICA DEVELOPMENTS LTD.

EDMONTON, ALBERTA



PREPARED BY

PARKLAND GEO-ENVIRONMENTAL LTD.

SHERWOOD PARK, ALBERTA



PROJECT No.:

ED-1513

DATE:

MARCH 4, 2014

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LIMITATIONS	Statement of Limitations

1.0 INTRODUCTION

TransAmerica Developments Ltd. (TransAmerica) is proposing to develop approximately 60 acres of industrial land within SW1/4-12-55-22-W4M & NW1/4-1-55-22-W4M. ParklandGEO was commissioned by TransAmerica c/o Prism Engineering to undertake a geotechnical investigation for the site with including the proposed storm water management pond in the south and road widening/alignment of 125 Street (Range Road 221). This report summarizes the geotechnical investigation and provides the results of field and laboratory testing programs and presents geotechnical recommendations for site preparation and other relevant issues for lot subdivision.

1.1 SCOPE OF WORK

The approved scope of work was outlined in ParklandGEO Proposal No. PRO-ED14-09 dated January 22, 2014. Authorization to proceed with this investigation was provided by Mr. Glen Kennedy, P.Eng, of Prism Engineering on January 24, 2014. The purpose of this study was to determine the existing soil conditions and assess the suitability of the site for development of industrial lots; including providing recommendations for road widening and realignment, a storm water management pond and preliminary recommendations for foundations.

1.2 PREVIOUS REPORTS

Existing reports for the site area and the quarter section to the east relating to geotechnical investigations were consulted for addition soil information. The following is a list of known reports:

- Opus Stewart Weir Geotechnical Site Investigation, Proposed Fabrication Yard, NW1/4 Sec.1 & SW1/4 Sec. 12 55-22 W4M. December 2013.
- Parkland Geo-Environmental Ltd. Geotechnical Investigation, Proposed Industrial Subdivision, NE1/4-22-05-22-W4M. November 2013.

2.0 SITE AND PROJECT DESCRIPTION

The site was located within the NW1/4-1-55-22-W4M and SW1/4-12-55-22-W4M near Fort Saskatchewan, Alberta, from the centre line of Range Road 221 west border of SW1/4-12-55-22-W4M to the east border of the section. It is understood that the proposed development will consist of the initial development of 60 acres of industrial land, including road widening and the installation of a storm water management pond. The site was bordered by Highway 15 to the north and Range Road 221 to the west.

The site was generally flat with small undulations. There was a gentle slope from the northwest to the southeast corners of the site. The site was vacant and cultivated farmland with a small slough observed in the middle portion of the quarter section.

3.0 FIELD AND LABORATORY PROGRAMS

Twelve (12) boreholes were drilled within the proposed industrial subdivision between January 29 to January 31, 2014. The boreholes were extended to depths of between 4.5 m and 10.0 m below existing grade. The locations of the boreholes are shown on the Site Plan (Figure 2). The drilling was conducted by SPT Drilling Ltd. using a 150 mm diameter solid stem, continuous flight auger truck mounted drill rig. Supervision of the drilling and on site testing were performed by Mr. Graeme Law, E.I.T. of ParklandGEO.

The soil encountered was visually examined during drilling and logged according to the Modified Unified Soil Classification System. Discrete samples were collected from the auger flights at 1.0 m intervals to determine the moisture profile. Additional discrete samples were collected at representative locations throughout the soil profile. All soil samples were returned to ParklandGEO's Sherwood Park laboratory for further examination and testing. The laboratory program consisted of moisture contents, Atterberg limit analysis, grain size distribution and sulphate analysis.

Ten (10) of the boreholes were completed with a 25 mm PVC standpipe in order to assess the groundwater conditions following drilling. The borehole locations were recorded using a hand held Garmin GPS.

4.0 SUBSURFACE CONDITIONS

In general, the subsurface stratigraphy at the boreholes consisted of topsoil underlain by clay over clay till with interbedded sand seams. Detailed descriptions of the soil conditions encountered are provided on the borehole logs in Appendix A. The results of all laboratory testing are shown on the borehole logs and reports are also included in Appendix A.

The soil logs presented in Opus Stewart Weir (2013) identify the soils in the upper stratigraphy as medium to highly plastic clay till. This is not consistent with historical publications for the area such as Kathol and McPherson (1975) as shown in Figure 3 and ParklandGEO's findings in both this investigation and recent ParklandGEO (2013) investigation of the adjacent quarter section.

4.1 TOPSOIL

Topsoil was encountered at the surface in all boreholes with the exception of Boreholes 14-01 to 14-04 which were drilled on the roadway. The topsoil layer was 100 to 300 mm thick, highly organic, damp and black. In Borehole 14-12, there was a layer of silt directly beneath the topsoil with a thickness of 0.8 m. This silt contained some clay and was soft in consistency, low plastic and light grey in colour.

4.2 ROAD SURFACE

An asphalted gravel road structure was encountered in Boreholes 14-01 to 14-04. This road structure was well-graded and approximately 300 mm thick.

4.3 CLAY FILL

Clay fill was encountered beneath the road structure extending to depths between 1.7 to 2.0 m below grade in Boreholes 14-01 to 14-04. The clay fill contained little silt, trace sand and trace organics. The fill was dark brown and damp to moist with moisture contents ranging from 26 to 34 percent, which is considered to be above the estimated optimum moisture content (OMC). A California Bearing Ratio (CBR) test gave the final value of 2.3, which classifies the clay fill as weak subgrade.

4.4 CLAY

Glacio-lacustrine clay was encountered underlying the topsoil and extended to depths of between approximately 4.2 m and 8.9 m below existing grade. Boreholes 14-01 to 14-04 and 14-08 to 14-12 encountered clay until the termination depths, which were between 4.5 and 6.0 m. The clay was firm to stiff in consistency with SPT "N" values ranging from 4 to 16 blows per 300 mm of penetration. In general, the clay became more stiff as depth increased. The clay contained 44 to 75 percent clay, 13 to 40 percent silt, 10 to 15 percent sand, and less than 1 percent gravel. Atterberg Limit analysis indicated that the clay was high plastic with Liquid Limits ranging from 48 to 72 percent and Plastic Limits ranging from 23 to 35 percent. The structure of the soil was laminated with occasional silt and sand lenses as well as rust staining observed. The clay was light grey/brown and damp to moist with moisture contents ranging from 19 to 40 percent, which is considered to be above the estimated OMC.

4.5 CLAY TILL

Clay till was encountered underlying the clay at depths of approximately between 7.8 m and 10.9 m in Boreholes 14-05, 14-06 and 14-07. The clay till contained 36 percent clay, 18 percent silt, 38 percent sand, and 8 percent gravel. SPT "N" values ranged from 16 to 28 per 300 mm of penetration, indicating the till was stiff to very stiff. The till was low to medium plastic with Atterberg Liquid Limits of approximately from 35 percent and Plastic Limits from 15 percent. Moisture contents within the till varied between 12 to 19 percent, indicating the till was dry to damp and within OMC. Interbedded sand pockets between 60 to 100 mm were encountered in the clay till deposit in Boreholes 13-06 and 13-07, respectively.

4.6 SOIL SULPHATES

Soil samples from Boreholes 14-03 and 14-07 at depths ranging from 4.5 to 8.3 m below grade were tested for water soluble sulphate concentrations. The concentrations of water soluble

sulphate ranged from 0.578 to 0.737 percent indicating a severe potential for sulphate attack on buried concrete in direct contact with soil.

4.7 GROUNDWATER

Groundwater levels were measured immediately upon completion of drilling and on February 18, 2014. The measured groundwater levels are presented in the following table.

TABLE 1: GROUNDWATER DEPTHS

Borehole	Groundwater Level at Completion (mbg)	Groundwater Level (mbg)
14-01	DRY	3.0
14-03	DRY	3.7
14-05	DRY	3.1
14-06	DRY	2.8
14-07	DRY	1.5
14-08	DRY	4.5
14-09	DRY	3.2
14-10	DRY	2.5
14-11	DRY	2.6
14-12	DRY	3.3

Based on the above, the groundwater levels varied between 1.5 m to 4.5 m below existing grade. The groundwater table may fluctuate upwards after snow-melt or periods of heavy/prolonged precipitation. It is suspected that the groundwater table had not fully stabilized in some boreholes, based on the measured variability.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 GENERAL GEOTECHNICAL EVALUATION

Geotechnically, the site soil conditions are considered favourable for the proposed development. The upper soil strata consists of high plastic lacustrine clay, which are susceptible to differential movement due to volume changes within the clay soil as a result of natural moisture fluctuations. An increase in moisture content results in swelling and lift, whereas a decrease in moisture content results in shrinkage and settlement. Care should be taken to minimize the disturbance of the lacustrine clay, which may bring water up and saturate the soil. Portions of the site that are to be used for roadways should be cut at least 1 m below grade and filled with imported gravel fill. Traffic loads are expected to be frequent daily heavily loaded trucks.

Several foundation options are considered feasible for this site, these include bored, cast-in-place concrete piles and belled end-bearing caissons, driven steel pipe piles and helical screw piles. Shallow footing foundations were considered but are not recommended due to the presence of highly plastic clay soils and high groundwater elevation at the site. Recommendations are presented in each foundation section to mitigate the impacts of the site conditions. Further geotechnical investigations will be necessary to develop foundation options specific for each proposed lot.

The soil conditions encountered at this site are considered to be suitable for the proposed development to pond storm water during peak flows and help ease the demand on storm sewers in this area. Due to the high plastic nature of the near surface lacustrine clay, the soil in the vicinity of the proposed pond is relatively non-permeable and considered suitable for use as a compacted clay liner. The local water table is at elevations measured as high as 2.5 m below current grade. Storage capacity of the pond will be decreased if the depth is below the current water table. It may be desirable option to consider a water discharge system in place.

Topsoil depths are between 200 to 500 mm in all boreholes therefore, it is expected that topsoil stripping volumes for this site will not be excessive.

Recommendations have been provided for site preparation, a stormwater management pond, roadway realignment, excavations, utility installation and concrete.

5.2 SITE PREPARATION

5.2.1 Building Areas

All topsoil and organics should be removed from areas to be developed for buildings. Where site grading is necessary, engineered fill should be placed under controlled conditions. All areas should be inspected to confirm all organics are removed and the exposed bearing surfaces should be tested for density, moisture content and identification of wet and/or weak soils. As such if

encountered, soft weak soils should be removed and replaced with controlled engineered fill.

Subsequent to removal of any undesirable soils, all exposed subgrade soils should be scarified to a minimum depth of 150 mm and compacted to 96 percent of Standard Proctor maximum dry density. The final compacted subgrade should then be proof-rolled and/or monitored by a geotechnical engineer to identify non-uniformity and weak/soft areas prior to placement of granular base layer. A woven geotextile separation layer may be utilized to minimize the ingress of granular material into the clay subgrade, which may be at the discretion of the field engineer at the time of construction.

It is recommended that quality control and testing be conducted by an experienced geotechnical engineer during placement of engineered fill. It is also recommended that the fill materials to be used be pre-approved by the geotechnical consultant prior to backfilling. Fill required to bring the lot areas up to design grade should consist of a low to medium plastic clay, or select pit-run gravel having a maximum particle size of 100 mm. Fill soils must be free of any organic materials, contamination, deleterious construction debris and stones greater than 100 mm in diameter. Uniformly graded sand or silt should be avoided since these materials require strict moisture control to achieve required compaction standards.

Thin fills within the proposed building areas should be placed to a uniform density of 98 percent of Standard Proctor Maximum Dry Density (SPMDD-ASTM D698). Fills of over 0.6 m deep within the building footprint and driveways, should be placed uniformly to at least 100 percent of Standard Proctor Maximum Dry Density (SPMDD) and be either at or slightly above optimum moisture content (OMC). It is recommended the maximum thickness of any lift after compaction should not exceed 150 mm for clay and 200 mm for granular fill. Uniformity of compaction is of the utmost importance to minimize differential settlement. If excessive soft subgrade conditions are encountered, these compaction recommendations and proposed construction procedures should be reviewed.

Water should not be allowed to pond on the lots. A minimum grade of 2 percent is recommended to promote surface runoff and minimize potential saturation and degradation of the subgrade.

5.2.2 Roads

The soil surface exposed during roadwork activities should be monitored by experienced geotechnical personnel. The main concern is to verify that the roadway subgrade conditions are uniform and stable. The relatively high plastic, weak clay subgrade will result a low to moderate level of subgrade support for pavement areas. The provision of relatively thick gravel pavement sections for heavy traffic areas. Care should be taken to identify excessively soft areas before significant disturbance to the subgrade. If these areas are encountered the local area should be subcut and materials removed. The depth of subcuts should be sufficient to remove the soft material or to bridge over the material to give proper support to construction traffic and pavement structures. Soft areas caused by shallow groundwater may be prone to re-occurrence after construction which could lead to costly annual maintenance. Provision of effective ditch-drains

adjacent to roadways can significantly improve the long term stability of these subgrade soils and overlying fill materials.

Localized areas with loose or soft soil along the proposed roadways is considered suitable to support pavement structures, either flexible or gravel pavement, with due quality control. The soft areas should be visually identified and tested by proof rolling by an experience geotechnical engineer or technologist.

During road construction, the subgrade may be susceptible to soft conditions caused by pumping of the groundwater to surface by construction activity, with the most likely occurrences where wet silty soils have less than 1 m of granular cover. Care should be exercised when using vibratory equipment since perched conditions may occur in the clay deposits caused by vibration. In these conditions, the subgrade may be prone to pumping particularly after periods of heavy precipitation. If coarse gravel is proposed as granular fill it is recommended to use gravel with a maximum aggregate size of 100 mm.

Subgrade problems are most often encountered during periods of snowmelt or heavy precipitation. In some cases, construction traffic on the fine grained soils can substantially weakening the subgrade. Methods to avoid subgrade failure may include: limiting construction traffic, modification of site preparation procedures (scarification, recompaction, etc.) and sub-cut and replacement with a suitable engineered fill material. In the most severe cases backhoe excavation equipment should be used for the sub-cut and gravel should be placed over the area in a single lift by end dumping and spreading with wide pad crawler equipment to protect the subgrade from further disturbance. The gravel should be placed on top of a filter fabric to keep the subgrade fines from migrating down into the clay. The initial lift of gravel should be nominally compacted in a manner to minimize disturbance to the soft subgrade. In pavement areas this extra gravel can be incorporated into the pavement subbase. The filter cloth should a minimum grab tensile strength of 900 N.

Water should not be allowed to pond on any road surface areas. A minimum grade of 5 percent is recommended to promote surface runoff and minimize potential saturation and degradation of the subgrade.

5.3 FOUNDATIONS

In general the soil conditions consisted of highly plastic clay overlying the clay till. Variable soil and groundwater conditions were encountered on the site. Deep foundation types consisting of bored, cast-in-place concrete piles and belled caissons, driven, steel pipe piles and helical screw piles should perform satisfactorily at this site. Construction difficulties, due to saturated sand seams in the clay till deposit should be expected for bored, cast-in-place concrete piles and belled caissons. Casing may be required on some sites to complete concrete pile installations. Belled caissons should bear on undisturbed, naturally deposited clay till. The depth of the clay till should be taken into account when discussing belled caissons due to the variable depths of the clay till encountered across the site.

Depending on pile type, the ultimate skin friction resistance may range approximately from 30 to 40 kPa in the clay and 50 to 70 kPa in the clay till. The ultimate end bearing resistance may range approximately from 375 to 475 kPa in the clay (for driven piles and screw piles only) and 800 to 1,000 kPa in the clay till.

One borehole for two lots is not sufficient for a reliable and cost-effective geotechnical design. Further geotechnical investigations specific to each lot are recommended for the development in each lot.

5.4 CONCRETE

Water soluble sulphate concentrations on two test samples from the site indicated a severe potential for chemical attack of subsurface concrete (SO₄ concentrations between 0.20 and 2.0 percent - CSA Exposure Class S-2). Sulphate Resistant Hydraulic (Type HS) cement may be used for all concrete in contact with soil at the site. The recommended minimum 56 day compressive strength is 32 MPa with a maximum water to cementing materials ratio of 0.45.

All concrete exposed to a freezing environment either during or after construction should be air entrained. Concrete should be placed in accordance with CSA Standard CAN3-A23.1-M00. All concrete exposed to a freezing environment either during or after construction should be air entrained.

5.5 SITE DRAINAGE

The development should be graded to ensure positive drainage from the lots and roadways into the storm water management pond. The groundwater table is expected to fluctuate seasonally. A standard weeping tile drain is recommended around the outside perimeter of any foundation walls to control potential surface infiltration around the perimeter of the proposed buildings. The weeping tile drain should be surrounded with free draining crushed rock or washed rock to prevent the fine grained native soil from being washed directly into the drain. Groundwater infiltration flows can be significantly increased by poor site drainage around buildings, improperly directed roof leaders and poorly graded or compacted backfill.

5.6 STORM WATER POND CONSTRUCTION

It is understood that the proposed storm water pond will be designed as a wet pond with a total volume of 320,000 m³ and a depth of approximately 4 m including freeboard. It is further understood that the preliminary design includes sides slopes of 3H:1V from a depth of 1.0 m below the normal water level to the base of the pond and side slopes of 5H:1V above this elevation to freeboard with a fence enclosure.

The soil conditions encountered at this site are considered to be suitable for the proposed development to impound storm water during peak flows and ease the demand on storm sewers in this area. The native clay soils at depth are considered to be suitable for use as a compacted clay liner for the proposed design.

5.6.1 Storm Water Pond Site Preparation

It is recommended that all topsoil, organic soil, fill or weak native sub-grade soils should be removed from areas to be occupied by berms, side slopes and the pond base, and where necessary should be replaced with an engineered fill placed under controlled conditions. The depth of organics at the borehole locations were approximately 150 mm.

Soil surfaces exposed at the site during initial site work activities should be monitored by experienced geotechnical personnel. The main concern is to verify that the sub-grade conditions are uniform and stable. Care should be taken to identify potential soft areas before significant disturbance to the sub-grade occurs. Any soft areas encountered should be sub-excavated and replaced with a suitable fill material. It is also important not to let the exposed sub-grade dry out to reduce the potential shrinkage and swelling of the soil. The depth of excavation should be sufficient to remove the soft material. If sand or gravel layers or pockets are encountered during construction, these should be subexcavated at least 1.5 m to minimize the potential of seepage occurring below the berms and the subcut backfilled with select fill.

Select fill required to bring the site up to grade should consist of select medium to highly plastic inorganic clay, with the native clay at depth being suitable for this purpose. Moisture conditioning of the native clay soils may be required prior to placement as fill in order to obtain specified densities. Fill soils must be clean, free of any organic materials, contamination, deleterious construction debris and stones greater than 100 mm in diameter.

5.6.2 Compacted Clay Liner

If a clay liner is proposed, the native lacustrine clay below the topsoil is considered to be suitable for use as a compacted clay liner. The average in-situ bulk hydraulic conductivity measured during slug tests was 1.2×10^{-9} m/s. Grain size analyses on two composite samples indicated that the soil consisted of 44 to 75 percent clay, 13 to 40 percent silt, 10 to 15 percent sand, and less than 1 percent gravel. Atterberg Limits indicated that the clay was medium to high plastic.

Excavated clay material to construct the proposed base liner should be placed to a uniform density of 95 percent of SPMDD (ASTM D698). To achieve these levels of compaction, the clay should be placed within 2 to 4 percent wet of Standard Proctor Optimum Moisture Content (OMC). Moisture contents on the clay ranged from 19 to 40 percent, which is considered to be generally within the estimated OMC of 28 percent and therefore, drying of the material will likely be required. Bulk samples should be analyzed for SPMDD and OMC prior to construction to confirm the amount of drying necessary.

It is recommended the maximum thickness of any lift after compaction should not exceed 150 mm for excavated native clay. Uniformity of compaction is of most importance. If soft sub-grade conditions are encountered these compaction recommendations and proposed construction procedures should be reviewed. The clay should be free of organics, debris, cobbles or rocks larger than 150 mm in diameter, ice, snow and compressible materials.

5.6.3 Berm and Liner Construction

The berms and liner around the pond should be constructed of a well-compacted, medium to highly plastic clay soil. The native clay at depth is expected to be suitable for berm construction with suitable moisture conditioning.

Fill material to construct the proposed berms and base liner should be placed to a uniform density of 95 percent of SPMDD (ASTM D698). Deeper fill, including trench backfill below the berms should be placed uniformly to at least 100 percent of SPMDD. To achieve these levels of compaction clay fill should be placed within 2 to 4 percent wet of Standard Proctor Optimum Moisture Content. It is recommended the maximum thickness of any lift after compaction should not exceed 150 mm for clay fill. Uniformity of compaction is of most importance. If soft sub-grade conditions are encountered these compaction recommendations and proposed construction procedures should be reviewed. The clay should be free of organics, debris, cobbles or rocks larger than 150 mm in diameter, ice, snow and compressible materials.

5.6.4 Recommendations

The groundwater depth varied between 2.5 m and 4.5 m below existing grade at the proposed pond area. As such, the base of the storm water pond may be below the groundwater table. Design considerations for the wet detention pond at this site include: the influence of impounded water on the local groundwater table, shoreline slope stability, shoreline erosion protection and drainage of the pond if the static groundwater table elevation drops with respect to the pond base elevation.

The subsurface conditions at this site are considered to be suitable for construction of the pond. The following recommendations are provided:

- The native subgrade should be subexcavated to a depth of 300 mm and replaced with a low permeable silty clay compacted to at least 95% of SPMDD in thin lifts (nominally less than 150 mm). An average of 2 - 5 % above OMC is optimum to achieve good compaction in pond construction and trench backfill as a means of minimizing post construction settlement.
- For preliminary design purposes the slope angles on the proposed wet pond should be at least 3H:1V below the static water level and 5H:1V for the portion of the slope above the static water level to freeboard. This is considered to be sufficient for maintaining slope stability.

- The pond shore line should be protected against erosion from wave action, because shoreline erosion may destabilize the pond slopes. Side slopes should be vegetated as soon as possible after construction.
- Various engineered erosion control products and vegetation reinforcement mats may also be used, particularly in high flow locations.
- Some restrictions might apply to pond operations, because rapid draw-down rates will impact slope stability. For safety reasons, municipal authorities typically require ponds to limit surface water rises to less than 1.0 m for a 1:25 year rainfall event and 2.5 m for a crisis event.

5.7 EXCAVATIONS

All excavation work must comply with the requirements of the Alberta Occupational Health and Safety Act (OHS Act, 2002), OHS Regulation (2003) and OHS Code (2003). The OHS Code contains the technical requirements that support the Act and Regulation.

Specifically with reference to Section 442 the OHS Code, the soils on this site would be classified as "likely to crack or crumble". The soils have been previously excavated but are not considered "soft, sandy or loose", however, the near surface high plastic clay is known to contain slickensides and fissures which reduce the stability of open cut faces. From Section 451 of the OHS Code, the soils may be cut to within 1.5 m of the base at an angle of not less than 45 degrees measured from the vertical or 1 (V) to 1 (H). The lower 1.5 m of excavation can be cut to a near vertical face. Any excavation within or adjacent to known or historical utility lines should be sloped at a 1 (V) to 1 (H) inclination from crest to toe, with no vertical cut allowed.

Alternatively, near vertical trenched excavations may be constructed in conjunction with a movable shield or shoring. Stockpiles of materials and excavated soil should be kept back from the crest by a distance equal to at least the depth of excavation. Similarly, wheel loads should be kept back at least 1 m from the crest.

5.8 ASPHALT PAVEMENT

5.8.1 Flexible Asphalt Pavements

The proposed pavement design sections are based on the assumption that the pavement will be constructed on a the existing native soil as a subgrade with a soaked California Bearing Ratio of approximately 2.3. This is indicative of a relatively low level of subgrade support as expected during spring thaw when the subgrade soils will exist in a weakened condition. As previously discussed in Section 5.2.2, subgrade problems may be encountered depending on local weather and groundwater conditions at the time of construction. If excessively soft subgrade conditions are encountered, it is assumed that the subgrade will be improved with coarse gravel to support construction traffic and paving activities. If required, the subgrade improvement gravel and the subbase layer are typically placed together effectively increasing the thickness of the sub-base layer. The flexible pavement design proposed in general for this site is a local industrial design for heavier traffic loads and in particular for the re-alignment of 125 Street. Option 1 is for the paved section of 125 Street and option 2 is for gravel roadways and the continuation of 125 Street.

TABLE 2: FLEXIBLE PAVEMENT DESIGN

Material	Industrial		Compaction % SPMDD
	Option 1 (mm)	Option 2 (mm)	
Asphaltic Concrete (ACP)	100	--	--
Class 20 Granular Base Coarse	300	350	100 %
Class 80 Granular Subbase Coarse	600	800	98 %
Scarify and recompactd exposed subgrade	150	150	98 %

The thickness of subbase given above is considered to be the minimum requirement assuming no subgrade improvement is required. If it is proposed to reduce the ACP layer for the heavy section as cost savings it is suggested to increase the subbase thickness, because the cost of a future overlay would be significantly less than repairing a subgrade problem. The pavement could be thickened in the future when the "serviceability performance" warrants an overlay. It is recommended to use a geotextile, specified as per Section 5.8.3, to separate the fine grained subgrade from the granular sub-base.

5.8.2 Suggested Pavement Materials

The performance of the proposed pavement design sections will be, in part, dependent on achieving an adequate level of compaction in subgrade and pavement materials. The recommended levels of compaction for the granular materials in the pavement section should be a minimum of 100 percent of SPMDD. The asphalt concrete should be compacted to a minimum of 97 percent of Marshall density based on a 50 blow laboratory Marshall test. Aggregate materials for base and subbase gravel should be composed of sound, hard, durable particles free from organics and other foreign material. It is recommended to use aggregates conforming to the following Alberta Transportation specifications. It is recommended to use pavement materials conforming to the following specifications in Table 4:

TABLE 3: ASPHALT CONCRETE

Parameter	Heavy
Stability (kN minimum)	5.4
Flow (mm)	2 - 4
Air Voids (percent)	3 - 5
VMA (minimum percent)	14.5
Asphalt Cement (penetration grade)	150-200 (A)

TABLE 4: RECOMMENDED AGGREGATE SPECIFICATIONS

Sieve Size (mm)	Percent Passing by Weight	
	Designation 3 Granular Base Class 20	Designation 3 Granular Sub-base Class 80
80	-	100
25	-	46 - 85
20	100	40 - 81
16	84 - 95	32 - 76
12.5	-	30 - 70
10	60 - 90	-
5	37 - 62	25 - 50
2	26 - 50	19 - 42
1.25	19 - 43	15 - 38
0.63	14 - 34	10 - 32
0.4	11 - 28	7 - 27
0.315	10 - 25	6 - 24
0.16	6 - 18	3 - 18
0.08	2 - 10	0 - 10

Sieve Size (mm)	Percent Passing by Weight	
	Designation 3 Granular Base Class 20	Designation 3 Granular Sub-base Class 80
Plasticity Index (PI)	6% max	N/A
% Fractures by Weight (2 faces)	60 min	N/A

The roadway areas should be sloped and graded to effectively remove all surface water as rapidly as possible. To minimize the occurrence of surface water ponding on lots, surface grades of at least 2 percent are recommended. Allowing water to pond on the pavement surface will lead to infiltration of the water into the subgrade which could result in weakening of the subgrade soils.

5.8.3 Filter Fabric

A geotextile filter fabric is recommended as a separation barrier for all transitions between gravel and fine grained soils in roadway areas as described in Section 5.2. Due to the shallow groundwater conditions and fine grained subgrade, filter cloth is recommended for all high and critical traffic areas of the site. In this application the filter cloth is used for separation not reinforcement, but it must be strong enough to withstand construction activities. For pavement applications it is recommended to use a woven filter fabric with a minimum Grab Tensile Strength of 900 N. The filter fabric should be provided with overlaps in conformance with the manufacturer's recommendations or at least 300 mm, whichever is greater. The geotextile should be laid only on the subgrade and not made to wrap the trench.

5.9 FROST PROTECTION FOR BURIED UTILITIES

Based on the 1 in 25 year return period winter, the depth of frost penetration in the Fort Saskatchewan area is approximately 2.3 m for clay at 29 percent moisture content. Therefore, the recommended minimum buried depth for water lines and sewers is 2.6 m.

5.10 INSPECTION

It is recommended that on-site inspection and testing be performed to verify that actual site conditions are consistent with assumed conditions which meet or exceed design criteria. Based on the Alberta Building Code, adequate levels of inspection include: testing of engineered fill and review of all exposed subgrade surfaces. It is also recommended that full marshall test be performed on the road structures.

6.0 LIMITATIONS AND CLOSURE

This report has been prepared for the exclusive use of **TransAmerica Developments Ltd. and their approved agents**. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. PARKLAND GEO-ENVIRONMENTAL LTD., and The ParklandGEO Consulting Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. No other warranty, expressed or implied, is made. The General Terms and Conditions of this report are attached and should be considered part of this report.

We trust that this report meets with your current requirements. If there are any questions, please contact the undersigned at 780 / 416 - 1755.

Respectfully Submitted,

PARKLAND GEO-ENVIRONMENTAL LTD.
APEGA Permit to Practice No. P - 8867



Melissa Kober, E.I.T.
Geotechnical Engineer



March 4, 2014

Ramon Facundo, P.Eng.
Senior Geotechnical Engineer

7.0 REFERENCES

Opus Stewart Weir Geotechnical Site Investigation, Proposed Fabrication Yard, NW 1/4 Sec. 1 & SW 1/4 Sec. 12 55-22 W4M. December 2013.

Parkland Geo-Environmental Ltd. Geotechnical Investigation, Proposed Industrial Subdivision, NE 1/4-22-05-22-W4M. November 2013.

Kathol, C.P. and McPherson, R.A. 1975. *Urban Geology of Edmonton*. Bulletin 32. Alberta Research Council. Edmonton, Alberta.

FIGURES

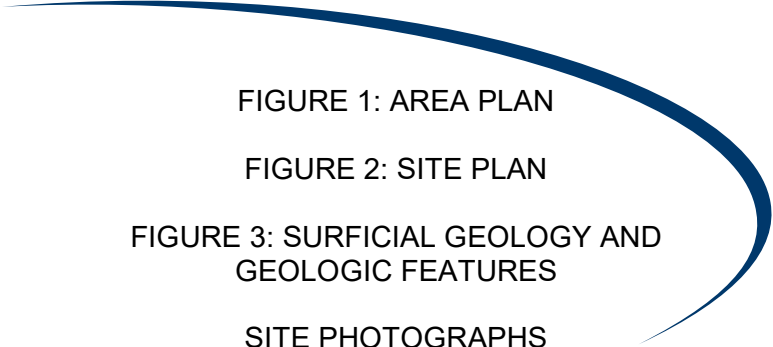
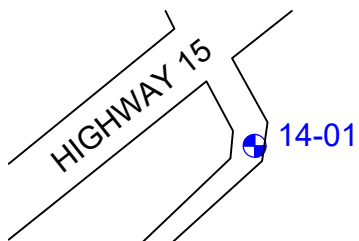


FIGURE 1: AREA PLAN

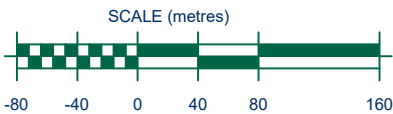
FIGURE 2: SITE PLAN

FIGURE 3: SURFICIAL GEOLOGY AND
GEOLOGIC FEATURES

SITE PHOTOGRAPHS



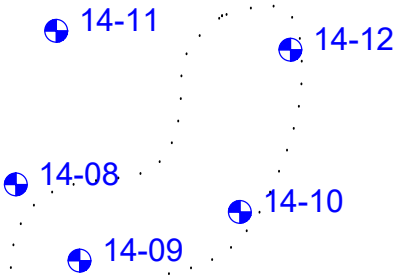
NOTE: THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. NOT ALL STRUCTURES OR FEATURES MAY BE SHOWN.



SW1/4 - 12 - 55 - 22 - W4M

NW1/4 - 1 - 55 - 22 - W4M

RANGE ROAD 221 (125 STREET)



PRELIMINARY POND LOCATION

14-07

14-06

14-05



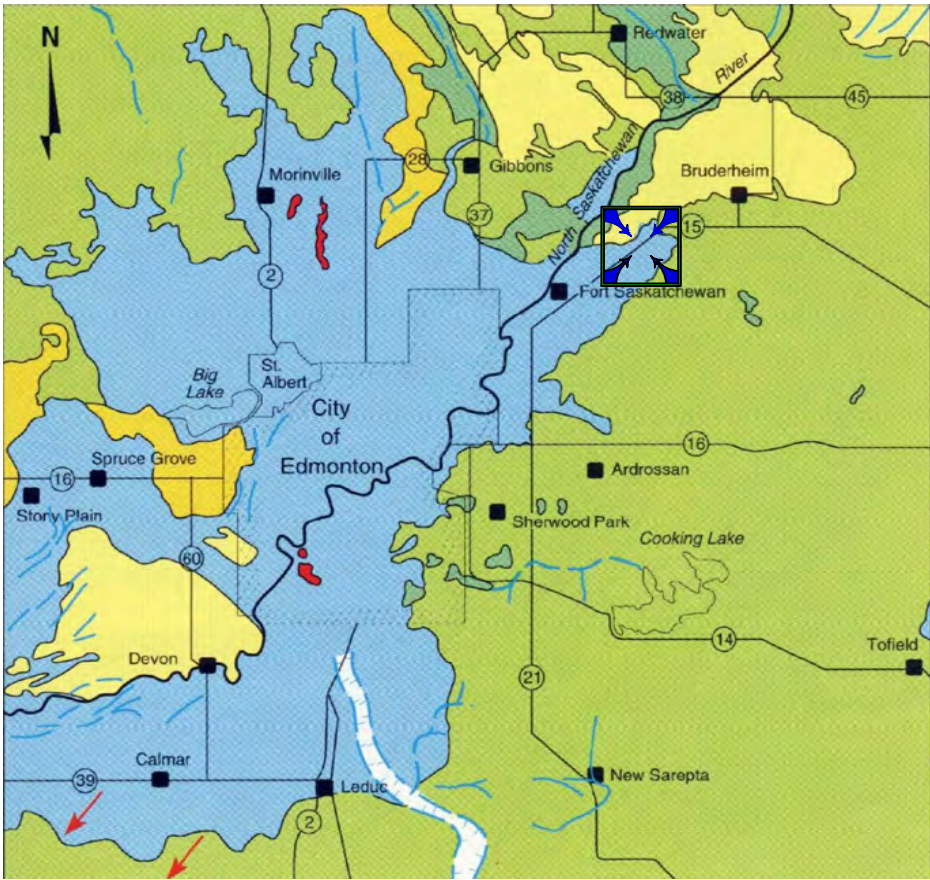
CLIENT:



SITE PLAN

PROPOSED INDUSTRIAL SUBDIVISION NW1/4 - 1 - 55 - 22 - W4M, NEAR FORT SASKATCHEWAN			
DRAWN: GL	CHK'D.: MK	REV #: 0	DATE: MARCH, 2014
SCALE: 1:5000	JOB NO. ED-1513	DRAWING NO. FIGURE 2	

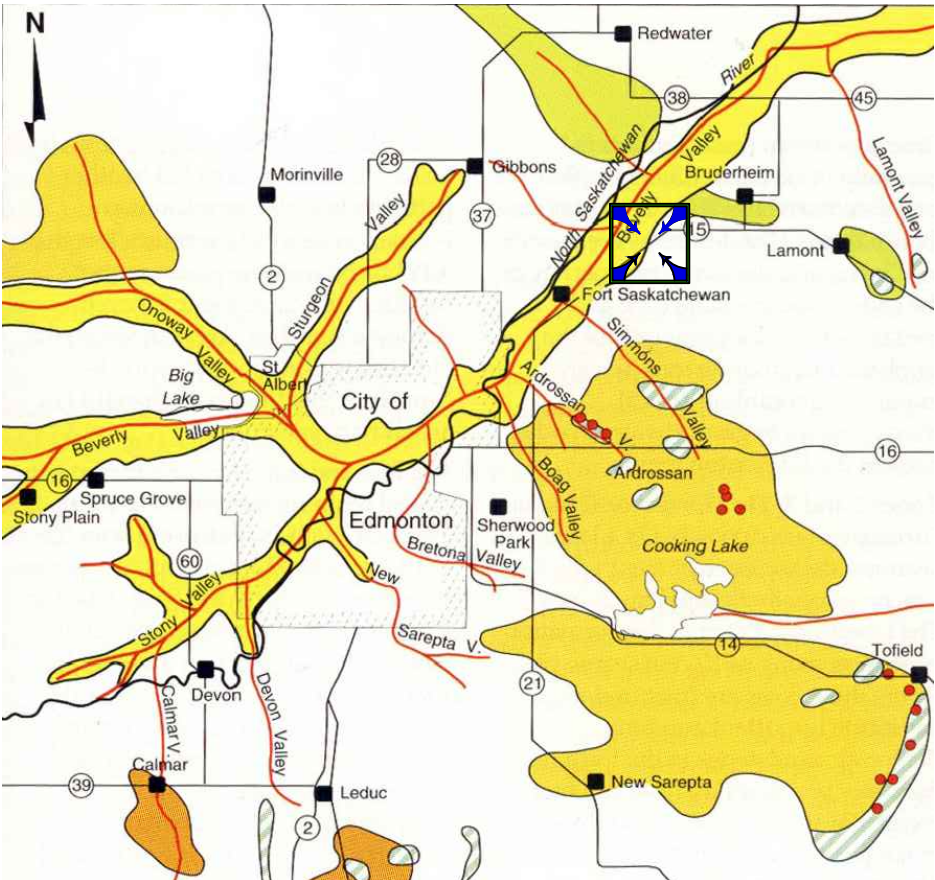
SURFICIAL GEOLOGY



0 10 20 30 km

-  Sand dunes with minor loess
medium- to fine-grained sand with silt
-  Glaciolacustrine deposits
variable, bedded sandy, silty clay; locally varved; pockets of till, sand or sandy gravel
-  Pitted delta
glaciofluvial sand with minor silt, occasional till pockets
-  Kame, esker
sand and gravel, commonly silty, with till inclusions
-  Outwash
gravel and sandy gravel, coarse- to medium-grained sand, up to 50% gravel
-  Moraine
till composed of clay, silt, sand with pebbles and boulders, minor lenses of sand and gravel
-  Glacial fluting
-  Meltwater channel (large)
-  Meltwater channel (small)

PRE-GLACIAL BURIED VALLEY SYSTEM, BEDROCK AQUIFERS
AND GROUNDWATER FEATURES



0 10 20 30 km

-  Thalweg of preglacial buried valley
-  Extent of buried valley aquifers (mainly Empress Formation)
- Formations and rock types comprising main bedrock aquifers
 -  Upper Horseshoe Canyon Formation (fractured sandstone)
 -  Lower Horseshoe Canyon Formation (coal seams)
 -  Birch Lake Member (sandstones)
 -  Area of flowing wells
-  Spring



REV #	DATE	DETAILS
		
CLIENT: 		
SURFICIAL GEOLOGY AND GEOLOGICAL FEATURES		
PROPOSED INDUSTRIAL SUBDIVISION NW1/4 - 1 - 55 - 22 - W4M, NEAR FORT SASKATCHEWAN		
DRAWN: MMc	CHK'D.: RF	DATE: MARCH, 2014
SCALE: NTS	JOB NO. ED-1513	DRAWING NO. FIGURE 3

APPENDIX A

PARKLANDGEO BOREHOLE LOGS

EXPLANATION SHEETS

LABORATORY RESULTS

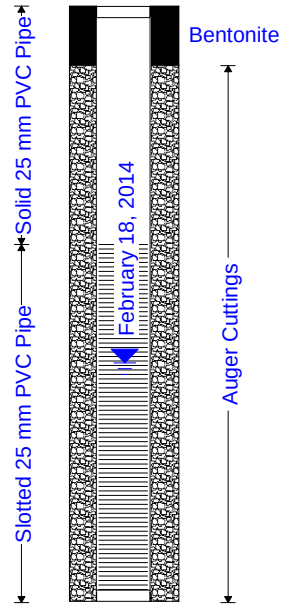


CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: Northern Borehole on Road

BOREHOLE NO.: 14-01

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%) (Wp ----- Wl) 25 50 75	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
		Asphalt	-0.3					
		Gravel Fill Well graded, hard, dry						
1		Clay Fill Little silt, trace sand, stiff, trace organics, dark brown						
2			-2.0					
3		Clay Some silt, trace sand, firm, laminated, medium to high plastic, rust staining, damp to moist, light brown		1U1				
4		Mottled grey with silt lenses at 3.0 m						
		Dark brown at 4.2 m						
5			-5.0	1D1		10		
		END OF BOREHOLE						
		Open and Dry upon Completion						
6								
7								
8								
9								
10								
11								



LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Truck Mounted Rig
 DATE: January 31, 2014

GROUND ELEVATION:
 NORTHING: 5955939
 EASTING: 358323



CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: Northern Borehole on Road

BOREHOLE NO.: 14-02

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
0.3		Asphalt	-0.3					
0.3		Gravel Fill Well graded, hard, dry						
1.8		Clay Fill Little silt, trace sand, stiff, trace organics, dark brown	-1.8					
2		Clay Some silt, trace sand, firm, laminated, medium to high plastic, rust staining, damp to moist, light brown with mottled grey						
3				2D1		7		
4								
5			-5.0	2D2		9		
5		END OF BOREHOLE Open and Dry upon Completion						
6								
7								
8								
9								
10								
11								

LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Truck Mounted Rig
 DATE: January 31, 2014

GROUND ELEVATION:
 NORTHING: 5955830
 EASTING: 358233

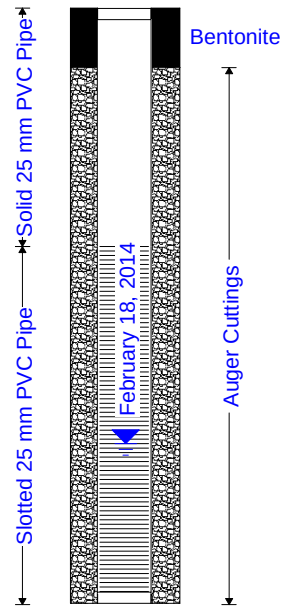


CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: Southern Borehole on Road

BOREHOLE NO.: 14-03

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%) (Wp -----x----- Wl) 25 50 75	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type			
0		GROUND SURFACE	0.0					
0.3		Asphalt	-0.3					
		Gravel Fill Well graded, hard, dry						
1		Clay Fill Little silt, trace sand, stiff, trace organics, dark brown						
1.7			-1.7	3U1				
2		Clay Some silt, trace sand, firm, laminated, medium to high plastic, rust staining, damp to moist, light brown with mottled grey						
3		Grey, silt pocket at 2.0 m						
4								
5			-5.0	3D1				
5		END OF BOREHOLE Open and Dry upon Completion						
6								
7								
8								
9								
10								
11								



PP: 150 kPa at 3.0 m

Lab Analysis at 4.5 m

Grain Size Distribution
 Gravel = 0.1 %
 Sand = 15.0 %
 Silt = 40.7 %
 Clay = 44.3 %

Atterbeg Limits
 W_L = 54 %
 W_P = 23 %
 P.I. = 31 %

LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Truck Mounted Rig
 DATE: January 31, 2014

GROUND ELEVATION:
 NORTHING: 5955722
 EASTING: 358232



CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: Southern Borehole on Road

BOREHOLE NO.: 14-04

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
0.3		Asphalt	-0.3					
0.3		Gravel Fill Well graded, hard, dry						
1.2		Clay Fill Little silt, trace sand, stiff, trace organics, dark brown	-1.2					
2.0		Clay Some silt, trace sand, firm, laminated, medium to high plastic, rust staining, damp to moist, light brown with mottled grey		4D1		7		
3.5		Dark grey and occasional sand lenses at 3.5 m						
5.0			-5.0	4D2		8		
5.0		END OF BOREHOLE Open and Dry upon Completion						
6.0								
7.0								
8.0								
9.0								
10.0								
11.0								

LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Truck Mounted Rig
 DATE: January 31, 2014

GROUND ELEVATION:
 NORTHING: 5955601
 EASTING: 358226



CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: Southwest Corner of 1/4 Section

BOREHOLE NO.: 14-05

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%) (Wp -----x----- Wl) 25 50 75	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
		Topsoil Organics, damp, black						
1		Clay Some silt, trace sand, firm, laminated, medium to high plastic, rust staining, damp to moist, light brown		5D1		10	28	
2		Mottled grey at 2.0 m					32	
		Medium brown at 2.7 m		5D2		7	33	
3		15 mm poorly graded sand lens at 3.0 m					37	
4		Stiff at 4.0 m		5D3		8	39	
5							36	
6				5D4		11	33	
7		5 mm well graded sand lens at 6.9 m					17	
				5D5		11	16	
8								
9			-8.9	5D6		14		
		Clay Till Some sand, some silt, very stiff, trace gravel, massive, low to medium plastic, rust staining, occasional coal chips, damp to moist, dark brown						
10			-10.4	5D7		20		
		END OF BOREHOLE						
11		Open and Dry upon Completion						

LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Track Mounted Rig
 DATE: January 29, 2014

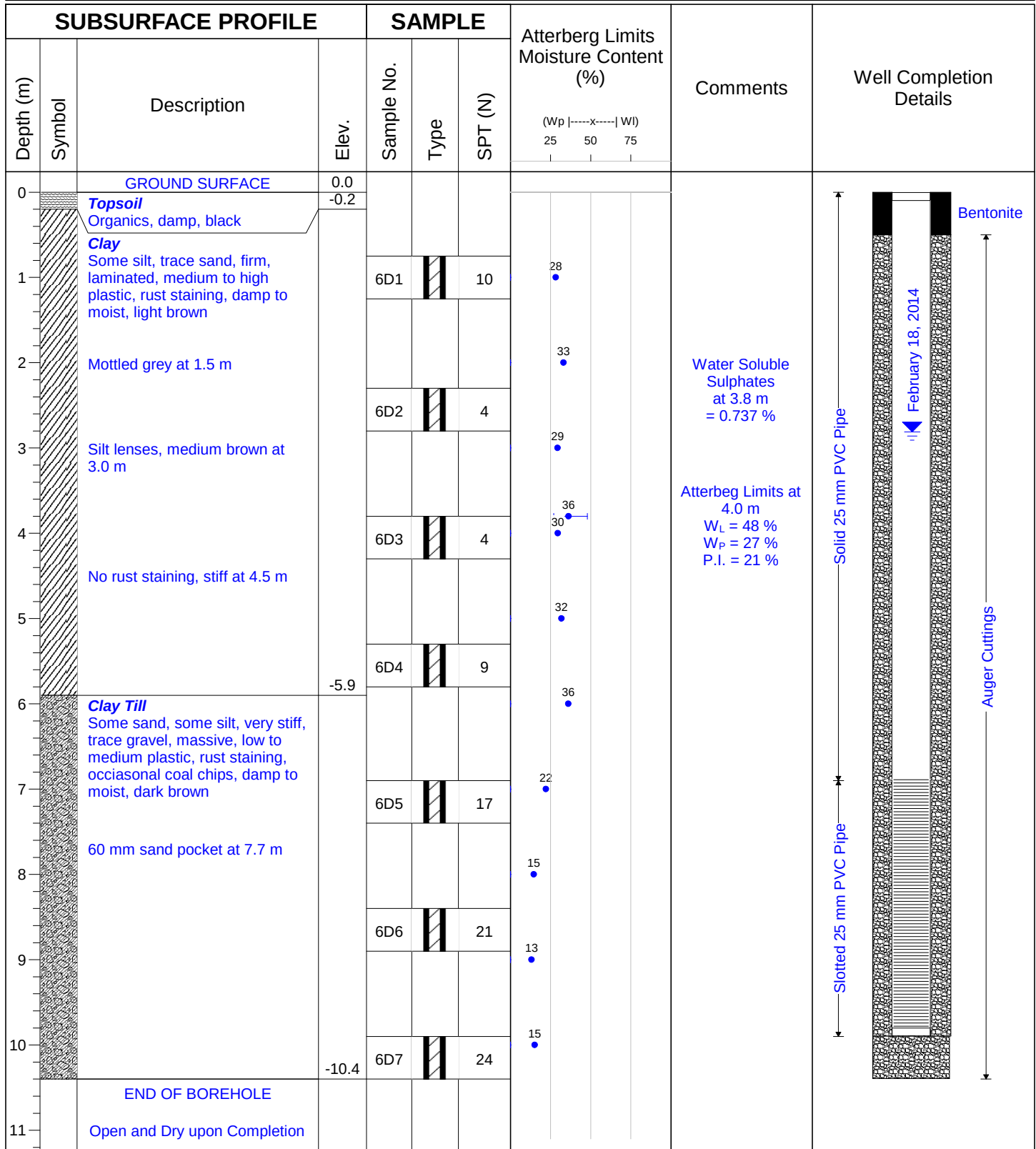
GROUND ELEVATION:
 NORTHING: 5954922
 EASTING: 358247



CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: Southeast Corner of 1/4 Section

BOREHOLE NO.: 14-06

PROJECT NO.: ED1513



LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Track Mounted Rig
 DATE: January 29, 2014

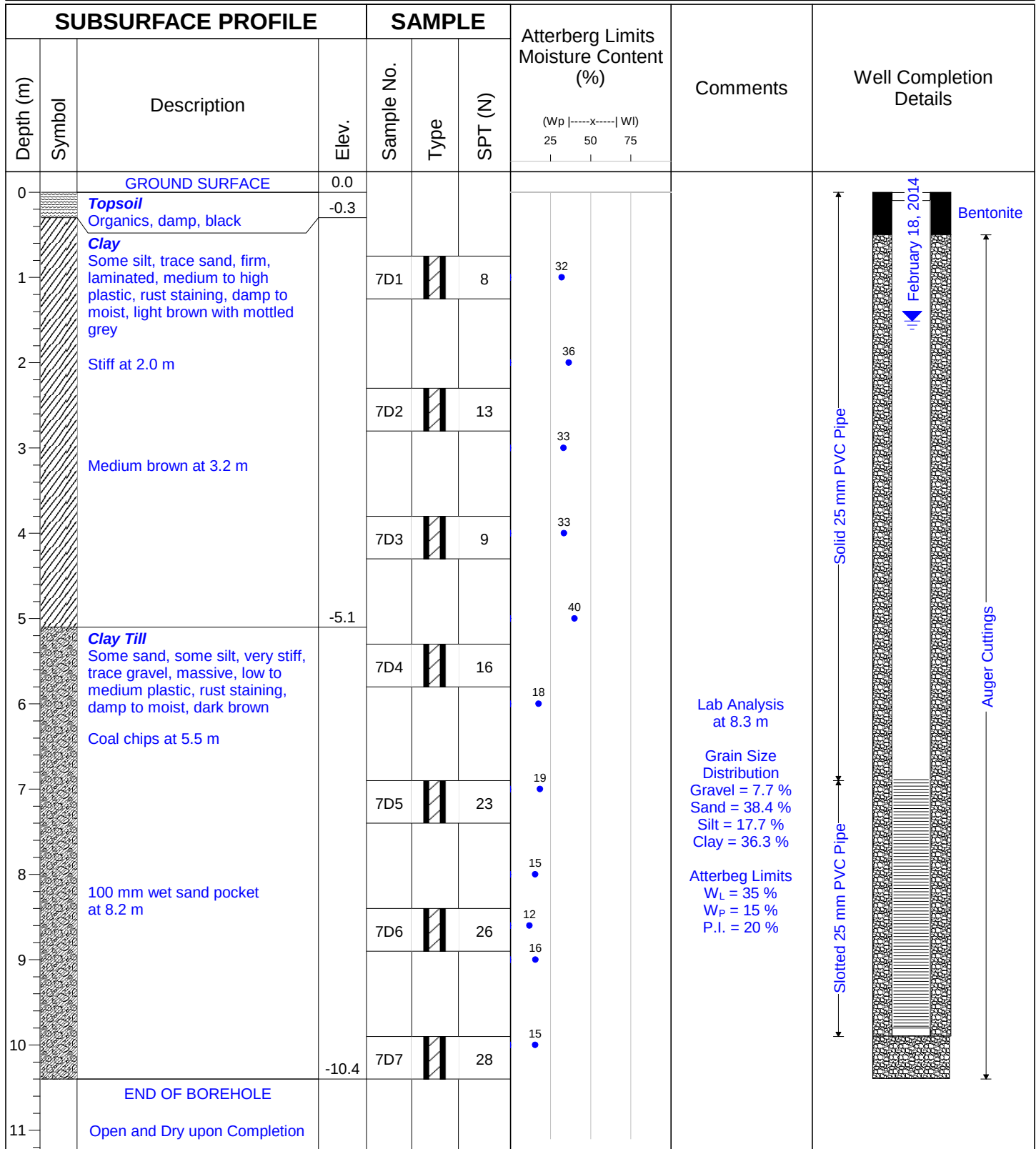
GROUND ELEVATION:
 NORTHING: 5954945
 EASTING: 358933



CLIENT: Trans America Developments Ltd.
 SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta
 BH LOCATION: East Side of 1/4 Section

BOREHOLE NO.: 14-07

PROJECT NO.: ED1513



LOGGED BY: GL
 CONTRACTOR: SPT Drilling Ltd.
 RIG/METHOD: Solid Stem Track Mounted Rig
 DATE: January 29, 2014

GROUND ELEVATION:
 NORTHING: 5955249
 EASTING: 358993



CLIENT: Trans America Developments Ltd.

SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta

BH LOCATION: West of Proposed Storm Water Pond

BOREHOLE NO.: 14-08

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%) (Wp -----x----- Wl) 25 50 75	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
		Topsoil Organics, damp, black	-0.2					
1		Clay Some silt, trace sand, stiff, laminated, medium to high plastic, rust staining, damp to moist, light brown		8U1			PP: 170 kPa at 1.0 m	
2								
3		Dark brown at 2.7 m		8D1		11	PP: 100 kPa at 3.0 m	
4								
5		15 mm silt lenses at 5.5 m						
6				8D2		13	PP: 70 kPa at 6.0 m	
7		END OF BOREHOLE	-6.6					
8		Open and Dry upon Completion						
9								
10								
11								

LOGGED BY: GL

CONTRACTOR: SPT Drilling Ltd.

RIG/METHOD: Solid Stem Track Mounted Rig

DATE: January 31, 2014

GROUND ELEVATION:

NORTHING: 5955282

EASTING: 358354



CLIENT: Trans America Developments Ltd.

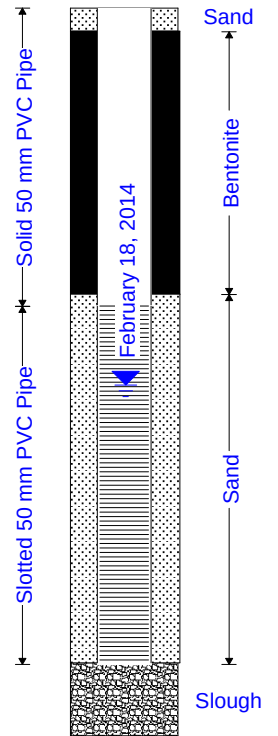
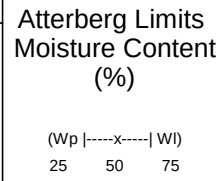
SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta

BH LOCATION: South of Proposed Storm Water Pond

BOREHOLE NO.: 14-09

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
0		Topsoil Organics, damp, black						
1		Clay Some silt, trace sand, stiff, laminated, medium to high plastic, rust staining, damp to moist, light brown						
2		Mottled grey at 1.9 m		9D1		13		
3		Stiff at 2.7 m						
3		Dark brown at 3.2 m		9U1				
4								
5		Silt lenses at 5.1 m		9D2		9		
6		END OF BOREHOLE	-6.1					
7		Open and Dry upon Completion						
8								
9								
10								
11								



LOGGED BY: GL

CONTRACTOR: SPT Drilling Ltd.

RIG/METHOD: Solid Stem Track Mounted Rig

DATE: January 31, 2014

GROUND ELEVATION:

NORTHING: 5955236

EASTING: 358397



CLIENT: Trans America Developments Ltd.

SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta

BH LOCATION: South-East of Proposed Storm Water Pond

BOREHOLE NO.: 14-10

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type			
0		GROUND SURFACE	0.0			(Wp ----- Wl) 25 50 75		
		Topsoil Organics, damp, black	-0.2					
1		Clay Some silt, trace sand, stiff, laminated, medium to high plastic, rust staining, damp to moist, light brown		10U1		19 27	PP: 170 kPa at 3.0 m	Solid 50 mm PVC Pipe
2		15 mm poorly graded sand lenses from 2.0 m to 2.7 m Stiff and dark grey at 2.3 m				33		
3		Dark brown at 3.2 m		10D1		38	PP: 110 kPa at 4.0 m	Slotted 50 mm PVC Pipe
4						39		
5		Poorly graded sand lens at 5.0 m				34	PP: 120 kPa at 6.0 m	Sand
6		Trace gravel at 6.5 m		10D2		35 41		
7		END OF BOREHOLE Open and Dry upon Completion	-6.6				Lab Analysis at 6.1 m Grain Size Distribution Gravel = 0.2 % Sand = 10.5 % Silt = 13.6 % Clay = 75.6 % Atterberg Limits W _L = 73 % W _P = 35 % P.I. = 38 % Water Soluble Sulphates = 0.737 %	Bentonite
8								
9								
10								
11								Slough

LOGGED BY: GL

CONTRACTOR: SPT Drilling Ltd.

RIG/METHOD: Solid Stem Track Mounted Rig

DATE: January 31, 2014

GROUND ELEVATION:

NORTHING: 5955258

EASTING: 358497



CLIENT: Trans America Developments Ltd.

SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta

BH LOCATION: North-West of Proposed Storm Water Pond

BOREHOLE NO.: 14-11

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
0		Topsoil Organics, damp, black						
1		Clay Some silt, trace sand, stiff, laminated, medium to high plastic, rust staining, damp to moist, light brown with mottled grey						
2				11D1		10		
3		Dark grey at 2.7 m Salt precipitates until 3.0 m						
4				11U1				
5		Occasional silt lens at 5.0 m Poorly graded sand lens at 5.0 m						
6								
7		END OF BOREHOLE Open and Dry upon Completion	-6.6	11D2		15		
8								
9								
10								
11								

LOGGED BY: GL

CONTRACTOR: SPT Drilling Ltd.

RIG/METHOD: Solid Stem Track Mounted Rig

DATE: January 31, 2014

GROUND ELEVATION:

NORTHING: 5955381

EASTING: 358382



CLIENT: Trans America Developments Ltd.

SITE: 1-55-22-W4M, Fort Saskatchewan, Alberta

BH LOCATION: North-East of Proposed Storm Water Pond

BOREHOLE NO.: 14-12

PROJECT NO.: ED1513

SUBSURFACE PROFILE			SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)		
0		GROUND SURFACE	0.0					
		Topsoil Organics, damp, black	-0.2					
1		Silt Some clay, soft, low plastic, crumbly, dry to damp, light grey	-1.0					
2		Clay Some silt, trace sand, stiff, laminated, medium to high plastic, rust staining, damp to moist, light brown		12D1		9		
3		Mottled grey at 2.0 m Medium grey at 2.7 m		12U1			PP: 150 kPa at 3.0 m	
4							PP: 140 kPa at 4.0 m	
5		Dark grey with occasional gravel at 5.1 m		12D2		15	PP: 110 kPa at 5.0 m	
6		END OF BOREHOLE	-6.1				PP: 130 kPa at 6.0 m	
7		Open and Dry upon Completion						
8								
9								
10								
11								

LOGGED BY: GL

CONTRACTOR: SPT Drilling Ltd.

RIG/METHOD: Solid Stem Track Mounted Rig

DATE: January 31, 2014

GROUND ELEVATION:

NORTHING: 5955365

EASTING: 358525

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following two pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The materials, boundaries, and conditions have been established only at the borehole location at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile usually have gradual rather than distinct unit boundaries as shown on the borehole logs.

- 1. PRINCIPAL SOIL TYPE** – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt & Clay	Smaller than 0.075 mm

- 2. DESCRIPTION OF MINOR SOIL TYPE** – Minor soil types are identified by weight of minor component.

Percent	Descriptor
35 to 50	and
20 to 35	some
10 to 20	little
1 to 10	trace

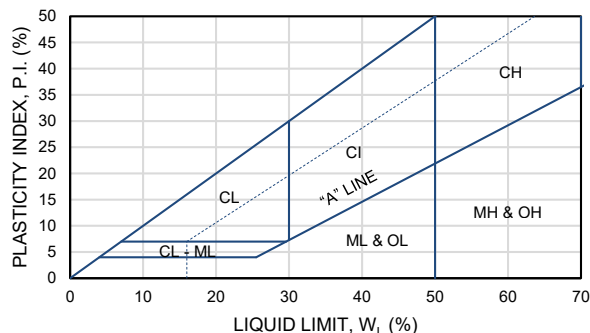
- 3. RELATIVE STRENGTH OF COARSE GRAINED SOIL** – The following terms are used relative to Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

Description	N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

- 4. CONSISTENCY OF FINE GRAINED SOILS** – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm. It is noted that this correlation needs to be used with caution as the correlation is only very approximate.

Description	Undrained Shear Strength, C_u (kPa)	N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS							
MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. LESS THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. LESS THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLECTIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLECTIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



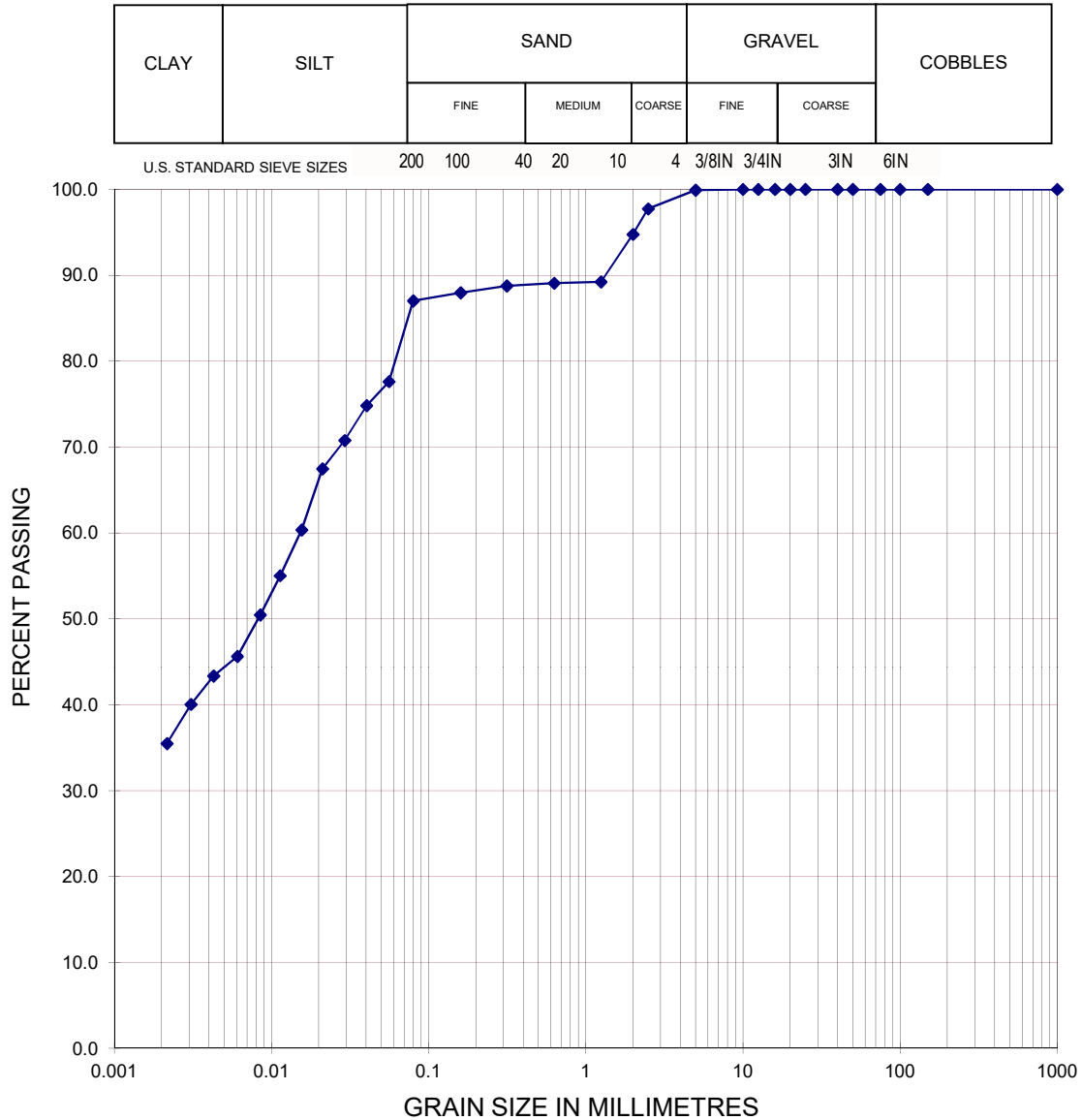
NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range by eight of minor components.



PROJECT Fort Saskatchewan Land Development
PROJECT # ED1513
BOREHOLE # 14-03 **DATE**
DEPTH 4.5 m **TECH** KG
SAMPLE # 3D1
LOCATION

GRAIN SIZE DISTRIBUTION



>0.075 mm = 15%

COMMENTS:

% Retained on 2 mm sieve 5.24%
 Soil Type

SUMMARY

D10 =	GRAVEL	0.10%
D30 =	SAND	14.94%
D60 =	SILT	40.71%
CU =	CLAY	44.25%
CC =		



PROJECT#
PROJECT
BOREHOLE
DEPTH
SAMPLE #
DATE
TECH

ED1513
Transamerica Ft Sask
14-3
4.5m
3D1
24-Feb-14
LK

SOIL PLASTICITY SUMMARY

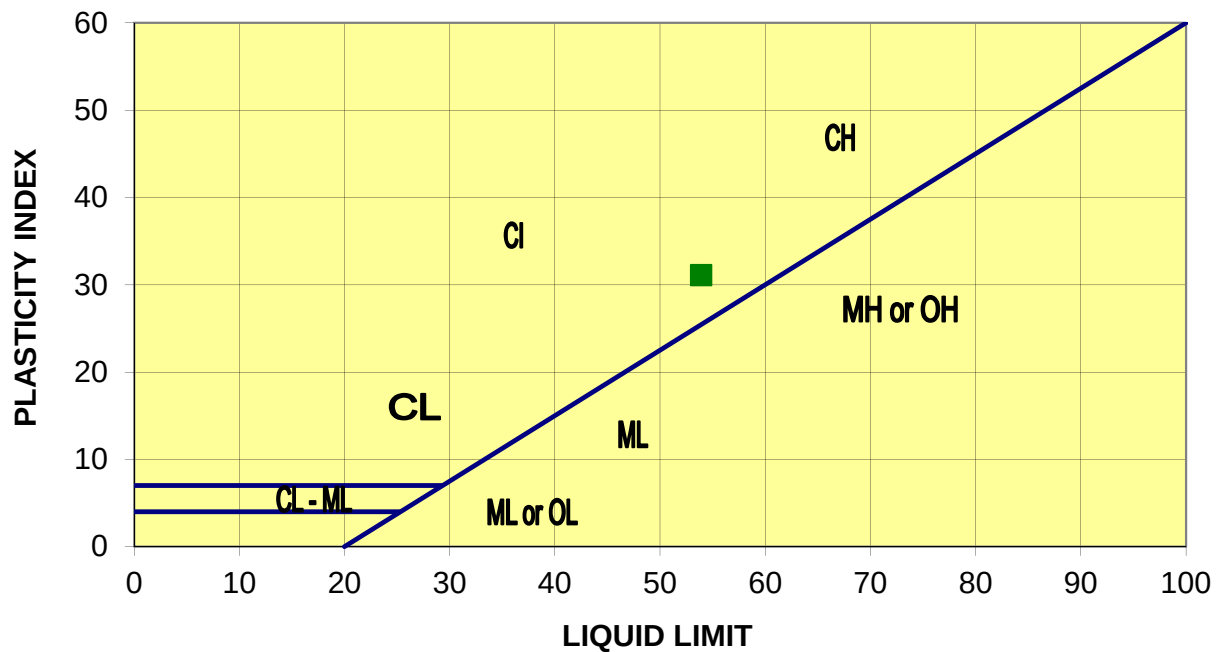
LIQUID LIMIT (LL)

Trial No.	1	2
No. Blows	20	20
Wt. Sample Wet + Tare	56.410	65.162
Wt. Sample Dry + Tare	46.715	52.367
Wt. Water	9.695	12.795
Tare Container	29.413	29.004
Wt. Dry Soil	17.302	23.363
Moisture Content	56.034	54.766
Corrected for Blow Count	54.541	53.307
Liquid Limit Average	53.9	

PLASTIC LIMIT (PL)

Trial No.	1	2	3
Wt. Wet Sample + Tare	13.832	13.936	16.550
Wt. Dry Sample+ Tare	13.325	13.396	15.546
Wt. Water	0.507	0.540	1.004
Tare Container	11.067	11.060	11.155
Wt. Dry Sample	2.258	2.336	4.391
Moisture Content	22.453	23.116	22.865
Plastic Limit Average	22.8		

PLASTICITY INDEX (PI) = LL-PL 31.1





PROJECT#	ED1513
PROJECT	Transamerica Ft Sask
BOREHOLE	14-6
DEPTH	3.6m
SAMPLE #	6D3
DATE	24-Feb-14
TECH	LK

SOIL PLASTICITY SUMMARY

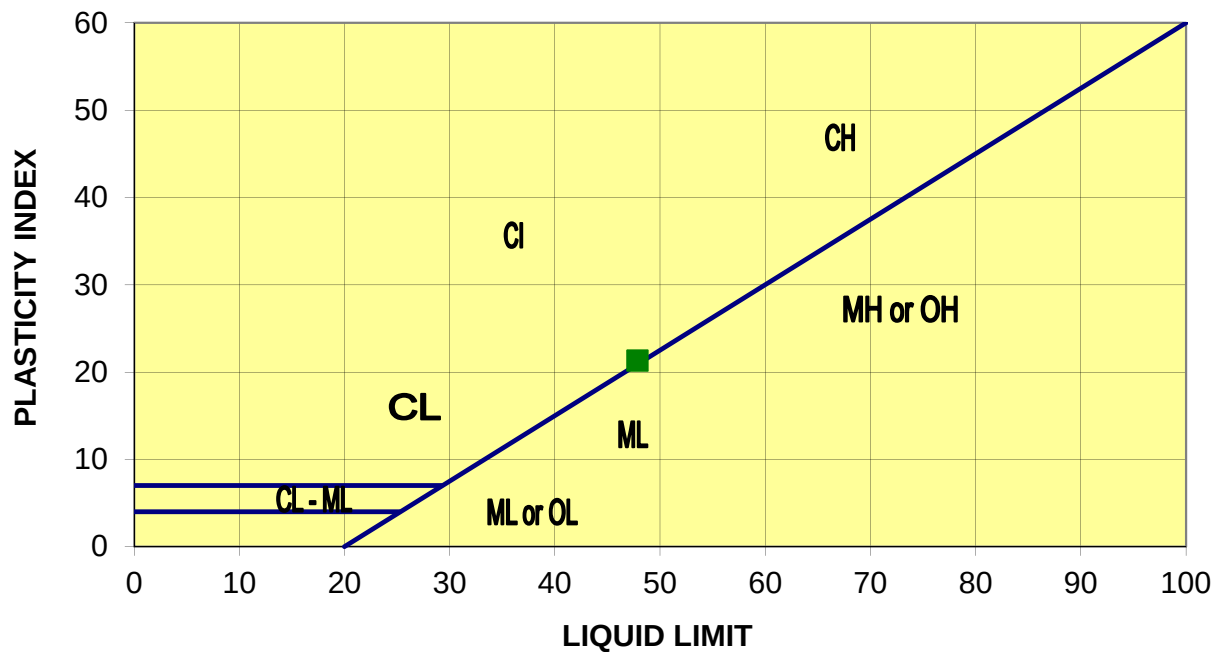
LIQUID LIMIT (LL)

Trial No.	1	2
No. Blows	20	20
Wt. Sample Wet + Tare	60.053	60.189
Wt. Sample Dry + Tare	49.925	49.981
Wt. Water	10.128	10.208
Tare Container	29.347	29.210
Wt. Dry Soil	20.578	20.771
Moisture Content	49.218	49.145
Corrected for Blow Count	47.906	47.836
Liquid Limit Average	47.9	

PLASTIC LIMIT (PL)

Trial No.	1	2	3
Wt. Wet Sample + Tare	14.897	18.483	16.550
Wt. Dry Sample+ Tare	14.094	16.922	15.432
Wt. Water	0.803	1.561	1.118
Tare Container	11.035	11.203	11.155
Wt. Dry Sample	3.059	5.719	4.277
Moisture Content	26.250	27.295	26.140
Plastic Limit Average	26.6		

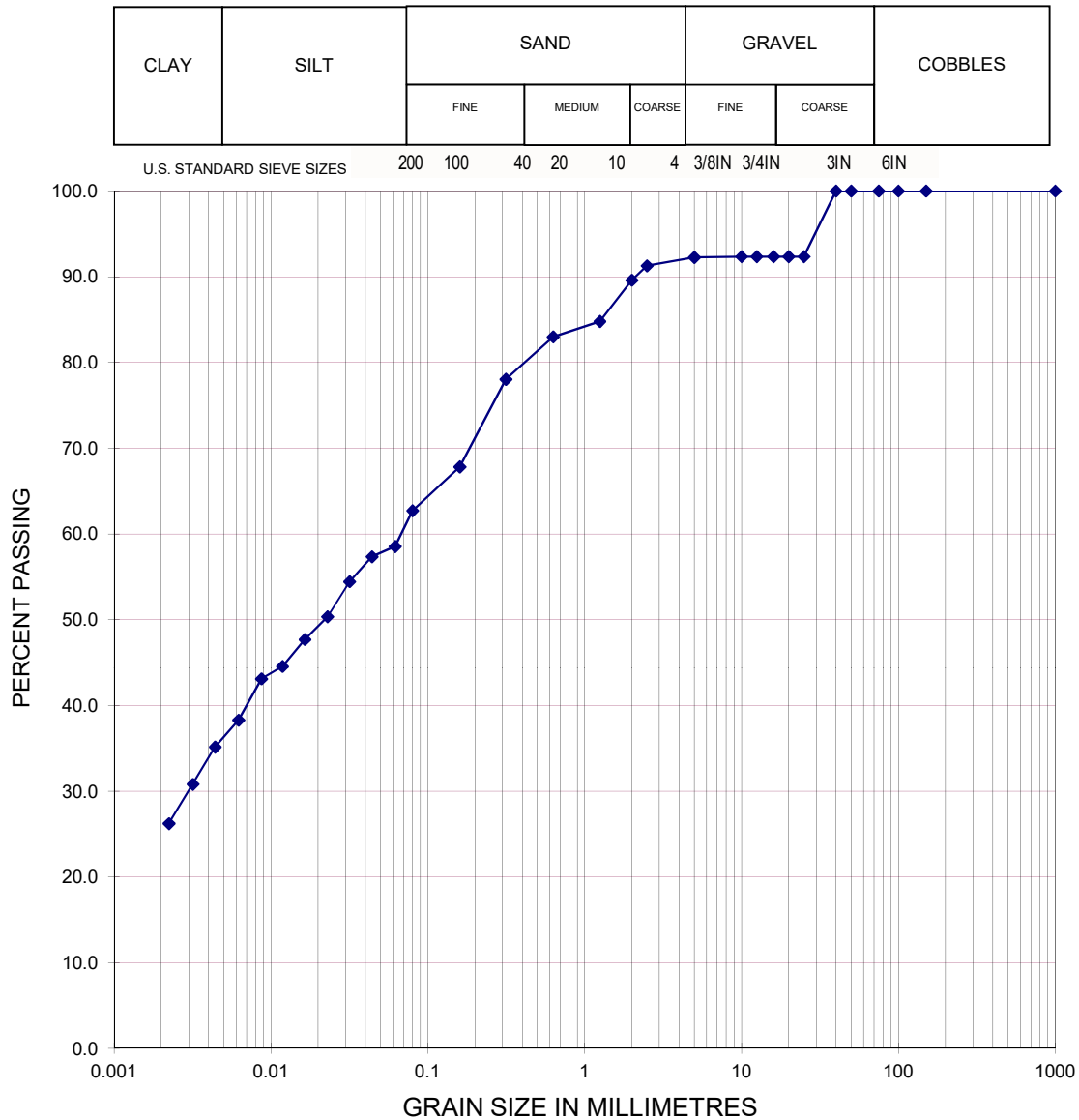
PLASTICITY INDEX (PI) = LL-PL 21.3





PROJECT Fort Saskatchewan Land Development
PROJECT # ED1513
BOREHOLE # 14-07 **DATE**
DEPTH 8.3 m **TECH**
SAMPLE # 7D6 **KG**
LOCATION

GRAIN SIZE DISTRIBUTION



>0.075 mm = 38%

COMMENTS:

% Retained on 2 mm sieve 10.40%
 Soil Type

SUMMARY

D10 =	GRAVEL	7.74%
D30 =	SAND	38.36%
D60 =	SILT	17.73%
CU =	CLAY	36.16%
CC =		



PROJECT#	ED1513
PROJECT	Transamerica Ft Sask
BOREHOLE	14-7
DEPTH	8.3m
SAMPLE #	7D6
DATE	24-Feb-14
TECH	LK

SOIL PLASTICITY SUMMARY

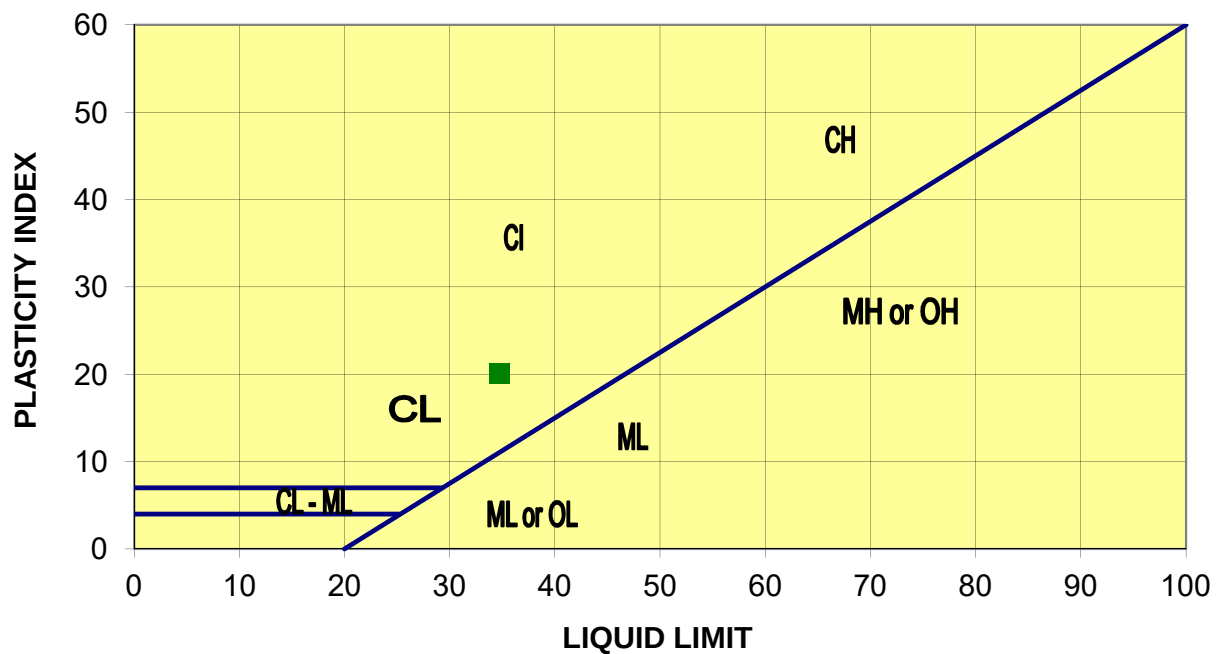
LIQUID LIMIT (LL)

Trial No.	1	2
No. Blows	30	30
Wt. Sample Wet + Tare	70.144	68.223
Wt. Sample Dry + Tare	59.713	58.387
Wt. Water	10.431	9.836
Tare Container	29.153	29.278
Wt. Dry Soil	30.560	29.109
Moisture Content	34.133	33.790
Corrected for Blow Count	34.894	34.544
Liquid Limit Average	34.7	

PLASTIC LIMIT (PL)

Trial No.	1	2	3
Wt. Wet Sample + Tare	16.446	17.329	16.550
Wt. Dry Sample+ Tare	15.784	16.536	15.855
Wt. Water	0.662	0.793	0.695
Tare Container	11.278	11.012	11.155
Wt. Dry Sample	4.506	5.524	4.700
Moisture Content	14.692	14.356	14.787
Plastic Limit Average	14.6		

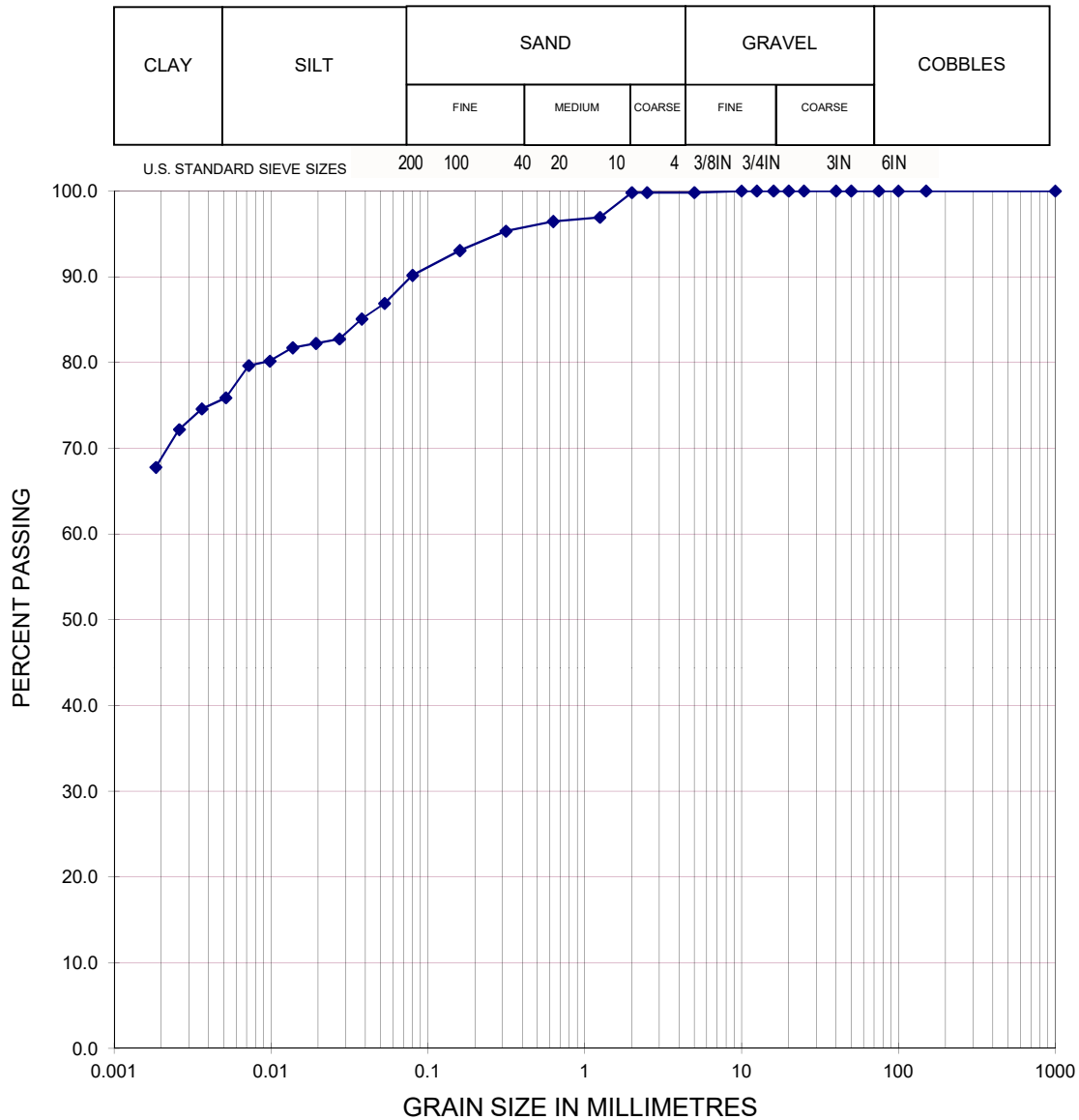
PLASTICITY INDEX (PI) = LL-PL 20.1





PROJECT Fort Saskatchewan Land Development
PROJECT # ED1513
BOREHOLE # 14-10 **DATE**
DEPTH 6.1 m **TECH** KG
SAMPLE # 10D2
LOCATION

GRAIN SIZE DISTRIBUTION



>0.075 mm = 10%

COMMENTS:

% Retained on 2 mm seive 0.18%
 Soil Type

SUMMARY

D10 =	GRAVEL	0.18%
D30 =	SAND	10.45%
D60 =	SILT	13.62%
CU =	CLAY	75.75%
CC =		



PROJECT#	ED1513
PROJECT	Transamerica Ft Sask
BOREHOLE	14-10
DEPTH	6.1
SAMPLE #	10D2
DATE	24-Feb-14
TECH	LK

SOIL PLASTICITY SUMMARY

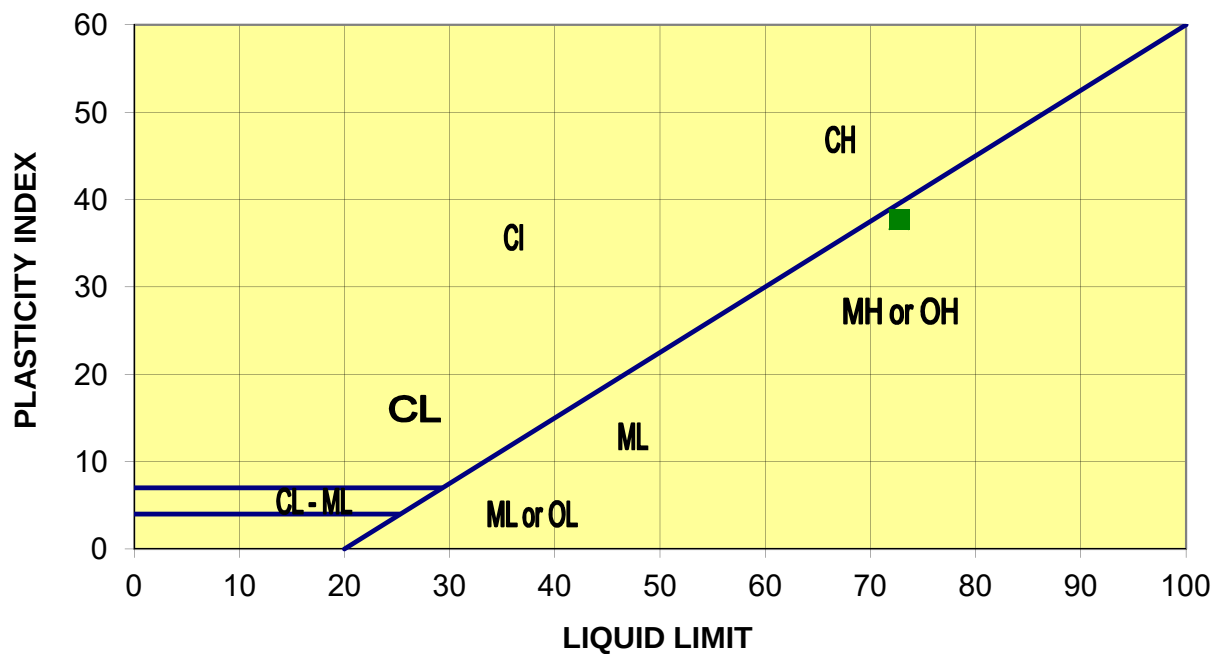
LIQUID LIMIT (LL)

Trial No.	1	2
No. Blows	30	30
Wt. Sample Wet + Tare	61.368	70.622
Wt. Sample Dry + Tare	47.911	53.435
Wt. Water	13.457	17.187
Tare Container	29.008	29.248
Wt. Dry Soil	18.903	24.187
Moisture Content	71.190	71.059
Corrected for Blow Count	72.778	72.644
Liquid Limit Average	72.7	

PLASTIC LIMIT (PL)

Trial No.	1	2	3
Wt. Wet Sample + Tare	13.861	14.482	16.550
Wt. Dry Sample+ Tare	13.138	13.598	15.155
Wt. Water	0.723	0.884	1.395
Tare Container	11.068	11.087	11.155
Wt. Dry Sample	2.070	2.511	4.000
Moisture Content	34.928	35.205	34.875
Plastic Limit Average	35.0		

PLASTICITY INDEX (PI) = LL-PL 37.7





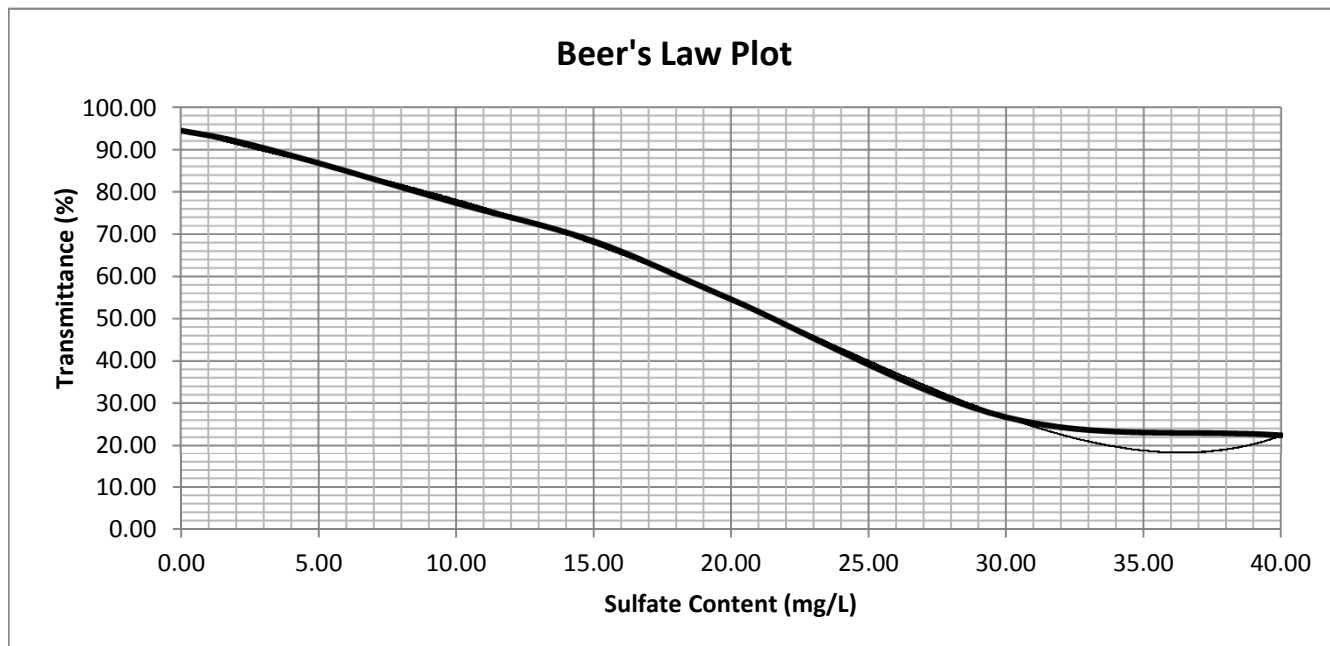
PROJECT	Transmission Land Development
PROJECT #	ED1513
BOREHOLE #	14-10
DEPTH	6.1
SAMPLE #	
DATE	3-Mar
TECH	NK

WATER SOLUBLE SULFATE CONTENT

INPUT		
Sample Name	Soil Weight (g)	Transmittance (%)
A1	30.1000	3.8
A2		21.8
B1	3.1000	56.2
B2		80.8

OUTPUT	
Sulfate Content (%)	0.737
Degree of Exposure*	SEVERE

*CSA A23.1 A23.2 2009 Table 3





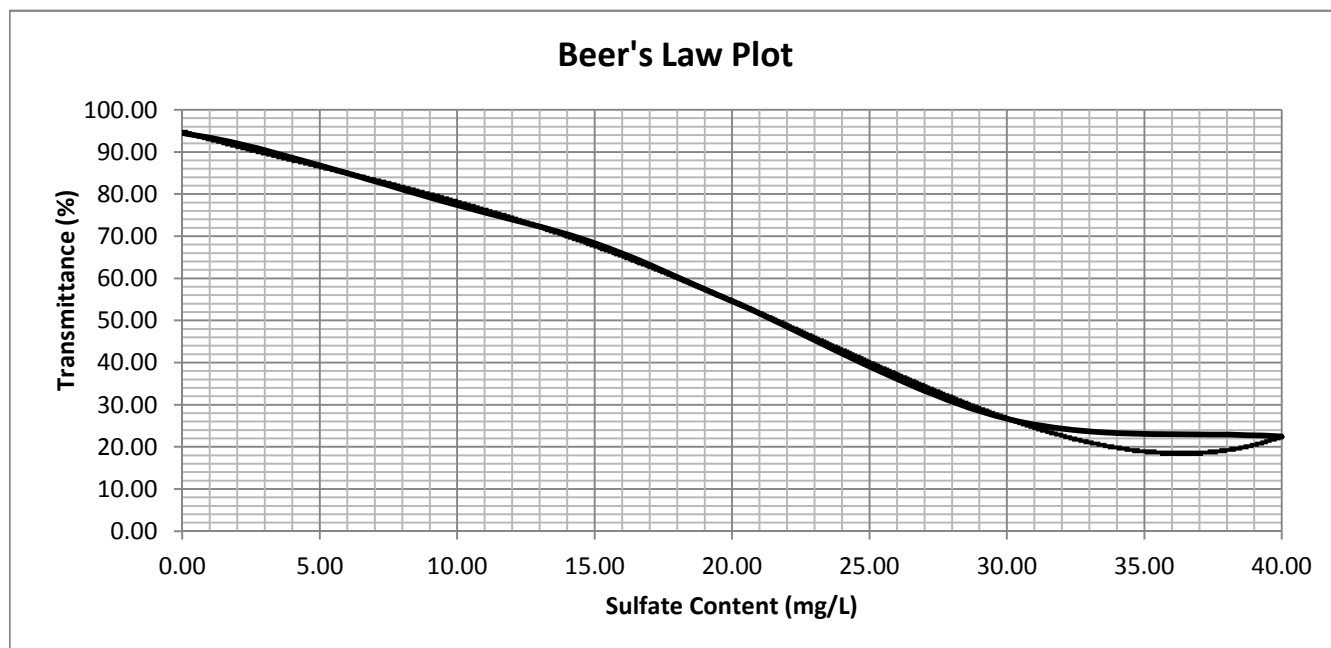
PROJECT	Transmission Land Development
PROJECT #	ED1513
BOREHOLE #	14-06
DEPTH	3.8m
SAMPLE #	
DATE	3-Mar
TECH	NK

WATER SOLUBLE SULFATE CONTENT

INPUT		
Sample Name	Soil Weight (g)	Transmittance (%)
A1	30.1000	48.9
A2	3.1000	70.1
B1	30.1000	90.2
B2	3.1	94.6

OUTPUT	
Sulfate Content (%)	0.578
Degree of Exposure*	SEVERE

*CSA A23.1 A23.2 2009 Table 3





CALIFORNIA BEARING RATIO TEST

PROJECT: TransAmerica Ft. Sask

PROJECT#: ED1513

TECH: LK+MEA

CLIENT: TransAmerica

SAMPLE #: BH's 1-4 @ 1.5-3m

LOCATION:

SOIL TYPE:

DATE: 13-Feb-14

PROCTOR TEST RESULTS

SPMDD = 1515 Kg/m³
Optimum MC = 23.5 %

APPARATUS PARAMETERS

Mold Diameter	15.22 cm	Mold Weight	4225.8 g
Mold Height	11.7 cm	Area of Piston	19.4 cm ²
Mold Volume	2128.65 cm ³		

SOAKED SAMPLE

Weight Mold + Sample	8294.7 g	Wet Density	1911.49 kg/m ³
% moisture	35.9	Dry Density	1406.54 kg/m ³
Initial Swell (in*0.001)	432	% Compaction	92.84
Final Swell (in*0.001)	577	% Swell	3.15
Surcharge Wt (lbs)	20	CBR =	2.3

Depth (mm)	Depth (inch)	Load (lb)	Force (kN)	Pressure (MPa)	CBR Value
0.0	0.00	0.0	0	0.00	
0.5	0.02	24.3	0.108222136	0.06	
1.0	0.04	42.5	0.189466773	0.10	
1.5	0.06	55.1	0.245606727	0.13	
2.0	0.08	63.4	0.282706364	0.15	
2.5	0.10	69.9	0.311779636	0.16	2.33
3.0	0.12	74.9	0.333807545	0.17	
4.0	0.16	82.5	0.367964182	0.19	
5.0	0.20	89.0	0.396948273	0.20	1.97
7.5	0.30	101.8	0.454113818	0.23	
10.0	0.40	112.4	0.501201818	0.26	
12.5	0.49	123.4	0.550341	0.28	



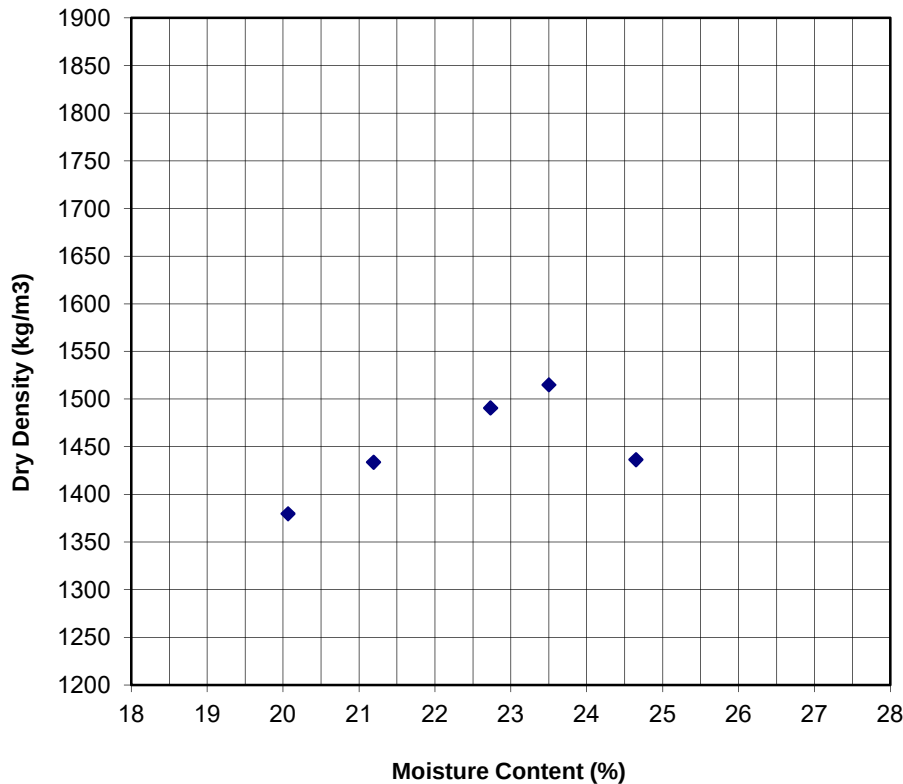
MOISTURE DENSITY RELATIONSHIP WORKSHEET

PROJECT Industrial Sub GEO PROJECT# ED1513
 CLIENT TransAmerica DATE 11-Feb-14

DRY DENSITY	SAMPLE NUMBER	1	2	3	4			DATE SAMPLED
	Wt. Sample Wet + Mold	6317.8	6355.4	6266.7	6188.4			CONTRACTOR
	Wt. Mold	4588	4588	4588	4588			SOURCE/LOCATION
	Wt. Sample Wet	1729.8	1767.4	1678.7	1600.4			SAMPLED BY
	Volume Mold	966	966	966	966			
	Wet Density kg/m3	1791	1830	1738	1657			PROCTOR # <u>14-02</u>
	Dry Density kg/m3	1437	1491	1434	1380			

MOISTURE	CONTAINER NUMBER	A	B	C	D		
	Wt. Sample Wet + Tare	210.4	208.8	201.7	207.9		
	Wt. Sample Dry + Tare	172	173	169.3	175.8		
	Wt. Water	38.4	35.8	32.4	32.1		
	Tare Container	16.2	15.5	16.4	15.8		
	Wt. Dry Soil	155.8	157.5	152.9	160		
	Moisture Content	24.6	22.7	21.2	20.1		

PREPARATION DRY / MOIST COMPACTON STANDARD ASTM D698 x
 RAMMER TYPE AUTO /MANUAL ASTM D1557



SOIL TYPE: Clay

 COMMENTS _____

PERCENT RETAINED
 4.75 mm SIEVE 0
 19.0 mm SIEVE _____

MAXIMUM DRY DENSITY 1515 kg/m3 OPTIMUM MOISTURE CONTENT 23.5 %

TECHNICIAN NK CHECKED _____

APPENDIX B

OPUS STEWART WEIR (2013)
BOREHOLE LOGS

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-01				
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955860				
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358264				
SAMPLE TYPE		☒ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ☐ GRAB SAMPLE ☐ NO RECOVERY						
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (180mm), black, moist, frozen					
1			CLAY TILL, silty, sandy, brown, moist, high plasticity, stiff, trace gravel, coal specks, rust specks, some salts					
2	CH							
3								
4								
5			End of borehole at 4.5m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
6								

BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

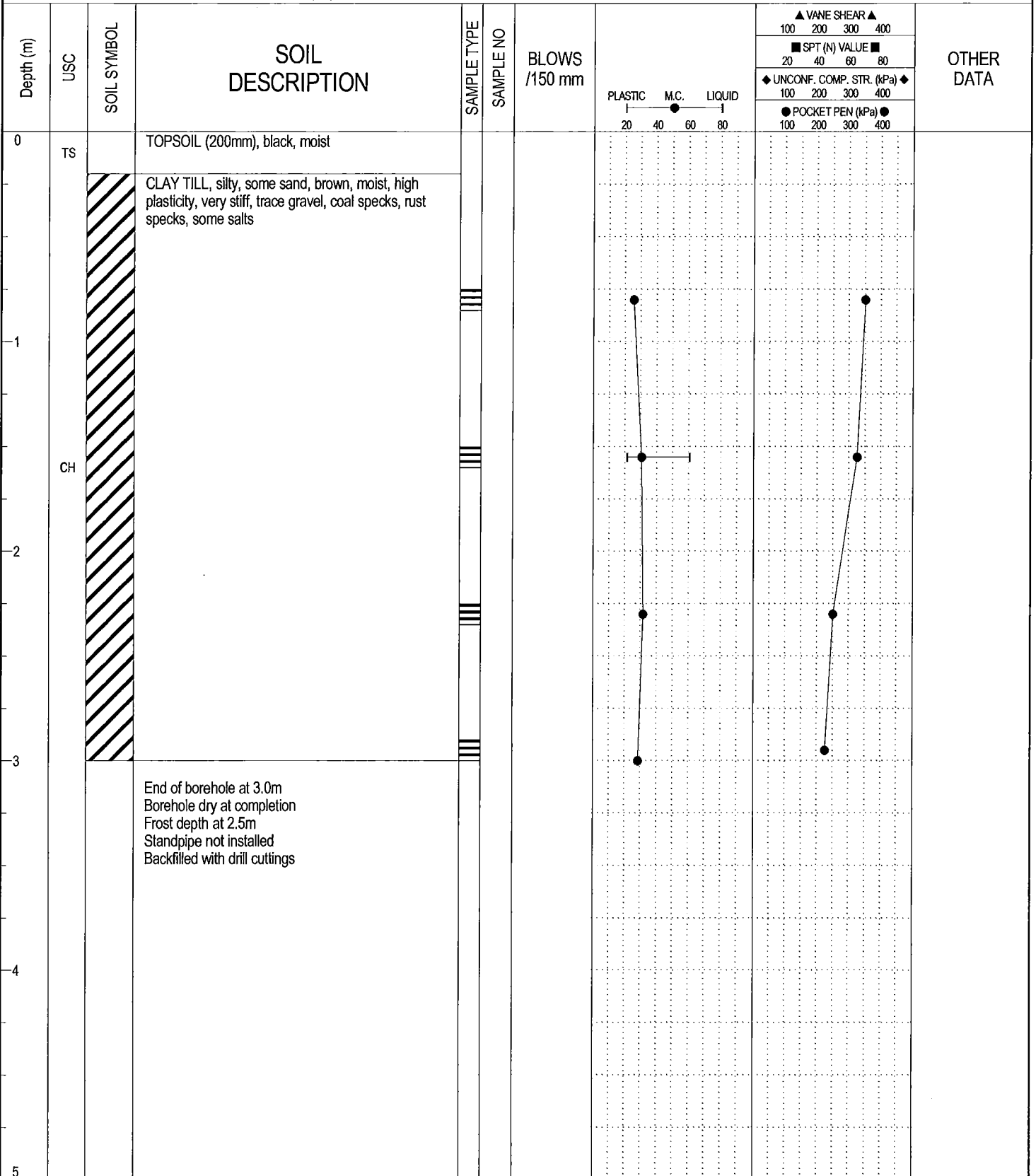
LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 4.50 m

COMPLETION DATE: 11/21/13

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-02
CLIENT: Cofely Fabricom Inc.			NORTHING: 5955934
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER	EASTING: 358399
SAMPLE TYPE	☒ SHELBY TUBE	☒ CORE SAMPLE	☒ SPT SAMPLE
		☒ GRAB SAMPLE	☐ NO RECOVERY



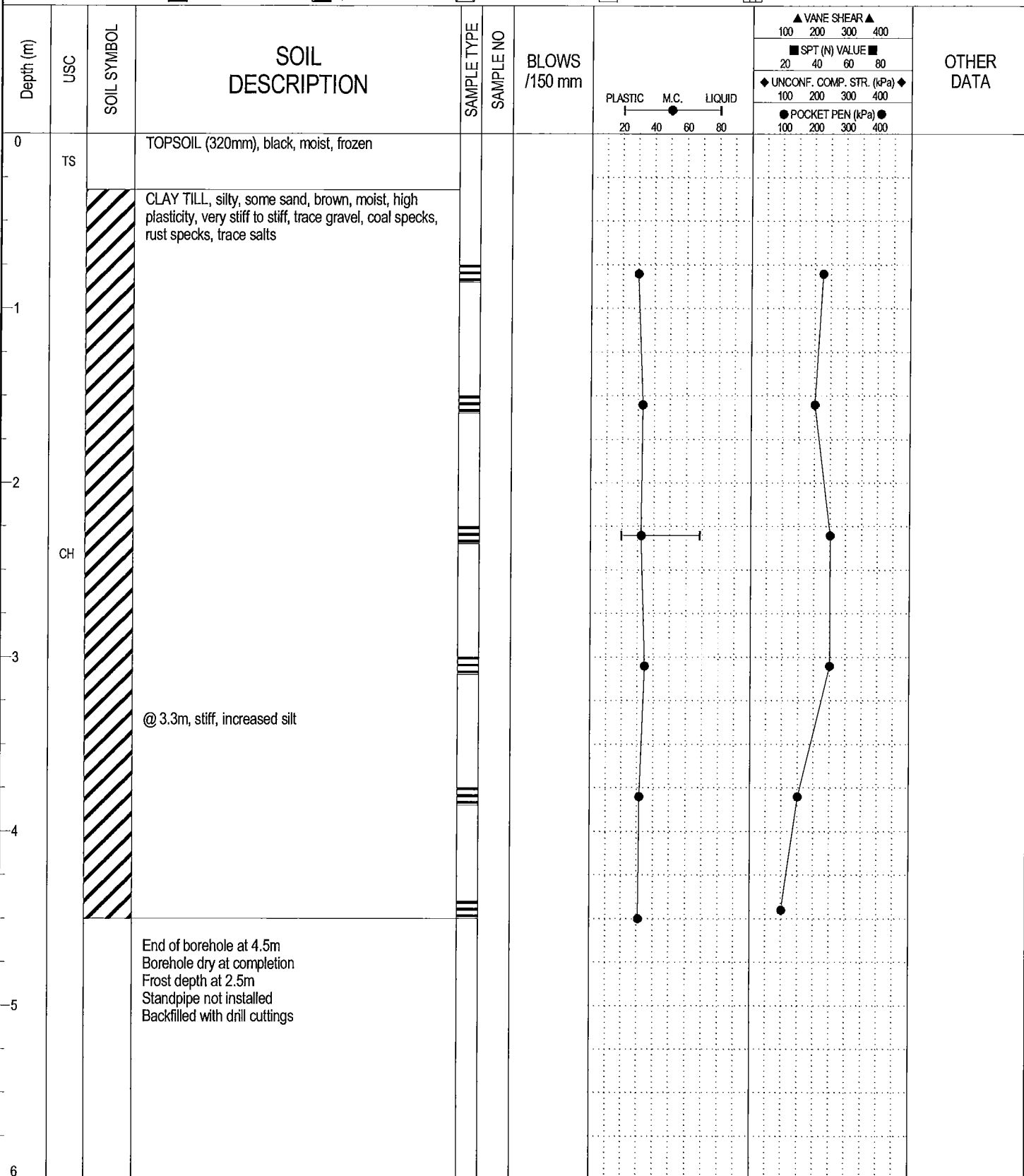
BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ	COMPLETION DEPTH: 3.00 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
Page 1 of 1	

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-03
CLIENT: Cofely Fabricom Inc.			NORTHING: 5956005
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER	EASTING: 358599
SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY			



BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



LOGGED BY: DJ	COMPLETION DEPTH: 4.50 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard	LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-04
CLIENT: Cofely Fabricom Inc.		NORTHING: 5956064
CONSULTANT PROJECT NO: ED51 36909 B	DRILL/METHOD: SOLID STEM AUGER	EASTING: 358797

SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY

Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	BLOWS /150 mm	PLASTIC	M.C.	LIQUID	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (320mm), black, moist, frozen								
1	CH		CLAY TILL, silty, some sand, brown, moist, high plasticity, very stiff, trace gravel, coal specks, rust specks, trace salts								
2											
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings								
4											
5											

BOREHOLE LOG ED67 36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

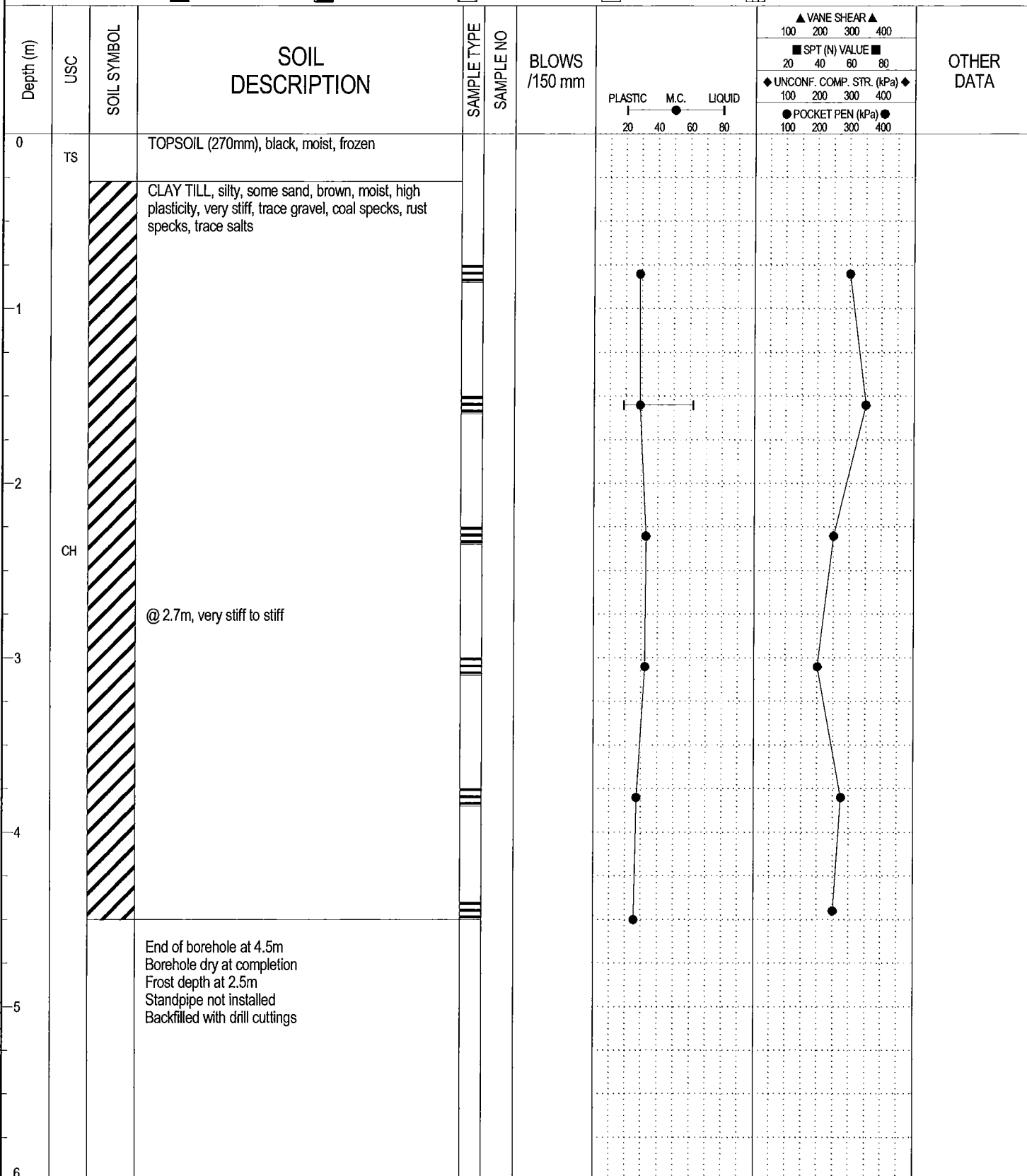
LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 3.00 m

COMPLETION DATE: 11/21/13

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-05
CLIENT: Cofely Fabricom Inc.			NORTHING: 5956122
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER	EASTING: 359017
SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY			



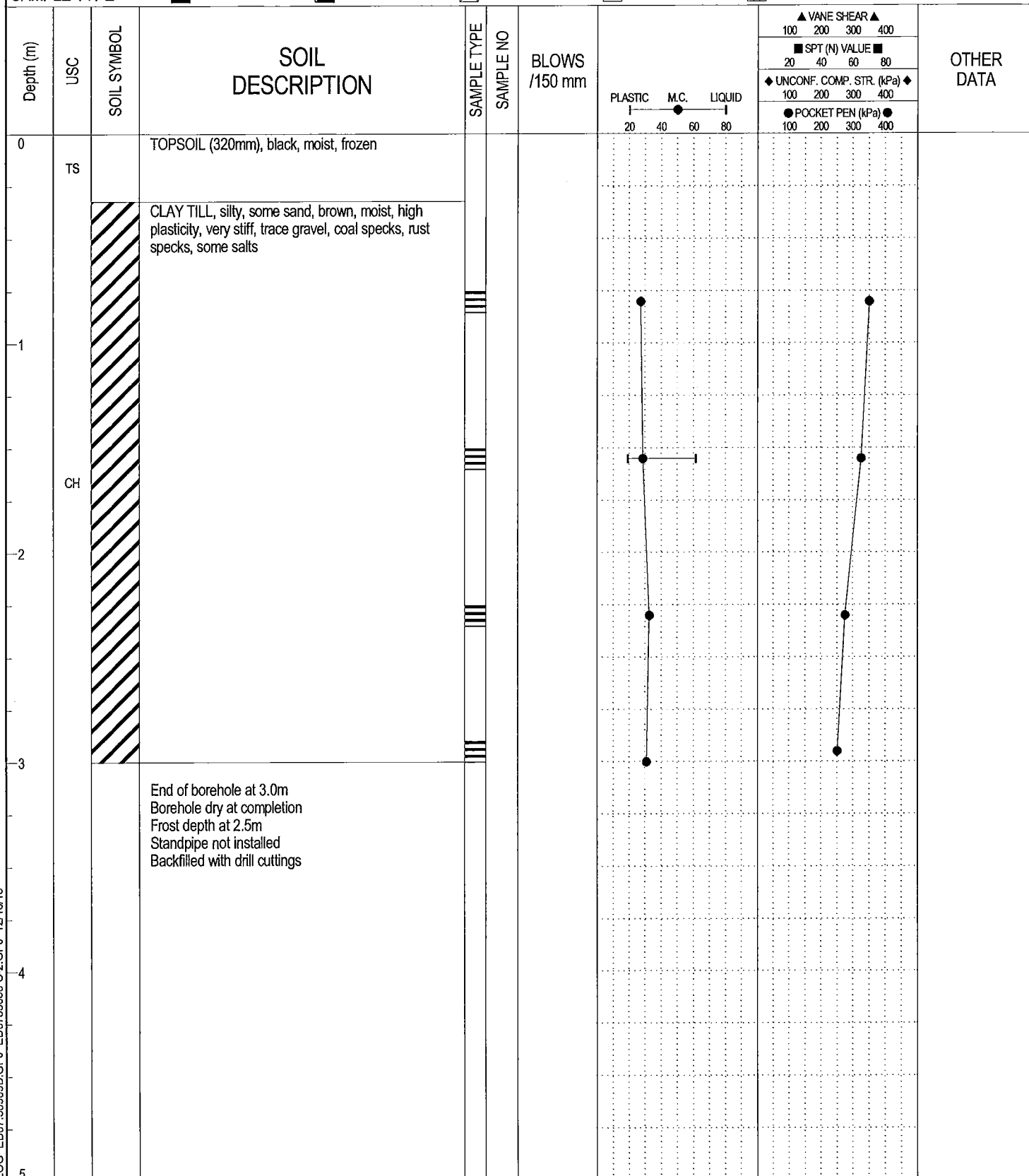
BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ	COMPLETION DEPTH: 4.50 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-06
CLIENT: Cofely Fabricom Inc.			NORTHING: 5955919
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER	EASTING: 359035
SAMPLE TYPE	☒ SHELBY TUBE	☒ CORE SAMPLE	☒ SPT SAMPLE
		☒ GRAB SAMPLE	☐ NO RECOVERY



BOREHOLE LOG ED67 36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ	COMPLETION DEPTH: 3.00 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-07				
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955888				
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358883				
SAMPLE TYPE		☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY						
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (230mm), black, moist, frozen					
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, hard, trace gravel, coal specks, rust specks, some salts					
2			@ 1.7m, very stiff to stiff					
3	CH							
4								
5			End of borehole at 4.5m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
6								


OPUS STEWART WEIR

LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 4.50 m

COMPLETION DATE: 11/21/13

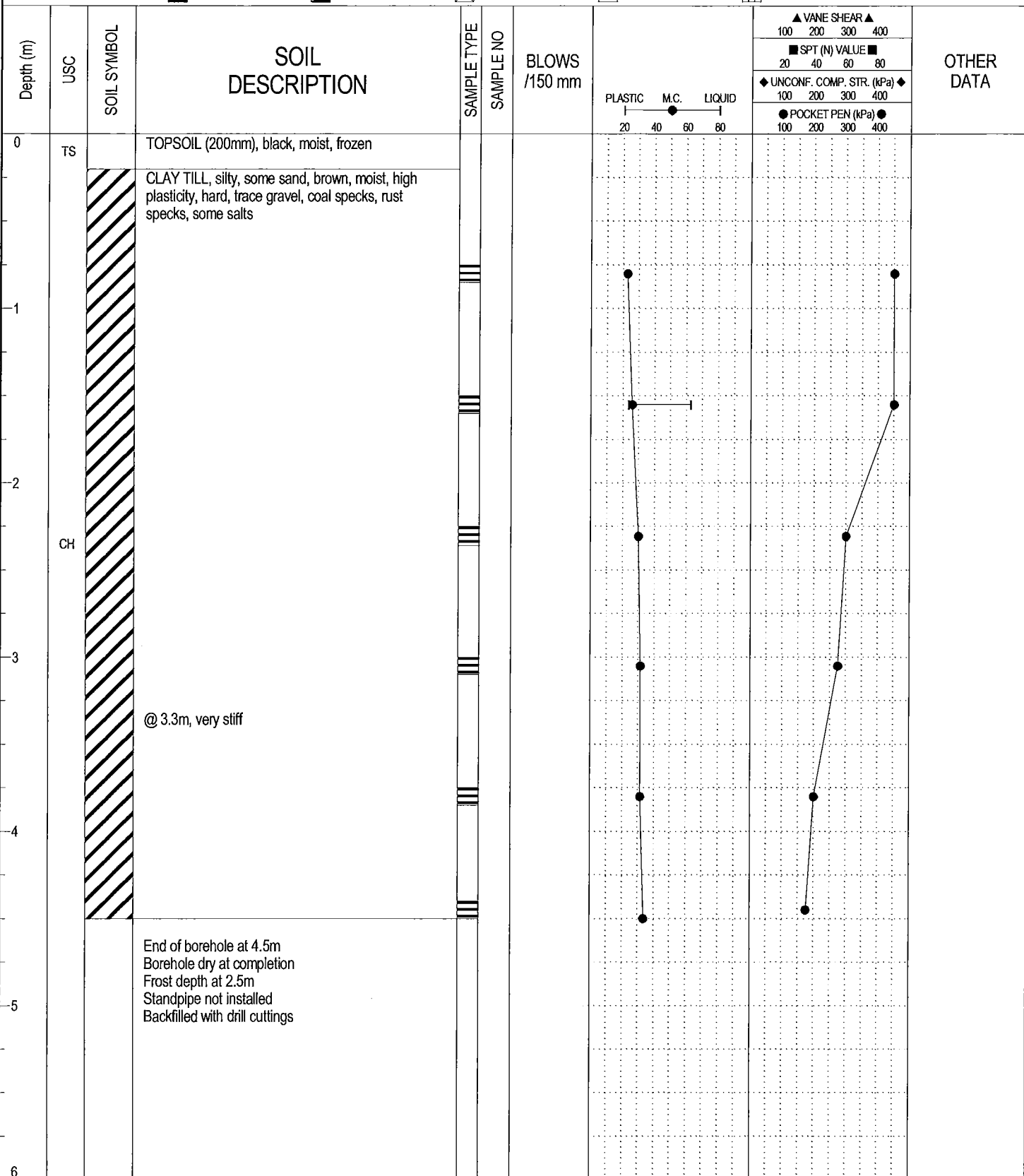
PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-08				
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955852				
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358679				
SAMPLE TYPE		☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY						
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (400mm), black, moist, frozen					
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, hard to very stiff, trace gravel, coal specks, rust specks, some salts					
2	CH							
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
4								
5								


OPUS STEWART WEIR

 LOGGED BY: DJ
 REVIEWED BY: NL

 COMPLETION DEPTH: 3.00 m
 COMPLETION DATE: 11/21/13

PROJECT: Proposed Fabrication Yard	LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-09
CLIENT: Cofely Fabricom Inc.		NORTHING: 5955817
CONSULTANT PROJECT NO: ED51 36909 B	DRILL/METHOD: SOLID STEM AUGER	EASTING: 358481
SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY		



BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



LOGGED BY: DJ	COMPLETION DEPTH: 4.50 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-10				
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955653				
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358257				
SAMPLE TYPE		☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY						
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (170mm), black, moist, frozen					
			CLAY TILL, silty, some sand, brown, moist, high plasticity, very stiff, trace gravel, coal specks, rust specks, some salts					
1								
	CH							
2								
3								
			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
4								
5								

BOREHOLE LOG ED67 36909B.GPJ ED6735036 C-2.GPJ 12/18/13

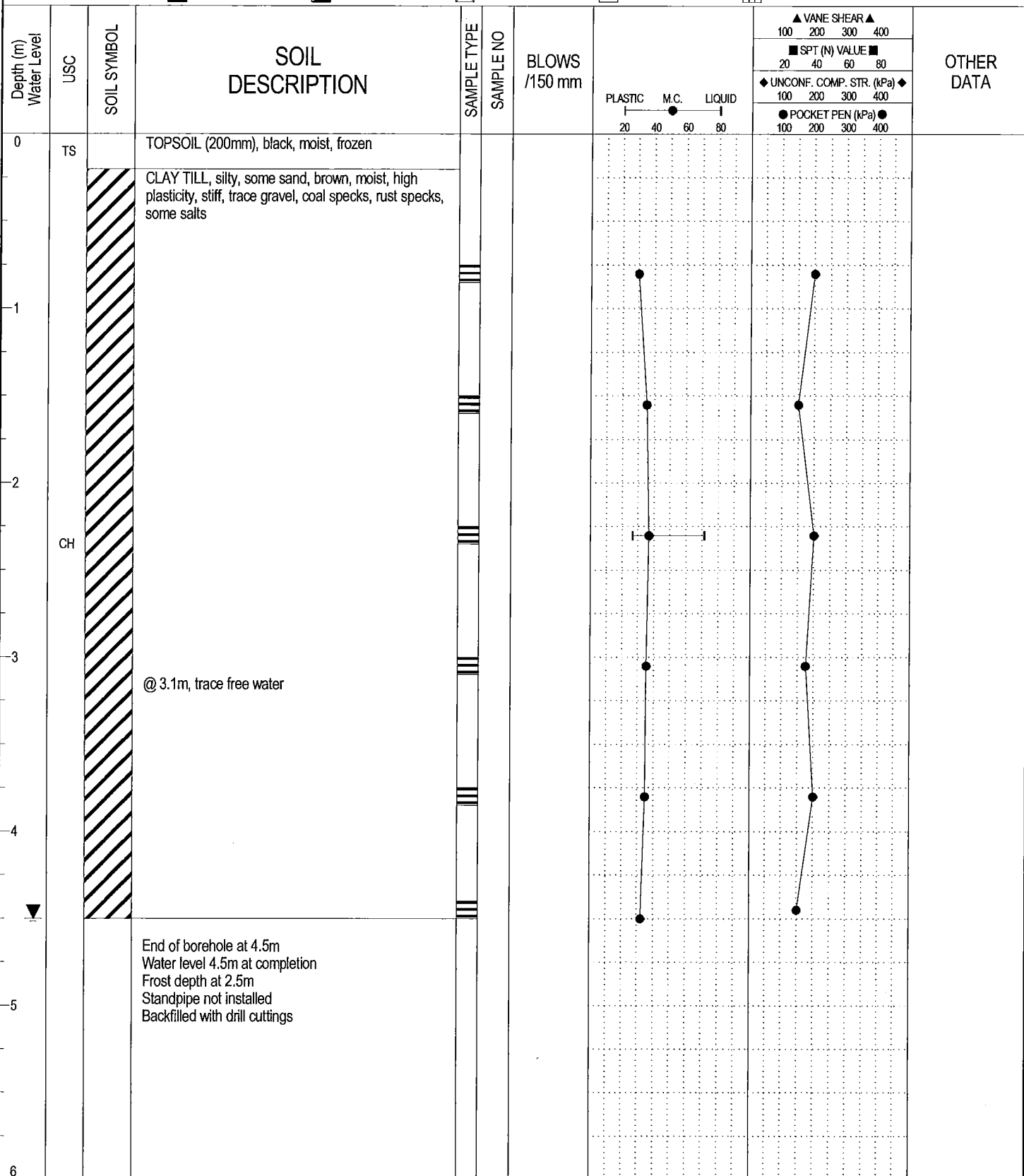


OPUS STEWART WEIR

LOGGED BY: DJ
REVIEWED BY: NL

COMPLETION DEPTH: 3.00 m
COMPLETION DATE: 11/21/13

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-11
CLIENT: Cofely Fabricom Inc.			NORTHING: 5955441
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER	EASTING: 358253
SAMPLE TYPE ☒ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ☐ GRAB SAMPLE ☐ NO RECOVERY			



BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



LOGGED BY: DJ	COMPLETION DEPTH: 4.50 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard	LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-12
CLIENT: Cofely Fabricom Inc.		NORTHING: 5955404
CONSULTANT PROJECT NO: ED51 36909 B	DRILL/METHOD: SOLID STEM AUGER	EASTING: 358448

SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY

Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC	M.C.	LIQUID	▲ VANE SHEAR ▲ 100 200 300 400	■ SPT (N) VALUE ■ 20 40 60 80	◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400	● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (330mm), black, moist, frozen											
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, very stiff to stiff, trace gravel, coal specks, rust specks, some salts											
2	CH													
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings											
4														
5														

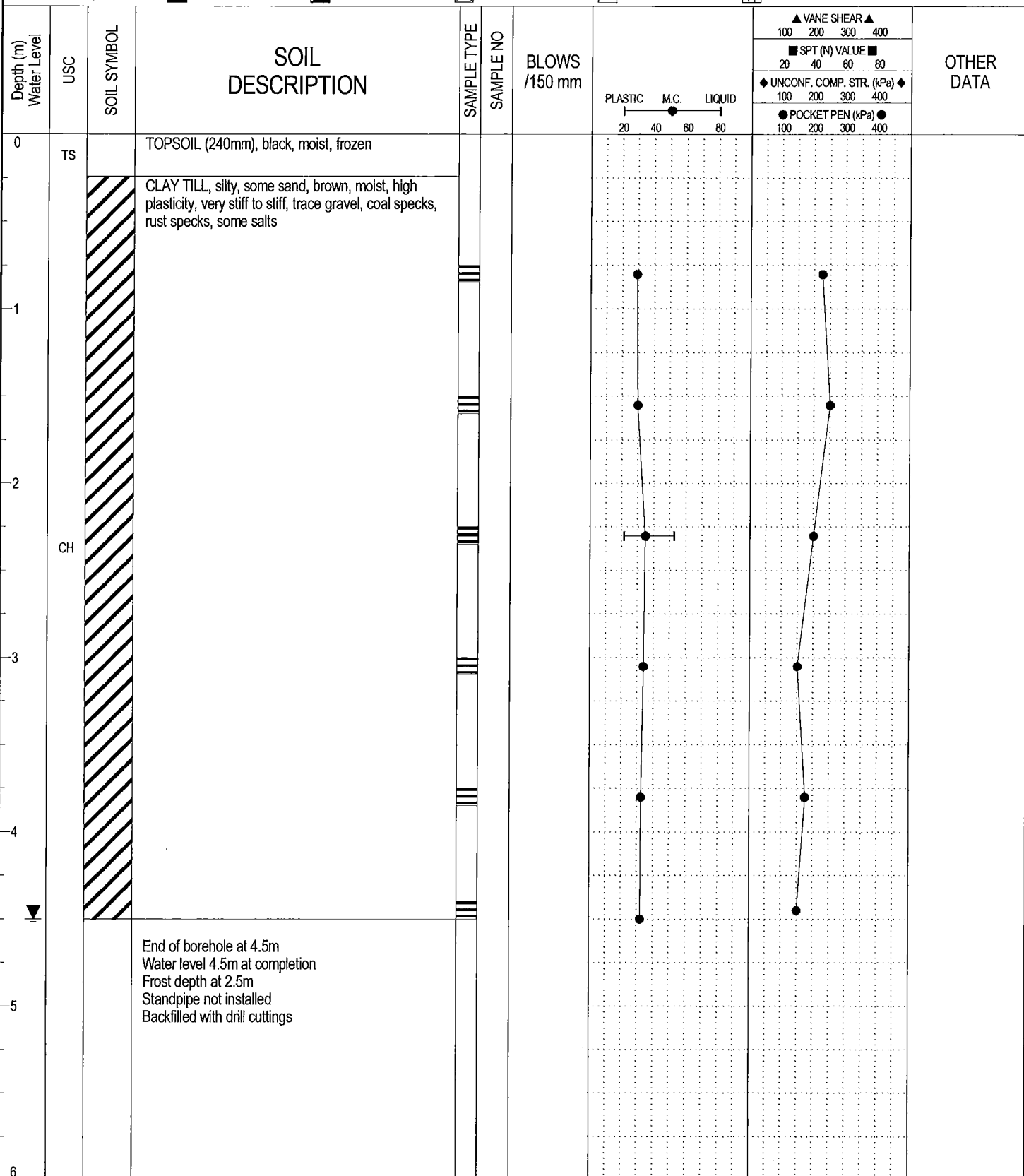
BOREHOLE LOG ED67-36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ	COMPLETION DEPTH: 3.00 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-13
CLIENT: Cofely Fabricom Inc.			NORTHING: 5955603
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER	EASTING: 358461
SAMPLE TYPE ☒ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ☐ GRAB SAMPLE ☐ NO RECOVERY			



BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



LOGGED BY: DJ	COMPLETION DEPTH: 4.50 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-14				
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955692				
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358800				
SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY								
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (230mm), black, moist, frozen					
			CLAY TILL, silty, some sand, brown, moist, high plasticity, very stiff, trace gravel, coal specks, rust specks, some salts					
1								
	CH							
2								
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
4								
5								

BOREHOLE LOG ED67-36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 3.00 m

COMPLETION DATE: 11/21/13

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-15				
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955501				
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358791				
SAMPLE TYPE ☒ SHELBY TUBE ☐ CORE SAMPLE ☒ SPT SAMPLE ☐ GRAB SAMPLE ☐ NO RECOVERY								
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (240mm), black, moist, frozen					
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, hard, trace gravel, coal specks, rust specks, trace salts					
2			@ 1.7m, very stiff					
3	CH							
4								
5			End of borehole at 4.5m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
6								

BOREHOLE LOG ED67.36909B.GPJ ED6735035 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 4.50 m

COMPLETION DATE: 11/21/13

PROJECT: Proposed Fabrication Yard		LOCATION: Fort Saskatchewan		BOREHOLE NO: 13-16	
CLIENT: Cofely Fabricom Inc.				NORTHING: 5955395	
CONSULTANT PROJECT NO: ED51 36909 B		DRILL/METHOD: SOLID STEM AUGER		EASTING: 358620	
SAMPLE TYPE		☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY			

Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID		▲ VANE SHEAR ▲ 100 200 300 400	■ SPT (N) VALUE ■ 20 40 60 80	◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400	POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (330mm), black, moist, frozen										
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, trace gravel, rust specks, coal specks, trace salts										
2	CH		@ 1.7m, very stiff										
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings										
4													
5													

BOREHOLE LOG ED67-36909B.GPJ ED6735036 C-2.GPJ 12/18/13

LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 3.00 m

COMPLETION DATE: 11/21/13

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BOREHOLE LOG ED67.36909B.GPJ ED6735035 C-2.GPJ 12/18/13

PROJECT: Proposed Fabrication Yard			LOCATION: Fort Saskatchewan			BOREHOLE NO: 13-17		
CLIENT: Cofely Fabricom Inc.						NORTHING: 5955288		
CONSULTANT PROJECT NO: ED51 36909 B			DRILL/METHOD: SOLID STEM AUGER			EASTING: 358776		
SAMPLE TYPE			☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY					
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (210mm), black, moist, frozen					
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, hard, trace gravel, coal specks, rust specks, trace salts					
2	CH		@ 1.7m, very stiff to stiff					
3								
4								
5			End of borehole at 4.5m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings					
6								


OPUS STEWART WEIR

LOGGED BY: DJ

REVIEWED BY: NL

COMPLETION DEPTH: 4.50 m

COMPLETION DATE: 11/21/13

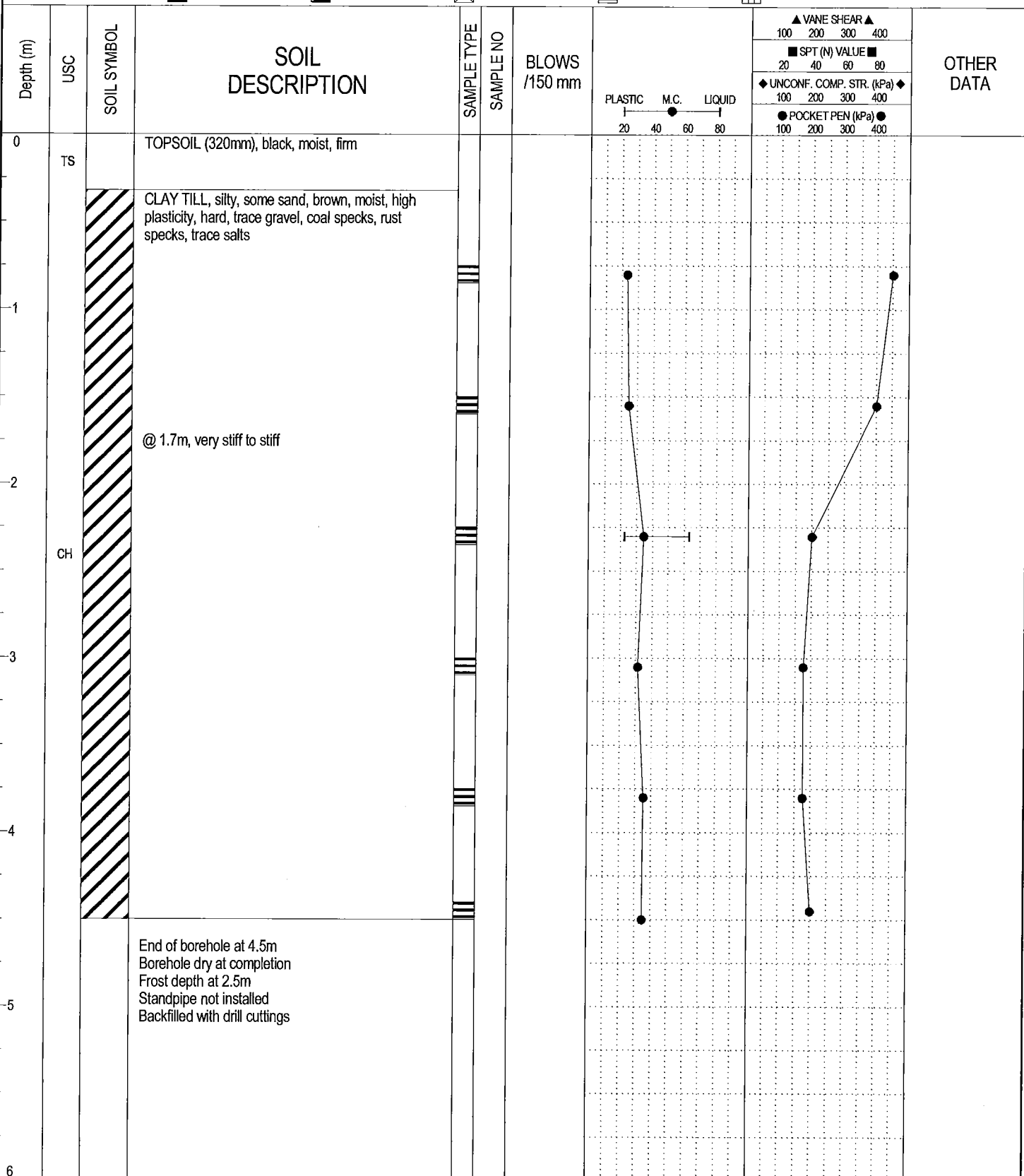
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PROJECT: Proposed Fabrication Yard			LOCATION: Fort Saskatchewan			BOREHOLE NO: 13-18		
CLIENT: Cofely Fabricom Inc.						NORTHING: 5955303		
CONSULTANT PROJECT NO: ED51 36909 B			DRILL/METHOD: SOLID STEM AUGER			EASTING: 359012		
SAMPLE TYPE			☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY					

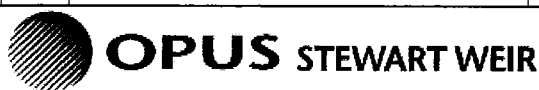
Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID 20 40 60 80	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (250mm), black, moist, frozen						
1	CH		CLAY TILL, silty, some sand, brown, moist, high plasticity, hard, trace gravel, coal specks, rust specks, trace salts						
2			@ 1.7m, very stiff to stiff						
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings						
4									
5									

BOREHOLE LOG ED67 36909B.GPJ ED6735036 C-2.GPJ 12/18/13	OPUS STEWART WEIR	LOGGED BY: DJ	COMPLETION DEPTH: 3.00 m
		REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard	LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-19
CLIENT: Cofely Fabricom Inc.		NORTHING: 5955521
CONSULTANT PROJECT NO: ED51 36909 B	DRILL/METHOD: SOLID STEM AUGER	EASTING: 359027
SAMPLE TYPE ☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY		



BOREHOLE LOG ED67.36909B.GPJ ED6735036 C-2.GPJ 12/18/13



LOGGED BY: DJ	COMPLETION DEPTH: 4.50 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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PROJECT: Proposed Fabrication Yard	LOCATION: Fort Saskatchewan	BOREHOLE NO: 13-20
CLIENT: Cofely Fabricom Inc.		NORTHING: 5955718
CONSULTANT PROJECT NO: ED51 36909 B	DRILL/METHOD: SOLID STEM AUGER	EASTING: 359032
SAMPLE TYPE	☒ SHELBY TUBE ☒ CORE SAMPLE ☒ SPT SAMPLE ☒ GRAB SAMPLE ☐ NO RECOVERY	

Depth (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC 20 40 60 80 M.C. LIQUID 20 40 60 80	▲ VANE SHEAR ▲ 100 200 300 400 ■ SPT (N) VALUE ■ 20 40 60 80 ◆ UNCONF. COMP. STR. (kPa) ◆ 100 200 300 400 ● POCKET PEN (kPa) ● 100 200 300 400	OTHER DATA
0	TS		TOPSOIL (330mm), black, moist, frozen						
1			CLAY TILL, silty, some sand, brown, moist, high plasticity, trace gravel, coal specks, rust specks, trace salts						
2	CH		@ 1.7m, very stiff to stiff						
3			End of borehole at 3.0m Borehole dry at completion Frost depth at 2.5m Standpipe not installed Backfilled with drill cuttings						
4									
5									

BOREHOLE LOG ED67 36909B.GPJ ED6735036 C-2.GPJ 12/18/13



OPUS STEWART WEIR

LOGGED BY: DJ	COMPLETION DEPTH: 3.00 m
REVIEWED BY: NL	COMPLETION DATE: 11/21/13
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LIMITATIONS

REPORT LIMITATIONS AND USAGE

The use of this attached report is subject to the following general terms and conditions.

1. **STANDARD OF CARE** - In the performance of professional services, ParklandGEO used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty expressed or implied is made in any manner.
2. **INTERPRETATION OF THE REPORT** - The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations and recommendation of ParklandGEO are based solely on the information available to him. Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities will be based on commonly accepted practices in geotechnical or environmental consulting practice in this area. ParklandGEO will not be responsible for the interpretation by others of the information developed.
3. **SITE INFORMATION** - The CLIENT has agreed to provide all information with respect to the past, present and proposed conditions and use of the Site, whether specifically requested or not. The CLIENT acknowledged that in order for ParklandGEO to properly advise and assist the CLIENT, ParklandGEO has relied on full disclosure by the CLIENT of all matters pertinent to the Site investigation.
4. **COMPLETE REPORT** - The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to ParklandGEO by the CLIENT, communications between ParklandGEO and the CLIENT, and to any other reports, writings or documents prepared by ParklandGEO for the CLIENT relative to the specific Site, all of which constitute the Report. The word "Report" shall refer to any and all of the documents referred to herein. In order to properly understand the suggestions, recommendations and opinions expressed by ParklandGEO, reference must be made to the whole of the Report. ParklandGEO cannot be responsible for use of any part or portions of the report without reference to the whole report. The CLIENT has agreed that "This report has been prepared for the exclusive use of the named CLIENT. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."

The CLIENT has agreed that in the event that any such report is released to a third party, the above disclaimer shall not be obliterated or altered in any manner. The CLIENT further agrees that all such reports shall be used solely for the purposes of the CLIENT and shall not be released or used by others without the prior written permission of ParklandGEO.

5. **LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER**
There is no warranty, expressed or implied, by ParklandGEO that:
 - a) the investigation uncovered all potential geo-hazards, contaminants or environmental liabilities on the Site; or
 - b) the Site is entirely free of all geo-hazards or contaminants as a result of any investigation or cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

The CLIENT acknowledged that:

- a) the investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
 - b) unless specifically stated in the agreed Scope of Work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
 - c) any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
 - d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
 - e) any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted; and
 - f) the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
 - g) there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently discovered as part of the investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials and in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.
6. **COST ESTIMATES** - Estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for construction or remediation are based on the known site conditions, which can vary as new information is discovered during construction. As some construction activities are an iterative exercise, ParklandGEO shall therefore not be liable for the accuracy of any estimates of remediation or construction costs provided.
 7. **LIMITATION OF LIABILITY** - The CLIENT has agreed that to the fullest extent permitted by the law ParklandGEO's total liability to CLIENT for any and all injuries, claims, losses, expenses or damages whatsoever arising out of or in anyway relating to the Project is contractually limited, as outlined in ParklandGEO's standard Consulting Services Agreement. Further, the CLIENT has agreed that to the fullest extent permitted by law ParklandGEO is not liable to the CLIENT for any special, indirect or consequential damages whatsoever, regardless of cause.
 8. **INDEMNIFICATION** - To the fullest extent permitted by law, the CLIENT has agreed to defend, indemnify and hold ParklandGEO, its directors, officers, employees, agents and subcontractors, harmless from and against any and all claims, defence costs, including legal fees on a full indemnity basis, damages, and other liabilities arising out of or in any way related to ParklandGEO's work, reports or recommendations.



APPENDIX F

Josephburg Road North Industrial ASP TIA





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**Josephburg Road North Industrial
Area Structure Plan
Transportation Impact Assessment**

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1.0 Introduction

1.1 BACKGROUND

Stantec Consulting Ltd. has been retained to provide professional services to the City of Fort Saskatchewan to develop an Area Structure Plan (ASP) for the Josephburg Road North Industrial Area. As part of the ASP, a Transportation Impact Assessment is being submitted in support of the ASP process.

1.2 OBJECTIVES

The objectives of this transportation assessment are to:

- Establish future background traffic conditions in the vicinity of the proposed development
- Estimate the magnitude and characteristics of traffic generated by the proposed land uses;
- Evaluate the impacts of vehicular traffic generated by the proposed development on the adjacent roadway system;

2.0 Site Context

2.1 STUDY AREA

The study area encompasses the Josephburg Road Industrial Area in northeastern Fort Saskatchewan which is bounded by Highway 15 on the northwest, by Range Road 220 on the east, and by Township Road 550 on the south. Figure 2.1 shows the location of the subject area.

To the north of the study area is a heavy industrial area. Southwest of the study area is the Eastgate Business park. South and east of the study area is outside City of Fort Saskatchewan limits and is part of the Agriculture Large Holdings Policy Area and Agri-Industrial Transition Policy Area within Strathcona County.

2.2 ROAD NETWORK

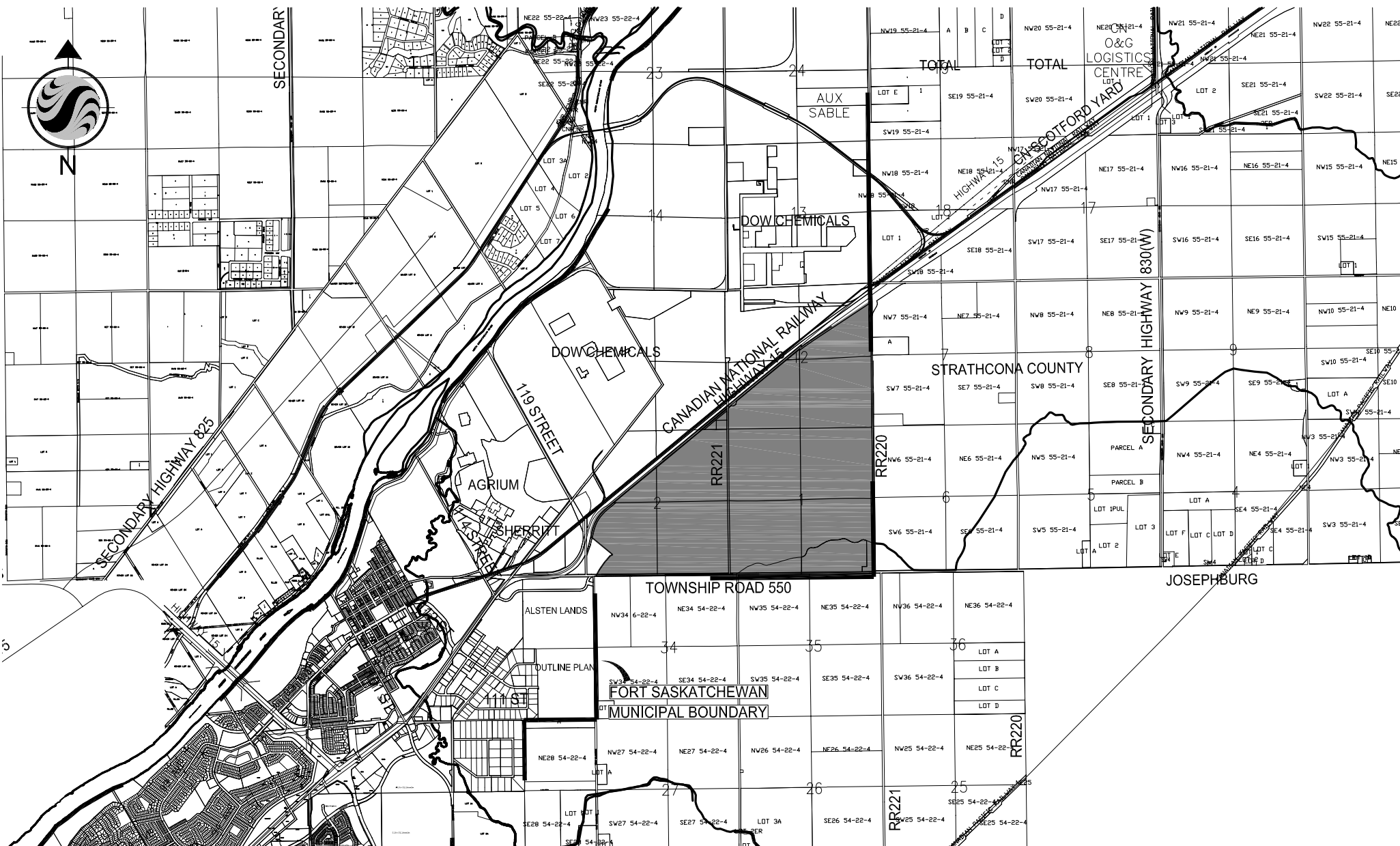
Key components of the current and future road network include Highway 15, Range Road 220, and Township Road 550. The following is a description of each, including its current status and any plans for future improvement.

Highway 15 is a four lane divided urban expressway and part of the provincially designated high load corridor system. Access to the Highway from the subject lands is currently from three separate intersections located at Range Roads 220, 221 and Township Road 550. The Fort Saskatchewan Transportation Master Plan (TMP) recommends that Highway 15 be widened to six lanes from Township Road 543 to 114 Street in the Long Term planning horizon (2022). Additionally, the TMP recommends signal installation at the intersections of Highway 15 – 114 Street and Highway 15 – 119 Street.

Township Road 550 is an improved, two lane rural road under the City of Fort Saskatchewan's municipal jurisdiction. The roadway terminates slightly west of the plan area where it intersects with Highway 15. The two range roads crossing Township Road 550 are not currently continuous. For the purposes of this TIA, it has been assumed that with the development of the area, and the preparation of Outline Plans, that the roadways would continuous across Township Road 550.

Range Road 220 is an unimproved two lane rural roadway under the jurisdiction of Strathcona County. The only internal roadway is Range Road 221, again an unimproved two lane rural roadway, extending north-south in the ASP.

The East By-Pass Road is discussed in the TMP it is recognized that an alignment has not yet been finalized for the facility. The TMP does recommend that it be constructed in the Long Term planning horizon (2022).



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TRANSPORTATION IMPACT ASSESSMENT

Figure No.
2.1

Title
Location Plan



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3.0 Development Proposal and Trip Characteristics

3.1 PROPOSED DEVELOPMENT

The Josephburg Road North Industrial ASP area is bounded by Highway 15 to the north and west, Township Road 550 to the south, and Rang Road 220 to the east. Figure 3.1 illustrates the development concept plan corresponding to the ASP area.

The ASP area covers approximately 590 ha (1,459 acre). Among them, about 168 ha (415 acre) of gross development land is proposed for light industrial purposes, 233 ha (575 acre) is for medium industrial purposes, and 53 ha (131 acre) is for medium industrial - Highway 15 vicinity overlay. Access to the ASP area will be via Highway 15, Rang Road 220, and Township Road 550.

3.2 PROJECTED BACKGROUND TRAFFIC

In order to project the future background traffic, the City of Fort Saskatchewan provided Stantec with their 2008 Transportation Master Plan Study report and the AM Peak Hour VISUM Model working files for various horizons. Based on the growth trend of this ASP area, the City long term transportation model (45,000 population horizon) containing Fort Saskatchewan East By Pass Road was utilized for the future background traffic projections.

Since the City transportation model has different access configuration at Highway 15 - 119 Street (as compared with the proposed road network in this ASP), the model was revised and re-run for trip distribution and traffic assignment. The AM Peak hour background traffic was then achieved by excluding the Josephburg Road North Industrial ASP area generated traffic.

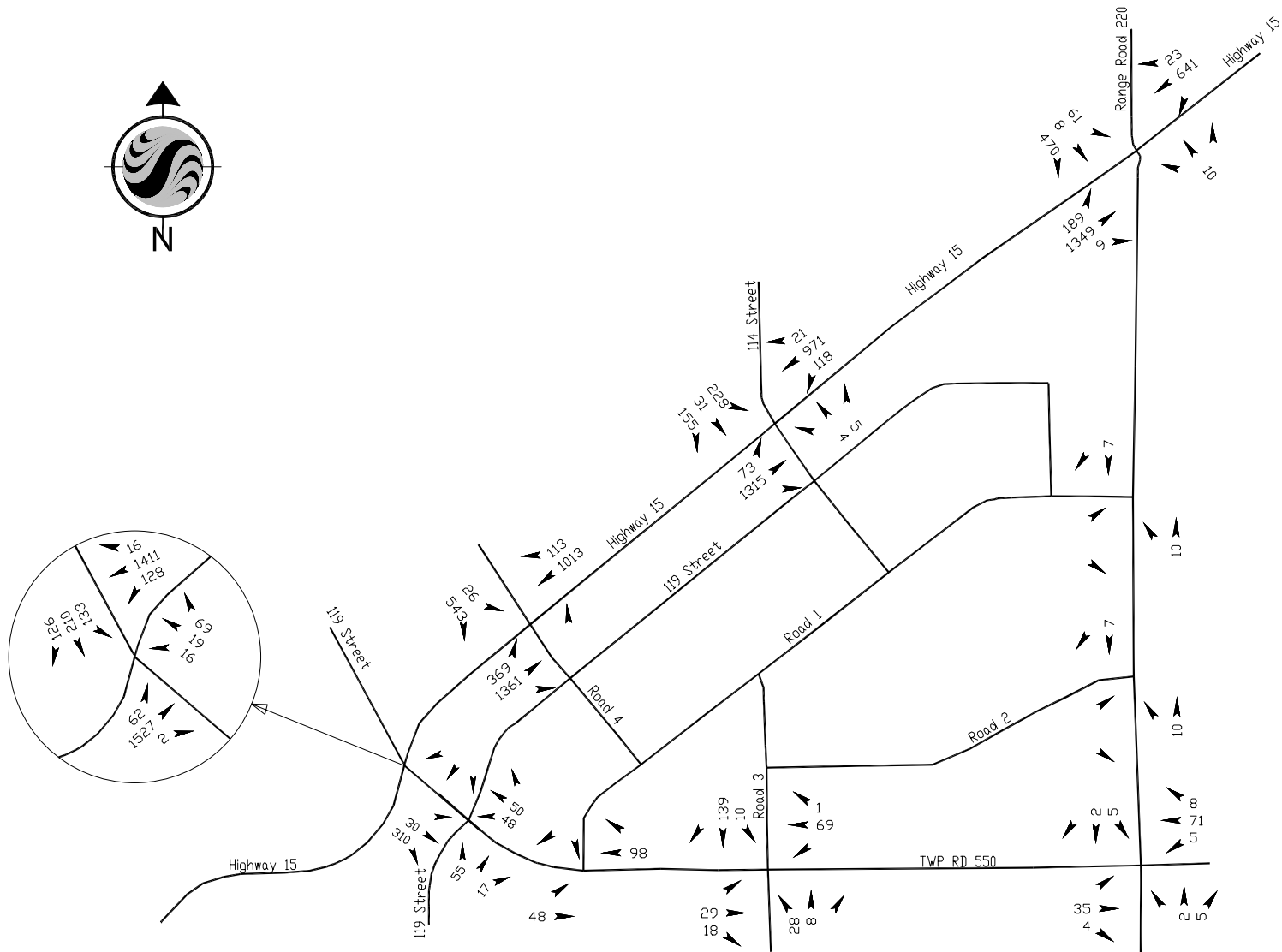
The PM Peak background volumes were calculated by reversing the projected AM Peak background volumes and factoring by 1.10.

The projected background volumes are illustrated in the following figures.

- Figure 3.2 (a) - Background Volumes - AM Full Build Out
- Figure 3.2 (b) - Background Volumes - PM Full Build Out

3.3 TRIP GENERATION

The trip rates per acre, per 1000 ft² and in/out splits used for this analysis are listed in Table 3.1. The light industrial trip rates were measured as part of the Northeast Fort Saskatchewan Industrial Transportation Impact Assessment prepared by Stantec in 2006. The medium industrial trip rates were blended from the measured light industrial trip rates and the heavy industrial land use from ITE 7th Edition Trip Generation manual. The trip rates for Shopping



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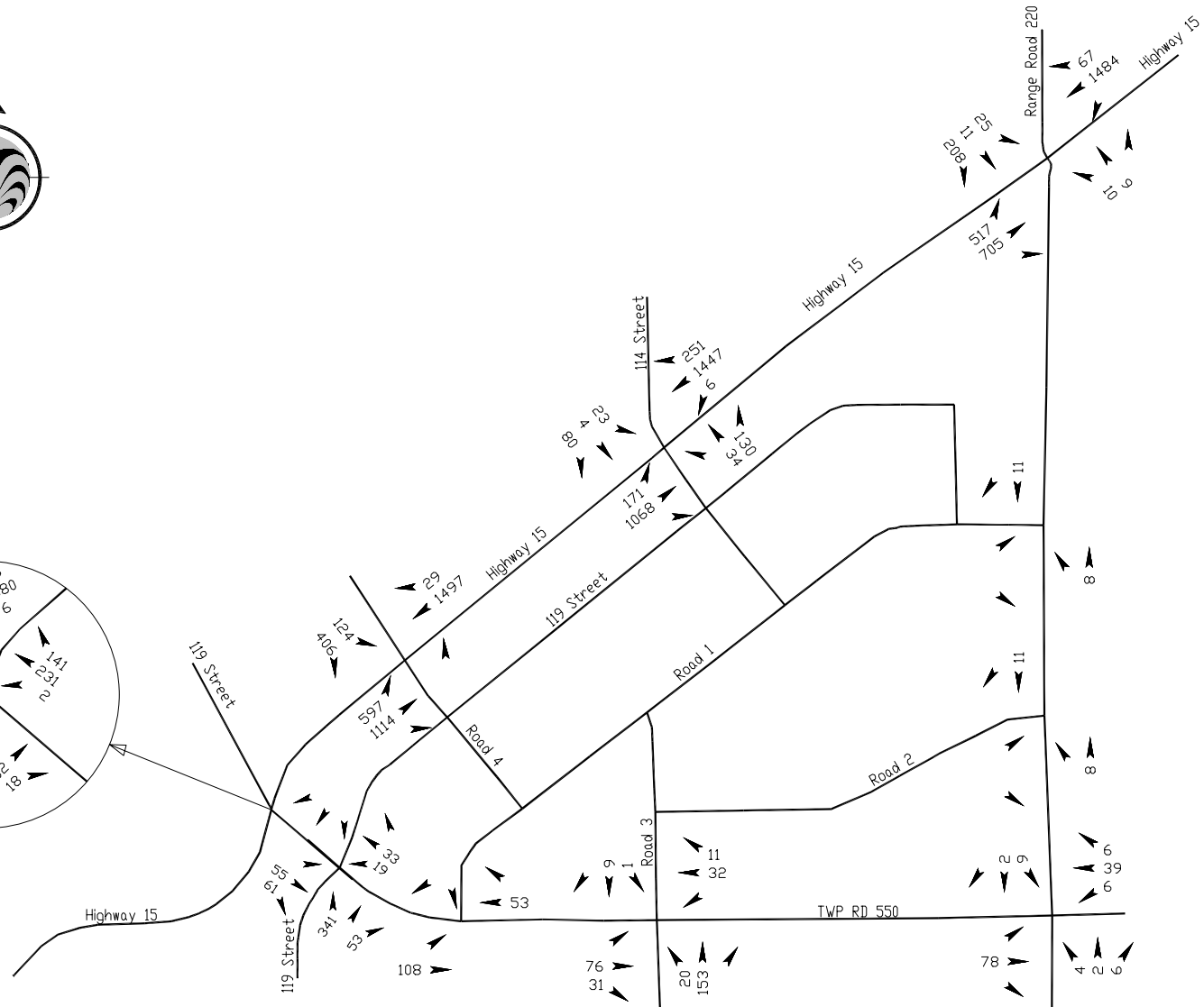
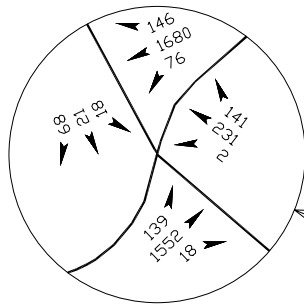
Figure No.

3.2(a)

Title

**Background Volumes
- AM Full Build Out**

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Figure No.

3.2(b)

Title

**Background Volumes
- PM Full Build Out**

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Centre (land use #820) in the ITE Trip Generation manual was adopted for the proposed medium industrial - Highway 15 vicinity overlay areas.

Table 3.1
Trip Generation Rates

		AM Peak			PM Peak		
	Unit	rate	in	out	rate	in	out
Light Industrial	Acre	5.97	85%	15%	6.58	30%	70%
Medium Industrial	Acre	4.75	85%	15%	4.71	30%	70%
Medium Industrial -Highway 15 Vicinity Overlay	1000 sq. ft.	1.03	50%	50%	3.75	50%	50%

For the trip generation analysis, the industrial sites assume approximately 79% of the areas are developed, allowing for local roadways, and park space that still need to be accounted for in the Outline Plans. For the medium industrial - Highway 15 vicinity overlay, an assumption that the area will be developed as relatively low density commercial with floor area ratio (FAR) of 20% has been made.

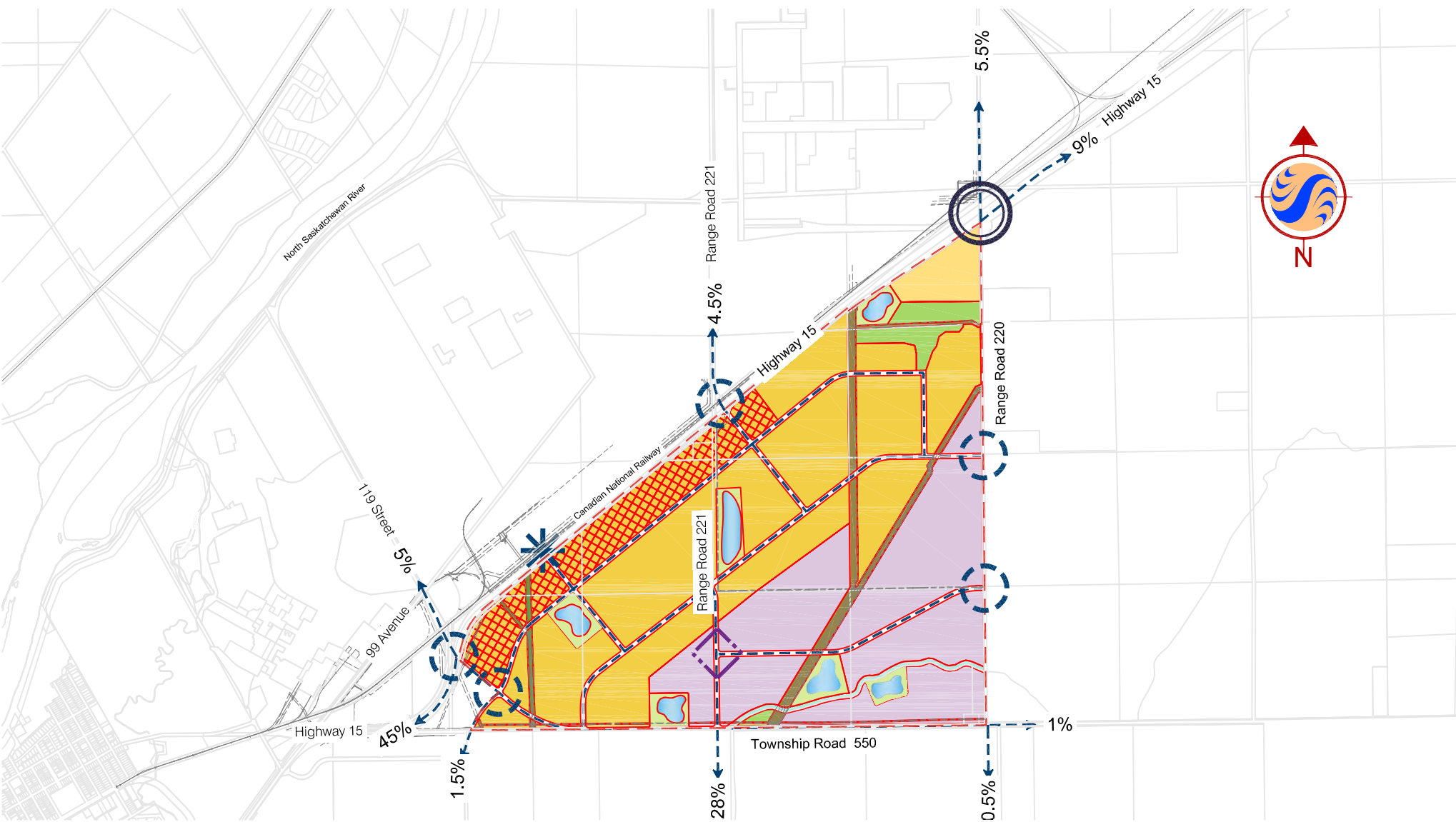
The proposed trip generation totals are shown in Table 3.2.

Table 3.1
Trip Generation Totals

		AM			PM		
	Size	in	out	total	in	out	total
Light Industrial (acre)	326	1,654	292	1,946	644	1,502	2,145
Medium Industrial (acre)	455	1,895	467	2,362	701	1,642	2,344
Commercial Areas (1000 sq.ft.)	954	492	492	983	1,790	1,790	3,480
Total		4,041	1,250	5,291	3,175	4,934	8,069

3.4 TRIP DISTRIBUTION AND ASSIGNMENT

Based on the City Long Term transportation model trip distribution pattern, the site-generated trips to and from this development were distributed throughout Fort Saskatchewan and surrounding area. The trip distribution percentages for each external gate are shown in Figure 3.3.



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Figure No.

3.3

Title

Trip Distribution

The same modeling tool used for the City 2008 Transportation Master Plan Study, VISUM was adopted to determine the assignment of the industrial and commercial trips. These trips from the development sites were assigned based on the access available and the most logical (minimum travel time) paths.

Trips for the commercial sites (medium industrial - Highway 15 vicinity overlay) are categorized as primary trips and pass-by trips. Pass-by trips are trips intercepted from the stream of traffic passing the site, which contribute to traffic volumes on site accesses, but do not contribute new traffic loading to the adjacent street system. Primary trips are trips made for the purpose of visiting the commercial site, for which the commercial generator is the primary reason for the trip.

Based on their sizes and locations, trips for the commercial sites are assumed as $\frac{3}{4}$ of primary trips and $\frac{1}{4}$ of pass-by trips.

Trips generated at full development of the study area are summarized in the following figures:

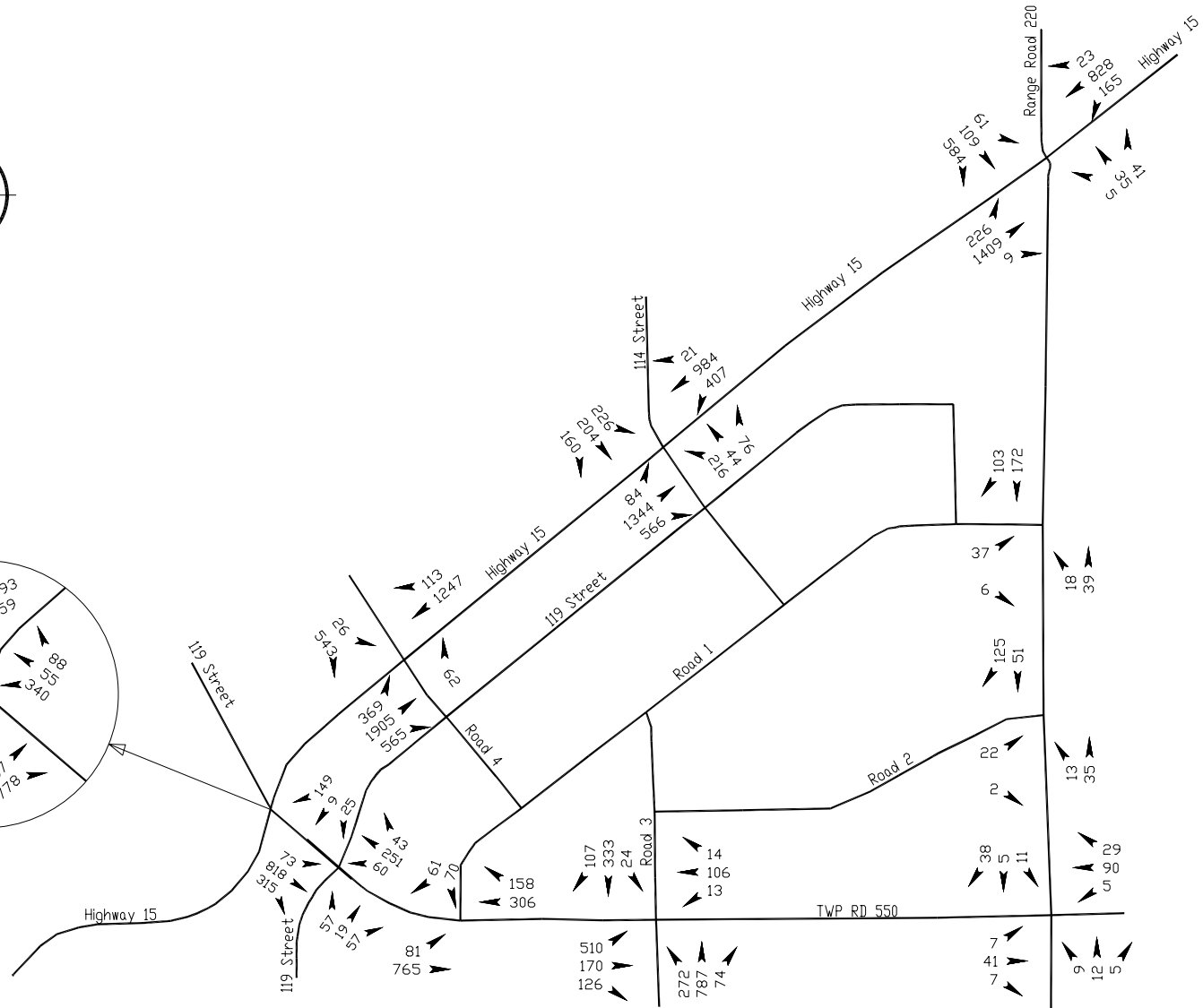
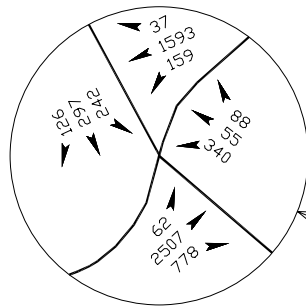
- Figure 3.4 (a) - Site-Generated Volumes - AM Full Build Out
- Figure 3.4 (b) - Site-Generated Volumes - PM Full Build Out

3.5 DESIGN VOLUMES

The design volumes include the future background traffic and the site-generated traffic. The daily traffic was projected based on the total of AM and PM design volumes and factored by 5.5.

The projected design volumes, as described above, are illustrated in the following figures.

- Figure 3.5 (a) - Design Volumes - AM Full Build Out
- Figure 3.5 (b) - Design Volumes - AM Full Build Out
- Figure 3.5 (c) - Design Volumes - Daily Full Build Out



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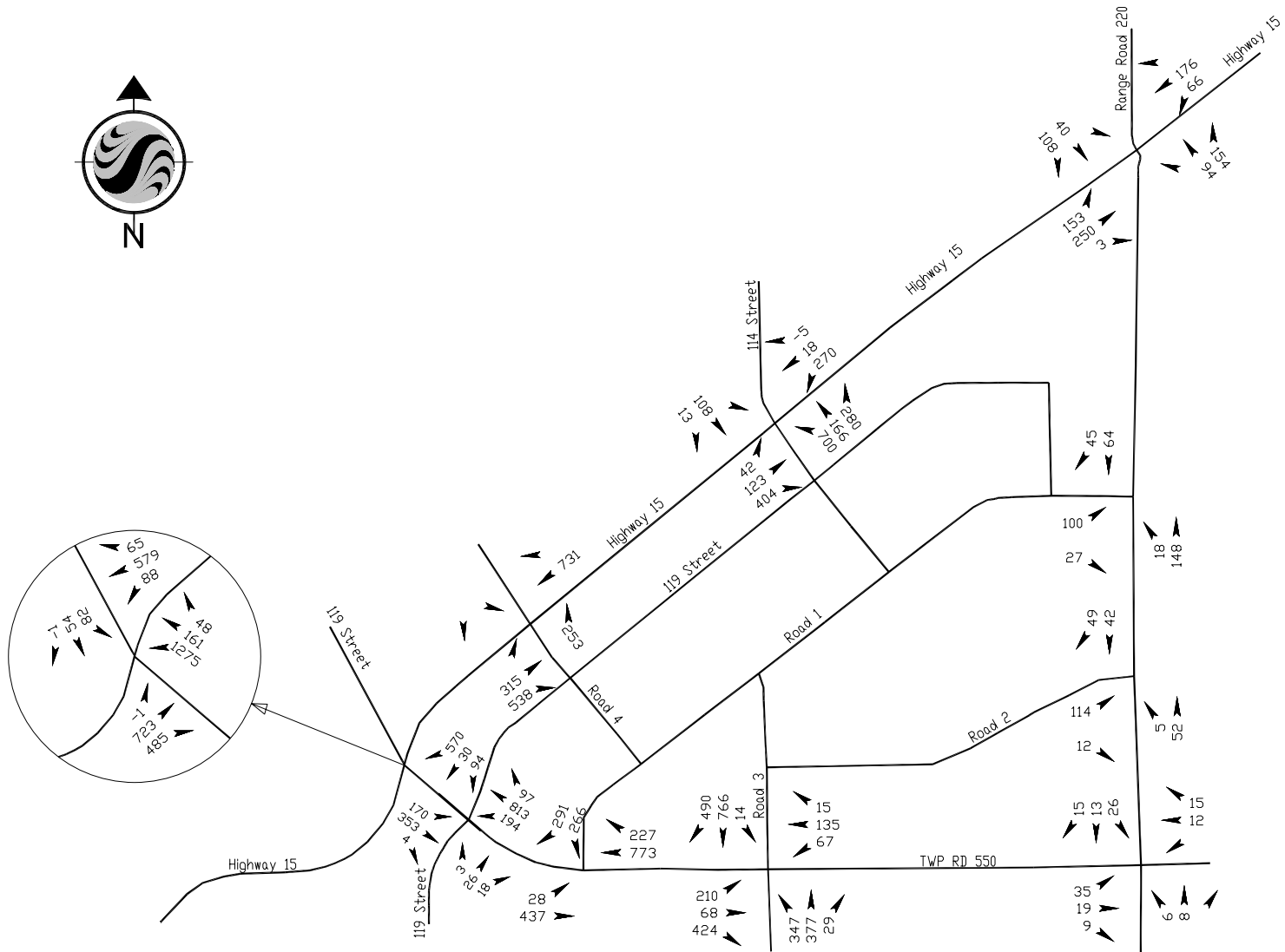
Figure No.

3.5(a)

Title

**Design Volumes
- AM Full Build Out**

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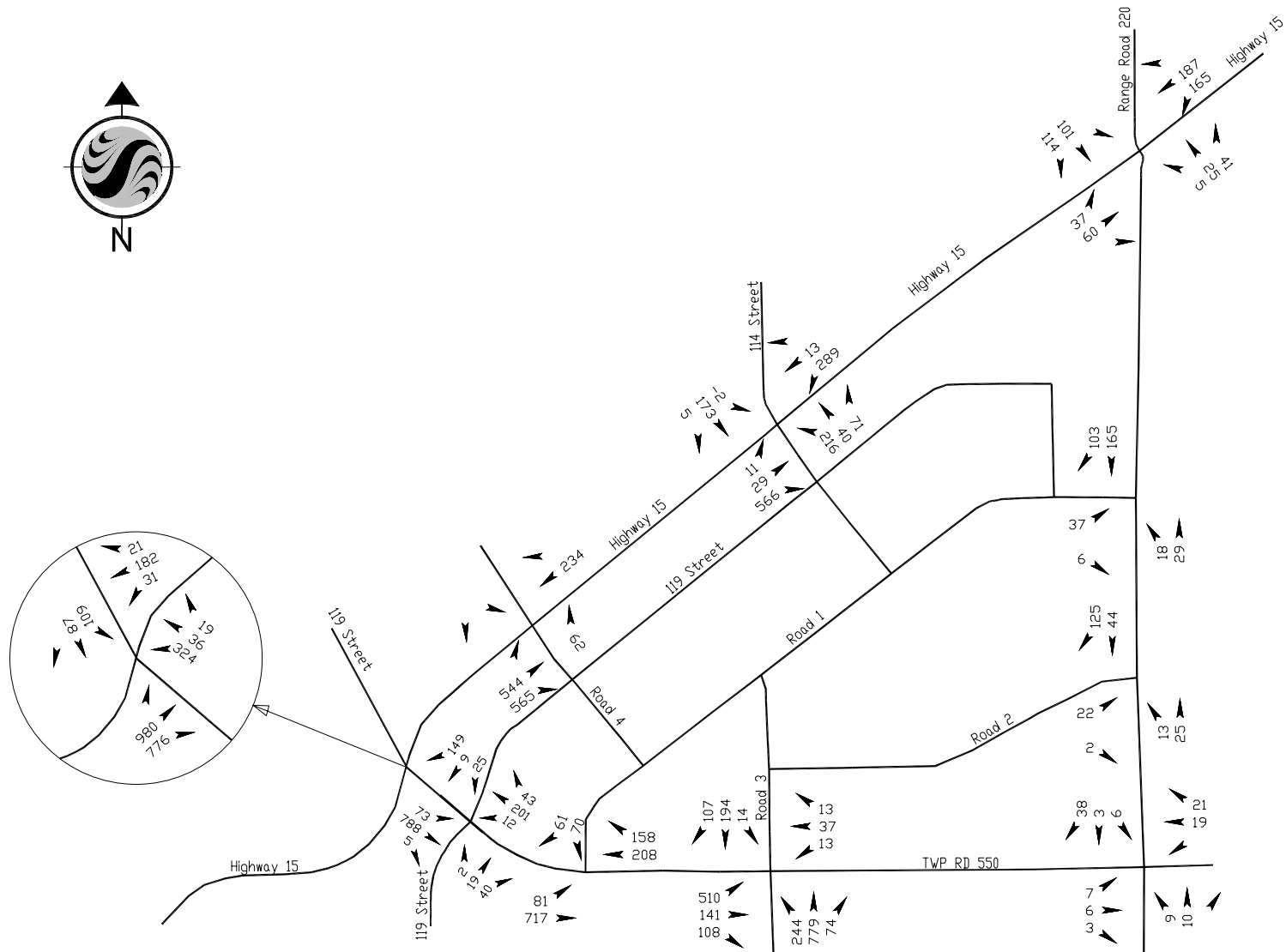
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3.4(b)

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**Site-Generated Volumes
- PM Full Build Out**

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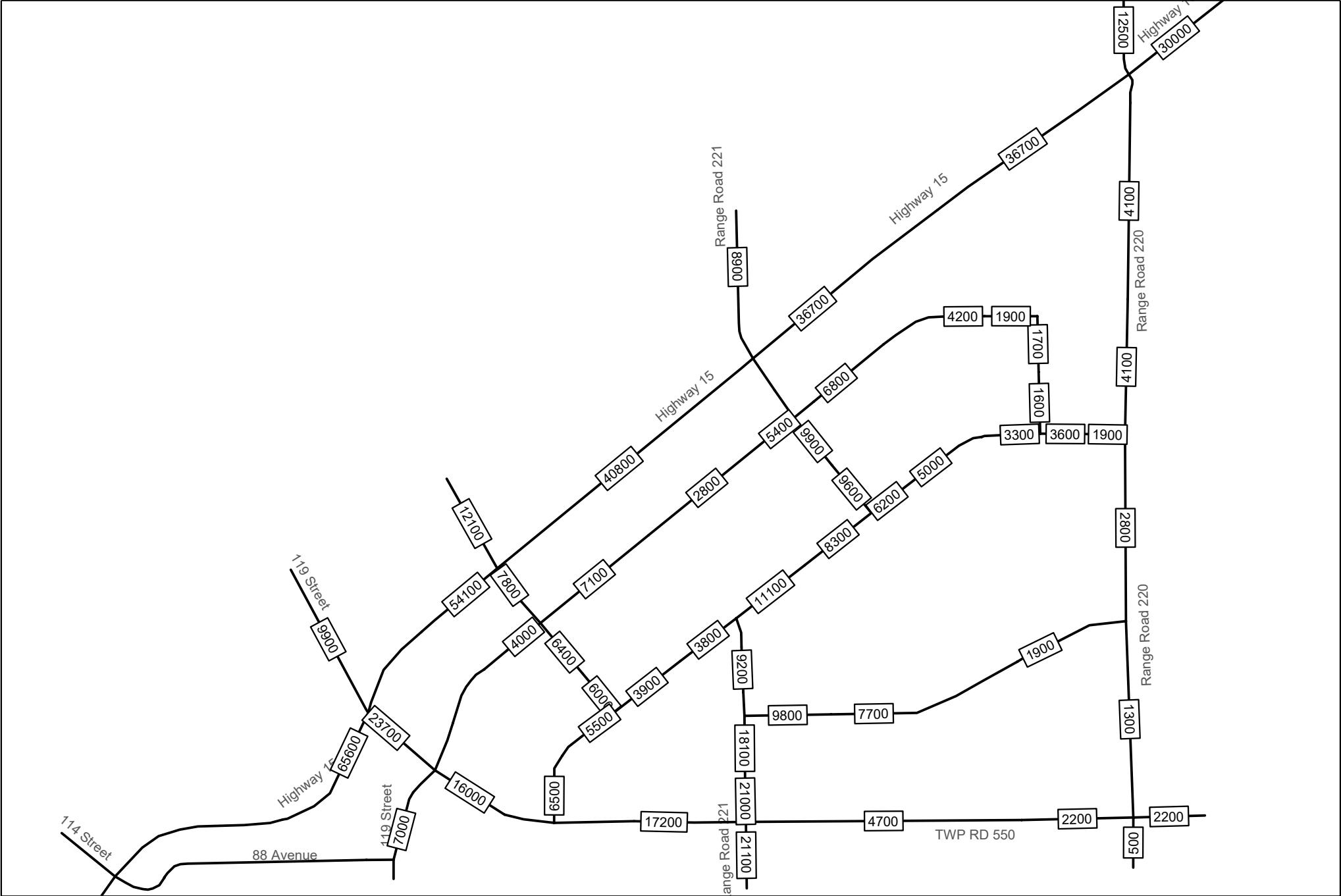
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3.4(a)

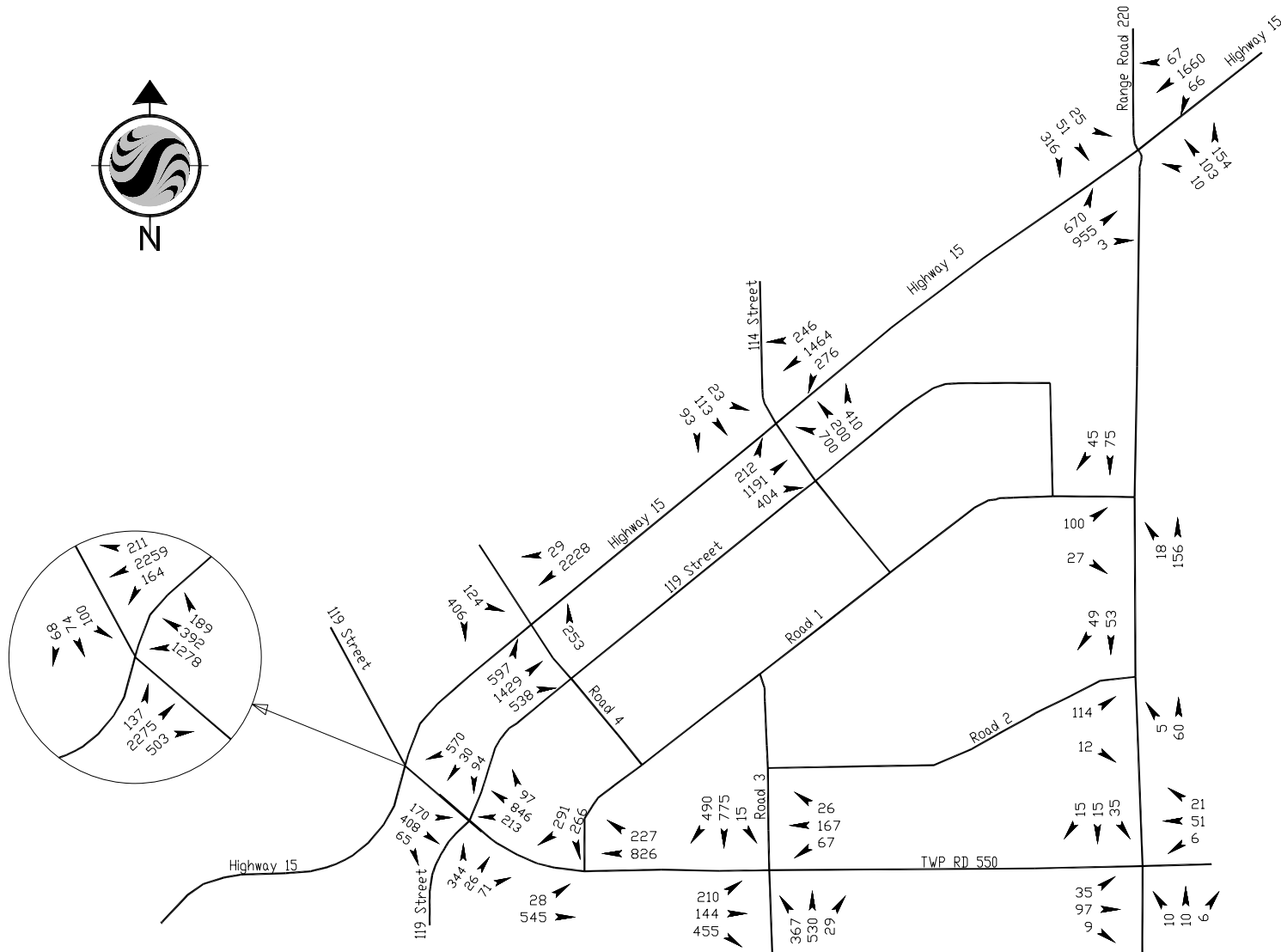
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**Site-Generated Volumes
- AM Full Build Out**

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	Stantec Consulting Ltd.	
	Figure 3.5(c) - Design Volumes - Daily Full Build Out	



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Figure No.

3.5(b)

Title

**Design Volumes
- PM Full Build Out**

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4.0 Transportation Assessment

4.1 CAPACITY ANALYSIS

The ten roadway intersections that provide access to the study area have been analyzed and are listed below:

Signalized Intersections

- Highway 15 – Township Road 550
- Highway 15 – Road 4
- Highway 15 – 114 Street
- Highway 15 – 85 Street (Range Road 220)
- Township Road 550 – 119 Street
- Township Road 550 – Road 1
- Township Road 550 – Road 3

Unsignalized Intersections

- Township Road 550 - 85 Street (Range Road 220)
- 85 Street (Range Road 220) – Road 2
- 85 Street (Range Road 220) – Road 1

Table A.1 and Table A.2 in Appendix A summarize the AM peak capacity analysis results for signalized and unsignalized intersections. Table A.3 and Table A.4 similarly summarizes the capacity information for the PM peak. Detailed outputs for Synchro are contained in Appendix B.

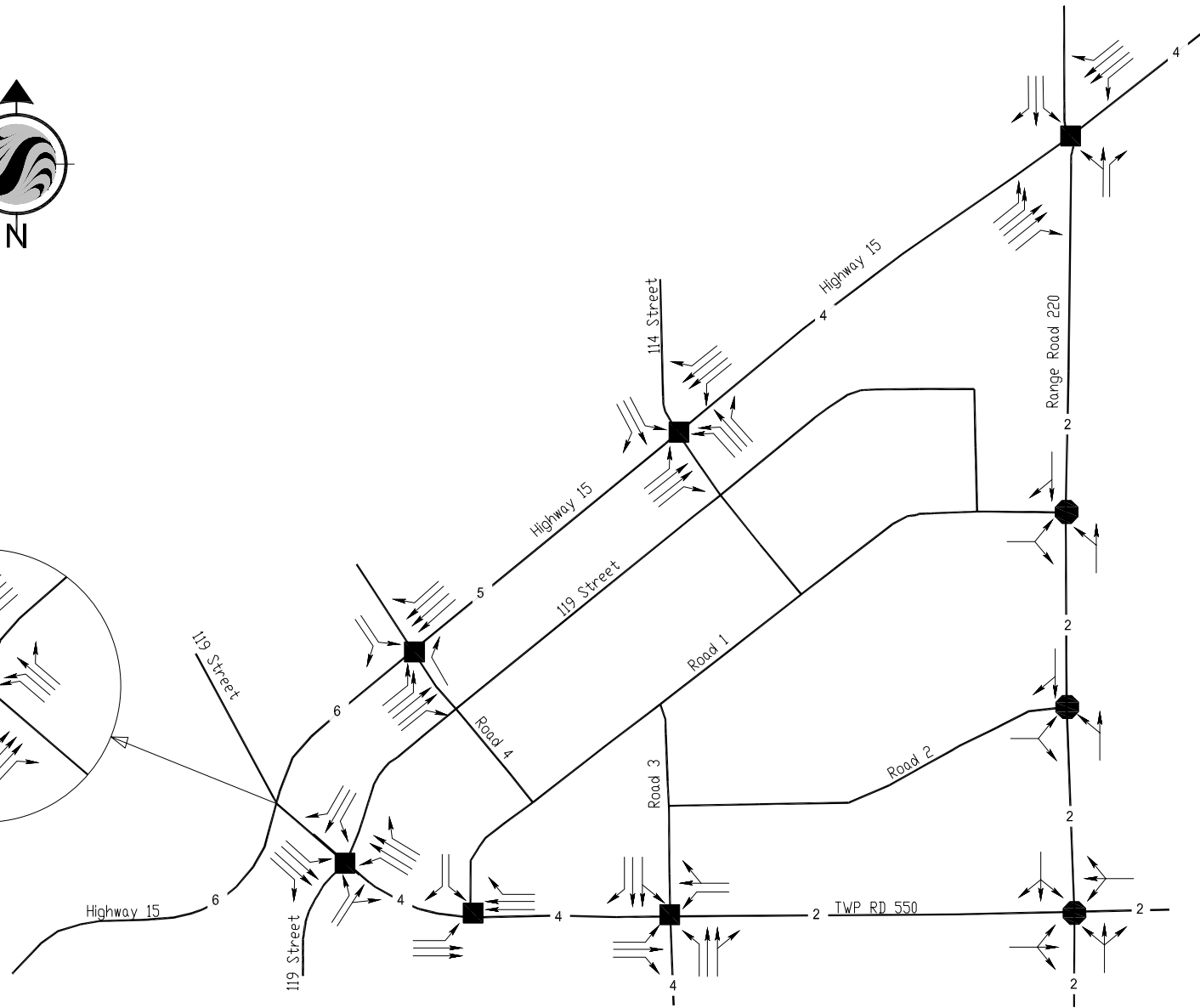
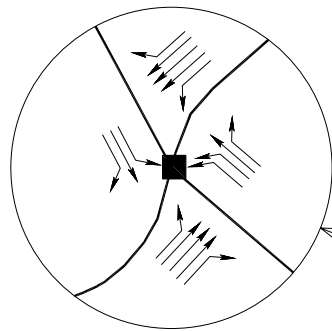
Figure 4.1 outlines the analyzed geometry, lane configuration, and intersection control for the analyzed intersections.

All unsignalized intersections are assumed to have single lane approaches. The intersection of Township Road 550 - 85 Street (Range Road 220) has been analyzed as a four-way stop controlled intersection, while the remaining two intersections are stop-controlled on the side street. There are no particular issues with the capacity analysis at the unsignalized intersections.

All signalized intersections were assumed to have single left and right turn bays unless otherwise noted. Intersections of particular interest are discussed in detail below:

Highway 15 - Township Road 550

With the proposed ASP transportation network, there is projected to be 1278 northwest bound left-turning vehicles in the PM peak hour. This number of left turning vehicles cannot normally be accommodated through traditional intersection measures. The intersections was analyzed



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Legend:



Signal Controlled Intersection



Stop Controlled Intersection

4 Number of Lanes

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Figure No.

4.1

Title

Lane Configuration

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with 3 through lanes along Highway 15, single through lanes along Township Road 550, and dual left-turn bays for the northwest bound left movement.

With this geometry the intersection operates with five movements over capacity, and the overall intersection operating over capacity.

It is recommended that demand be accommodated through an additional access that allows the northwest-bound left-turning movement from the study area onto Highway 15, possibly at Road 4, the access across from the DOW site.

Highway 15 – Road 4

This intersection is analyzed with a geometry allowing full access to the DOW site, and right-in right-out access to the study area. A northwest bound dual left-turn bay is required to accommodate the PM peak traffic into the DOW site and three southwest bound through lanes are required.

With this geometry the maximum volume capacity (v/c) ratio reported for both the morning and afternoon peak is 0.86, and the worst Level of Service (LOS) is E.

Highway 15 – 114 Street

A northwest dual left-turn bay is required to accommodate the projected 700 veh/h exiting the study area at this intersection. It has been assumed that Highway 15 will have two through lanes in each direction near this intersection.

With this geometry the northwest-bound left-turn and the southwest-bound through movements are both reported to v/c ratios over 0.9 at 0.96 and 0.94 respectively in the PM peak. In the AM peak, the northeast bound through movement is reported to have a v/c ratio of 0.93 and the southwest-bound left is reported to have a v/c ratio of 0.91. The worst reported LOS is E, with three movements experiencing delay over 60 seconds in the PM peak, and four movements over 60 seconds in the AM peak.

Highway 15 – 86 Street

Dual northeast-bound left-turn bays are required at this intersection. There is assumed to be an exclusive lane for each southbound movement. The northbound left and through share a lane, and there is assumed to be a northbound right-turn bay. Highway 15 is assumed to have two through lanes in each direction near this intersection.

There are no reported v/c ratios in the morning or afternoon peak over 0.9. The shared northbound-left-and-through and the southbound-left movements report a LOS of E in the PM peak.

Township Road 550 – 119 Street

The northbound approach has been analyzed with an exclusive left turn lane and a shared right and through lane. The southbound approach has been analyzed exclusive left and right-turn bays and a single through lane. Township Road 550 has been analyzed with two through lanes and single left and right turn bays for both the eastbound and westbound approaches.

The highest v/c ratio reported is 0.93 for the southbound right movement in the PM peak. This movement is expected to experience significantly less demand with the provision of another all directional access to Highway 15. The northbound left experiences the worst delay, at LOS E in the PM peak.

Other Intersections

The remaining two intersections have been analyzed with single right and left turn bays. No noteworthy issues exist with the planned geometry in the AM or PM for the remaining two intersections.

5.0 Conclusions

Based on the analysis described above, the following conclusions can be reached:

- Capacity constraints and geometric improvements are identified and based on the projected traffic volumes;
- The intersection of Highway 15 - Township 550 is operating over capacity;
- The provision of an additional all directional access to Highway 15 should be investigated;
- Roadways crossing Township 550 should be continuous; and
- The internal roadway network should be analyzed and further study should be performed with the development of Outline Plans for the area.

6.0 Appendix A – Capacity Analysis Summary

Table A.1 - AM Peak Hour Capacity Analysis - Signalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
HWY 15 & 85 Street														ICU = 72.4% C	Cycle Length = 95 seconds
Intersection / Laning Characteristics	1	1	1	SH	1	1	2	2	1	1	2	1			
Volumes(veh/h)	61	109	584	5	35	41	226	1409	9	165	828	23			
Volume/Capacity Ratio (V/C)	0.25	0.33	0.88	-	0.12	0.13	0.23	0.7	0.01	0.75	0.5	0.03			
Total Delay	35.9	36.3	37.8	-	33.2	11.1	4.4	14.8	3.9	36.2	16.7	4.7			
Level of Service (LOS)	D	D	D	-	C	B	A	B	A	D	B	A			
TWP RD 550 & HWY 15														ICU = 95.9% D	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	3	1	1	3	1	1	1	1	2	1	1			
Volumes(veh/h)	159	1593	37	62	2507	778	242	297	126	340	55	88			
Volume/Capacity Ratio (V/C)	1.04	0.59	0.04	0.38	0.95	0.81	0.64	0.94	0.37	1.05	0.38	0.43			
Total Delay	107.7	18.1	3.6	14.1	33.8	19.1	44.3	83.5	18.4	96.1	56	17.7			
Level of Service (LOS)	F	B	A	B	C	B	D	F	B	F	E	B			
TWP RD 550 & Road 1														ICU = 31.7% B	Cycle Length = 50 seconds
Intersection / Laning Characteristics	1	-	1	-	-	-	1	2	-	-	2	1			
Volumes(veh/h)	70	-	61	-	-	-	81	765	-	-	306	158			
Volume/Capacity Ratio (V/C)	0.09	-	0.09	-	-	-	0.22	0.61	-	-	0.24	0.24			
Total Delay	8	-	2.9	-	-	-	12.4	14.9	-	-	11.2	3.2			
Level of Service (LOS)	A	-	A	-	-	-	B	B	-	-	B	A			
TWP RD 550 & 119 Street														ICU = 45.8% B	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	1	1	1	1	SH	1	2	1	1	2	1			
Volumes(veh/h)	25	9	149	57	19	57	73	818	315	60	251	43			
Volume/Capacity Ratio (V/C)	0.06	0.02	0.26	0.14	0.15	-	0.12	0.51	0.36	0.17	0.15	0.06			
Total Delay	29.3	28.4	5.6	30.4	11.3	-	10.1	23.1	3.9	10.3	16	4.4			
Level of Service (LOS)	C	C	A	C	B	-	B	C	A	B	B	A			
HWY 15 & 114 Street														ICU = 91.1% D	Cycle Length = 148 seconds
Intersection / Laning Characteristics	1	1	1	2	1	1	1	2	1	1	2	1			
Volumes(veh/h)	266	204	160	216	44	76	84	1344	566	407	984	21			
Volume/Capacity Ratio (V/C)	0.88	0.7	0.42	0.73	0.24	0.34	0.31	0.93	0.73	0.91	0.47	0.02			
Total Delay	79.3	70.7	10.7	65.3	63.7	15.7	14.4	50.7	25.3	67.1	14.4	3.4			
Level of Service (LOS)	E	E	B	E	E	B	B	D	C	E	B	A			
HWY 15 & Road 4														ICU = 62.7% A	Cycle Length = 80 seconds
Intersection / Laning Characteristics	1	0	1	0	0	1	2	2	1	0	3	1			
Volumes(veh/h)	26	0	543	0	0	62	369	1905	565	0	1247	113			
Volume/Capacity Ratio (V/C)	0.09	-	0.37	-	-	0.04	0.6	0.8	0.46	-	0.46	0.13			
Total Delay	28.6	-	0.7	-	-	0	8.4	10.3	1.5	-	10.4	1.9			
Level of Service (LOS)	C	-	A	-	-	A	A	B	A	-	B	A			
TWP RD 550 & Road 3														ICU = 78.9% C	Cycle Length = 70 seconds
Intersection / Laning Characteristics	SH	2	1	1	2	SH	1	1	1	1	1	SH			
Volumes(veh/h)	24	333	107	272	787	74	510	170	126	13	106	14			
Volume/Capacity Ratio (V/C)	-	0.49	0.23	0.86	0.68	-	0.87	0.2	0.16	0.02	0.14	-			
Total Delay	-	24.6	6	45	20.7	-	33.3	10.4	2.5	9.1	8.9	-			
Level of Service (LOS)	-	C	A	D	C	-	C	B	A	A	A	-			

Table A.2 - AM Peak Capacity Analysis Summary - Unsignalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
	L	T	R	L	T	R	L	T	R	L	T	R			
85 Street & Road 2														ICU = 17.7%	
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-	ICU = 23.2% Max = 0.11 1.3	Unsignalized Stop Controlled E-W	
Volumes(veh/h)	-	51	125	13	35	-	22	-	2	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.11	0.11	0.01	0.01	-	0.03	-	0.03	-	-	-			
Queue Length 95th (m)	-	0	0	0.2	0.2	-	0.8	-	0.8	-	-	-			
Total Delay (Sec)	-	0	0	2.1	2.1	-	9.6	-	9.6	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	A	-	A	-	-	-			
Road 1 & 85 Street														ICU = 27.9% Max = 0.18 1.6	Unsignalized Stop Controlled E-W
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-			
Volumes(veh/h)	-	172	103	18	39	-	37	-	6	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.18	0.18	0.02	0.02	-	0.07	-	0.07	-	-	-			
Queue Length 95th (m)	-	0	0	0.4	0.4	-	1.7	-	1.7	-	-	-			
Total Delay (Sec)	-	0	0	2.6	2.6	-	10.7	-	10.7	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	B	-	B	-	-	-			
Township Road 550 & 85 Street														ICU = 18% Max = 0.15 7.6	Unsignalized Stop Controlled 4-Ways
Intersection / Laning Characteristics	SH	1	SH	SH	1	SH	SH	1	SH	SH	1	SH			
Volumes(veh/h)	11	5	38	9	12	5	7	41	7	5	90	29			
Volume/Capacity Ratio (V/C)	-	0.07	-	-	0.03	-	-	0.07	-	-	0.15	-			
Queue Length 95th (m)	-	0	-	-	0	-	-	0	-	-	0	-			
Total Delay (Sec)	-	7.3	-	-	7.5	-	-	7.5	-	-	7.5	-			
Level of Service (LOS)	-	A	-	-	A	-	-	A	-	-	A	-			

Table A.3 - PM Peak Hour Capacity Analysis - Signalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
HWY 15 & 85 Street														ICU = 87.6% C	Cycle Length = 128 seconds
Intersection / Laning Characteristics	1	1	1	SH	1	1	2	2	1	1	2	1			
Volumes(veh/h)	25	51	316	10	103	154	670	955	3	66	1660	67			
Volume/Capacity Ratio (V/C)	0.23	0.23	0.57	-	0.53	0.48	0.86	0.39	0	0.21	0.88	0.08			
Total Delay	55.9	53.4	35.7	-	61.8	12.4	47.5	6.5	2.7	15.9	30.4	2.9			
Level of Service (LOS)	E	D	D	-	E	B	D	A	A	B	C	A			
TWP RD 660 & HWY 15														ICU = 106.7% F	Cycle Length = 150 seconds
Intersection / Laning Characteristics	1	3	1	1	3	1	1	1	1	2	1	1			
Volumes(veh/h)	164	2259	211	137	2275	503	100	74	68	1278	392	189			
Volume/Capacity Ratio (V/C)	1.13	1.07	0.28	1.02	1.09	0.42	0.61	0.58	0.4	1.11	0.68	0.33			
Total Delay	143.4	80.1	6.7	114	89.5	4.2	49.5	84.5	19.9	147.8	53.6	14.6			
Level of Service (LOS)	F	F	A	F	F	A	D	F	B	F	D	B			
TWP RD 660 & Road 1														ICU = 47.5% B	Cycle Length = 50 seconds
Intersection / Laning Characteristics	1	-	1	-	-	-	1	2	-	-	2	1			
Volumes(veh/h)	266	-	291	-	-	-	28	545	-	-	826	227			
Volume/Capacity Ratio (V/C)	0.35	-	0.42	-	-	-	0.2	0.44	-	-	0.66	0.32			
Total Delay	10.3	-	9.7	-	-	-	14.5	12.8	-	-	15.7	3.2			
Level of Service (LOS)	B	-	A	-	-	-	B	B	-	-	B	A			
TWP RD 660 & 119 Street														ICU = 87.7% C	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	1	1	1	1	SH	1	2	1	1	2	1			
Volumes(veh/h)	94	30	570	344	26	71	170	408	65	213	846	97			
Volume/Capacity Ratio (V/C)	0.26	0.06	0.93	0.85	0.18	-	0.54	0.25	0.09	0.4	0.51	0.12			
Total Delay	32.7	29	47.5	57.9	11	-	16.2	18.2	4	12.3	20.7	3.2			
Level of Service (LOS)	C	C	D	E	B	-	B	B	A	B	C	A			
HWY 15 & 114 Street														ICU = 88.9% D	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	1	1	2	1	1	1	2	1	1	2	1			
Volumes(veh/h)	23	113	93	700	200	410	212	1191	404	276	1464	264			
Volume/Capacity Ratio (V/C)	0.13	0.56	0.37	0.96	0.46	0.71	0.89	0.87	0.48	0.83	0.94	0.32			
Total Delay	31.7	60.7	13.4	61.5	41.9	19.3	63.9	34.6	2.7	51.4	41.4	3			
Level of Service (LOS)	C	E	B	E	D	B	E	C	A	D	D	A			
HWY 15 & Road 4														ICU = 76.9% B	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	0	1	0	0	1	2	2	1	0	3	1			
Volumes(veh/h)	124	0	406	0	0	253	597	1429	538	0	2228	29			
Volume/Capacity Ratio (V/C)	0.53	-	0.28	-	-	0.17	0.77	0.55	0.42	-	0.86	0.04			
Total Delay	56.4	-	0.4	-	-	0.2	38.5	5.5	1.2	-	20.5	5.8			
Level of Service (LOS)	E	-	A	-	-	A	D	A	A	-	C	A			
TWP RD 660 & Road 3														ICU = 77.5% B	Cycle Length = 70 seconds
Intersection / Laning Characteristics	SH	2	1	1	2	SH	1	1	1	1	1	SH			
Volumes(veh/h)	15	775	490	367	530	29	210	144	455	67	167	26			
Volume/Capacity Ratio (V/C)	-	0.71	0.67	0.88	0.28	-	0.78	0.29	0.66	0.21	0.39	-			
Total Delay	-	23.5	11.3	36.2	7	-	44	21.3	9.8	21.1	21.7	-			
Level of Service (LOS)	-	C	B	D	A	-	D	C	A	C	C	-			

Table A.4 - PM Peak Hour Capacity Analysis - Unsignalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
	L	T	R	L	T	R	L	T	R	L	T	R			
Road 2 & 85 Street														ICU = 26.4%	
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-	ICU = 21.7% Max = 0.14 4.2	Unsignalized Stop Controlled E-W	
Volumes(veh/h)	-	53	49	5	60	-	12	-	114	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.07	0.07	0	0	-	0.14	-	0.14	-	-	-			
Queue Length 95th (m)	-	0	0	0.1	0.1	-	3.8	-	3.8	-	-	-			
Total Delay (Sec)	-	0	0	0.6	0.6	-	9.4	-	9.4	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	A	-	A	-	-	-			
Road 1 & 85 Street														ICU = 29.7% Max = 0.19 3.7	Unsignalized Stop Controlled E-W
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-			
Volumes(veh/h)	-	45	75	18	156	-	100	-	27	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.08	0.08	0.01	0.01	-	0.19	-	0.19	-	-	-			
Queue Length 95th (m)	-	0	0	0.3	0.3	-	5.3	-	5.3	-	-	-			
Total Delay (Sec)	-	0	0	0.9	0.9	-	11.1	-	11.1	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	B	-	B	-	-	-			
Road 1 & 85 Street														ICU = 26% Max = 0.18 8	Unsignalized Stop Controlled 4-Ways
Intersection / Laning Characteristics	SH	1	SH	SH	1	SH	SH	1	SH	SH	1	SH			
Volumes(veh/h)	35	15	15	10	10	6	35	97	9	6	51	21			
Volume/Capacity Ratio (V/C)	-	0.09	-	-	0.04	-	-	0.18	-	-	0.1	-			
Queue Length 95th (m)	-	0	-	-	0	-	-	0	-	-	0	-			
Total Delay (Sec)	-	7.9	-	-	7.9	-	-	8.2	-	-	7.6	-			
Level of Service (LOS)	-	A	-	-	A	-	-	A	-	-	A	-			

7.0 Appendix B – Synchro Output

Lanes, Volumes, Timings
5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	670	955	3	66	1660	67	10	103	154	25	51	316
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	150.0		120.0	0.0		150.0	0.0		50.0	150.0		150.0
Storage Lanes	2		1	0		1	0		1	1		1
Taper Length (m)	2.5		2.5	0.0		2.5	0.0		2.5	2.5		2.5
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	0	1876	1601	1789	1883	1601
Flt Permitted	0.059			0.276				0.975		0.499		
Satd. Flow (perm)	216	3579	1601	520	3579	1601	0	1836	1601	940	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			3			73			167			14
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		1017.6			210.7			780.1			303.3	
Travel Time (s)		52.3			10.8			46.8			18.2	
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
Adj. Flow (vph)	728	1038	3	72	1804	73	11	112	167	27	55	343
Shared Lane Traffic (%)												
Lane Group Flow (vph)	728	1038	3	72	1804	73	0	123	167	27	55	343
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm		Perm	Perm		pt+ov
Protected Phases	7	4		3	8			2			6	6 7
Permitted Phases	4		4	8		8	2		2	6		
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	
Total Split (s)	31.0	99.0	99.0	9.0	77.0	77.0	20.0	20.0	20.0	20.0	20.0	51.0
Total Split (%)	24.2%	77.3%	77.3%	7.0%	60.2%	60.2%	15.6%	15.6%	15.6%	15.6%	15.6%	39.8%
Maximum Green (s)	27.0	95.0	95.0	5.0	73.0	73.0	16.0	16.0	16.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lead	Lag	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0	0		0	0	0	0	0	0	0	
Act Effect Green (s)	95.0	95.0	95.0	73.0	73.0	73.0		16.0	16.0	16.0	16.0	47.0
Actuated g/C Ratio	0.74	0.74	0.74	0.57	0.57	0.57		0.12	0.12	0.12	0.12	0.37
v/c Ratio	0.86	0.39	0.00	0.21	0.88	0.08		0.53	0.48	0.23	0.23	0.57
Control Delay	47.5	6.5	2.7	15.9	30.4	2.9		61.8	12.4	55.9	53.4	35.7

Lanes, Volumes, Timings

5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	47.5	6.5	2.7	15.9	30.4	2.9		61.8	12.4	55.9	53.4	35.7
LOS	D	A	A	B	C	A		E	B	E	D	D
Approach Delay		23.3			28.8			33.4			39.3	
Approach LOS		C			C			C			D	

Intersection Summary

Area Type: Other

Cycle Length: 128

Actuated Cycle Length: 128

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 27.9

Intersection LOS: C

Intersection Capacity Utilization 87.6%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 5: HWY 15 & 85 Street

																	
ø3	ø2		ø4			ø6	ø7	ø8									
20 s			99 s			20 s	31 s	77 s									9 s

Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	74	68	1278	392	189	137	2275	503	164	2259	211
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	120.0		120.0	120.0		120.0
Storage Lanes	0		0	0		0	1		1	1		1
Taper Length (m)	0.0		0.0	0.0		0.0	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Fr't			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	3471	1883	1601	1789	5142	1601	1789	5142	1601
Flt Permitted	0.514			0.401			0.061			0.060		
Satd. Flow (perm)	968	1883	1601	1465	1883	1601	115	5142	1601	113	5142	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			74			134			184			185
Link Speed (k/h)		60			60			70			70	
Link Distance (m)		97.9			175.7			499.4			256.9	
Travel Time (s)		5.9			10.5			25.7			13.2	
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
Adj. Flow (vph)	109	80	74	1389	426	205	149	2473	547	178	2455	229
Shared Lane Traffic (%)												
Lane Group Flow (vph)	109	80	74	1389	426	205	149	2473	547	178	2455	229
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		pm+ov	pm+pt		Perm
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	20.0	8.0	8.0	20.0	20.0
Total Split (s)	13.0	15.0	15.0	52.0	54.0	54.0	12.0	70.0	52.0	13.0	71.0	71.0
Total Split (%)	8.7%	10.0%	10.0%	34.7%	36.0%	36.0%	8.0%	46.7%	34.7%	8.7%	47.3%	47.3%
Maximum Green (s)	9.0	11.0	11.0	48.0	50.0	50.0	8.0	66.0	48.0	9.0	67.0	67.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lead	Lag	Lag
Lead-Lag Optimize?		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0			5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0			11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0			0	0
Act Effect Green (s)	20.0	11.0	11.0	63.0	50.0	50.0	74.0	66.0	118.0	76.0	67.0	67.0
Actuated g/C Ratio	0.13	0.07	0.07	0.42	0.33	0.33	0.49	0.44	0.79	0.51	0.45	0.45
v/c Ratio	0.61	0.58	0.40	1.11	0.68	0.33	1.02	1.09	0.42	1.13	1.07	0.28
Control Delay	49.5	84.5	19.9	96.9	49.6	14.6	114.0	89.5	4.2	143.4	80.1	6.7

Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	50.9	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.5	84.5	19.9	147.8	53.6	14.6	114.0	89.5	4.2	143.4	80.1	6.7
LOS	D	F	B	F	D	B	F	F	A	F	F	A
Approach Delay	51.8			114.4			75.9			78.2		
Approach LOS	D			F			E			E		

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Natural Cycle: 150

Control Type: Pretimed

Maximum v/c Ratio: 1.13

Intersection Signal Delay: 85.3

Intersection LOS: F

Intersection Capacity Utilization 106.7%

ICU Level of Service G

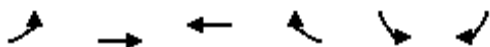
Analysis Period (min) 15

Splits and Phases: 10: TWP RD 550 & HWY 15

 ø1	 ø2	 ø3	 ø4
13 s	70 s	52 s	15 s
 ø5	 ø6	 ø7	 ø8
12 s	71 s	13 s	54 s

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

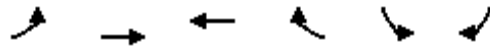
1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	28	545	826	227	266	291
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			120.0	0.0	0.0
Storage Lanes	1			1	0	0
Taper Length (m)	2.5			2.5	0.0	0.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	3579	3579	1601	1789	1601
Flt Permitted	0.211				0.950	
Satd. Flow (perm)	397	3579	3579	1601	1789	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				247		46
Link Speed (k/h)		60	60		48	
Link Distance (m)		298.7	400.0		120.2	
Travel Time (s)		17.9	24.0		9.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	30	592	898	247	289	316
Shared Lane Traffic (%)						
Lane Group Flow (vph)	30	592	898	247	289	316
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.7	3.7		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	23.0	23.0	23.0	23.0	27.0	27.0
Total Split (%)	46.0%	46.0%	46.0%	46.0%	54.0%	54.0%
Maximum Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effect Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.46	0.46
v/c Ratio	0.20	0.44	0.66	0.32	0.35	0.42
Control Delay	14.5	12.8	15.7	3.2	10.3	9.7

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.5	12.8	15.7	3.2	10.3	9.7
LOS	B	B	B	A	B	A
Approach Delay		12.9	13.0		9.9	
Approach LOS		B	B		A	

Intersection Summary

Area Type: Other

Cycle Length: 50

Actuated Cycle Length: 50

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.66

Intersection Signal Delay: 12.2

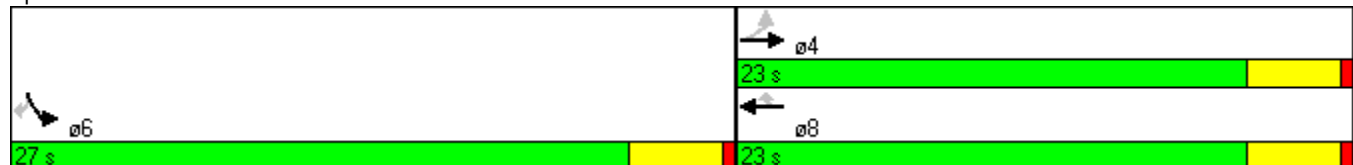
Intersection LOS: B

Intersection Capacity Utilization 47.5%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 11: TWP RD 550 & Road 1



Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	170	408	65	213	846	97	344	26	71	94	30	570
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	120.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		1	0		0	0		0
Taper Length (m)	0.0		0.0	2.5		2.5	0.0		0.0	0.0		0.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.890				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1676	0	1789	1883	1601
Flt Permitted	0.228			0.438			0.736			0.670		
Satd. Flow (perm)	429	3579	1601	825	3579	1601	1386	1676	0	1262	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			71			105			77			230
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		175.7			298.7			187.2			183.5	
Travel Time (s)		10.5			17.9			11.2			11.0	
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
Adj. Flow (vph)	185	443	71	232	920	105	374	28	77	102	33	620
Shared Lane Traffic (%)												
Lane Group Flow (vph)	185	443	71	232	920	105	374	105	0	102	33	620
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	13.0	63.0	63.0	15.0	65.0	65.0	42.0	42.0	0.0	42.0	42.0	42.0
Total Split (%)	10.8%	52.5%	52.5%	12.5%	54.2%	54.2%	35.0%	35.0%	0.0%	35.0%	35.0%	35.0%
Maximum Green (s)	9.0	59.0	59.0	11.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0		0	0	0
Act Effect Green (s)	68.0	59.0	59.0	72.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Actuated g/C Ratio	0.57	0.49	0.49	0.60	0.51	0.51	0.32	0.32		0.32	0.32	0.32
v/c Ratio	0.54	0.25	0.09	0.40	0.51	0.12	0.85	0.18		0.26	0.06	0.93
Control Delay	16.2	18.2	4.0	12.3	20.7	3.2	57.9	11.0		32.7	29.0	47.5

Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	16.2	18.2	4.0	12.3	20.7	3.2	57.9	11.0		32.7	29.0	47.5
LOS	B	B	A	B	C	A	E	B		C	C	D
Approach Delay		16.2			17.7			47.6			44.7	
Approach LOS		B			B			D			D	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 55

Control Type: Pretimed

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 28.3

Intersection LOS: C

Intersection Capacity Utilization 87.7%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 12: TWP RD 550 & 119 Street

 ø2	 ø3	 ø4
42 s	15 s	63 s
 ø6	 ø7	 ø8
42 s	13 s	65 s

Lanes, Volumes, Timings
25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	212	1191	404	276	1464	264	700	200	410	23	113	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		120.0	120.0		120.0	0.0		0.0
Storage Lanes	1		1	1		1	1		1	0		0
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	0.0		0.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.080			0.074			0.385			0.622		
Satd. Flow (perm)	151	3579	1601	139	3579	1601	1407	1883	1601	1172	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			439			287			307			101
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		679.9			1017.6			199.0			148.1	
Travel Time (s)		35.0			52.3			11.9			8.9	
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
Adj. Flow (vph)	230	1295	439	300	1591	287	761	217	446	25	123	101
Shared Lane Traffic (%)												
Lane Group Flow (vph)	230	1295	439	300	1591	287	761	217	446	25	123	101
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4			7.4	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	17.0	54.0	54.0	24.0	61.0	61.0	24.0	34.0	34.0	8.0	18.0	18.0
Total Split (%)	14.2%	45.0%	45.0%	20.0%	50.8%	50.8%	20.0%	28.3%	28.3%	6.7%	15.0%	15.0%
Maximum Green (s)	13.0	50.0	50.0	20.0	57.0	57.0	20.0	30.0	30.0	4.0	14.0	14.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	63.0	50.0	50.0	74.0	57.0	57.0	38.0	30.0	30.0	18.0	14.0	14.0
Actuated g/C Ratio	0.52	0.42	0.42	0.62	0.48	0.48	0.32	0.25	0.25	0.15	0.12	0.12
v/c Ratio	0.89	0.87	0.48	0.83	0.94	0.32	0.96	0.46	0.71	0.13	0.56	0.37
Control Delay	63.9	34.6	2.7	51.4	41.4	3.0	61.5	41.9	19.3	31.7	60.7	13.4

Lanes, Volumes, Timings 25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.9	34.6	2.7	51.4	41.4	3.0	61.5	41.9	19.3	31.7	60.7	13.4
LOS	E	C	A	D	D	A	E	D	B	C	E	B
Approach Delay	30.9			37.7			45.3			38.6		
Approach LOS	C			D			D			D		

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 37.3

Intersection LOS: D

Intersection Capacity Utilization 88.9%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 25: HWY 15 & 114 Street

 ø1	 ø2	 ø3	 ø4
8 s	34 s	24 s	54 s
 ø5	 ø6	 ø7	 ø8
24 s	18 s	17 s	61 s

Lanes, Volumes, Timings
28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	597	1429	538	0	2228	29	0	0	253	124	0	406
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	0.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	0		1	0		0	0		0
Taper Length (m)	2.5		2.5	0.0		2.5	0.0		0.0	0.0		0.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr't			0.850			0.850			0.865			0.850
Flt Protected	0.950									0.950		
Satd. Flow (prot)	3471	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Flt Permitted	0.057									0.950		
Satd. Flow (perm)	208	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			585			32			117			426
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		154.1			679.9			244.1			137.0	
Travel Time (s)		7.9			35.0			17.6			9.9	
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
Adj. Flow (vph)	649	1553	585	0	2422	32	0	0	275	135	0	441
Shared Lane Traffic (%)												
Lane Group Flow (vph)	649	1553	585	0	2422	32	0	0	275	135	0	441
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm			Perm			Free	custom		Free
Protected Phases	7	4			8							
Permitted Phases	4		4			8			Free	6		Free
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0				17.0		
Total Split (s)	29.0	99.0	99.0	0.0	70.0	70.0	0.0	0.0	0.0	21.0	0.0	0.0
Total Split (%)	24.2%	82.5%	82.5%	0.0%	58.3%	58.3%	0.0%	0.0%	0.0%	17.5%	0.0%	0.0%
Maximum Green (s)	25.0	95.0	95.0		66.0	66.0				17.0		
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5				3.5		
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5				0.5		
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0				5.0		
Flash Dont Walk (s)		11.0	11.0		11.0	11.0				11.0		
Pedestrian Calls (#/hr)		0	0		0	0				0		
Act Effect Green (s)	95.0	95.0	95.0		66.0	66.0			120.0	17.0		120.0
Actuated g/C Ratio	0.79	0.79	0.79		0.55	0.55			1.00	0.14		1.00
v/c Ratio	0.77	0.55	0.42		0.86	0.04			0.17	0.53		0.28
Control Delay	38.5	5.5	1.2		20.5	5.8			0.2	56.4		0.4

Lanes, Volumes, Timings

28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0		0.0	0.0			0.0	0.0		0.0
Total Delay	38.5	5.5	1.2		20.5	5.8			0.2	56.4		0.4
LOS	D	A	A		C	A			A	E		A
Approach Delay		12.3			20.3							
Approach LOS		B			C							

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 70

Control Type: Pretimed

Maximum v/c Ratio: 0.86

Intersection Signal Delay: 15.1

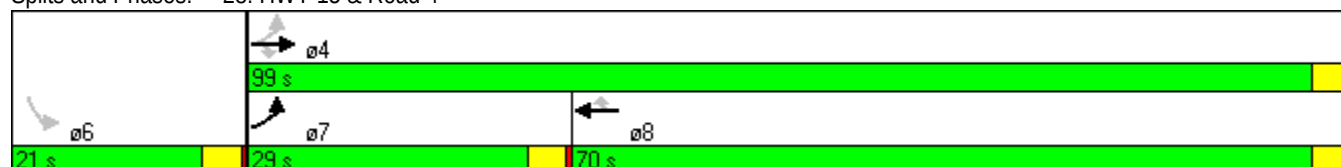
Intersection LOS: B

Intersection Capacity Utilization 76.9%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 28: HWY 15 & Road 4



Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	144	455	67	167	26	367	530	29	15	775	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		0.0	120.0		0.0	120.0		0.0	0.0		120.0
Storage Lanes	1		0	1		0	1		0	0		1
Taper Length (m)	2.5		0.0	2.5		0.0	2.5		0.0	0.0		2.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Frt			0.850		0.980			0.992				0.850
Flt Protected	0.950			0.950			0.950				0.999	
Satd. Flow (prot)	1789	1883	1601	1789	1846	0	1789	3550	0	0	3575	1601
Flt Permitted	0.545			0.632			0.158				0.940	
Satd. Flow (perm)	1026	1883	1601	1190	1846	0	298	3550	0	0	3364	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			403		11			14				346
Link Speed (k/h)		60			60			60				60
Link Distance (m)		400.0			826.2			176.8				226.2
Travel Time (s)		24.0			49.6			10.6				13.6
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
Adj. Flow (vph)	228	157	495	73	182	28	399	576	32	16	842	533
Shared Lane Traffic (%)												
Lane Group Flow (vph)	228	157	495	73	210	0	399	608	0	0	858	533
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7				3.7
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm		Perm	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0		8.0	20.0		20.0	20.0	20.0
Total Split (s)	24.0	24.0	24.0	24.0	24.0	0.0	17.0	46.0	0.0	29.0	29.0	29.0
Total Split (%)	34.3%	34.3%	34.3%	34.3%	34.3%	0.0%	24.3%	65.7%	0.0%	41.4%	41.4%	41.4%
Maximum Green (s)	20.0	20.0	20.0	20.0	20.0		13.0	42.0		25.0	25.0	25.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Walk Time (s)	5.0	5.0	5.0	5.0	5.0			5.0		5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0			11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0			0		0	0	0
Act Effect Green (s)	20.0	20.0	20.0	20.0	20.0		42.0	42.0			25.0	25.0
Actuated g/C Ratio	0.29	0.29	0.29	0.29	0.29		0.60	0.60			0.36	0.36
v/c Ratio	0.78	0.29	0.66	0.21	0.39		0.88	0.28			0.71	0.67
Control Delay	44.0	21.3	9.8	21.1	21.7		36.2	7.0			23.5	11.3

Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	0.0
Total Delay	44.0	21.3	9.8	21.1	21.7		36.2	7.0			23.5	11.3
LOS	D	C	A	C	C		D	A			C	B
Approach Delay		20.7			21.5			18.6			18.8	
Approach LOS		C			C			B			B	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 70

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 55

Control Type: Pretimed

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 19.4

Intersection LOS: B

Intersection Capacity Utilization 77.5%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 32: TWP RD 550 & Road 3



HCM Unsignalized Intersection Capacity Analysis

15: TWP RD 550 & 85 Street

1/5/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	41	7	5	90	29	9	12	5	11	5	38
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	45	8	5	98	32	10	13	5	12	5	41
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	60	135	28	59								
Volume Left (vph)	8	5	10	12								
Volume Right (vph)	8	32	5	41								
Hadj (s)	-0.02	-0.10	-0.01	-0.35								
Departure Headway (s)	4.2	4.0	4.4	4.0								
Degree Utilization, x	0.07	0.15	0.03	0.07								
Capacity (veh/h)	830	866	778	854								
Control Delay (s)	7.5	7.8	7.5	7.3								
Approach Delay (s)	7.5	7.8	7.5	7.3								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay				7.6								
HCM Level of Service				A								
Intersection Capacity Utilization				17.7%	ICU Level of Service	A						
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis

19: 85 Street &

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	22	2	13	35	51	125
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	24	2	14	38	55	136
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	190	123	191			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	190	123	191			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	100	99			
cM capacity (veh/h)	791	927	1382			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	26	52	191			
Volume Left	24	14	0			
Volume Right	2	0	136			
cSH	801	1382	1700			
Volume to Capacity	0.03	0.01	0.11			
Queue Length 95th (m)	0.8	0.2	0.0			
Control Delay (s)	9.6	2.1	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.6	2.1	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			23.2%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

22: Road 1 & 85 Street

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	37	6	18	39	172	103
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	40	7	20	42	187	112
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	324	243	299			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	324	243	299			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	99	98			
cM capacity (veh/h)	659	796	1262			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	47	62	299			
Volume Left	40	20	0			
Volume Right	7	0	112			
cSH	675	1262	1700			
Volume to Capacity	0.07	0.02	0.18			
Queue Length 95th (m)	1.7	0.4	0.0			
Control Delay (s)	10.7	2.6	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.7	2.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			1.6			
Intersection Capacity Utilization			27.9%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	226	1409	9	165	828	23	5	35	41	61	109	584
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	150.0		120.0	0.0		150.0	0.0		50.0	150.0		150.0
Storage Lanes	2		1	1		1	0		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950				0.994		0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	0	1872	1601	1789	1883	1601
Flt Permitted	0.214			0.112				0.973		0.729		
Satd. Flow (perm)	782	3579	1601	211	3579	1601	0	1833	1601	1373	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			10			25			45			103
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		1017.6			210.7			780.1			303.3	
Travel Time (s)		52.3			10.8			46.8			18.2	
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
Adj. Flow (vph)	246	1532	10	179	900	25	5	38	45	66	118	635
Shared Lane Traffic (%)												
Lane Group Flow (vph)	246	1532	10	179	900	25	0	43	45	66	118	635
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm		Perm	Perm		pt+ov
Protected Phases	7	4		3	8			2			6	6 7
Permitted Phases	4		4	8		8	2		2	6		
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	
Total Split (s)	21.0	62.0	62.0	11.0	52.0	52.0	22.0	22.0	22.0	22.0	22.0	43.0
Total Split (%)	22.1%	65.3%	65.3%	11.6%	54.7%	54.7%	23.2%	23.2%	23.2%	23.2%	23.2%	45.3%
Maximum Green (s)	17.0	58.0	58.0	7.0	48.0	48.0	18.0	18.0	18.0	18.0	18.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0	0		0	0	0	0	0	0	0	
Act Effect Green (s)	69.0	58.0	58.0	55.0	48.0	48.0		18.0	18.0	18.0	18.0	39.0
Actuated g/C Ratio	0.73	0.61	0.61	0.58	0.51	0.51		0.19	0.19	0.19	0.19	0.41
v/c Ratio	0.23	0.70	0.01	0.75	0.50	0.03		0.12	0.13	0.25	0.33	0.88
Control Delay	4.4	14.8	3.9	36.2	16.7	4.7		33.2	11.1	35.9	36.3	37.8

Lanes, Volumes, Timings 5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	4.4	14.8	3.9	36.2	16.7	4.7		33.2	11.1	35.9	36.3	37.8
LOS	A	B	A	D	B	A		C	B	D	D	D
Approach Delay		13.3			19.6			21.9			37.4	
Approach LOS		B			B			C			D	

Intersection Summary

Area Type: Other

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 20.5

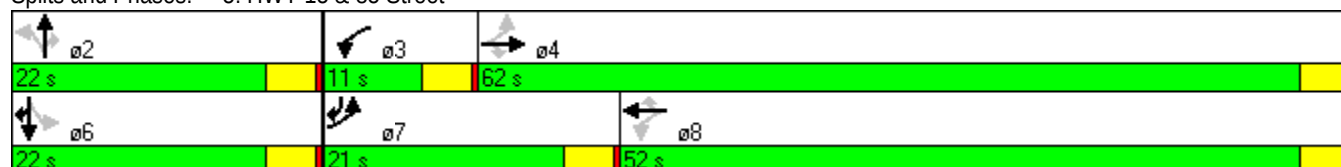
Intersection LOS: C

Intersection Capacity Utilization 72.4%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 5: HWY 15 & 85 Street



Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	242	297	126	340	55	88	62	2507	778	159	1593	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	120.0		120.0	120.0		120.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	3471	1883	1601	1789	5142	1601	1789	5142	1601
Flt Permitted	0.513			0.400			0.083			0.059		
Satd. Flow (perm)	966	1883	1601	1462	1883	1601	156	5142	1601	111	5142	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			95			96			350			40
Link Speed (k/h)		60			60			70			70	
Link Distance (m)		97.9			175.7			499.4			256.9	
Travel Time (s)		5.9			10.5			25.7			13.2	
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
Adj. Flow (vph)	263	323	137	370	60	96	67	2725	846	173	1732	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	263	323	137	370	60	96	67	2725	846	173	1732	40
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	12.0	12.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	24.0	26.0	26.0	12.0	14.0	14.0	10.0	71.0	71.0	11.0	72.0	72.0
Total Split (%)	20.0%	21.7%	21.7%	10.0%	11.7%	11.7%	8.3%	59.2%	59.2%	9.2%	60.0%	60.0%
Maximum Green (s)	20.0	22.0	22.0	8.0	10.0	10.0	6.0	67.0	67.0	7.0	68.0	68.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	34.0	22.0	22.0	18.0	10.0	10.0	73.0	67.0	67.0	75.0	68.0	68.0
Actuated g/C Ratio	0.28	0.18	0.18	0.15	0.08	0.08	0.61	0.56	0.56	0.62	0.57	0.57
v/c Ratio	0.64	0.94	0.37	1.05	0.38	0.43	0.38	0.95	0.81	1.04	0.59	0.04
Control Delay	44.3	83.5	18.4	96.1	56.0	17.7	14.1	33.8	19.1	107.7	18.1	3.6

Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.3	83.5	18.4	96.1	56.0	17.7	14.1	33.8	19.1	107.7	18.1	3.6
LOS	D	F	B	F	E	B	B	C	B	F	B	A
Approach Delay	56.9			77.2			30.0			25.7		
Approach LOS	E			E			C			C		

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 1.05

Intersection Signal Delay: 35.3

Intersection LOS: D

Intersection Capacity Utilization 95.9%

ICU Level of Service F

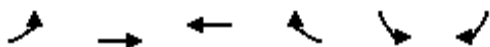
Analysis Period (min) 15

Splits and Phases: 10: TWP RD 550 & HWY 15

 ø1	 ø2	 ø3	 ø4
11 s	71 s	12 s	26 s
 ø5	 ø6	 ø7	 ø8
10 s	72 s	24 s	14 s

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

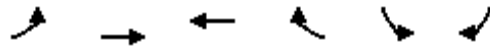
1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	81	765	306	158	70	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			120.0	0.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5			2.5	2.5	2.5
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	3579	3579	1601	1789	1601
Flt Permitted	0.551				0.950	
Satd. Flow (perm)	1038	3579	3579	1601	1789	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				172		66
Link Speed (k/h)		60	60		60	
Link Distance (m)		298.7	400.0		120.2	
Travel Time (s)		17.9	24.0		7.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	88	832	333	172	76	66
Shared Lane Traffic (%)						
Lane Group Flow (vph)	88	832	333	172	76	66
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.7	3.7		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	23.0	23.0	23.0	23.0	27.0	27.0
Total Split (%)	46.0%	46.0%	46.0%	46.0%	54.0%	54.0%
Maximum Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effect Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.46	0.46
v/c Ratio	0.22	0.61	0.24	0.24	0.09	0.09
Control Delay	12.4	14.9	11.2	3.2	8.0	2.9

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.4	14.9	11.2	3.2	8.0	2.9
LOS	B	B	B	A	A	A
Approach Delay		14.7	8.5		5.7	
Approach LOS		B	A		A	

Intersection Summary

Area Type: Other

Cycle Length: 50

Actuated Cycle Length: 50

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.61

Intersection Signal Delay: 11.9

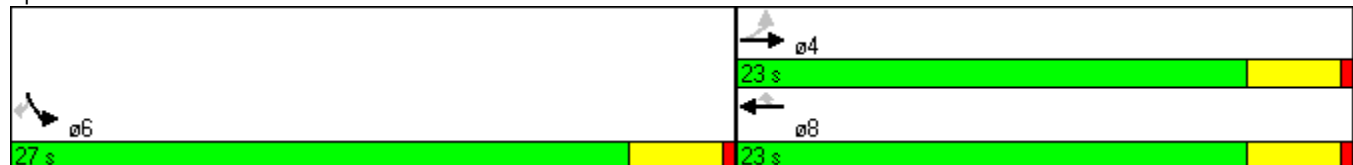
Intersection LOS: B

Intersection Capacity Utilization 31.7%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 11: TWP RD 550 & Road 1



Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	73	818	315	60	251	43	57	19	57	25	9	149
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	120.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	1		0	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.888				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1672	0	1789	1883	1601
Flt Permitted	0.584			0.218			0.751			0.703		
Satd. Flow (perm)	1100	3579	1601	411	3579	1601	1414	1672	0	1324	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			342			47			62			162
Link Speed (k/h)		60			60			48			48	
Link Distance (m)		175.7			298.7			187.2			183.5	
Travel Time (s)		10.5			17.9			14.0			13.8	
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
Adj. Flow (vph)	79	889	342	65	273	47	62	21	62	27	10	162
Shared Lane Traffic (%)												
Lane Group Flow (vph)	79	889	342	65	273	47	62	83	0	27	10	162
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	13.0	63.0	63.0	15.0	65.0	65.0	42.0	42.0	0.0	42.0	42.0	42.0
Total Split (%)	10.8%	52.5%	52.5%	12.5%	54.2%	54.2%	35.0%	35.0%	0.0%	35.0%	35.0%	35.0%
Maximum Green (s)	9.0	59.0	59.0	11.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0		0	0	0
Act Effect Green (s)	68.0	59.0	59.0	72.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Actuated g/C Ratio	0.57	0.49	0.49	0.60	0.51	0.51	0.32	0.32		0.32	0.32	0.32
v/c Ratio	0.12	0.51	0.36	0.17	0.15	0.06	0.14	0.15		0.06	0.02	0.26
Control Delay	10.1	22.7	3.9	10.3	16.0	4.4	30.4	11.3		29.3	28.4	5.6

Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	10.1	23.1	3.9	10.3	16.0	4.4	30.4	11.3		29.3	28.4	5.6
LOS	B	C	A	B	B	A	C	B		C	C	A
Approach Delay	17.3			13.6			19.5			10.0		
Approach LOS	B			B			B			A		

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 50

Control Type: Pretimed

Maximum v/c Ratio: 0.51

Intersection Signal Delay: 16.0

Intersection LOS: B

Intersection Capacity Utilization 45.8%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 12: TWP RD 550 & 119 Street

 ø2	 ø3	 ø4
42 s	15 s	63 s
 ø6	 ø7	 ø8
42 s	13 s	65 s

Lanes, Volumes, Timings
25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	84	1344	566	407	984	21	216	44	76	266	204	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		120.0	120.0		120.0	0.0		0.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.267			0.058			0.453			0.581		
Satd. Flow (perm)	503	3579	1601	109	3579	1601	1655	1883	1601	1094	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			249			23			83			172
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		679.9			1017.6			199.0			89.1	
Travel Time (s)		35.0			52.3			14.3			6.4	
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
Adj. Flow (vph)	91	1461	615	442	1070	23	235	48	83	289	222	174
Shared Lane Traffic (%)												
Lane Group Flow (vph)	91	1461	615	442	1070	23	235	48	83	289	222	174
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4			7.4	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	10.0	69.0	69.0	40.0	99.0	99.0	10.0	20.0	20.0	19.0	29.0	29.0
Total Split (%)	6.8%	46.6%	46.6%	27.0%	66.9%	66.9%	6.8%	13.5%	13.5%	12.8%	19.6%	19.6%
Maximum Green (s)	6.0	65.0	65.0	36.0	95.0	95.0	6.0	16.0	16.0	15.0	25.0	25.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	71.0	65.0	65.0	105.0	95.0	95.0	22.0	16.0	16.0	35.0	25.0	25.0
Actuated g/C Ratio	0.48	0.44	0.44	0.71	0.64	0.64	0.15	0.11	0.11	0.24	0.17	0.17
v/c Ratio	0.31	0.93	0.73	0.91	0.47	0.02	0.73	0.24	0.34	0.88	0.70	0.42
Control Delay	14.4	50.7	25.3	67.1	14.4	3.4	65.3	63.7	15.7	79.3	70.7	10.7

Lanes, Volumes, Timings 25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.4	50.7	25.3	67.1	14.4	3.4	65.3	63.7	15.7	79.3	70.7	10.7
LOS	B	D	C	E	B	A	E	E	B	E	E	B
Approach Delay	42.0			29.4			53.8			59.1		
Approach LOS	D			C			D			E		

Intersection Summary

Area Type: Other

Cycle Length: 148

Actuated Cycle Length: 148

Offset: 132 (89%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 41.3

Intersection LOS: D

Intersection Capacity Utilization 91.1%

ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 25: HWY 15 & 114 Street

 ø1	 ø2	 ø3	 ø4
19 s	20 s	40 s	69 s
 ø5	 ø6	 ø7	 ø8
10 s	29 s	10 s	99 s

Lanes, Volumes, Timings
28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	369	1905	565	0	1247	113	0	0	62	26	0	543
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	0.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	0		1	0		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.865			0.850
Flt Protected	0.950									0.950		
Satd. Flow (prot)	3471	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Flt Permitted	0.140									0.950		
Satd. Flow (perm)	512	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			614			123			201			384
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		154.1			679.9			244.1			137.0	
Travel Time (s)		7.9			35.0			14.6			8.2	
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
Adj. Flow (vph)	401	2071	614	0	1355	123	0	0	67	28	0	590
Shared Lane Traffic (%)												
Lane Group Flow (vph)	401	2071	614	0	1355	123	0	0	67	28	0	590
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm			Perm			Free	custom		Free
Protected Phases	7	4			8							
Permitted Phases	4		4			8			Free	6		Free
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0				17.0		
Total Split (s)	12.0	62.0	62.0	0.0	50.0	50.0	0.0	0.0	0.0	18.0	0.0	0.0
Total Split (%)	15.0%	77.5%	77.5%	0.0%	62.5%	62.5%	0.0%	0.0%	0.0%	22.5%	0.0%	0.0%
Maximum Green (s)	8.0	58.0	58.0		46.0	46.0				14.0		
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5				3.5		
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5				0.5		
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0				5.0		
Flash Dont Walk (s)		11.0	11.0		11.0	11.0				11.0		
Pedestrian Calls (#/hr)		0	0		0	0				0		
Act Effect Green (s)	58.0	58.0	58.0		46.0	46.0			80.0	14.0		80.0
Actuated g/C Ratio	0.72	0.72	0.72		0.58	0.58			1.00	0.18		1.00
v/c Ratio	0.60	0.80	0.46		0.46	0.13			0.04	0.09		0.37
Control Delay	8.4	10.3	1.5		10.4	1.9			0.0	28.6		0.7

Lanes, Volumes, Timings

28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0		0.0	0.0			0.0	0.0		0.0
Total Delay	8.4	10.3	1.5		10.4	1.9			0.0	28.6		0.7
LOS	A	B	A		B	A			A	C		A
Approach Delay		8.3			9.7							
Approach LOS		A			A							

Intersection Summary

Area Type: Other

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.80

Intersection Signal Delay: 7.8

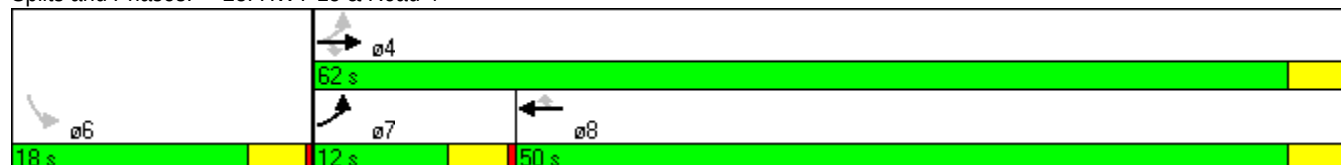
Intersection LOS: A

Intersection Capacity Utilization 62.7%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 28: HWY 15 & Road 4



Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	510	170	126	13	106	14	272	787	74	24	333	107
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		0.0	120.0		0.0	120.0		0.0	0.0		120.0
Storage Lanes	1		1	1		0	1		0	0		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Frt			0.850		0.983			0.987				0.850
Flt Protected	0.950			0.950			0.950				0.997	
Satd. Flow (prot)	1789	1883	1601	1789	1851	0	1789	3532	0	0	3568	1601
Flt Permitted	0.674			0.641			0.364				0.862	
Satd. Flow (perm)	1269	1883	1601	1207	1851	0	686	3532	0	0	3085	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			137		13			16				116
Link Speed (k/h)		60			60			60				60
Link Distance (m)		400.0			826.2			176.8				226.2
Travel Time (s)		24.0			49.6			10.6				13.6
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
Adj. Flow (vph)	554	185	137	14	115	15	296	855	80	26	362	116
Shared Lane Traffic (%)												
Lane Group Flow (vph)	554	185	137	14	130	0	296	935	0	0	388	116
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7				3.7
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm		Perm	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0		8.0	20.0		20.0	20.0	20.0
Total Split (s)	39.0	39.0	39.0	39.0	39.0	0.0	9.0	31.0	0.0	22.0	22.0	22.0
Total Split (%)	55.7%	55.7%	55.7%	55.7%	55.7%	0.0%	12.9%	44.3%	0.0%	31.4%	31.4%	31.4%
Maximum Green (s)	35.0	35.0	35.0	35.0	35.0		5.0	27.0		18.0	18.0	18.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Walk Time (s)	5.0	5.0	5.0	5.0	5.0			5.0		5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0			11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0			0		0	0	0
Act Effect Green (s)	35.0	35.0	35.0	35.0	35.0		27.0	27.0			18.0	18.0
Actuated g/C Ratio	0.50	0.50	0.50	0.50	0.50		0.39	0.39			0.26	0.26
v/c Ratio	0.87	0.20	0.16	0.02	0.14		0.86	0.68			0.49	0.23
Control Delay	33.3	10.4	2.5	9.1	8.9		45.0	20.7			24.6	6.0

Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	0.0
Total Delay	33.3	10.4	2.5	9.1	8.9		45.0	20.7			24.6	6.0
LOS	C	B	A	A	A		D	C			C	A
Approach Delay		23.6			9.0			26.5			20.3	
Approach LOS		C			A			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 70

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.87

Intersection Signal Delay: 23.6

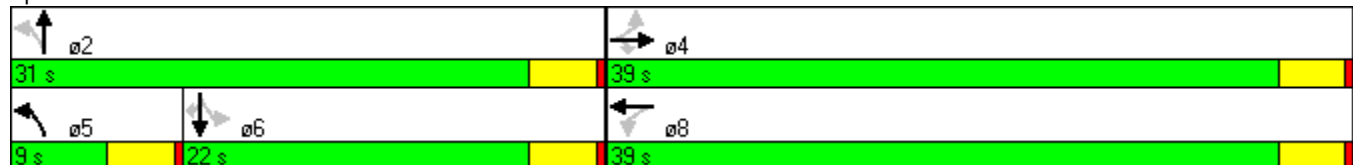
Intersection LOS: C

Intersection Capacity Utilization 78.9%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 32: TWP RD 550 & Road 3



HCM Unsignalized Intersection Capacity Analysis

15: TWP RD 550 & 85 Street

1/5/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	35	97	9	6	51	21	10	10	6	35	15	15
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)	38	105	10	7	55	23	11	11	7	38	16	16
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	153	85	28	71								
Volume Left (vph)	38	7	11	38								
Volume Right (vph)	10	23	7	16								
Hadj (s)	0.05	-0.11	-0.03	0.00								
Departure Headway (s)	4.3	4.2	4.5	4.5								
Degree Utilization, x	0.18	0.10	0.04	0.09								
Capacity (veh/h)	821	832	751	754								
Control Delay (s)	8.2	7.6	7.7	7.9								
Approach Delay (s)	8.2	7.6	7.7	7.9								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.0									
HCM Level of Service			A									
Intersection Capacity Utilization			26.4%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

19: Road 2 & 85 Street

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	12	114	5	60	53	49
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	124	5	65	58	53
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	160	84	111			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	160	84	111			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	87	100			
cM capacity (veh/h)	828	975	1479			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	137	71	111			
Volume Left	13	5	0			
Volume Right	124	0	53			
cSH	959	1479	1700			
Volume to Capacity	0.14	0.00	0.07			
Queue Length 95th (m)	3.8	0.1	0.0			
Control Delay (s)	9.4	0.6	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.4	0.6	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			4.2			
Intersection Capacity Utilization			21.7%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

22: Road 1 & 85 Street

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	100	27	18	156	45	75
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	109	29	20	170	49	82
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	298	90	130			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	298	90	130			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	84	97	99			
cM capacity (veh/h)	684	968	1455			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	138	189	130			
Volume Left	109	20	0			
Volume Right	29	0	82			
cSH	729	1455	1700			
Volume to Capacity	0.19	0.01	0.08			
Queue Length 95th (m)	5.3	0.3	0.0			
Control Delay (s)	11.1	0.9	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.1	0.9	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			3.7			
Intersection Capacity Utilization			29.7%	ICU Level of Service		A
Analysis Period (min)			15			



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**Josephburg Road North Industrial
Area Structure Plan
Transportation Impact Assessment**

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1.0 Introduction

1.1 BACKGROUND

Stantec Consulting Ltd. has been retained to provide professional services to the City of Fort Saskatchewan to develop an Area Structure Plan (ASP) for the Josephburg Road North Industrial Area. As part of the ASP, a Transportation Impact Assessment is being submitted in support of the ASP process.

1.2 OBJECTIVES

The objectives of this transportation assessment are to:

- Establish future background traffic conditions in the vicinity of the proposed development
- Estimate the magnitude and characteristics of traffic generated by the proposed land uses;
- Evaluate the impacts of vehicular traffic generated by the proposed development on the adjacent roadway system;

2.0 Site Context

2.1 STUDY AREA

The study area encompasses the Josephburg Road Industrial Area in northeastern Fort Saskatchewan which is bounded by Highway 15 on the northwest, by Range Road 220 on the east, and by Township Road 550 on the south. Figure 2.1 shows the location of the subject area.

To the north of the study area is a heavy industrial area. Southwest of the study area is the Eastgate Business park. South and east of the study area is outside City of Fort Saskatchewan limits and is part of the Agriculture Large Holdings Policy Area and Agri-Industrial Transition Policy Area within Strathcona County.

2.2 ROAD NETWORK

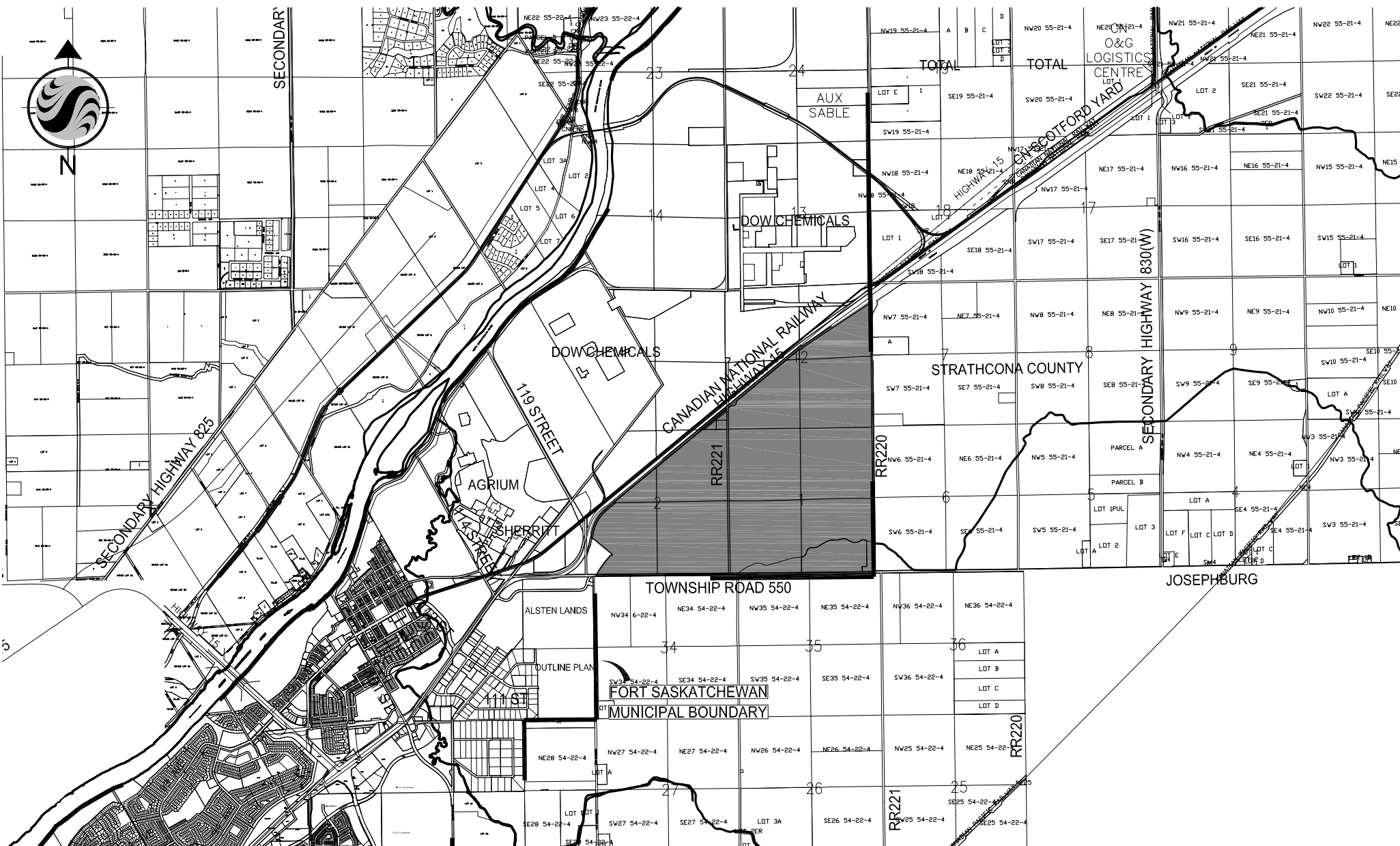
Key components of the current and future road network include Highway 15, Range Road 220, and Township Road 550. The following is a description of each, including its current status and any plans for future improvement.

Highway 15 is a four lane divided urban expressway and part of the provincially designated high load corridor system. Access to the Highway from the subject lands is currently from three separate intersections located at Range Roads 220, 221 and Township Road 550. The Fort Saskatchewan Transportation Master Plan (TMP) recommends that Highway 15 be widened to six lanes from Township Road 543 to 114 Street in the Long Term planning horizon (2022). Additionally, the TMP recommends signal installation at the intersections of Highway 15 – 114 Street and Highway 15 – 119 Street.

Township Road 550 is an improved, two lane rural road under the City of Fort Saskatchewan's municipal jurisdiction. The roadway terminates slightly west of the plan area where it intersects with Highway 15. The two range roads crossing Township Road 550 are not currently continuous. For the purposes of this TIA, it has been assumed that with the development of the area, and the preparation of Outline Plans, that the roadways would continuous across Township Road 550.

Range Road 220 is an unimproved two lane rural roadway under the jurisdiction of Strathcona County. The only internal roadway is Range Road 221, again an unimproved two lane rural roadway, extending north-south in the ASP.

The East By-Pass Road is discussed in the TMP it is recognized that an alignment has not yet been finalized for the facility. The TMP does recommend that it be constructed in the Long Term planning horizon (2022).



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JOSEPHBURG ROAD NORTH INDUSTRIAL
TRANSPORTATION IMPACT ASSESSMENT

Figure No.
2.1

Title
Location Plan



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3.0 Development Proposal and Trip Characteristics

3.1 PROPOSED DEVELOPMENT

The Josephburg Road North Industrial ASP area is bounded by Highway 15 to the north and west, Township Road 550 to the south, and Rang Road 220 to the east. Figure 3.1 illustrates the development concept plan corresponding to the ASP area.

The ASP area covers approximately 590 ha (1,459 acre). Among them, about 168 ha (415 acre) of gross development land is proposed for light industrial purposes, 233 ha (575 acre) is for medium industrial purposes, and 53 ha (131 acre) is for medium industrial - Highway 15 vicinity overlay. Access to the ASP area will be via Highway 15, Rang Road 220, and Township Road 550.

3.2 PROJECTED BACKGROUND TRAFFIC

In order to project the future background traffic, the City of Fort Saskatchewan provided Stantec with their 2008 Transportation Master Plan Study report and the AM Peak Hour VISUM Model working files for various horizons. Based on the growth trend of this ASP area, the City long term transportation model (45,000 population horizon) containing Fort Saskatchewan East By Pass Road was utilized for the future background traffic projections.

Since the City transportation model has different access configuration at Highway 15 - 119 Street (as compared with the proposed road network in this ASP), the model was revised and re-run for trip distribution and traffic assignment. The AM Peak hour background traffic was then achieved by excluding the Josephburg Road North Industrial ASP area generated traffic.

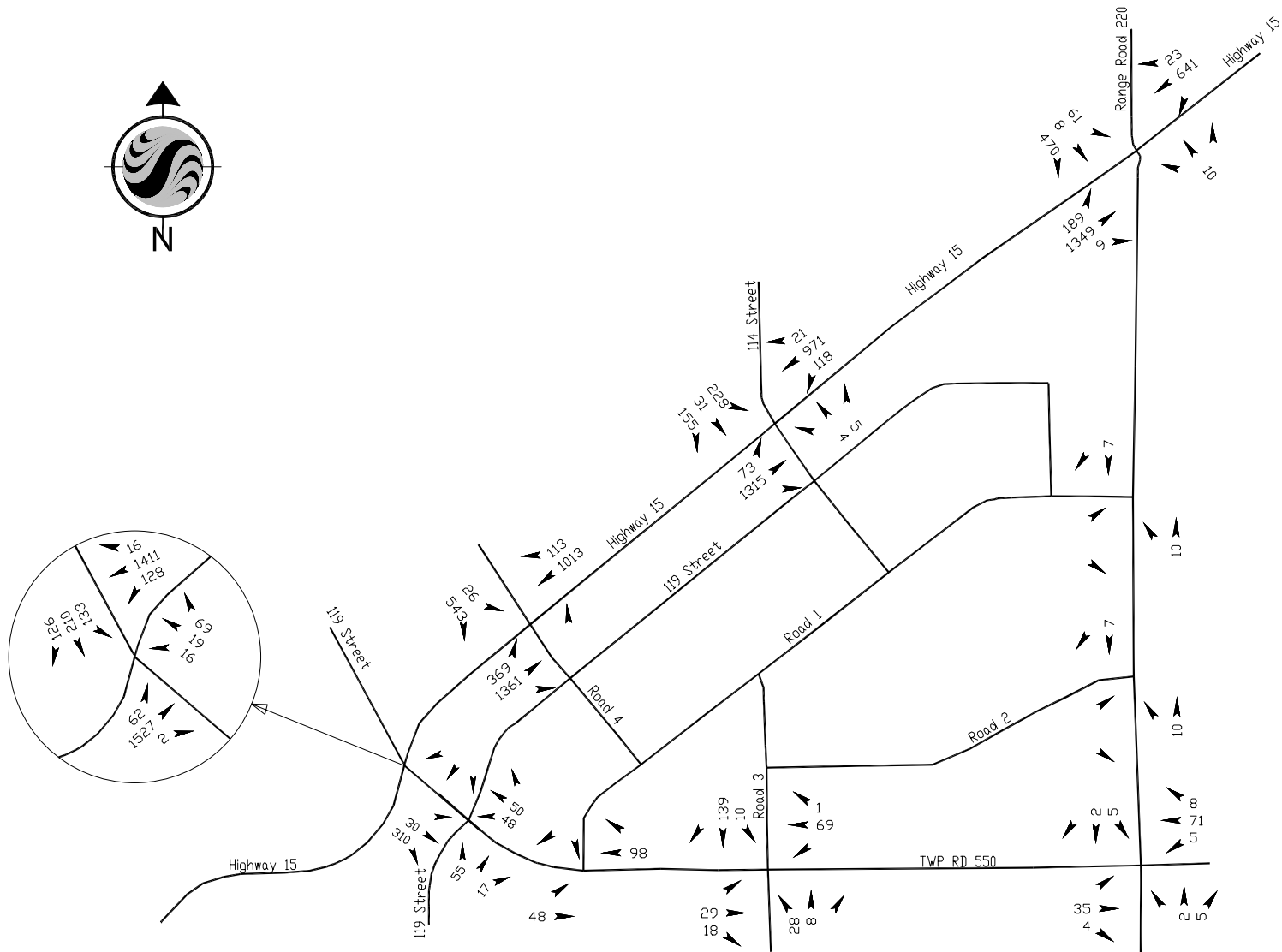
The PM Peak background volumes were calculated by reversing the projected AM Peak background volumes and factoring by 1.10.

The projected background volumes are illustrated in the following figures.

- Figure 3.2 (a) - Background Volumes - AM Full Build Out
- Figure 3.2 (b) - Background Volumes - PM Full Build Out

3.3 TRIP GENERATION

The trip rates per acre, per 1000 ft² and in/out splits used for this analysis are listed in Table 3.1. The light industrial trip rates were measured as part of the Northeast Fort Saskatchewan Industrial Transportation Impact Assessment prepared by Stantec in 2006. The medium industrial trip rates were blended from the measured light industrial trip rates and the heavy industrial land use from ITE 7th Edition Trip Generation manual. The trip rates for Shopping



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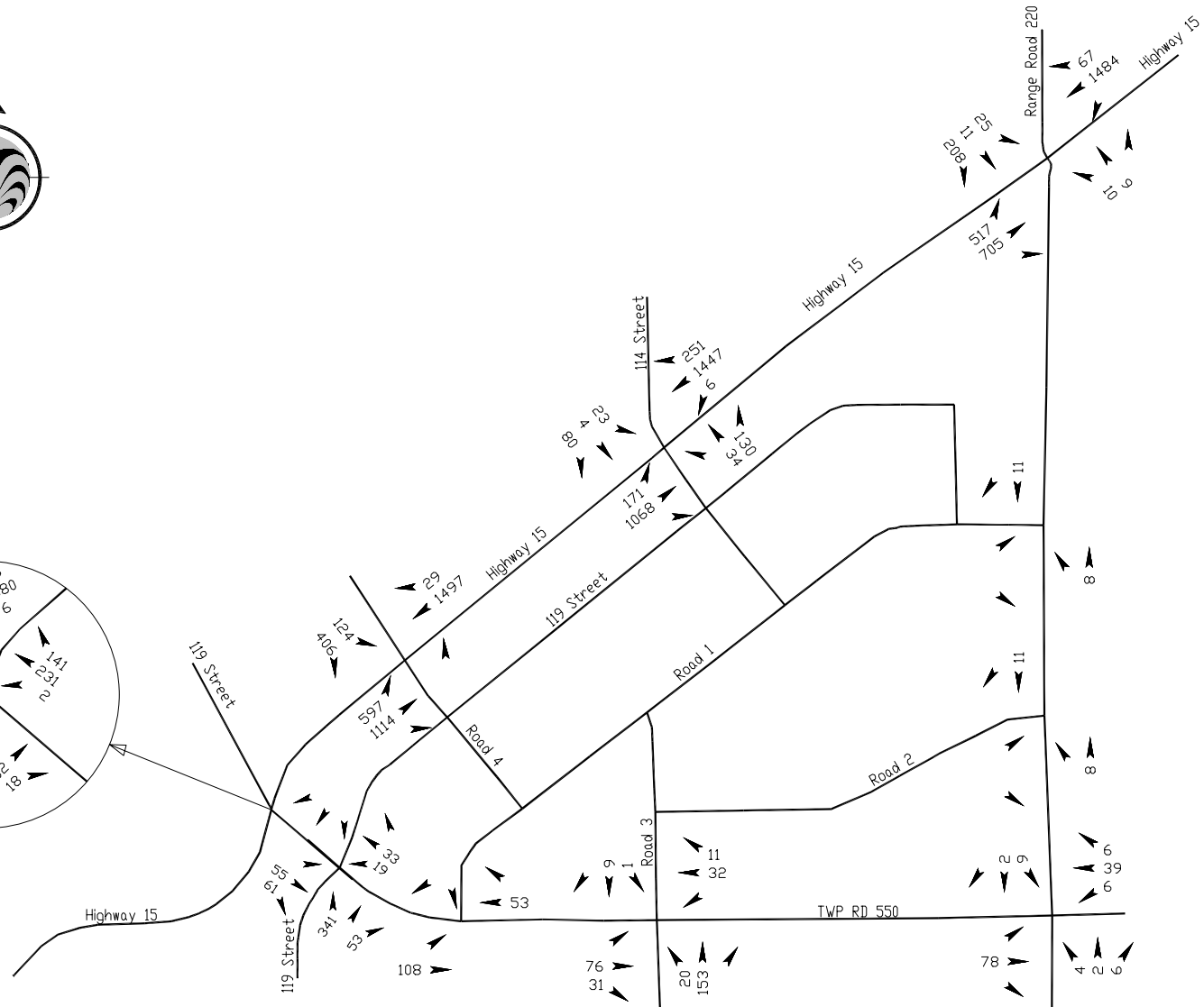
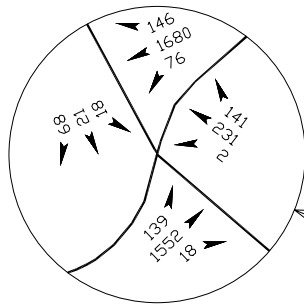
Figure No.

3.2(a)

Title

**Background Volumes
- AM Full Build Out**

December 2009
1161 70800



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TRANSPORTATION IMPACT ASSESSMENT

Figure No.

3.2(b)

Title

**Background Volumes
- PM Full Build Out**

December 2009
1161 70800

Centre (land use #820) in the ITE Trip Generation manual was adopted for the proposed medium industrial - Highway 15 vicinity overlay areas.

Table 3.1
Trip Generation Rates

		AM Peak			PM Peak		
	Unit	rate	in	out	rate	in	out
Light Industrial	Acre	5.97	85%	15%	6.58	30%	70%
Medium Industrial	Acre	4.75	85%	15%	4.71	30%	70%
Medium Industrial -Highway 15 Vicinity Overlay	1000 sq. ft.	1.03	50%	50%	3.75	50%	50%

For the trip generation analysis, the industrial sites assume approximately 79% of the areas are developed, allowing for local roadways, and park space that still need to be accounted for in the Outline Plans. For the medium industrial - Highway 15 vicinity overlay, an assumption that the area will be developed as relatively low density commercial with floor area ratio (FAR) of 20% has been made.

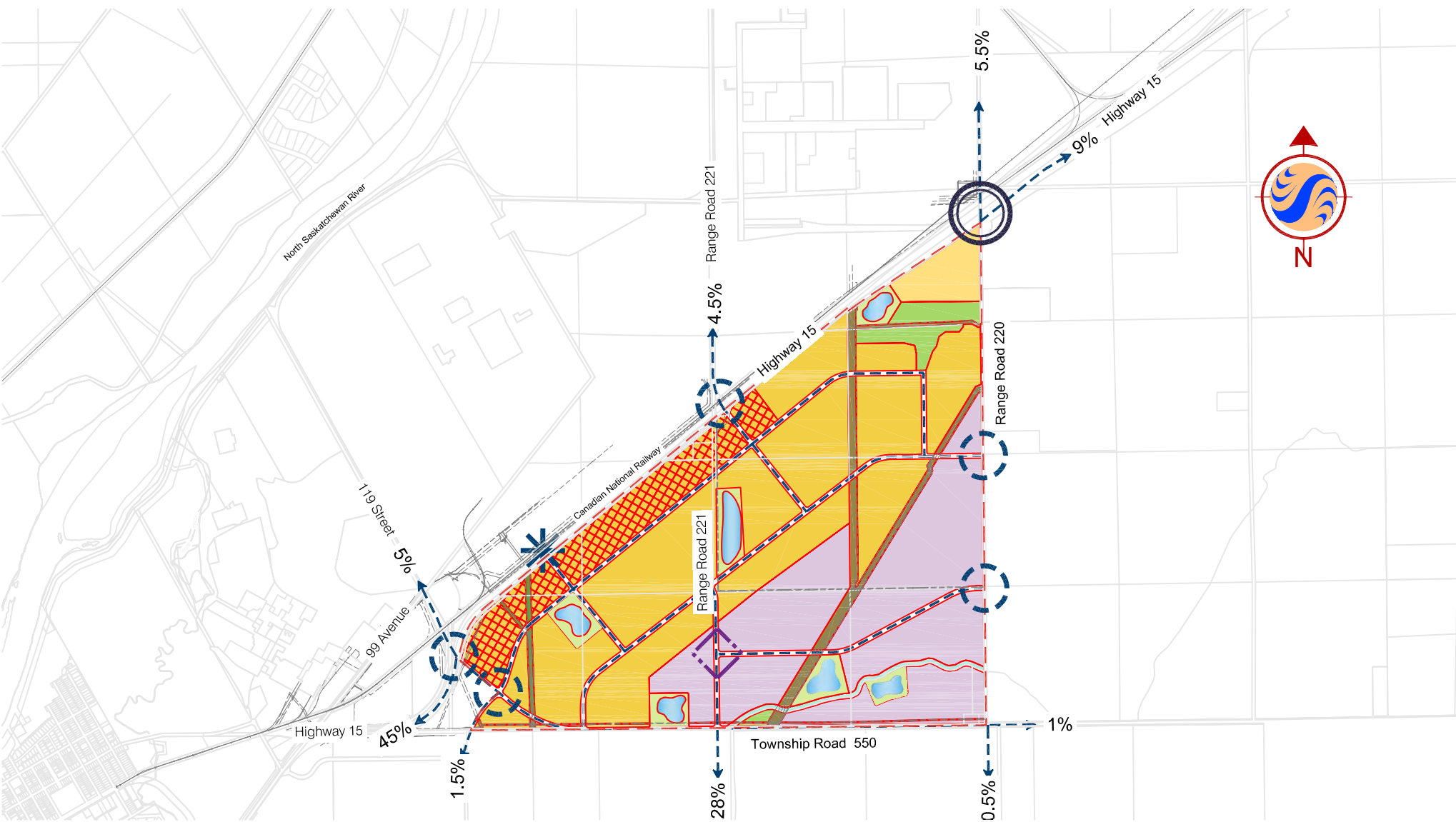
The proposed trip generation totals are shown in Table 3.2.

Table 3.1
Trip Generation Totals

		AM			PM		
	Size	in	out	total	in	out	total
Light Industrial (acre)	326	1,654	292	1,946	644	1,502	2,145
Medium Industrial (acre)	455	1,895	467	2,362	701	1,642	2,344
Commercial Areas (1000 sq.ft.)	954	492	492	983	1,790	1,790	3,480
Total		4,041	1,250	5,291	3,175	4,934	8,069

3.4 TRIP DISTRIBUTION AND ASSIGNMENT

Based on the City Long Term transportation model trip distribution pattern, the site-generated trips to and from this development were distributed throughout Fort Saskatchewan and surrounding area. The trip distribution percentages for each external gate are shown in Figure 3.3.



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JOSEPHBURG ROAD NORTH INDUSTRIAL
TRANSPORTATION IMPACT ASSESSMENT

Figure No.

3.3

Title

Trip Distribution

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The same modeling tool used for the City 2008 Transportation Master Plan Study, VISUM was adopted to determine the assignment of the industrial and commercial trips. These trips from the development sites were assigned based on the access available and the most logical (minimum travel time) paths.

Trips for the commercial sites (medium industrial - Highway 15 vicinity overlay) are categorized as primary trips and pass-by trips. Pass-by trips are trips intercepted from the stream of traffic passing the site, which contribute to traffic volumes on site accesses, but do not contribute new traffic loading to the adjacent street system. Primary trips are trips made for the purpose of visiting the commercial site, for which the commercial generator is the primary reason for the trip.

Based on their sizes and locations, trips for the commercial sites are assumed as $\frac{3}{4}$ of primary trips and $\frac{1}{4}$ of pass-by trips.

Trips generated at full development of the study area are summarized in the following figures:

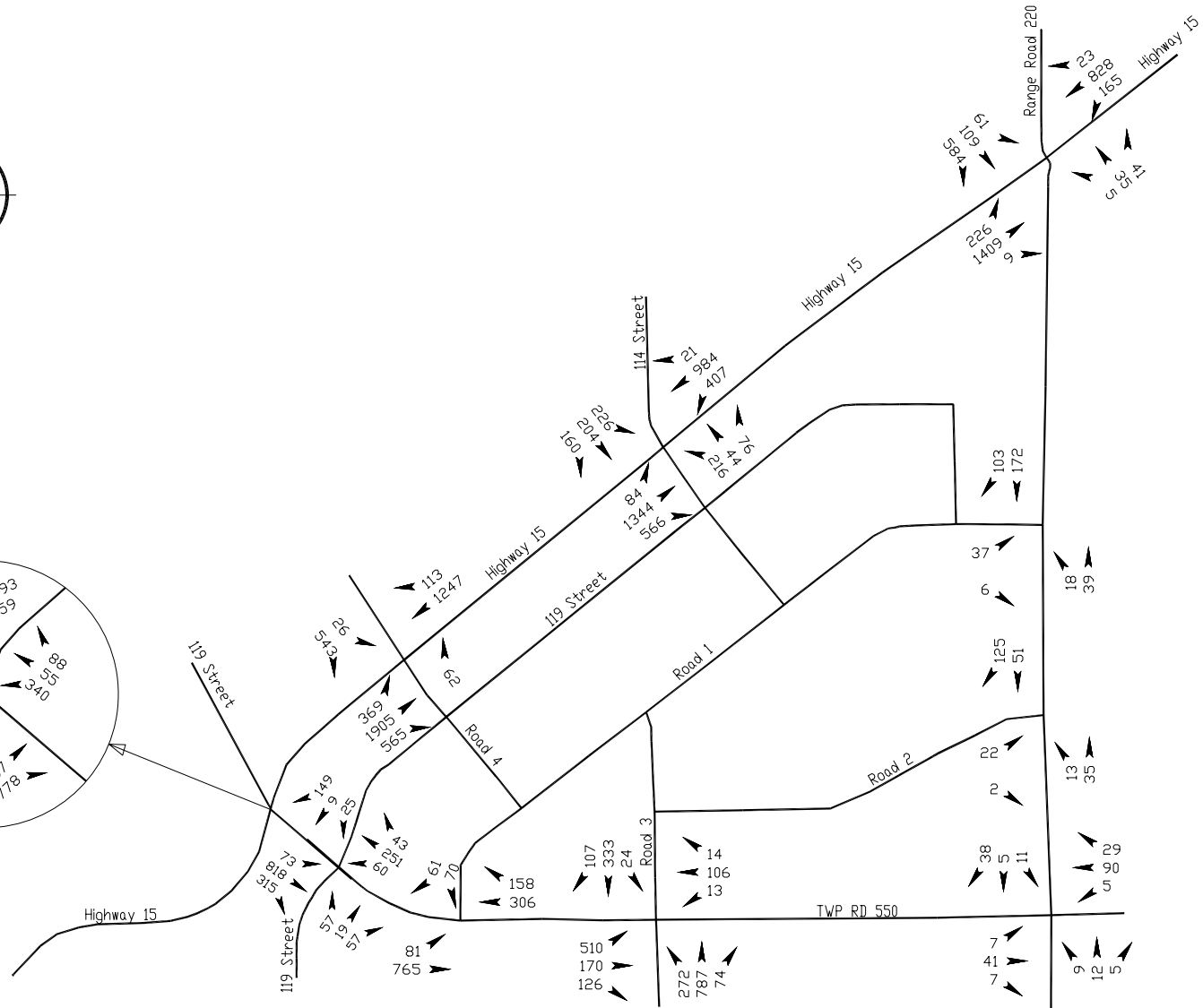
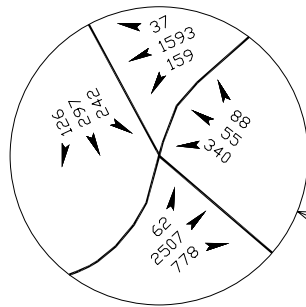
- Figure 3.4 (a) - Site-Generated Volumes - AM Full Build Out
- Figure 3.4 (b) - Site-Generated Volumes - PM Full Build Out

3.5 DESIGN VOLUMES

The design volumes include the future background traffic and the site-generated traffic. The daily traffic was projected based on the total of AM and PM design volumes and factored by 5.5.

The projected design volumes, as described above, are illustrated in the following figures.

- Figure 3.5 (a) - Design Volumes - AM Full Build Out
- Figure 3.5 (b) - Design Volumes - AM Full Build Out
- Figure 3.5 (c) - Design Volumes - Daily Full Build Out



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JOSEPHBURG ROAD NORTH INDUSTRIAL
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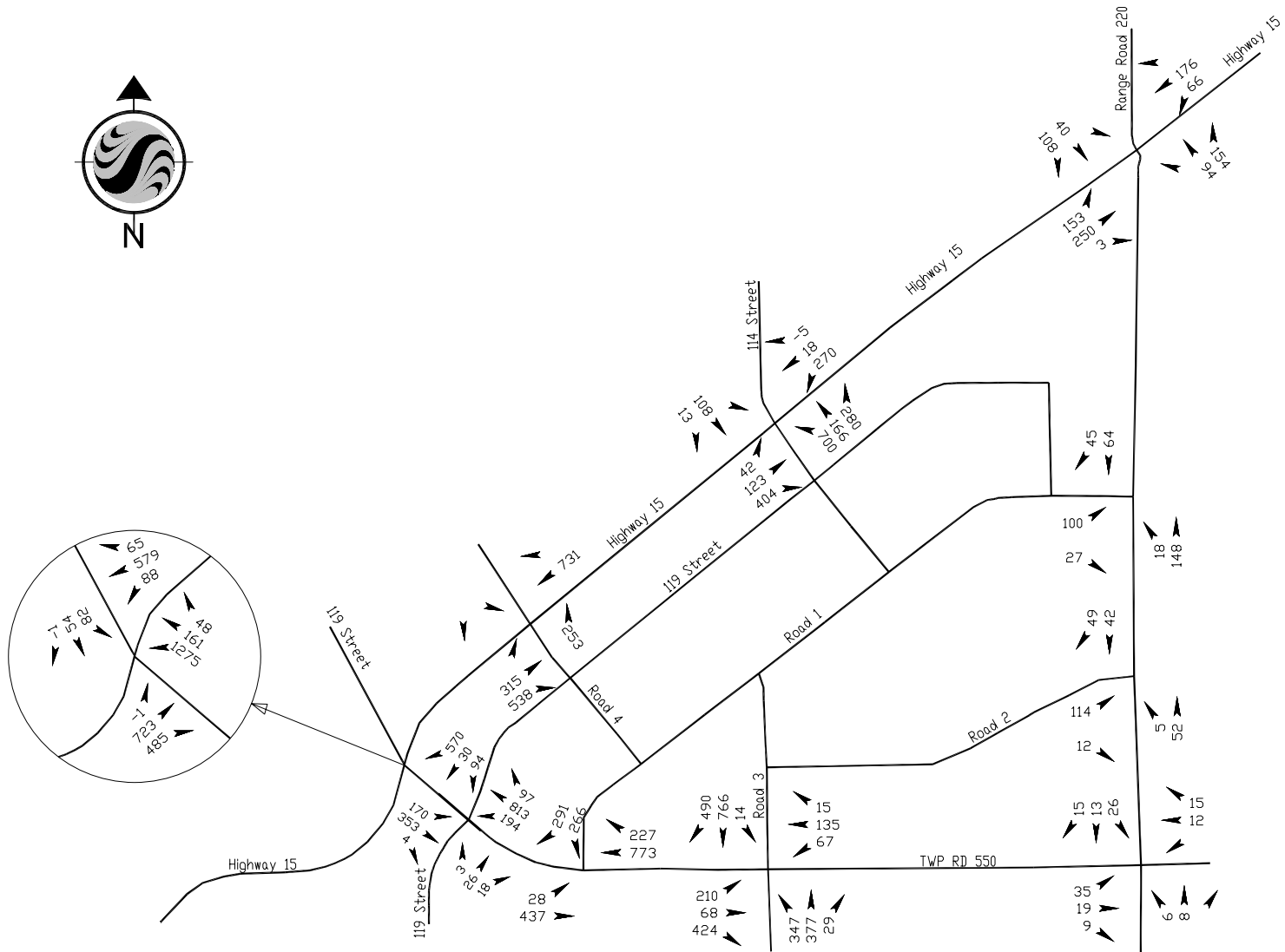
Figure No.

3.5(a)

Title

**Design Volumes
- AM Full Build Out**

December 2009
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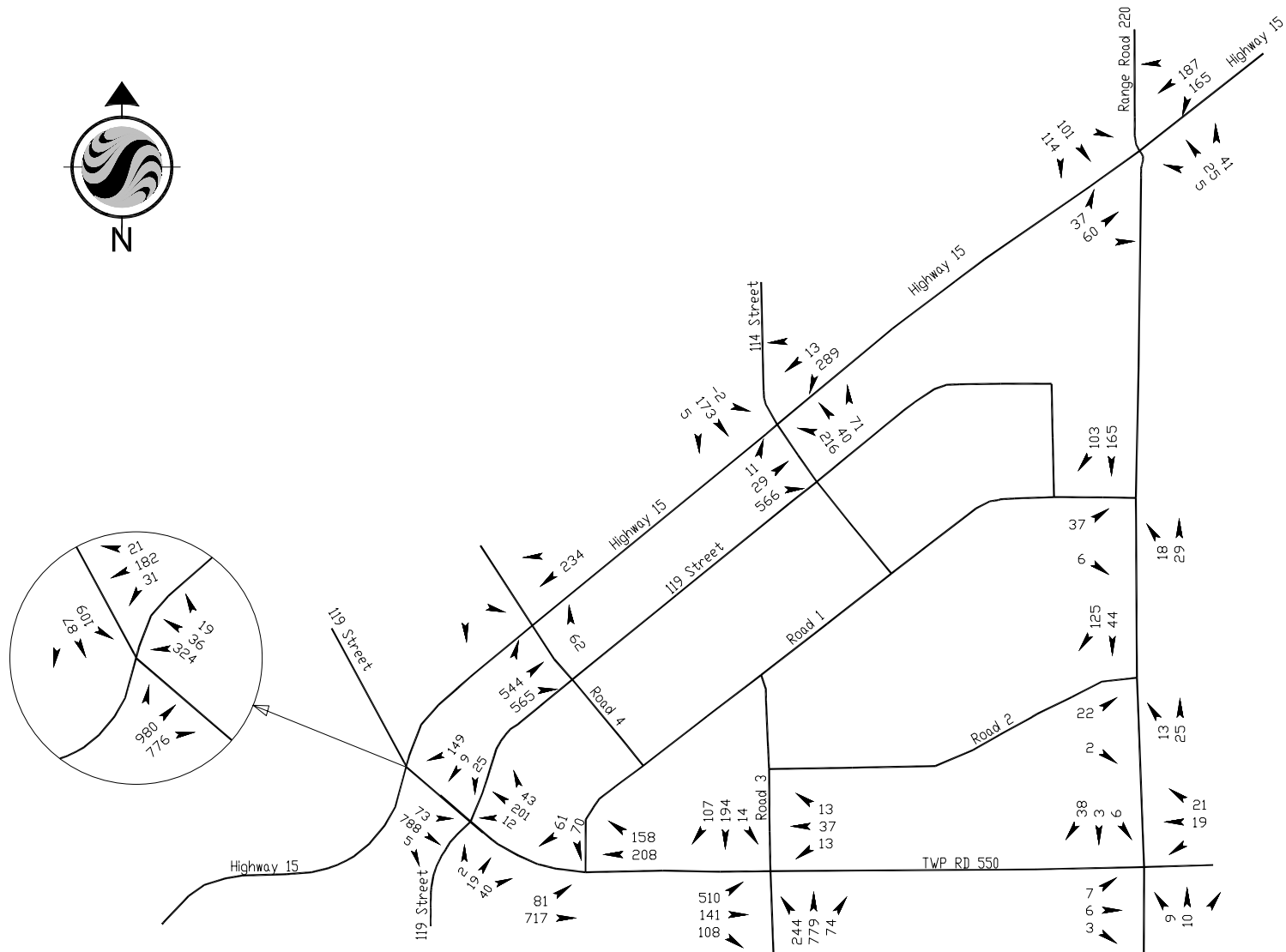
Figure No.

3.4(b)

Title

**Site-Generated Volumes
- PM Full Build Out**

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1161 70800



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Client/Project

THE CITY OF FORT SASKATCHEWAN
JOSEPHBURG ROAD NORTH INDUSTRIAL
TRANSPORTATION IMPACT ASSESSMENT

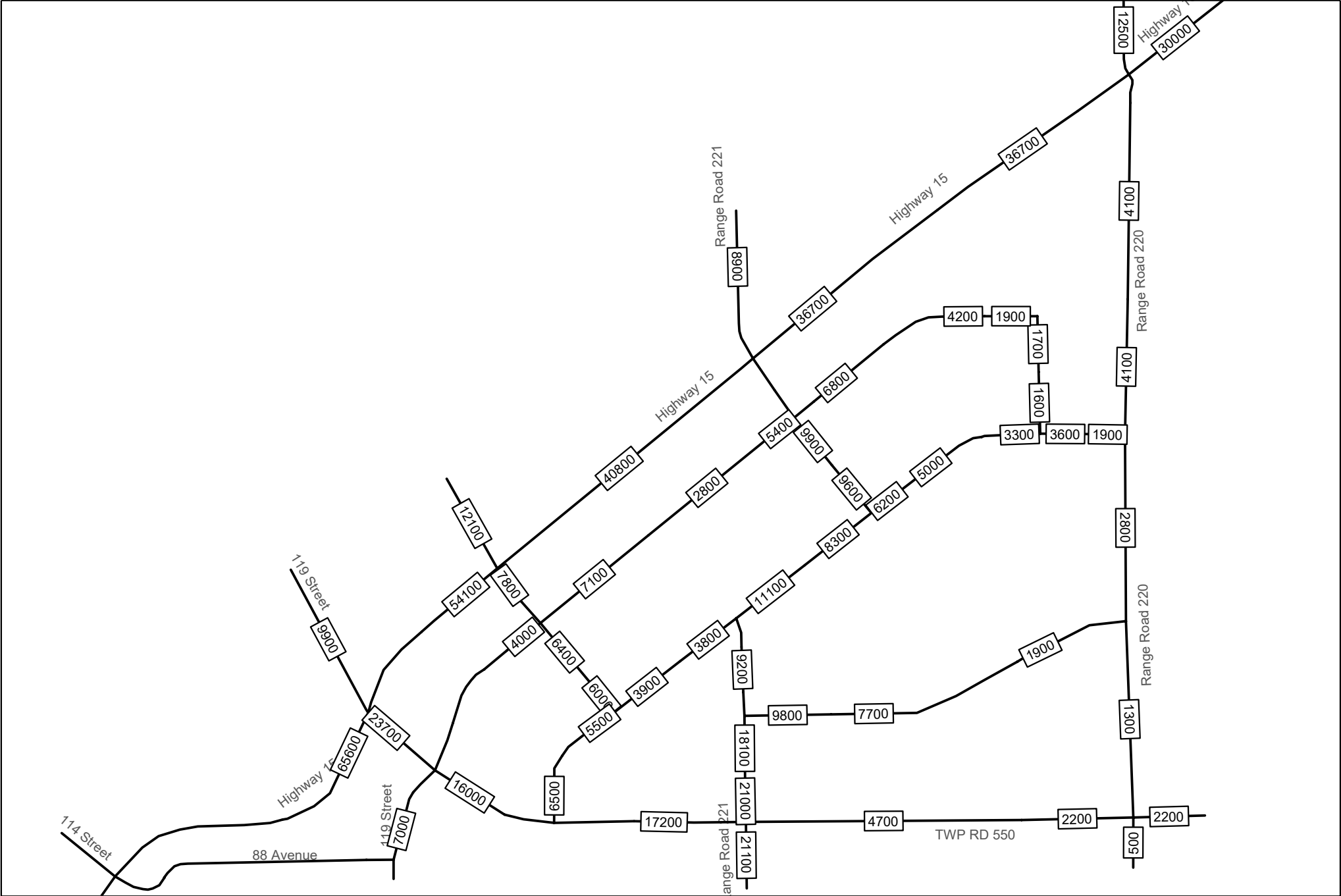
Figure No.

3.4(a)

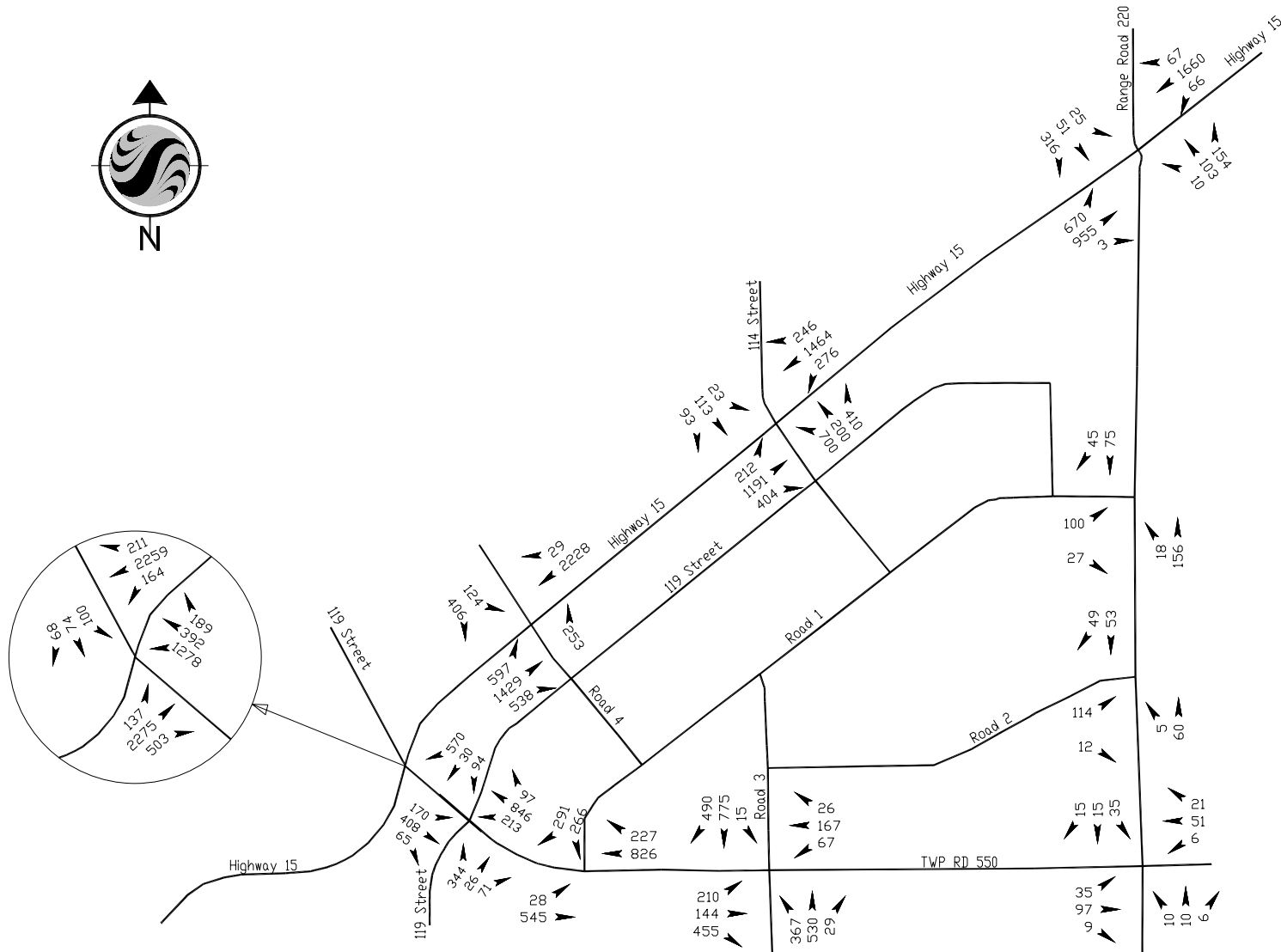
Title

**Site-Generated Volumes
- AM Full Build Out**

December 2009
1161 70800



	Stantec Consulting Ltd.	
	Figure 3.5(c) - Design Volumes - Daily Full Build Out	



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JOSEPHBURG ROAD NORTH INDUSTRIAL
TRANSPORTATION IMPACT ASSESSMENT

Figure No.

3.5(b)

Title

**Design Volumes
- PM Full Build Out**

December 2009
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4.0 Transportation Assessment

4.1 CAPACITY ANALYSIS

The ten roadway intersections that provide access to the study area have been analyzed and are listed below:

Signalized Intersections

- Highway 15 – Township Road 550
- Highway 15 – Road 4
- Highway 15 – 114 Street
- Highway 15 – 85 Street (Range Road 220)
- Township Road 550 – 119 Street
- Township Road 550 – Road 1
- Township Road 550 – Road 3

Unsignalized Intersections

- Township Road 550 - 85 Street (Range Road 220)
- 85 Street (Range Road 220) – Road 2
- 85 Street (Range Road 220) – Road 1

Table A.1 and Table A.2 in Appendix A summarize the AM peak capacity analysis results for signalized and unsignalized intersections. Table A.3 and Table A.4 similarly summarizes the capacity information for the PM peak. Detailed outputs for Synchro are contained in Appendix B.

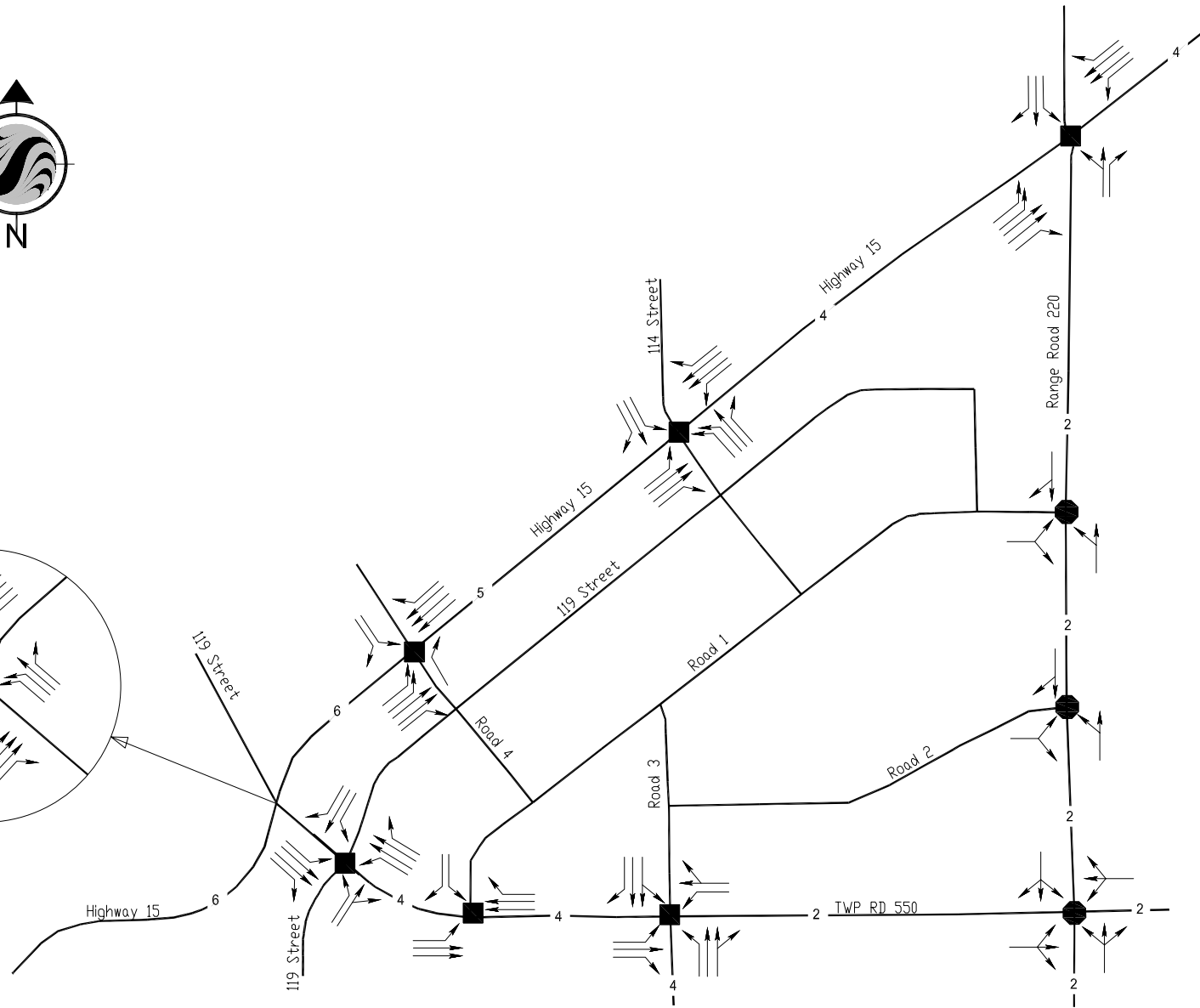
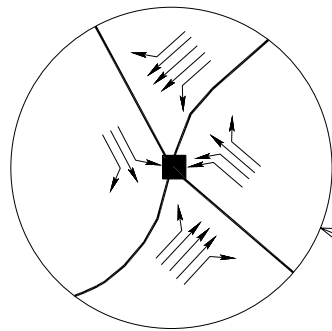
Figure 4.1 outlines the analyzed geometry, lane configuration, and intersection control for the analyzed intersections.

All unsignalized intersections are assumed to have single lane approaches. The intersection of Township Road 550 - 85 Street (Range Road 220) has been analyzed as a four-way stop controlled intersection, while the remaining two intersections are stop-controlled on the side street. There are no particular issues with the capacity analysis at the unsignalized intersections.

All signalized intersections were assumed to have single left and right turn bays unless otherwise noted. Intersections of particular interest are discussed in detail below:

Highway 15 - Township Road 550

With the proposed ASP transportation network, there is projected to be 1278 northwest bound left-turning vehicles in the PM peak hour. This number of left turning vehicles cannot normally be accommodated through traditional intersection measures. The intersections was analyzed



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Legend:



Signal Controlled Intersection



Stop Controlled Intersection

4 Number of Lanes

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Figure No.

4.1

Title

Lane Configuration

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with 3 through lanes along Highway 15, single through lanes along Township Road 550, and dual left-turn bays for the northwest bound left movement.

With this geometry the intersection operates with five movements over capacity, and the overall intersection operating over capacity.

It is recommended that demand be accommodated through an additional access that allows the northwest-bound left-turning movement from the study area onto Highway 15, possibly at Road 4, the access across from the DOW site.

Highway 15 – Road 4

This intersection is analyzed with a geometry allowing full access to the DOW site, and right-in right-out access to the study area. A northwest bound dual left-turn bay is required to accommodate the PM peak traffic into the DOW site and three southwest bound through lanes are required.

With this geometry the maximum volume capacity (v/c) ratio reported for both the morning and afternoon peak is 0.86, and the worst Level of Service (LOS) is E.

Highway 15 – 114 Street

A northwest dual left-turn bay is required to accommodate the projected 700 veh/h exiting the study area at this intersection. It has been assumed that Highway 15 will have two through lanes in each direction near this intersection.

With this geometry the northwest-bound left-turn and the southwest-bound through movements are both reported to v/c ratios over 0.9 at 0.96 and 0.94 respectively in the PM peak. In the AM peak, the northeast bound through movement is reported to have a v/c ratio of 0.93 and the southwest-bound left is reported to have a v/c ratio of 0.91. The worst reported LOS is E, with three movements experiencing delay over 60 seconds in the PM peak, and four movements over 60 seconds in the AM peak.

Highway 15 – 86 Street

Dual northeast-bound left-turn bays are required at this intersection. There is assumed to be an exclusive lane for each southbound movement. The northbound left and through share a lane, and there is assumed to be a northbound right-turn bay. Highway 15 is assumed to have two through lanes in each direction near this intersection.

There are no reported v/c ratios in the morning or afternoon peak over 0.9. The shared northbound-left-and-through and the southbound-left movements report a LOS of E in the PM peak.

Township Road 550 – 119 Street

The northbound approach has been analyzed with an exclusive left turn lane and a shared right and through lane. The southbound approach has been analyzed exclusive left and right-turn bays and a single through lane. Township Road 550 has been analyzed with two through lanes and single left and right turn bays for both the eastbound and westbound approaches.

The highest v/c ratio reported is 0.93 for the southbound right movement in the PM peak. This movement is expected to experience significantly less demand with the provision of another all directional access to Highway 15. The northbound left experiences the worst delay, at LOS E in the PM peak.

Other Intersections

The remaining two intersections have been analyzed with single right and left turn bays. No noteworthy issues exist with the planned geometry in the AM or PM for the remaining two intersections.

5.0 Conclusions

Based on the analysis described above, the following conclusions can be reached:

- Capacity constraints and geometric improvements are identified and based on the projected traffic volumes;
- The intersection of Highway 15 - Township 550 is operating over capacity;
- The provision of an additional all directional access to Highway 15 should be investigated;
- Roadways crossing Township 550 should be continuous; and
- The internal roadway network should be analyzed and further study should be performed with the development of Outline Plans for the area.

6.0 Appendix A – Capacity Analysis Summary

Table A.1 - AM Peak Hour Capacity Analysis - Signalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
HWY 15 & 85 Street														ICU = 72.4% C	Cycle Length = 95 seconds
Intersection / Laning Characteristics	1	1	1	SH	1	1	2	2	1	1	2	1			
Volumes(veh/h)	61	109	584	5	35	41	226	1409	9	165	828	23			
Volume/Capacity Ratio (V/C)	0.25	0.33	0.88	-	0.12	0.13	0.23	0.7	0.01	0.75	0.5	0.03			
Total Delay	35.9	36.3	37.8	-	33.2	11.1	4.4	14.8	3.9	36.2	16.7	4.7			
Level of Service (LOS)	D	D	D	-	C	B	A	B	A	D	B	A			
TWP RD 550 & HWY 15														ICU = 95.9% D	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	3	1	1	3	1	1	1	1	2	1	1			
Volumes(veh/h)	159	1593	37	62	2507	778	242	297	126	340	55	88			
Volume/Capacity Ratio (V/C)	1.04	0.59	0.04	0.38	0.95	0.81	0.64	0.94	0.37	1.05	0.38	0.43			
Total Delay	107.7	18.1	3.6	14.1	33.8	19.1	44.3	83.5	18.4	96.1	56	17.7			
Level of Service (LOS)	F	B	A	B	C	B	D	F	B	F	E	B			
TWP RD 550 & Road 1														ICU = 31.7% B	Cycle Length = 50 seconds
Intersection / Laning Characteristics	1	-	1	-	-	-	1	2	-	-	2	1			
Volumes(veh/h)	70	-	61	-	-	-	81	765	-	-	306	158			
Volume/Capacity Ratio (V/C)	0.09	-	0.09	-	-	-	0.22	0.61	-	-	0.24	0.24			
Total Delay	8	-	2.9	-	-	-	12.4	14.9	-	-	11.2	3.2			
Level of Service (LOS)	A	-	A	-	-	-	B	B	-	-	B	A			
TWP RD 550 & 119 Street														ICU = 45.8% B	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	1	1	1	1	SH	1	2	1	1	2	1			
Volumes(veh/h)	25	9	149	57	19	57	73	818	315	60	251	43			
Volume/Capacity Ratio (V/C)	0.06	0.02	0.26	0.14	0.15	-	0.12	0.51	0.36	0.17	0.15	0.06			
Total Delay	29.3	28.4	5.6	30.4	11.3	-	10.1	23.1	3.9	10.3	16	4.4			
Level of Service (LOS)	C	C	A	C	B	-	B	C	A	B	B	A			
HWY 15 & 114 Street														ICU = 91.1% D	Cycle Length = 148 seconds
Intersection / Laning Characteristics	1	1	1	2	1	1	1	2	1	1	2	1			
Volumes(veh/h)	266	204	160	216	44	76	84	1344	566	407	984	21			
Volume/Capacity Ratio (V/C)	0.88	0.7	0.42	0.73	0.24	0.34	0.31	0.93	0.73	0.91	0.47	0.02			
Total Delay	79.3	70.7	10.7	65.3	63.7	15.7	14.4	50.7	25.3	67.1	14.4	3.4			
Level of Service (LOS)	E	E	B	E	E	B	B	D	C	E	B	A			
HWY 15 & Road 4														ICU = 62.7% A	Cycle Length = 80 seconds
Intersection / Laning Characteristics	1	0	1	0	0	1	2	2	1	0	3	1			
Volumes(veh/h)	26	0	543	0	0	62	369	1905	565	0	1247	113			
Volume/Capacity Ratio (V/C)	0.09	-	0.37	-	-	0.04	0.6	0.8	0.46	-	0.46	0.13			
Total Delay	28.6	-	0.7	-	-	0	8.4	10.3	1.5	-	10.4	1.9			
Level of Service (LOS)	C	-	A	-	-	A	A	B	A	-	B	A			
TWP RD 550 & Road 3														ICU = 78.9% C	Cycle Length = 70 seconds
Intersection / Laning Characteristics	SH	2	1	1	2	SH	1	1	1	1	1	SH			
Volumes(veh/h)	24	333	107	272	787	74	510	170	126	13	106	14			
Volume/Capacity Ratio (V/C)	-	0.49	0.23	0.86	0.68	-	0.87	0.2	0.16	0.02	0.14	-			
Total Delay	-	24.6	6	45	20.7	-	33.3	10.4	2.5	9.1	8.9	-			
Level of Service (LOS)	-	C	A	D	C	-	C	B	A	A	A	-			

Table A.2 - AM Peak Capacity Analysis Summary - Unsignalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
	L	T	R	L	T	R	L	T	R	L	T	R			
85 Street & Road 2														ICU = 17.7%	
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-	ICU = 23.2% Max = 0.11 1.3	Unsignalized Stop Controlled E-W	
Volumes(veh/h)	-	51	125	13	35	-	22	-	2	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.11	0.11	0.01	0.01	-	0.03	-	0.03	-	-	-			
Queue Length 95th (m)	-	0	0	0.2	0.2	-	0.8	-	0.8	-	-	-			
Total Delay (Sec)	-	0	0	2.1	2.1	-	9.6	-	9.6	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	A	-	A	-	-	-			
Road 1 & 85 Street														ICU = 27.9% Max = 0.18 1.6	Unsignalized Stop Controlled E-W
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-			
Volumes(veh/h)	-	172	103	18	39	-	37	-	6	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.18	0.18	0.02	0.02	-	0.07	-	0.07	-	-	-			
Queue Length 95th (m)	-	0	0	0.4	0.4	-	1.7	-	1.7	-	-	-			
Total Delay (Sec)	-	0	0	2.6	2.6	-	10.7	-	10.7	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	B	-	B	-	-	-			
Township Road 550 & 85 Street														ICU = 18% Max = 0.15 7.6	Unsignalized Stop Controlled 4-Ways
Intersection / Laning Characteristics	SH	1	SH	SH	1	SH	SH	1	SH	SH	1	SH			
Volumes(veh/h)	11	5	38	9	12	5	7	41	7	5	90	29			
Volume/Capacity Ratio (V/C)	-	0.07	-	-	0.03	-	-	0.07	-	-	0.15	-			
Queue Length 95th (m)	-	0	-	-	0	-	-	0	-	-	0	-			
Total Delay (Sec)	-	7.3	-	-	7.5	-	-	7.5	-	-	7.5	-			
Level of Service (LOS)	-	A	-	-	A	-	-	A	-	-	A	-			

Table A.3 - PM Peak Hour Capacity Analysis - Signalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
HWY 15 & 85 Street														ICU = 87.6% C	Cycle Length = 128 seconds
Intersection / Laning Characteristics	1	1	1	SH	1	1	2	2	1	1	2	1			
Volumes(veh/h)	25	51	316	10	103	154	670	955	3	66	1660	67			
Volume/Capacity Ratio (V/C)	0.23	0.23	0.57	-	0.53	0.48	0.86	0.39	0	0.21	0.88	0.08			
Total Delay	55.9	53.4	35.7	-	61.8	12.4	47.5	6.5	2.7	15.9	30.4	2.9			
Level of Service (LOS)	E	D	D	-	E	B	D	A	A	B	C	A			
TWP RD 660 & HWY 15														ICU = 106.7% F	Cycle Length = 150 seconds
Intersection / Laning Characteristics	1	3	1	1	3	1	1	1	1	2	1	1			
Volumes(veh/h)	164	2259	211	137	2275	503	100	74	68	1278	392	189			
Volume/Capacity Ratio (V/C)	1.13	1.07	0.28	1.02	1.09	0.42	0.61	0.58	0.4	1.11	0.68	0.33			
Total Delay	143.4	80.1	6.7	114	89.5	4.2	49.5	84.5	19.9	147.8	53.6	14.6			
Level of Service (LOS)	F	F	A	F	F	A	D	F	B	F	D	B			
TWP RD 660 & Road 1														ICU = 47.5% B	Cycle Length = 50 seconds
Intersection / Laning Characteristics	1	-	1	-	-	-	1	2	-	-	2	1			
Volumes(veh/h)	266	-	291	-	-	-	28	545	-	-	826	227			
Volume/Capacity Ratio (V/C)	0.35	-	0.42	-	-	-	0.2	0.44	-	-	0.66	0.32			
Total Delay	10.3	-	9.7	-	-	-	14.5	12.8	-	-	15.7	3.2			
Level of Service (LOS)	B	-	A	-	-	-	B	B	-	-	B	A			
TWP RD 660 & 119 Street														ICU = 87.7% C	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	1	1	1	1	SH	1	2	1	1	2	1			
Volumes(veh/h)	94	30	570	344	26	71	170	408	65	213	846	97			
Volume/Capacity Ratio (V/C)	0.26	0.06	0.93	0.85	0.18	-	0.54	0.25	0.09	0.4	0.51	0.12			
Total Delay	32.7	29	47.5	57.9	11	-	16.2	18.2	4	12.3	20.7	3.2			
Level of Service (LOS)	C	C	D	E	B	-	B	B	A	B	C	A			
HWY 15 & 114 Street														ICU = 88.9% D	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	1	1	2	1	1	1	2	1	1	2	1			
Volumes(veh/h)	23	113	93	700	200	410	212	1191	404	276	1464	264			
Volume/Capacity Ratio (V/C)	0.13	0.56	0.37	0.96	0.46	0.71	0.89	0.87	0.48	0.83	0.94	0.32			
Total Delay	31.7	60.7	13.4	61.5	41.9	19.3	63.9	34.6	2.7	51.4	41.4	3			
Level of Service (LOS)	C	E	B	E	D	B	E	C	A	D	D	A			
HWY 15 & Road 4														ICU = 76.9% B	Cycle Length = 120 seconds
Intersection / Laning Characteristics	1	0	1	0	0	1	2	2	1	0	3	1			
Volumes(veh/h)	124	0	406	0	0	253	597	1429	538	0	2228	29			
Volume/Capacity Ratio (V/C)	0.53	-	0.28	-	-	0.17	0.77	0.55	0.42	-	0.86	0.04			
Total Delay	56.4	-	0.4	-	-	0.2	38.5	5.5	1.2	-	20.5	5.8			
Level of Service (LOS)	E	-	A	-	-	A	D	A	A	-	C	A			
TWP RD 660 & Road 3														ICU = 77.5% B	Cycle Length = 70 seconds
Intersection / Laning Characteristics	SH	2	1	1	2	SH	1	1	1	1	1	SH			
Volumes(veh/h)	15	775	490	367	530	29	210	144	455	67	167	26			
Volume/Capacity Ratio (V/C)	-	0.71	0.67	0.88	0.28	-	0.78	0.29	0.66	0.21	0.39	-			
Total Delay	-	23.5	11.3	36.2	7	-	44	21.3	9.8	21.1	21.7	-			
Level of Service (LOS)	-	C	B	D	A	-	D	C	A	C	C	-			

Table A.4 - PM Peak Hour Capacity Analysis - Unsignalized Intersections

Intersection Location	Intersection Movements												Overall Intersection	Comments/Critical Movements	
Description	SB			NB			EB			WB					
	L	T	R	L	T	R	L	T	R	L	T	R			
	L	T	R	L	T	R	L	T	R	L	T	R			
Road 2 & 85 Street														ICU = 26.4%	
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-	ICU = 21.7% Max = 0.14 4.2	Unsignalized Stop Controlled E-W	
Volumes(veh/h)	-	53	49	5	60	-	12	-	114	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.07	0.07	0	0	-	0.14	-	0.14	-	-	-			
Queue Length 95th (m)	-	0	0	0.1	0.1	-	3.8	-	3.8	-	-	-			
Total Delay (Sec)	-	0	0	0.6	0.6	-	9.4	-	9.4	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	A	-	A	-	-	-			
Road 1 & 85 Street														ICU = 29.7% Max = 0.19 3.7	Unsignalized Stop Controlled E-W
Intersection / Laning Characteristics	-	1	SH	SH	1	-	1	-	SH	-	-	-			
Volumes(veh/h)	-	45	75	18	156	-	100	-	27	-	-	-			
Volume/Capacity Ratio (V/C)	-	0.08	0.08	0.01	0.01	-	0.19	-	0.19	-	-	-			
Queue Length 95th (m)	-	0	0	0.3	0.3	-	5.3	-	5.3	-	-	-			
Total Delay (Sec)	-	0	0	0.9	0.9	-	11.1	-	11.1	-	-	-			
Level of Service (LOS)	-	A	A	A	A	-	B	-	B	-	-	-			
Road 1 & 85 Street														ICU = 26% Max = 0.18 8	Unsignalized Stop Controlled 4-Ways
Intersection / Laning Characteristics	SH	1	SH	SH	1	SH	SH	1	SH	SH	1	SH			
Volumes(veh/h)	35	15	15	10	10	6	35	97	9	6	51	21			
Volume/Capacity Ratio (V/C)	-	0.09	-	-	0.04	-	-	0.18	-	-	0.1	-			
Queue Length 95th (m)	-	0	-	-	0	-	-	0	-	-	0	-			
Total Delay (Sec)	-	7.9	-	-	7.9	-	-	8.2	-	-	7.6	-			
Level of Service (LOS)	-	A	-	-	A	-	-	A	-	-	A	-			

7.0 Appendix B – Synchro Output

Lanes, Volumes, Timings
5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	670	955	3	66	1660	67	10	103	154	25	51	316
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	150.0		120.0	0.0		150.0	0.0		50.0	150.0		150.0
Storage Lanes	2		1	0		1	0		1	1		1
Taper Length (m)	2.5		2.5	0.0		2.5	0.0		2.5	2.5		2.5
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	0	1876	1601	1789	1883	1601
Flt Permitted	0.059			0.276				0.975		0.499		
Satd. Flow (perm)	216	3579	1601	520	3579	1601	0	1836	1601	940	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			3			73			167			14
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		1017.6			210.7			780.1			303.3	
Travel Time (s)		52.3			10.8			46.8			18.2	
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
Adj. Flow (vph)	728	1038	3	72	1804	73	11	112	167	27	55	343
Shared Lane Traffic (%)												
Lane Group Flow (vph)	728	1038	3	72	1804	73	0	123	167	27	55	343
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm		Perm	Perm		pt+ov
Protected Phases	7	4		3	8			2			6	6 7
Permitted Phases	4		4	8		8	2		2	6		
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	
Total Split (s)	31.0	99.0	99.0	9.0	77.0	77.0	20.0	20.0	20.0	20.0	20.0	51.0
Total Split (%)	24.2%	77.3%	77.3%	7.0%	60.2%	60.2%	15.6%	15.6%	15.6%	15.6%	15.6%	39.8%
Maximum Green (s)	27.0	95.0	95.0	5.0	73.0	73.0	16.0	16.0	16.0	16.0	16.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lead	Lead	Lag	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0	0		0	0	0	0	0	0	0	
Act Effect Green (s)	95.0	95.0	95.0	73.0	73.0	73.0		16.0	16.0	16.0	16.0	47.0
Actuated g/C Ratio	0.74	0.74	0.74	0.57	0.57	0.57		0.12	0.12	0.12	0.12	0.37
v/c Ratio	0.86	0.39	0.00	0.21	0.88	0.08		0.53	0.48	0.23	0.23	0.57
Control Delay	47.5	6.5	2.7	15.9	30.4	2.9		61.8	12.4	55.9	53.4	35.7

Lanes, Volumes, Timings 5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	47.5	6.5	2.7	15.9	30.4	2.9		61.8	12.4	55.9	53.4	35.7
LOS	D	A	A	B	C	A		E	B	E	D	D
Approach Delay		23.3			28.8			33.4			39.3	
Approach LOS		C			C			C			D	

Intersection Summary

Area Type: Other

Cycle Length: 128

Actuated Cycle Length: 128

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 27.9

Intersection LOS: C

Intersection Capacity Utilization 87.6%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 5: HWY 15 & 85 Street

																	
ø3	ø2		ø4			ø6	ø7	ø8									
20 s			99 s			20 s	31 s	77 s									9 s

Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	74	68	1278	392	189	137	2275	503	164	2259	211
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	120.0		120.0	120.0		120.0
Storage Lanes	0		0	0		0	1		1	1		1
Taper Length (m)	0.0		0.0	0.0		0.0	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	3471	1883	1601	1789	5142	1601	1789	5142	1601
Flt Permitted	0.514			0.401			0.061			0.060		
Satd. Flow (perm)	968	1883	1601	1465	1883	1601	115	5142	1601	113	5142	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			74			134			184			185
Link Speed (k/h)		60			60			70			70	
Link Distance (m)		97.9			175.7			499.4			256.9	
Travel Time (s)		5.9			10.5			25.7			13.2	
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
Adj. Flow (vph)	109	80	74	1389	426	205	149	2473	547	178	2455	229
Shared Lane Traffic (%)												
Lane Group Flow (vph)	109	80	74	1389	426	205	149	2473	547	178	2455	229
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		pm+ov	pm+pt		Perm
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	12.0	12.0	8.0	12.0	12.0	8.0	20.0	8.0	8.0	20.0	20.0
Total Split (s)	13.0	15.0	15.0	52.0	54.0	54.0	12.0	70.0	52.0	13.0	71.0	71.0
Total Split (%)	8.7%	10.0%	10.0%	34.7%	36.0%	36.0%	8.0%	46.7%	34.7%	8.7%	47.3%	47.3%
Maximum Green (s)	9.0	11.0	11.0	48.0	50.0	50.0	8.0	66.0	48.0	9.0	67.0	67.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lead	Lag	Lag
Lead-Lag Optimize?		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0			5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0			11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0			0	0
Act Effect Green (s)	20.0	11.0	11.0	63.0	50.0	50.0	74.0	66.0	118.0	76.0	67.0	67.0
Actuated g/C Ratio	0.13	0.07	0.07	0.42	0.33	0.33	0.49	0.44	0.79	0.51	0.45	0.45
v/c Ratio	0.61	0.58	0.40	1.11	0.68	0.33	1.02	1.09	0.42	1.13	1.07	0.28
Control Delay	49.5	84.5	19.9	96.9	49.6	14.6	114.0	89.5	4.2	143.4	80.1	6.7

Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	50.9	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.5	84.5	19.9	147.8	53.6	14.6	114.0	89.5	4.2	143.4	80.1	6.7
LOS	D	F	B	F	D	B	F	F	A	F	F	A
Approach Delay	51.8			114.4			75.9			78.2		
Approach LOS	D			F			E			E		

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Natural Cycle: 150

Control Type: Pretimed

Maximum v/c Ratio: 1.13

Intersection Signal Delay: 85.3

Intersection LOS: F

Intersection Capacity Utilization 106.7%

ICU Level of Service G

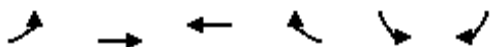
Analysis Period (min) 15

Splits and Phases: 10: TWP RD 550 & HWY 15

 ø1	 ø2	 ø3	 ø4
13 s	70 s	52 s	15 s
 ø5	 ø6	 ø7	 ø8
12 s	71 s	13 s	54 s

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

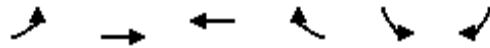
1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	28	545	826	227	266	291
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			120.0	0.0	0.0
Storage Lanes	1			1	0	0
Taper Length (m)	2.5			2.5	0.0	0.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	3579	3579	1601	1789	1601
Flt Permitted	0.211				0.950	
Satd. Flow (perm)	397	3579	3579	1601	1789	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				247		46
Link Speed (k/h)		60	60		48	
Link Distance (m)		298.7	400.0		120.2	
Travel Time (s)		17.9	24.0		9.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	30	592	898	247	289	316
Shared Lane Traffic (%)						
Lane Group Flow (vph)	30	592	898	247	289	316
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.7	3.7		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	23.0	23.0	23.0	23.0	27.0	27.0
Total Split (%)	46.0%	46.0%	46.0%	46.0%	54.0%	54.0%
Maximum Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effect Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.46	0.46
v/c Ratio	0.20	0.44	0.66	0.32	0.35	0.42
Control Delay	14.5	12.8	15.7	3.2	10.3	9.7

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.5	12.8	15.7	3.2	10.3	9.7
LOS	B	B	B	A	B	A
Approach Delay		12.9	13.0		9.9	
Approach LOS		B	B		A	

Intersection Summary

Area Type: Other

Cycle Length: 50

Actuated Cycle Length: 50

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.66

Intersection Signal Delay: 12.2

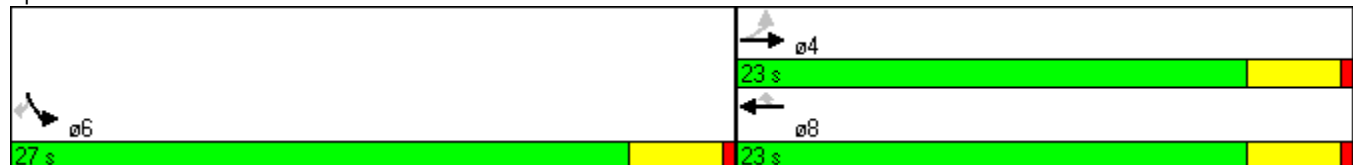
Intersection LOS: B

Intersection Capacity Utilization 47.5%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 11: TWP RD 550 & Road 1



Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	170	408	65	213	846	97	344	26	71	94	30	570
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	120.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	0		0	1		1	0		0	0		0
Taper Length (m)	0.0		0.0	2.5		2.5	0.0		0.0	0.0		0.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.890				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1676	0	1789	1883	1601
Flt Permitted	0.228			0.438			0.736			0.670		
Satd. Flow (perm)	429	3579	1601	825	3579	1601	1386	1676	0	1262	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			71			105			77			230
Link Speed (k/h)		60			60			60			60	
Link Distance (m)		175.7			298.7			187.2			183.5	
Travel Time (s)		10.5			17.9			11.2			11.0	
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
Adj. Flow (vph)	185	443	71	232	920	105	374	28	77	102	33	620
Shared Lane Traffic (%)												
Lane Group Flow (vph)	185	443	71	232	920	105	374	105	0	102	33	620
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	13.0	63.0	63.0	15.0	65.0	65.0	42.0	42.0	0.0	42.0	42.0	42.0
Total Split (%)	10.8%	52.5%	52.5%	12.5%	54.2%	54.2%	35.0%	35.0%	0.0%	35.0%	35.0%	35.0%
Maximum Green (s)	9.0	59.0	59.0	11.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0		0	0	0
Act Effect Green (s)	68.0	59.0	59.0	72.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Actuated g/C Ratio	0.57	0.49	0.49	0.60	0.51	0.51	0.32	0.32		0.32	0.32	0.32
v/c Ratio	0.54	0.25	0.09	0.40	0.51	0.12	0.85	0.18		0.26	0.06	0.93
Control Delay	16.2	18.2	4.0	12.3	20.7	3.2	57.9	11.0		32.7	29.0	47.5

Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	16.2	18.2	4.0	12.3	20.7	3.2	57.9	11.0		32.7	29.0	47.5
LOS	B	B	A	B	C	A	E	B		C	C	D
Approach Delay		16.2			17.7			47.6			44.7	
Approach LOS		B			B			D			D	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 55

Control Type: Pretimed

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 28.3

Intersection LOS: C

Intersection Capacity Utilization 87.7%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 12: TWP RD 550 & 119 Street

 ø2	 ø3	 ø4
42 s	15 s	63 s
 ø6	 ø7	 ø8
42 s	13 s	65 s

Lanes, Volumes, Timings
25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	212	1191	404	276	1464	264	700	200	410	23	113	93
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		120.0	120.0		120.0	0.0		0.0
Storage Lanes	1		1	1		1	1		1	0		0
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	0.0		0.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.080			0.074			0.385			0.622		
Satd. Flow (perm)	151	3579	1601	139	3579	1601	1407	1883	1601	1172	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			439			287			307			101
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		679.9			1017.6			199.0			148.1	
Travel Time (s)		35.0			52.3			11.9			8.9	
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
Adj. Flow (vph)	230	1295	439	300	1591	287	761	217	446	25	123	101
Shared Lane Traffic (%)												
Lane Group Flow (vph)	230	1295	439	300	1591	287	761	217	446	25	123	101
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4			7.4	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	17.0	54.0	54.0	24.0	61.0	61.0	24.0	34.0	34.0	8.0	18.0	18.0
Total Split (%)	14.2%	45.0%	45.0%	20.0%	50.8%	50.8%	20.0%	28.3%	28.3%	6.7%	15.0%	15.0%
Maximum Green (s)	13.0	50.0	50.0	20.0	57.0	57.0	20.0	30.0	30.0	4.0	14.0	14.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	63.0	50.0	50.0	74.0	57.0	57.0	38.0	30.0	30.0	18.0	14.0	14.0
Actuated g/C Ratio	0.52	0.42	0.42	0.62	0.48	0.48	0.32	0.25	0.25	0.15	0.12	0.12
v/c Ratio	0.89	0.87	0.48	0.83	0.94	0.32	0.96	0.46	0.71	0.13	0.56	0.37
Control Delay	63.9	34.6	2.7	51.4	41.4	3.0	61.5	41.9	19.3	31.7	60.7	13.4

Lanes, Volumes, Timings 25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.9	34.6	2.7	51.4	41.4	3.0	61.5	41.9	19.3	31.7	60.7	13.4
LOS	E	C	A	D	D	A	E	D	B	C	E	B
Approach Delay	30.9			37.7			45.3			38.6		
Approach LOS	C			D			D			D		

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.96

Intersection Signal Delay: 37.3

Intersection LOS: D

Intersection Capacity Utilization 88.9%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 25: HWY 15 & 114 Street

 ø1	 ø2	 ø3	 ø4
8 s	34 s	24 s	54 s
 ø5	 ø6	 ø7	 ø8
24 s	18 s	17 s	61 s

Lanes, Volumes, Timings
28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  							
Volume (vph)	597	1429	538	0	2228	29	0	0	253	124	0	406
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	0.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	0		1	0		0	0		0
Taper Length (m)	2.5		2.5	0.0		2.5	0.0		0.0	0.0		0.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.865			0.850
Flt Protected	0.950									0.950		
Satd. Flow (prot)	3471	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Flt Permitted	0.057									0.950		
Satd. Flow (perm)	208	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			585			32			117			426
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		154.1			679.9			244.1			137.0	
Travel Time (s)		7.9			35.0			17.6			9.9	
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
Adj. Flow (vph)	649	1553	585	0	2422	32	0	0	275	135	0	441
Shared Lane Traffic (%)												
Lane Group Flow (vph)	649	1553	585	0	2422	32	0	0	275	135	0	441
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm			Perm			Free	custom		Free
Protected Phases	7	4			8							
Permitted Phases	4		4			8			Free	6		Free
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0				17.0		
Total Split (s)	29.0	99.0	99.0	0.0	70.0	70.0	0.0	0.0	0.0	21.0	0.0	0.0
Total Split (%)	24.2%	82.5%	82.5%	0.0%	58.3%	58.3%	0.0%	0.0%	0.0%	17.5%	0.0%	0.0%
Maximum Green (s)	25.0	95.0	95.0		66.0	66.0				17.0		
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5				3.5		
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5				0.5		
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0				5.0		
Flash Dont Walk (s)		11.0	11.0		11.0	11.0				11.0		
Pedestrian Calls (#/hr)		0	0		0	0				0		
Act Effect Green (s)	95.0	95.0	95.0		66.0	66.0			120.0	17.0		120.0
Actuated g/C Ratio	0.79	0.79	0.79		0.55	0.55			1.00	0.14		1.00
v/c Ratio	0.77	0.55	0.42		0.86	0.04			0.17	0.53		0.28
Control Delay	38.5	5.5	1.2		20.5	5.8			0.2	56.4		0.4

Lanes, Volumes, Timings

28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0		0.0	0.0			0.0	0.0		0.0
Total Delay	38.5	5.5	1.2		20.5	5.8			0.2	56.4		0.4
LOS	D	A	A		C	A			A	E		A
Approach Delay		12.3			20.3							
Approach LOS		B			C							

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 70

Control Type: Pretimed

Maximum v/c Ratio: 0.86

Intersection Signal Delay: 15.1

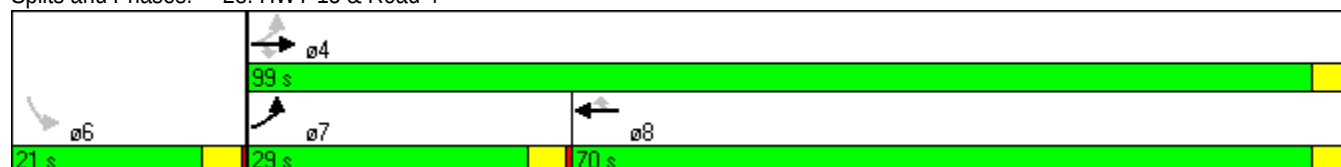
Intersection LOS: B

Intersection Capacity Utilization 76.9%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 28: HWY 15 & Road 4



Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	144	455	67	167	26	367	530	29	15	775	490
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		0.0	120.0		0.0	120.0		0.0	0.0		120.0
Storage Lanes	1		0	1		0	1		0	0		1
Taper Length (m)	2.5		0.0	2.5		0.0	2.5		0.0	0.0		2.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Frt			0.850		0.980			0.992				0.850
Flt Protected	0.950			0.950			0.950				0.999	
Satd. Flow (prot)	1789	1883	1601	1789	1846	0	1789	3550	0	0	3575	1601
Flt Permitted	0.545			0.632			0.158				0.940	
Satd. Flow (perm)	1026	1883	1601	1190	1846	0	298	3550	0	0	3364	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			403		11			14				346
Link Speed (k/h)		60			60			60				60
Link Distance (m)		400.0			826.2			176.8			226.2	
Travel Time (s)		24.0			49.6			10.6			13.6	
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
Adj. Flow (vph)	228	157	495	73	182	28	399	576	32	16	842	533
Shared Lane Traffic (%)												
Lane Group Flow (vph)	228	157	495	73	210	0	399	608	0	0	858	533
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm		Perm	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0		8.0	20.0		20.0	20.0	20.0
Total Split (s)	24.0	24.0	24.0	24.0	24.0	0.0	17.0	46.0	0.0	29.0	29.0	29.0
Total Split (%)	34.3%	34.3%	34.3%	34.3%	34.3%	0.0%	24.3%	65.7%	0.0%	41.4%	41.4%	41.4%
Maximum Green (s)	20.0	20.0	20.0	20.0	20.0		13.0	42.0		25.0	25.0	25.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Walk Time (s)	5.0	5.0	5.0	5.0	5.0			5.0		5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0			11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0			0		0	0	0
Act Effect Green (s)	20.0	20.0	20.0	20.0	20.0		42.0	42.0			25.0	25.0
Actuated g/C Ratio	0.29	0.29	0.29	0.29	0.29		0.60	0.60			0.36	0.36
v/c Ratio	0.78	0.29	0.66	0.21	0.39		0.88	0.28			0.71	0.67
Control Delay	44.0	21.3	9.8	21.1	21.7		36.2	7.0			23.5	11.3

Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	0.0
Total Delay	44.0	21.3	9.8	21.1	21.7		36.2	7.0			23.5	11.3
LOS	D	C	A	C	C		D	A			C	B
Approach Delay		20.7			21.5			18.6			18.8	
Approach LOS		C			C			B			B	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 70

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 55

Control Type: Pretimed

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 19.4

Intersection LOS: B

Intersection Capacity Utilization 77.5%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 32: TWP RD 550 & Road 3

 ø2	 ø4
46 s	24 s
 ø5	 ø8
17 s	24 s
 ø6	
29 s	

HCM Unsignalized Intersection Capacity Analysis

15: TWP RD 550 & 85 Street

1/5/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	41	7	5	90	29	9	12	5	11	5	38
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	45	8	5	98	32	10	13	5	12	5	41
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	60	135	28	59								
Volume Left (vph)	8	5	10	12								
Volume Right (vph)	8	32	5	41								
Hadj (s)	-0.02	-0.10	-0.01	-0.35								
Departure Headway (s)	4.2	4.0	4.4	4.0								
Degree Utilization, x	0.07	0.15	0.03	0.07								
Capacity (veh/h)	830	866	778	854								
Control Delay (s)	7.5	7.8	7.5	7.3								
Approach Delay (s)	7.5	7.8	7.5	7.3								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			7.6									
HCM Level of Service			A									
Intersection Capacity Utilization			17.7%	ICU Level of Service					A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

19: 85 Street &

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	22	2	13	35	51	125
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	24	2	14	38	55	136
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	190	123	191			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	190	123	191			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	100	99			
cM capacity (veh/h)	791	927	1382			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	26	52	191			
Volume Left	24	14	0			
Volume Right	2	0	136			
cSH	801	1382	1700			
Volume to Capacity	0.03	0.01	0.11			
Queue Length 95th (m)	0.8	0.2	0.0			
Control Delay (s)	9.6	2.1	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.6	2.1	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			23.2%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

22: Road 1 & 85 Street

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	37	6	18	39	172	103
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	40	7	20	42	187	112
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	324	243	299			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	324	243	299			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	99	98			
cM capacity (veh/h)	659	796	1262			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	47	62	299			
Volume Left	40	20	0			
Volume Right	7	0	112			
cSH	675	1262	1700			
Volume to Capacity	0.07	0.02	0.18			
Queue Length 95th (m)	1.7	0.4	0.0			
Control Delay (s)	10.7	2.6	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.7	2.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			1.6			
Intersection Capacity Utilization			27.9%	ICU Level of Service		A
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	226	1409	9	165	828	23	5	35	41	61	109	584
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	150.0		120.0	0.0		150.0	0.0		50.0	150.0		150.0
Storage Lanes	2		1	1		1	0		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950				0.994		0.950		
Satd. Flow (prot)	3471	3579	1601	1789	3579	1601	0	1872	1601	1789	1883	1601
Flt Permitted	0.214			0.112				0.973		0.729		
Satd. Flow (perm)	782	3579	1601	211	3579	1601	0	1833	1601	1373	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			10			25			45			103
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		1017.6			210.7			780.1			303.3	
Travel Time (s)		52.3			10.8			46.8			18.2	
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
Adj. Flow (vph)	246	1532	10	179	900	25	5	38	45	66	118	635
Shared Lane Traffic (%)												
Lane Group Flow (vph)	246	1532	10	179	900	25	0	43	45	66	118	635
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm		Perm	Perm		pt+ov
Protected Phases	7	4		3	8			2			6	6 7
Permitted Phases	4		4	8		8	2		2	6		
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	
Total Split (s)	21.0	62.0	62.0	11.0	52.0	52.0	22.0	22.0	22.0	22.0	22.0	43.0
Total Split (%)	22.1%	65.3%	65.3%	11.6%	54.7%	54.7%	23.2%	23.2%	23.2%	23.2%	23.2%	45.3%
Maximum Green (s)	17.0	58.0	58.0	7.0	48.0	48.0	18.0	18.0	18.0	18.0	18.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0	11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0	0		0	0	0	0	0	0	0	
Act Effect Green (s)	69.0	58.0	58.0	55.0	48.0	48.0		18.0	18.0	18.0	18.0	39.0
Actuated g/C Ratio	0.73	0.61	0.61	0.58	0.51	0.51		0.19	0.19	0.19	0.19	0.41
v/c Ratio	0.23	0.70	0.01	0.75	0.50	0.03		0.12	0.13	0.25	0.33	0.88
Control Delay	4.4	14.8	3.9	36.2	16.7	4.7		33.2	11.1	35.9	36.3	37.8

Lanes, Volumes, Timings 5: HWY 15 & 85 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
Total Delay	4.4	14.8	3.9	36.2	16.7	4.7		33.2	11.1	35.9	36.3	37.8
LOS	A	B	A	D	B	A		C	B	D	D	D
Approach Delay		13.3			19.6			21.9			37.4	
Approach LOS		B			B			C			D	

Intersection Summary

Area Type: Other

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.88

Intersection Signal Delay: 20.5

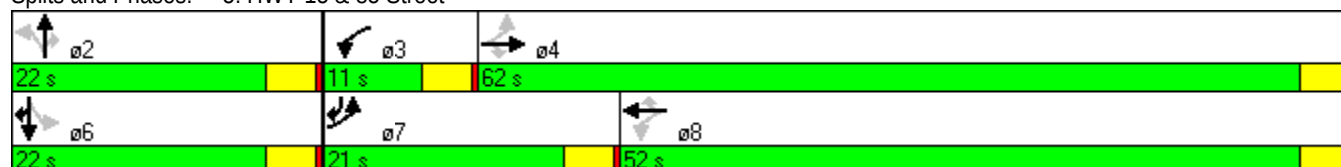
Intersection LOS: C

Intersection Capacity Utilization 72.4%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 5: HWY 15 & 85 Street



Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	242	297	126	340	55	88	62	2507	778	159	1593	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	0.0		0.0	120.0		120.0	120.0		120.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	1883	1601	3471	1883	1601	1789	5142	1601	1789	5142	1601
Flt Permitted	0.513			0.400			0.083			0.059		
Satd. Flow (perm)	966	1883	1601	1462	1883	1601	156	5142	1601	111	5142	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			95			96			350			40
Link Speed (k/h)		60			60			70			70	
Link Distance (m)		97.9			175.7			499.4			256.9	
Travel Time (s)		5.9			10.5			25.7			13.2	
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
Adj. Flow (vph)	263	323	137	370	60	96	67	2725	846	173	1732	40
Shared Lane Traffic (%)												
Lane Group Flow (vph)	263	323	137	370	60	96	67	2725	846	173	1732	40
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	12.0	12.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	24.0	26.0	26.0	12.0	14.0	14.0	10.0	71.0	71.0	11.0	72.0	72.0
Total Split (%)	20.0%	21.7%	21.7%	10.0%	11.7%	11.7%	8.3%	59.2%	59.2%	9.2%	60.0%	60.0%
Maximum Green (s)	20.0	22.0	22.0	8.0	10.0	10.0	6.0	67.0	67.0	7.0	68.0	68.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	34.0	22.0	22.0	18.0	10.0	10.0	73.0	67.0	67.0	75.0	68.0	68.0
Actuated g/C Ratio	0.28	0.18	0.18	0.15	0.08	0.08	0.61	0.56	0.56	0.62	0.57	0.57
v/c Ratio	0.64	0.94	0.37	1.05	0.38	0.43	0.38	0.95	0.81	1.04	0.59	0.04
Control Delay	44.3	83.5	18.4	96.1	56.0	17.7	14.1	33.8	19.1	107.7	18.1	3.6

Lanes, Volumes, Timings
10: TWP RD 550 & HWY 15

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.3	83.5	18.4	96.1	56.0	17.7	14.1	33.8	19.1	107.7	18.1	3.6
LOS	D	F	B	F	E	B	B	C	B	F	B	A
Approach Delay	56.9			77.2			30.0			25.7		
Approach LOS	E			E			C			C		

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 1.05

Intersection Signal Delay: 35.3

Intersection LOS: D

Intersection Capacity Utilization 95.9%

ICU Level of Service F

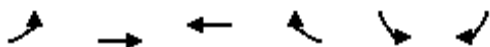
Analysis Period (min) 15

Splits and Phases: 10: TWP RD 550 & HWY 15

 ø1	 ø2	 ø3	 ø4
11 s	71 s	12 s	26 s
 ø5	 ø6	 ø7	 ø8
10 s	72 s	24 s	14 s

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

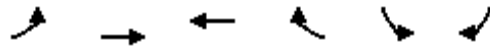
1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	81	765	306	158	70	61
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0			120.0	0.0	0.0
Storage Lanes	1			1	1	1
Taper Length (m)	2.5			2.5	2.5	2.5
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt				0.850		0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1789	3579	3579	1601	1789	1601
Flt Permitted	0.551				0.950	
Satd. Flow (perm)	1038	3579	3579	1601	1789	1601
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)				172		66
Link Speed (k/h)		60	60		60	
Link Distance (m)		298.7	400.0		120.2	
Travel Time (s)		17.9	24.0		7.2	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	88	832	333	172	76	66
Shared Lane Traffic (%)						
Lane Group Flow (vph)	88	832	333	172	76	66
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.7	3.7		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	23.0	23.0	23.0	23.0	27.0	27.0
Total Split (%)	46.0%	46.0%	46.0%	46.0%	54.0%	54.0%
Maximum Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag						
Lead-Lag Optimize?						
Walk Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0	0
Act Effect Green (s)	19.0	19.0	19.0	19.0	23.0	23.0
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.46	0.46
v/c Ratio	0.22	0.61	0.24	0.24	0.09	0.09
Control Delay	12.4	14.9	11.2	3.2	8.0	2.9

Lanes, Volumes, Timings
11: TWP RD 550 & Road 1

1/5/2010



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.4	14.9	11.2	3.2	8.0	2.9
LOS	B	B	B	A	A	A
Approach Delay		14.7	8.5		5.7	
Approach LOS		B	A		A	

Intersection Summary

Area Type: Other

Cycle Length: 50

Actuated Cycle Length: 50

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.61

Intersection Signal Delay: 11.9

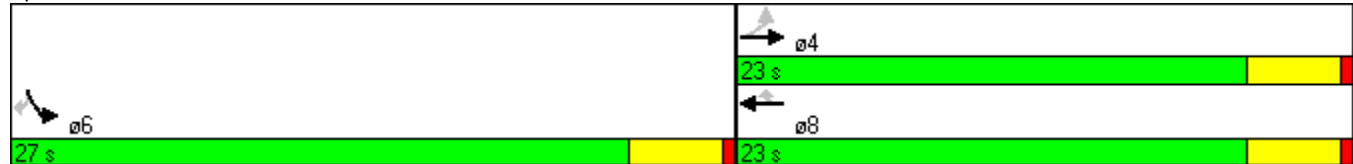
Intersection LOS: B

Intersection Capacity Utilization 31.7%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 11: TWP RD 550 & Road 1



Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	73	818	315	60	251	43	57	19	57	25	9	149
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	0.0		0.0	120.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	1		0	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.888				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1672	0	1789	1883	1601
Flt Permitted	0.584			0.218			0.751			0.703		
Satd. Flow (perm)	1100	3579	1601	411	3579	1601	1414	1672	0	1324	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			342			47		62				162
Link Speed (k/h)		60			60			48			48	
Link Distance (m)		175.7			298.7			187.2			183.5	
Travel Time (s)		10.5			17.9			14.0			13.8	
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
Adj. Flow (vph)	79	889	342	65	273	47	62	21	62	27	10	162
Shared Lane Traffic (%)												
Lane Group Flow (vph)	79	889	342	65	273	47	62	83	0	27	10	162
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0
Total Split (s)	13.0	63.0	63.0	15.0	65.0	65.0	42.0	42.0	0.0	42.0	42.0	42.0
Total Split (%)	10.8%	52.5%	52.5%	12.5%	54.2%	54.2%	35.0%	35.0%	0.0%	35.0%	35.0%	35.0%
Maximum Green (s)	9.0	59.0	59.0	11.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag						
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0	5.0	5.0		5.0	5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0	11.0	11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0	0	0		0	0	0
Act Effect Green (s)	68.0	59.0	59.0	72.0	61.0	61.0	38.0	38.0		38.0	38.0	38.0
Actuated g/C Ratio	0.57	0.49	0.49	0.60	0.51	0.51	0.32	0.32		0.32	0.32	0.32
v/c Ratio	0.12	0.51	0.36	0.17	0.15	0.06	0.14	0.15		0.06	0.02	0.26
Control Delay	10.1	22.7	3.9	10.3	16.0	4.4	30.4	11.3		29.3	28.4	5.6

Lanes, Volumes, Timings
12: TWP RD 550 & 119 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	10.1	23.1	3.9	10.3	16.0	4.4	30.4	11.3		29.3	28.4	5.6
LOS	B	C	A	B	B	A	C	B		C	C	A
Approach Delay		17.3			13.6			19.5			10.0	
Approach LOS		B			B			B			A	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 50

Control Type: Pretimed

Maximum v/c Ratio: 0.51

Intersection Signal Delay: 16.0

Intersection LOS: B

Intersection Capacity Utilization 45.8%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 12: TWP RD 550 & 119 Street

 ø2	 ø3	 ø4
42 s	15 s	63 s
 ø6	 ø7	 ø8
42 s	13 s	65 s

Lanes, Volumes, Timings
25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	84	1344	566	407	984	21	216	44	76	266	204	160
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	120.0		120.0	120.0		120.0	0.0		0.0
Storage Lanes	1		1	1		1	1		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	3471	1883	1601	1789	1883	1601
Flt Permitted	0.267			0.058			0.453			0.581		
Satd. Flow (perm)	503	3579	1601	109	3579	1601	1655	1883	1601	1094	1883	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			249			23			83			172
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		679.9			1017.6			199.0			89.1	
Travel Time (s)		35.0			52.3			14.3			6.4	
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
Adj. Flow (vph)	91	1461	615	442	1070	23	235	48	83	289	222	174
Shared Lane Traffic (%)												
Lane Group Flow (vph)	91	1461	615	442	1070	23	235	48	83	289	222	174
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			7.4			7.4	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0	8.0	20.0	20.0
Total Split (s)	10.0	69.0	69.0	40.0	99.0	99.0	10.0	20.0	20.0	19.0	29.0	29.0
Total Split (%)	6.8%	46.6%	46.6%	27.0%	66.9%	66.9%	6.8%	13.5%	13.5%	12.8%	19.6%	19.6%
Maximum Green (s)	6.0	65.0	65.0	36.0	95.0	95.0	6.0	16.0	16.0	15.0	25.0	25.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0	0		0	0		0	0
Act Effect Green (s)	71.0	65.0	65.0	105.0	95.0	95.0	22.0	16.0	16.0	35.0	25.0	25.0
Actuated g/C Ratio	0.48	0.44	0.44	0.71	0.64	0.64	0.15	0.11	0.11	0.24	0.17	0.17
v/c Ratio	0.31	0.93	0.73	0.91	0.47	0.02	0.73	0.24	0.34	0.88	0.70	0.42
Control Delay	14.4	50.7	25.3	67.1	14.4	3.4	65.3	63.7	15.7	79.3	70.7	10.7

Lanes, Volumes, Timings 25: HWY 15 & 114 Street

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.4	50.7	25.3	67.1	14.4	3.4	65.3	63.7	15.7	79.3	70.7	10.7
LOS	B	D	C	E	B	A	E	E	B	E	E	B
Approach Delay	42.0			29.4			53.8			59.1		
Approach LOS	D			C			D			E		

Intersection Summary

Area Type: Other

Cycle Length: 148

Actuated Cycle Length: 148

Offset: 132 (89%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 90

Control Type: Pretimed

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 41.3

Intersection LOS: D

Intersection Capacity Utilization 91.1%

ICU Level of Service F

Analysis Period (min) 15

Splits and Phases: 25: HWY 15 & 114 Street

 ø1	 ø2	 ø3	 ø4
19 s	20 s	40 s	69 s
 ø5	 ø6	 ø7	 ø8
10 s	29 s	10 s	99 s

Lanes, Volumes, Timings
28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 			  							
Volume (vph)	369	1905	565	0	1247	113	0	0	62	26	0	543
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		120.0	0.0		120.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	0		1	0		1	1		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850			0.865			0.850
Flt Protected	0.950									0.950		
Satd. Flow (prot)	3471	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Flt Permitted	0.140									0.950		
Satd. Flow (perm)	512	3579	1601	0	5142	1601	0	0	1629	1789	0	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			614			123			201			384
Link Speed (k/h)		70			70			60			60	
Link Distance (m)		154.1			679.9			244.1			137.0	
Travel Time (s)		7.9			35.0			14.6			8.2	
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
Adj. Flow (vph)	401	2071	614	0	1355	123	0	0	67	28	0	590
Shared Lane Traffic (%)												
Lane Group Flow (vph)	401	2071	614	0	1355	123	0	0	67	28	0	590
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		7.4			7.4			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	pm+pt		Perm			Perm			Free	custom		Free
Protected Phases	7	4			8							
Permitted Phases	4		4			8			Free	6		Free
Minimum Split (s)	8.0	20.0	20.0		20.0	20.0				17.0		
Total Split (s)	12.0	62.0	62.0	0.0	50.0	50.0	0.0	0.0	0.0	18.0	0.0	0.0
Total Split (%)	15.0%	77.5%	77.5%	0.0%	62.5%	62.5%	0.0%	0.0%	0.0%	22.5%	0.0%	0.0%
Maximum Green (s)	8.0	58.0	58.0		46.0	46.0				14.0		
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5				3.5		
All-Red Time (s)	0.5	0.5	0.5		0.5	0.5				0.5		
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Walk Time (s)		5.0	5.0		5.0	5.0				5.0		
Flash Dont Walk (s)		11.0	11.0		11.0	11.0				11.0		
Pedestrian Calls (#/hr)		0	0		0	0				0		
Act Effect Green (s)	58.0	58.0	58.0		46.0	46.0			80.0	14.0		80.0
Actuated g/C Ratio	0.72	0.72	0.72		0.58	0.58			1.00	0.18		1.00
v/c Ratio	0.60	0.80	0.46		0.46	0.13			0.04	0.09		0.37
Control Delay	8.4	10.3	1.5		10.4	1.9			0.0	28.6		0.7

Lanes, Volumes, Timings

28: HWY 15 & Road 4

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0		0.0	0.0			0.0	0.0		0.0
Total Delay	8.4	10.3	1.5		10.4	1.9			0.0	28.6		0.7
LOS	A	B	A		B	A			A	C		A
Approach Delay		8.3			9.7							
Approach LOS		A			A							

Intersection Summary

Area Type: Other

Cycle Length: 80

Actuated Cycle Length: 80

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.80

Intersection Signal Delay: 7.8

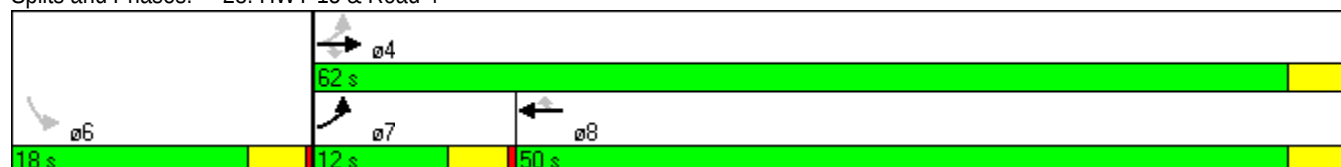
Intersection LOS: A

Intersection Capacity Utilization 62.7%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 28: HWY 15 & Road 4



Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	510	170	126	13	106	14	272	787	74	24	333	107
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (m)	120.0		0.0	120.0		0.0	120.0		0.0	0.0		120.0
Storage Lanes	1		1	1		0	1		0	0		1
Taper Length (m)	2.5		2.5	2.5		2.5	2.5		2.5	2.5		2.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	1.00
Frt			0.850		0.983			0.987				0.850
Flt Protected	0.950			0.950			0.950				0.997	
Satd. Flow (prot)	1789	1883	1601	1789	1851	0	1789	3532	0	0	3568	1601
Flt Permitted	0.674			0.641			0.364				0.862	
Satd. Flow (perm)	1269	1883	1601	1207	1851	0	686	3532	0	0	3085	1601
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			137		13			16				116
Link Speed (k/h)		60			60			60				60
Link Distance (m)		400.0			826.2			176.8				226.2
Travel Time (s)		24.0			49.6			10.6				13.6
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
Adj. Flow (vph)	554	185	137	14	115	15	296	855	80	26	362	116
Shared Lane Traffic (%)												
Lane Group Flow (vph)	554	185	137	14	130	0	296	935	0	0	388	116
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		3.7			3.7			3.7				3.7
Link Offset(m)		0.0			0.0			0.0				0.0
Crosswalk Width(m)		1.6			1.6			1.6				1.6
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm		Perm	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0		8.0	20.0		20.0	20.0	20.0
Total Split (s)	39.0	39.0	39.0	39.0	39.0	0.0	9.0	31.0	0.0	22.0	22.0	22.0
Total Split (%)	55.7%	55.7%	55.7%	55.7%	55.7%	0.0%	12.9%	44.3%	0.0%	31.4%	31.4%	31.4%
Maximum Green (s)	35.0	35.0	35.0	35.0	35.0		5.0	27.0		18.0	18.0	18.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Walk Time (s)	5.0	5.0	5.0	5.0	5.0			5.0		5.0	5.0	5.0
Flash Dont Walk (s)	11.0	11.0	11.0	11.0	11.0			11.0		11.0	11.0	11.0
Pedestrian Calls (#/hr)	0	0	0	0	0			0		0	0	0
Act Effect Green (s)	35.0	35.0	35.0	35.0	35.0		27.0	27.0			18.0	18.0
Actuated g/C Ratio	0.50	0.50	0.50	0.50	0.50		0.39	0.39			0.26	0.26
v/c Ratio	0.87	0.20	0.16	0.02	0.14		0.86	0.68			0.49	0.23
Control Delay	33.3	10.4	2.5	9.1	8.9		45.0	20.7			24.6	6.0

Lanes, Volumes, Timings
32: TWP RD 550 & Road 3

1/5/2010

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0			0.0	0.0
Total Delay	33.3	10.4	2.5	9.1	8.9		45.0	20.7			24.6	6.0
LOS	C	B	A	A	A		D	C			C	A
Approach Delay		23.6			9.0			26.5			20.3	
Approach LOS		C			A			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 70

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.87

Intersection Signal Delay: 23.6

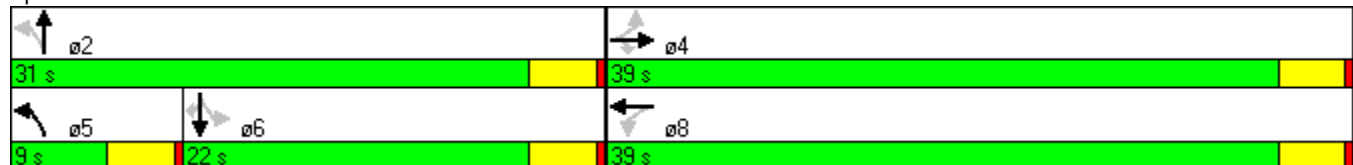
Intersection LOS: C

Intersection Capacity Utilization 78.9%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 32: TWP RD 550 & Road 3



HCM Unsignalized Intersection Capacity Analysis

15: TWP RD 550 & 85 Street

1/5/2010

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	35	97	9	6	51	21	10	10	6	35	15	15
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)	38	105	10	7	55	23	11	11	7	38	16	16
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	153	85	28	71								
Volume Left (vph)	38	7	11	38								
Volume Right (vph)	10	23	7	16								
Hadj (s)	0.05	-0.11	-0.03	0.00								
Departure Headway (s)	4.3	4.2	4.5	4.5								
Degree Utilization, x	0.18	0.10	0.04	0.09								
Capacity (veh/h)	821	832	751	754								
Control Delay (s)	8.2	7.6	7.7	7.9								
Approach Delay (s)	8.2	7.6	7.7	7.9								
Approach LOS	A	A	A	A								
Intersection Summary												
Delay			8.0									
HCM Level of Service			A									
Intersection Capacity Utilization			26.4%	ICU Level of Service					A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

19: Road 2 & 85 Street

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	12	114	5	60	53	49
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	124	5	65	58	53
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	160	84	111			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	160	84	111			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	87	100			
cM capacity (veh/h)	828	975	1479			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	137	71	111			
Volume Left	13	5	0			
Volume Right	124	0	53			
cSH	959	1479	1700			
Volume to Capacity	0.14	0.00	0.07			
Queue Length 95th (m)	3.8	0.1	0.0			
Control Delay (s)	9.4	0.6	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.4	0.6	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay		4.2				
Intersection Capacity Utilization		21.7%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

22: Road 1 & 85 Street

1/5/2010



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	100	27	18	156	45	75
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	109	29	20	170	49	82
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	298	90	130			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	298	90	130			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	84	97	99			
cM capacity (veh/h)	684	968	1455			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	138	189	130			
Volume Left	109	20	0			
Volume Right	29	0	82			
cSH	729	1455	1700			
Volume to Capacity	0.19	0.01	0.08			
Queue Length 95th (m)	5.3	0.3	0.0			
Control Delay (s)	11.1	0.9	0.0			
Lane LOS	B	A				
Approach Delay (s)	11.1	0.9	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			3.7			
Intersection Capacity Utilization			29.7%	ICU Level of Service		A
Analysis Period (min)			15			



APPENDIX G

Highway 15/125 Street Intersection Review Technical Memorandum



TECHNICAL MEMORANDUM

DATE: July 22, 2014
PROJECT NO: 3060.18
PROJECT: Fort Saskatchewan NE Industrial – Cofely Fabricom Development
SUBJECT: Highway 15/125 Street Intersection Review – FINAL REPORT

TO: Mark Procyk, City of Fort Saskatchewan
Janel Smith, City of Fort Saskatchewan
Grant Schaffer, City of Fort Saskatchewan
FROM: Dallas Karhut, P.Eng.
CC: Bob Horton, Trans America Group
Glen Kennedy, Prism Engineering

INTRODUCTION

Background

Bunt & Associates was retained to provide transportation engineering consulting services on behalf of Trans America Group to prepare the Highway 15/125 Street Intersection Review study to guide and support the development of a proposed 60-acre industrial site in Fort Saskatchewan. The 60-acre lot is proposed to be located south of Highway 15 and east of 125 Street in the Fort Saskatchewan NE Industrial area and is anticipated to accommodate Cofely Fabricom, a module builder for the oil and gas industry.

The Fort Saskatchewan NE industrial subdivision is located in the Josephburg Road North Industrial Area Structure Plan (ASP). The Josephburg Road North Industrial ASP and ASP Traffic Impact Assessment (TIA) were both prepared by Stantec Consulting Limited. In regards to this particular development, the end-user, Cofely Fabricom, has requested a 60-acre lot which is considerably larger than the lots originally planned for the area. City of Fort Saskatchewan representatives have indicated that the purpose of the ASP is to guide development rather than dictate development and, as such, there is some flexibility built into the ASP plan to better accommodate the development of the area as it is realized.

Study Rationale

Typical of many industrial subdivisions, lot sizes for development are often driven by the end user. While an Area Structure Plan (ASP) provides guidance, there can be room for flexibility to better accommodate end users with special development circumstances and needs. Within the Fort Saskatchewan NE Industrial

area, an end-user has requested a 60-acre lot, which is considerably larger than the lots initially planned for within the ASP. To accommodate a 60-acre lot, Trans America Group is proposing to modify the planned ASP roadway network. Therefore, the potential transportation impacts associated with a modified roadway network needs to be reviewed.

Careful consideration must also be given to potential increases in traffic demands generated by the site. The central theme of this study is to provide a transportation plan which is compatible and easily integrated with the existing roadway network while considering the overall ASP development. It is anticipated the report contents will be of sufficient detail to provide the Client Group and the City of Fort Saskatchewan with a clear appreciation of the traffic characteristics associated with the proposed industrial development.

Study Scope

The scope of the study includes a review of the proposed modifications to the planned ASP roadway network and identification of potential impacts on future developments within the ASP. The study also includes an evaluation of the transportation requirements and potential transportation impacts associated with the proposed industrial development on the adjacent existing and future roadway network. Recommended strategies for mitigating identified impacts on City of Fort Saskatchewan roadways are advanced.

EXISTING CONDITIONS

Existing Land Uses

All ASP area lands are currently developed as farmland; the ASP area is planned to accommodate industrial developments. Lands north of Highway 15 in the vicinity of 125 Street are currently controlled by DOW Chemical with the majority of the lands developed to accommodate industrial plants.

Existing Roadway Network

The existing roadway network in the vicinity of the study area includes:

Highway 15 in the vicinity of 125 Street is currently developed as a divided four-lane roadway and is constructed to a semi-urban cross-section standard (raised median with ditches) as illustrated in **Photo 1**. The posted speed limit along Highway 15 in the vicinity of 125 Street is 70 km/h. East of 125 Street, the speed limit transitions to 80 km/h.

Photo 1: Highway 15 west of 125 Street – Looking East



125 Street (also referred to as Range Road 221) is a two-lane roadway constructed to a rural cross-section standard. The roadway width is estimated to be in the order of about 8 metres. The speed limit is not posted in the vicinity of Highway 15; it is assumed to be 80 km/h.

Photo 2: 125 Street about 250 metres south of Highway 15 – Looking South



Highway 15/125 Street Intersection is a four-legged signalized intersection. The intersection approaches along Highway 15 include left turn bays and right turn deceleration and acceleration lanes. 125 Street intersects Highway 15 at a slight skew. The intersection is illuminated.

Photo 3: Highway 15/125 Street Intersection

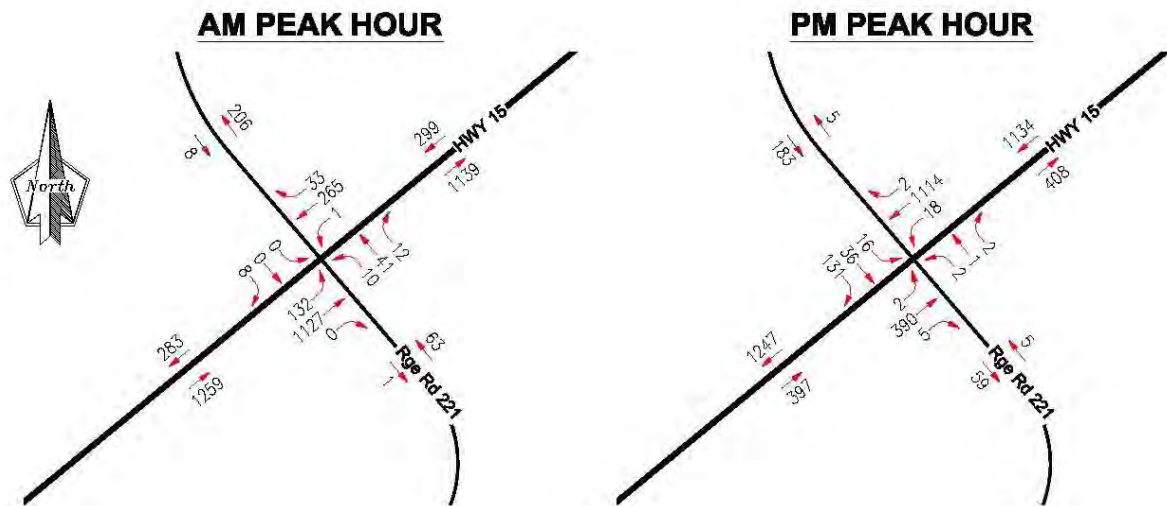


CN Railway

A CN Railway runs along the north side of Highway 15. The railway is parallel to Highway 15 and is offset about 30 metres from the northwest edge of pavement. The railway crosses 125 Street just north of the Highway 15/125 Street intersection by way of an at-grade crossing that includes warning flasher signals on both sides of the crossing.

Existing Traffic Volumes

To qualify and quantify the existing traffic conditions at the Highway 15/125 Street intersection, Bunt & Associates completed an intersection turning movement survey at the intersection from 6 AM to 9 AM and from 4 PM to 7 PM on Thursday, March 13, 2014. The AM peak hour occurred from 6:00 AM to 7:00 AM and the PM peak hour occurred from 4:15 PM to 5:15 PM. Heavy vehicles accounted for about 2% to 4% of the traffic along Highway 15 during the AM peak hour and for about 5% to 8% of the traffic during the PM peak hour. During both the AM and PM peak hours, heavy vehicles accounted for less than 2% of the traffic along the 125 Street approaches. The measured traffic volumes at the Highway 15/125 Street intersection are illustrated in **Figure 1** and the intersection turning movement survey data is included in **Appendix A**.

Figure 1: Existing Traffic Volumes – Highway 15/125 Street

PROPOSED LAND USE CONCEPT

Cofely Fabricom Site

Operations

The site is proposed to include an office and employee parking area (located on the western portion of the site), a maintenance shed (located on the central portion of the site) and numerous mod-construction areas (located on the central and eastern portions of the site). Cofely Fabricom anticipates an employment requirement of about 250 people, which will include trade workers, office employees and support staff. The site is anticipated to be operational during regular weekday business hours. While it is acknowledged that the site may, on occasion, extend its operational hours into the evening and/or weekends to accommodate overtime shifts, these occurrences are anticipated to be infrequent and are not anticipated to represent typical operations.

Access

The site is proposed to be developed with three accesses: two all-directional accesses to 125 Street, and a right-in/right-out access to Highway 15 (which will also intersect the service road proposed to run along the northwest boundary of the parcel). The north access to Highway 15 is proposed to be gated at all times and will only be used to accommodate oversized loads exiting or entering the site. Oversized loads are anticipated to access and egress the site during the late evening/early morning hours when traffic along Highway 15 is minimal. Cofely Fabricom anticipates about 75 over-sized loads leaving the site per year.

Buildout Horizon

Cofely Fabricom is anticipating the site will be developed and operational by late fall 2014; therefore, the study will consider the buildout horizon of 2014. A long-term horizon was not considered for the following reasons:

- Development of lands immediately adjacent the proposed 60-acre site, with the exception of the remnant parcel to the north which is currently being marketed, is not anticipated to occur in the immediate future; and,
- As recommended in the ASP TIA, the internal roadway network should be analyzed with the development of the area and it is assumed that the traffic impacts associated with future development will be identified in their respective TIAs.

Generally, all site-generated traffic, which includes employee traffic and an estimated 15 supply deliveries per week, will be accommodated via the west access to 125 Street. It is noted that supply deliveries are anticipated to occur during weekdays, between the AM and PM peak hours of the adjacent street.

Remnant Parcel

Given the location of the remnant parcel located to the north of the proposed Cofely Fabricom site and, more specifically, the location of the proposed service road relative to the Highway 15/125 Street intersection, the traffic impacts associated with the development of the parcel were also considered in the assessment. By assessing the traffic impacts associated with both the Cofely Fabricom development and the development of the remnant parcel, it is assumed that any impacts the traffic operations at the Highway 15/125 Street intersection may have on the 125 Street/Service Road intersection would be identified.

Trans America has indicated that while there are no imminent plans to develop the remnant parcel, the parcel is currently being marketed to attract a potential industrial development. Trans America Group is interested in developing the parcel in the near-term horizon.

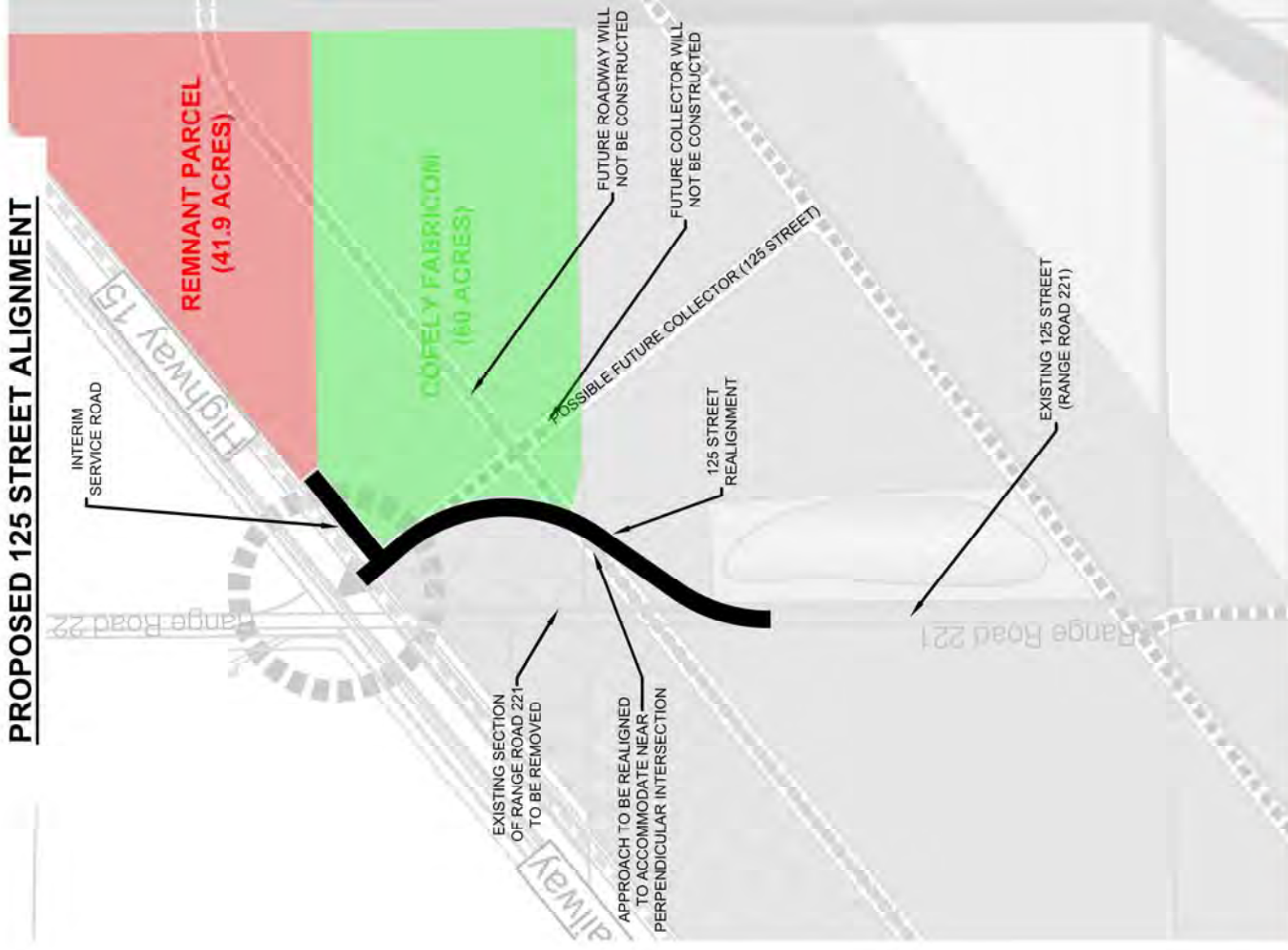
Proposed ASP Roadway Network

The Josephburg Road North Industrial ASP identified the future roadway network for the area; however, in order to accommodate a 60-acre lot, Trans America Group is proposing to realign 125 Street. The purpose of this task is to identify the proposed roadway network modifications and the potential impacts on the ASP roadway network. **Exhibit 2** illustrates the planned ASP roadway network and the proposed modifications.

PLANNED 125 STREET ALIGNMENT



PROPOSED 125 STREET ALIGNMENT



PROJECT 3060.18 - Fort Saskatchewan NE Industrial

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Exhibit 2

DATE July 22, 2014

125 Street Realignment Impacts 125 Street Realignment



As illustrated in Exhibit 2, the proposed modifications to the ASP road network are generally in the vicinity of the Highway 15/125 Street intersection and include the following:

- **Realignment of 125 Street** – Given the location and orientation of the 60-acre lot, consideration was given to maintaining 125 Street, which is oriented north-south, rather than construct the collector road planned to run perpendicular to Highway 15. The realignment of 125 Street south of Highway 15 provides a tangent section of roadway at the intersection approach while realigning the road in a curvi-linear orientation to better fit the proposed development boundaries.
- **Highway 15 Service Road** – To provide access to the remnant parcel to the north of the proposed 60-acre lot, a service road is proposed along the south side of Highway 15 east of 125 Street. The service road is proposed to be constructed as an 8-metre rural road within a 30-metre right-of-way (ROW). Note that the Service Road will only be constructed if the remnant parcel to the north is developed in the short term. In the long term, it is anticipated that the Service Road will no longer be viable as traffic volumes increase along 125 Street and the Service Road will be eliminated. Ultimately, the remnant parcel will be accessible from the east via a future collector roadway and the Highway 15 Service Road will be eliminated.

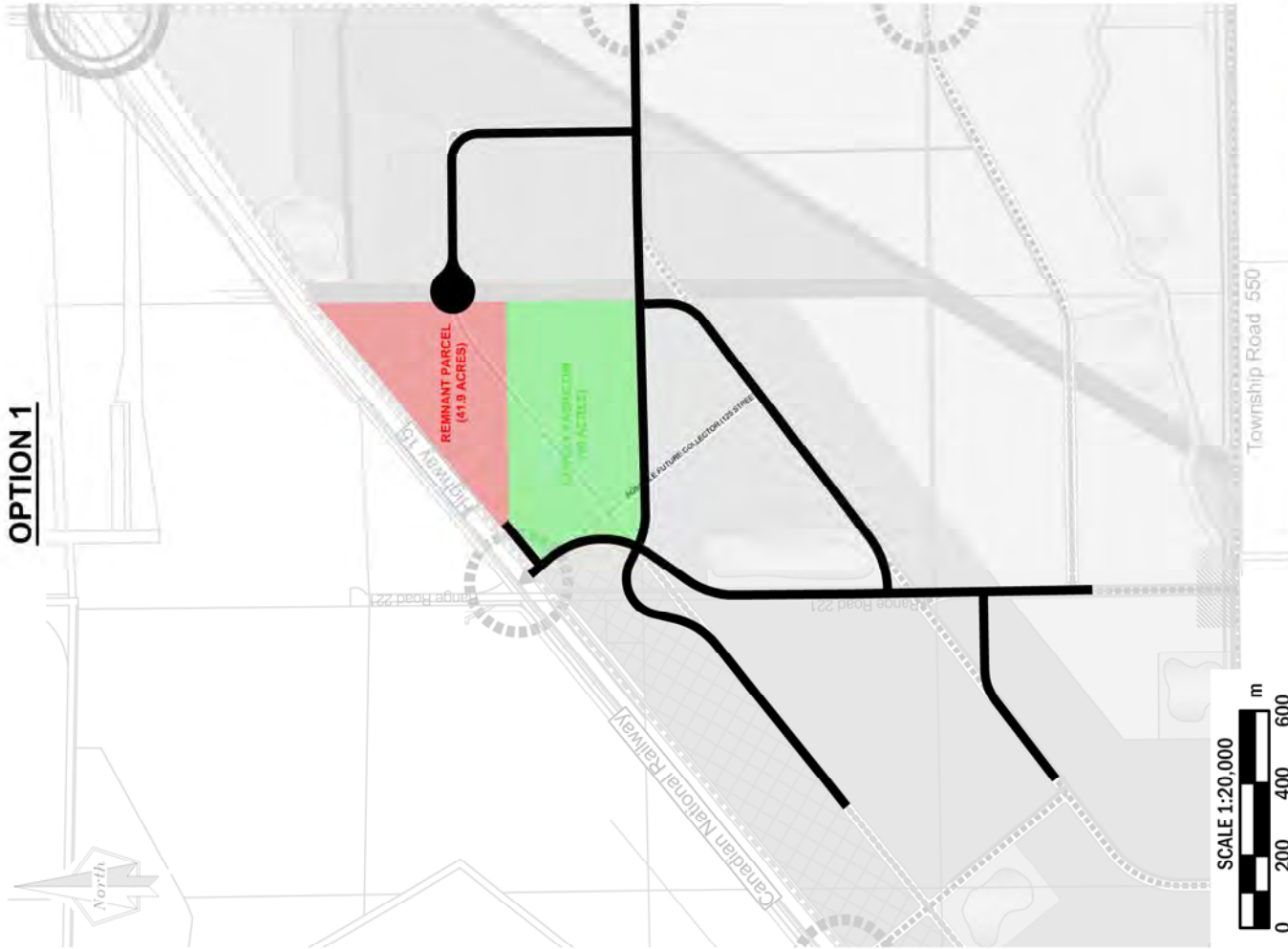
As the proposed 60-acre lot is anticipated to impact the planned internal roadway network, Bunt & Associates reviewed the 125 Street realignment in terms of the potential impact on the ASP roadway network. To address the potential impacts the development of the 60-acre lot may have on the roadway network planned for the ASP area, Bunt & Associates prepared a series of internal roadway network options illustrating potential development concepts. The potential development concepts are illustrated in **Exhibits 3 and 4**. It is anticipated the internal roadway network options will provide a sense of the possibilities available to the City of Fort Saskatchewan regarding the future development of the ASP road network.

The planned ASP roadway network in the vicinity of the development site, as shown in Exhibit 2, includes a road that runs perpendicular to Highway 15 (125 Street) and two roads that each run parallel to Highway 15. All ASP roadway network options presented generally include these three links; however, the roads are realigned to fit future area development. Also, it is important to note that the connection to Highway 15 generally remains unchanged in terms of providing a north-south link through the ASP area to Highway 15.

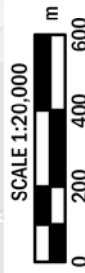
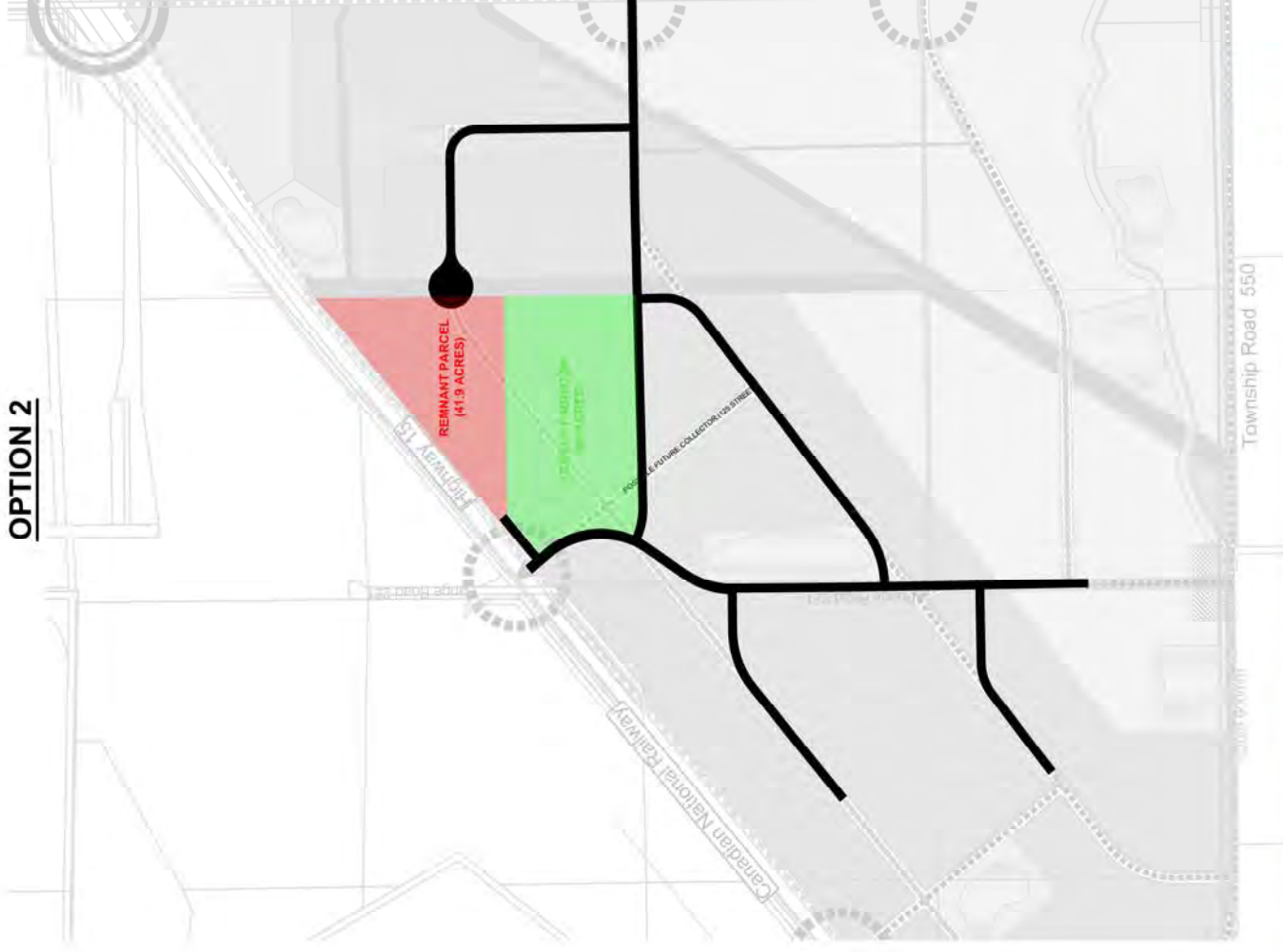
As the connection to Highway 15 is not anticipated to be affected and comparable north-south and east-west links are provided for each option, a significant redistribution of the traffic projected to be generated by the ASP area is not anticipated. Therefore, it is assumed that for all options considered, the traffic operations projected in the ASP TIA for the Highway 15/125 Street intersection will continue to be valid.



OPTION 1



OPTION 2



PROJECT 3060.18 - Fort Saskatchewan NE Industrial

SHEET NO.

Exhibit 3

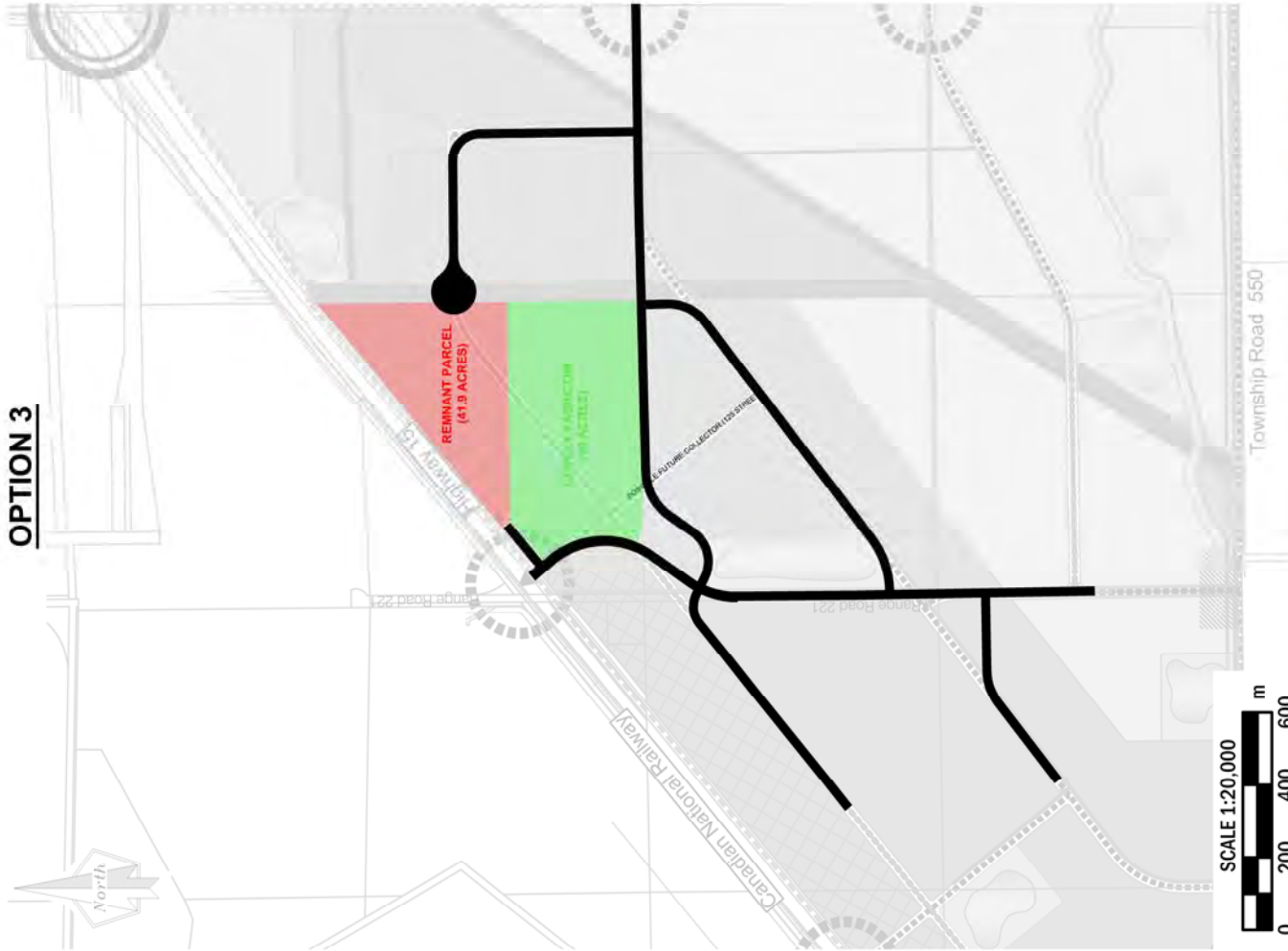
DATE July 22, 2014

125 Street Realignment Impacts
Potential Future ASP Roadway Network - Options 1 and 2

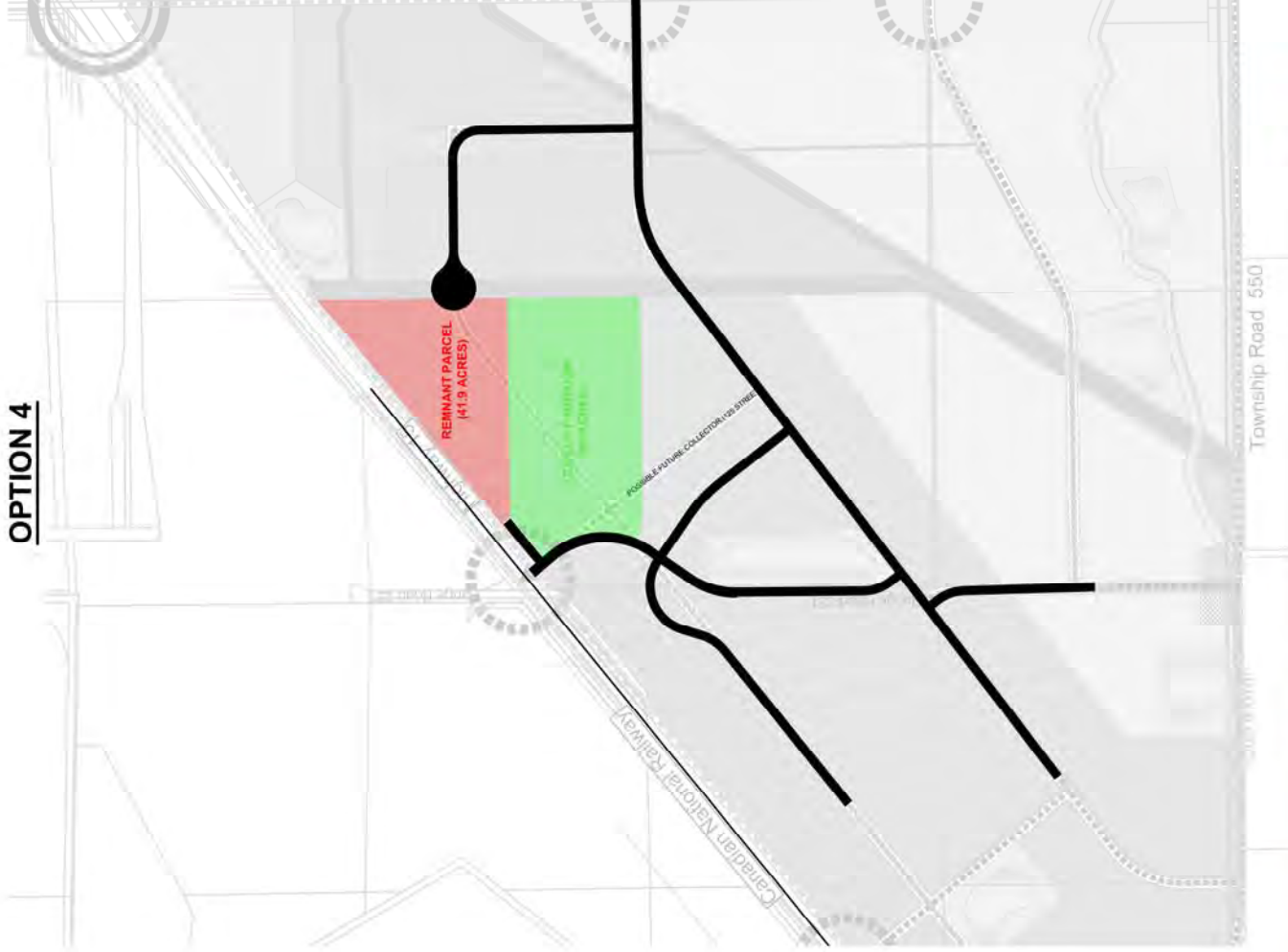




OPTION 3



OPTION 4



PROJECT 3060.18 - Fort Saskatchewan NE Industrial

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Exhibit 4

DATE July 22, 2014

125 Street Realignment Impacts

Potential Future ASP Roadway Network - Options 3 and 4



125 Street Cross-Section

Based on the daily traffic volume projections identified in the ASP TIA, 125 Street in the vicinity of Highway 15 is anticipated to carry about 10,000 vehicles per day under the full build-out of the ASP area. While the ASP TIA focused on the capacity of the major intersections along Highway 15, it did not provide a recommendation for the cross-section of the internal roads. Based on a daily traffic volume of about 10,000 vehicles and the anticipated access requirements along the corridor, Bunt & Associates recommends developing 125 Street as an undivided four-lane urban arterial roadway.

Based on a review of the City of Fort Saskatchewan's Engineering Standards for Roadways, the undivided arterial standard is anticipated to represent an appropriate cross-section for this portion of 125 Street under the full build-out of the ASP area (Drawing Number G1.4 is included in **Appendix B**). The standard includes a 15.8-metre roadway within a 33.0-metre right-of-way developed to an urban cross-section standard.

SITE TRAFFIC CHARACTERISTICS

Trip Generation Assumptions

In order to establish appropriate trip generation rates for the proposed industrial development, measured trip generation rates were reviewed in combination with the trip rates established through first principles.

Measured Industrial Subdivision Trip Generation Rates

Bunt & Associates completed a trip generation survey in 2010 for a development area within Parkland Industrial Estates in Acheson. Based on a development area of about 305 acres, the measured trip generation rate for the total developed area was in the order of 2.10 trips per acre during the AM peak hour and 1.96 trips per acre during the PM peak hour. To account for potentially higher peak generation land uses, an AM and PM peak hour rate of 3.5 trips per acre has been used in previous studies within Acheson Industrial.

First Principles Trip Generation Rates

Based on information provided by Cofely Fabricom, about 250 people will be employed on site. Crews will work eight hours per day, five days per week. In addition, it is estimated that about 10 to 15 delivery trucks will access the site on a weekly basis. Cofely Fabricom anticipates that about 75 oversized loads per year will leave the site. These oversized loads will be transporting manufactured modules and will typically move out during off-peak hours. **Table 1** summarizes the potential peak hour trip generation characteristics associated with the Cofely Fabricom site based on first principles.

Based on a first principles review, it is estimated that the proposed industrial site may generate about 3.43 trips/hour during the AM and PM peak hour. An estimated trip generation rate of about 3.43 trips/acre is comparable to the trip generation rate of 3.50 trips/acre used in previous studies. To be conservative, a trip rate of 3.50 trips/acre for the AM and PM peak hours was used in this assessment.

Table 1: Cofely Fabricom Trip Generation Summary

User Group	Variable	Peak Hour Trips	Notes
Employees	250 employees	250	One trip during each the AM and PM peak hour per employee
% Drop-Off/Pick-Up	5%	13	
Persons per Vehicle (ppv)	1.1 ppv	-21	Assuming 1 of 10 employees rideshares
Trucks – Parts Delivery	15 per week	0	Assumed to occur outside of peak hours
Oversized Loads	75 per year	0	Assumed to occur outside of peak hours
SUB-TOTAL		242	
% trips during peak hour of adjacent street	85%	206	
TOTAL		206	
Trips/Acre	60 acres	3.43 trips per acre	

Trip Generation Totals

The AM and PM peak hour trip generation characteristics associated with the Cofely Fabricom site and the remnant parcel are summarized in **Table 2**. Combined, both sites are anticipated to generate in the order of 357 two-way trips during the AM and PM peak hours.

Table 2: Trip Generation Estimates

Land Use	Area (acres)	AM Peak Hour					PM Peak Hour				
		Rate	In		Out		Rate	In		Out	
Cofely Fabricom	60.0	3.50	79%	166	21%	44	3.50	24%	50	76%	160
Remnant Parcel	42.0	3.50	79%	116	21%	31	3.50	24%	35	76%	112
Total	102.0		282		75			85		272	
			357					357			

The magnitude of trips projected to be generated by the development sites during the AM and PM peak hours were then compared to those projected in the ASP TIA. **Table 3** summarizes the trips projected to be generated by the industrial developments based on the rates assumed in the ASP TIA and those assumed by Bunt & Associates. Additional information used to determine the magnitude of trips estimated to be generated in the ASP TIA are included in **Appendix C**.

Table 3: Trip Generation Comparison

Area	AM Peak Hour				PM Peak Hour			
	Trips			% of ASP Trips	Trips			% of ASP Trips
	ASP	Proj.	Diff.		ASP	Proj.	Diff.	
Cofely Fabricom	303	210	93	69%	556	210	346	38%
Remnant Parcel	193	147	46	76%	213	147	66	69%
TOTAL	496	357	139	72%	769	357	412	46%

As summarized in Table 3, the industrial developments are anticipated to generate approximately 72% and 46% of the trips projected in the ASP TIA during the AM and PM peak hours respectively. Although the magnitude of trips estimated to be generated based on the Bunt's assumptions are considerably less than those estimated in the ASP TIA, Bunt's assumptions are anticipated to be more development-specific as compared to the generic trip rates assumed in the ASP TIA.

Trip Distribution and Assignment

Existing traffic volumes at the Highway 15/125 Street intersection were reviewed to determine the distribution of site trips to the network. Table 4 summarizes the trip distribution used in the assessment.

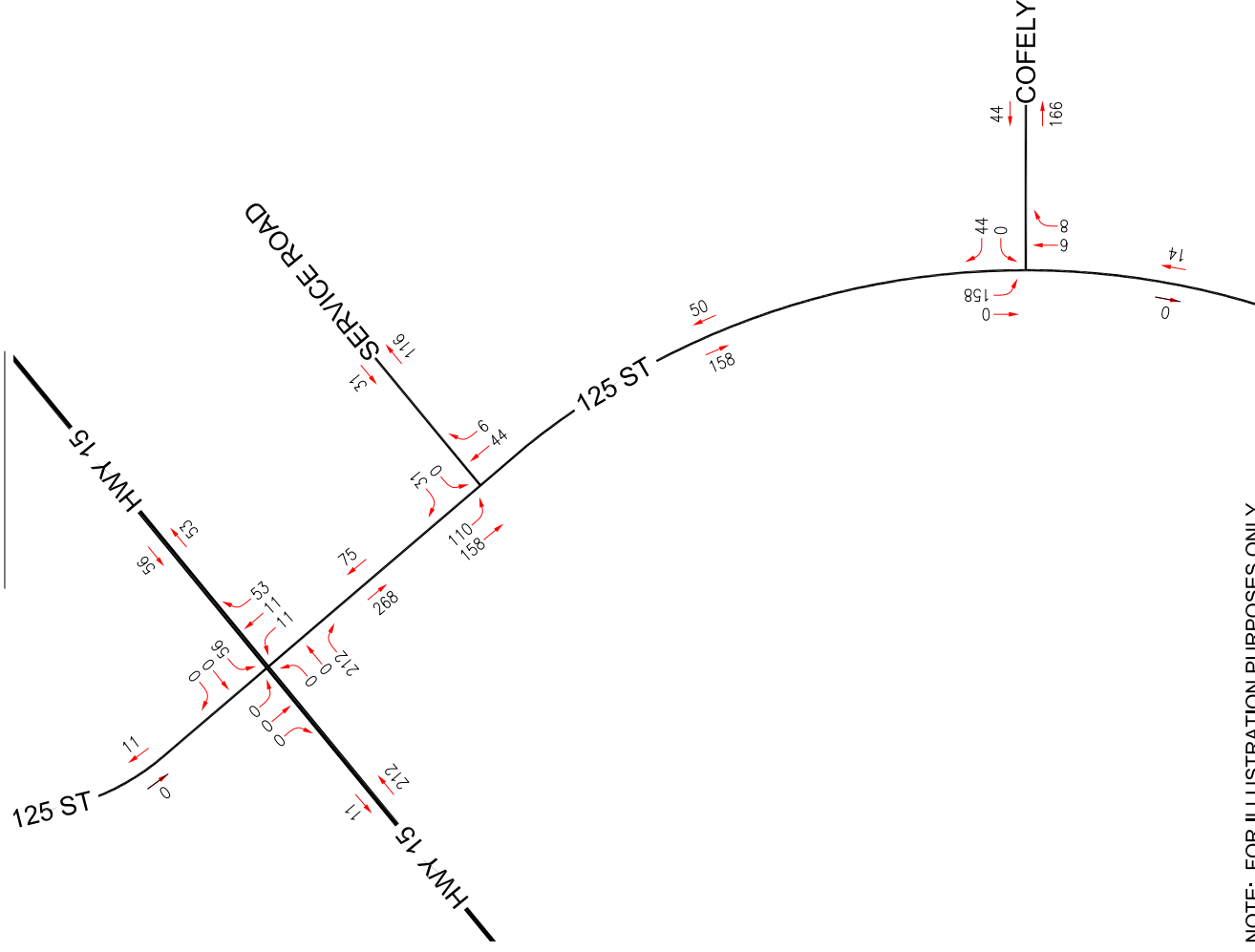
Table 4: Trip Distribution

Area	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
Highway 15 – East	20%	70%	65%	25%
Highway 15 – West	75%	15%	25%	70%
125 Street – South	5%	0%	0%	5%
125 Street - North	0%	15%	10%	0%
TOTAL	100%	100%	100%	100%

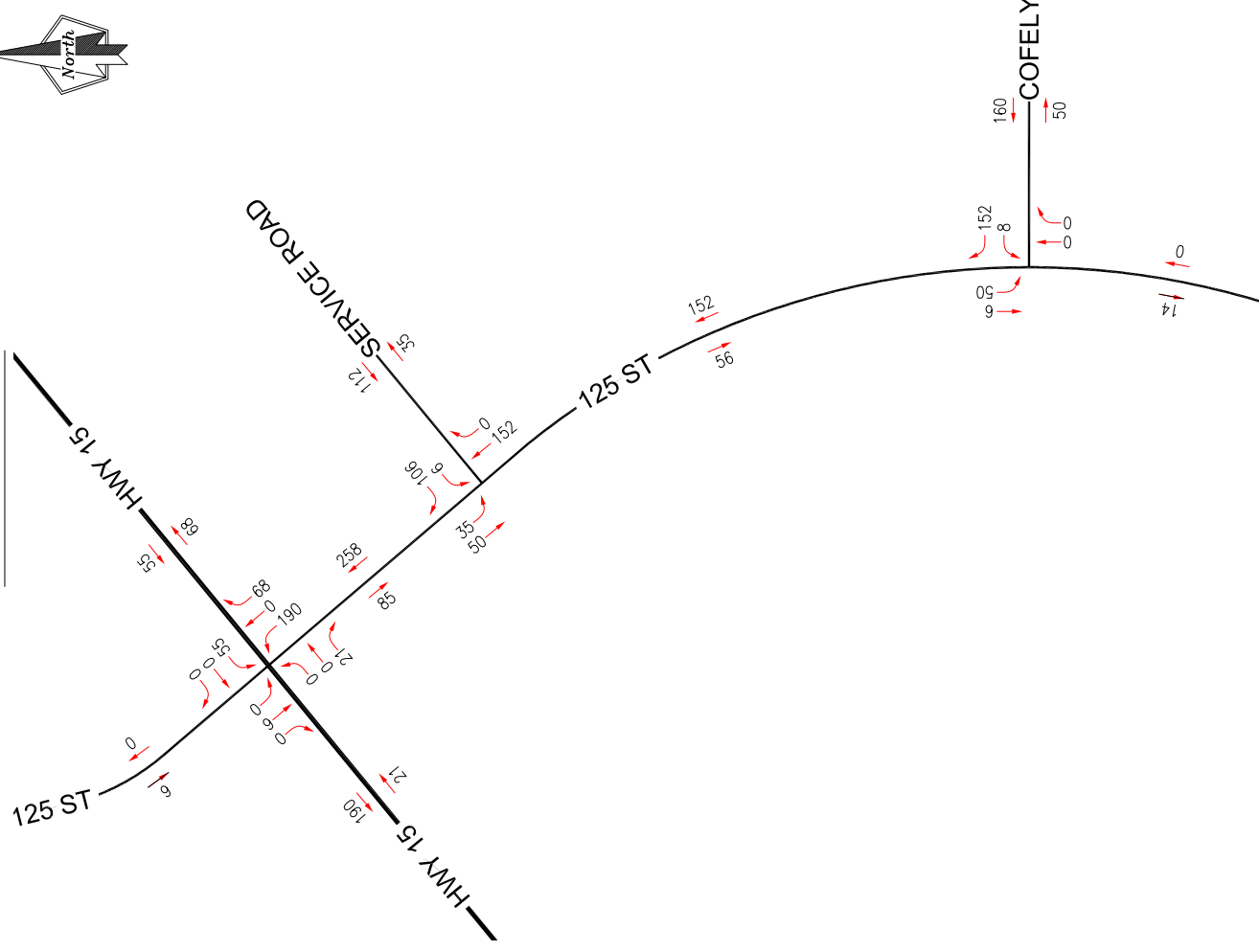
Total Traffic

The AM and PM peak hour traffic volumes associated with the Cofely Fabricom site and the remnant parcel to the north are illustrated in **Exhibit 5**. Note that while the Cofely Fabricom site plan identifies two accesses to 125 Street, the traffic analysis only considered a single access; this approach can be considered somewhat conservative. The AM and PM total traffic volumes (existing + site) are illustrated in **Exhibit 6**.

AM PEAK HOUR



PM PEAK HOUR



NOTE: FOR ILLUSTRATION PURPOSES ONLY

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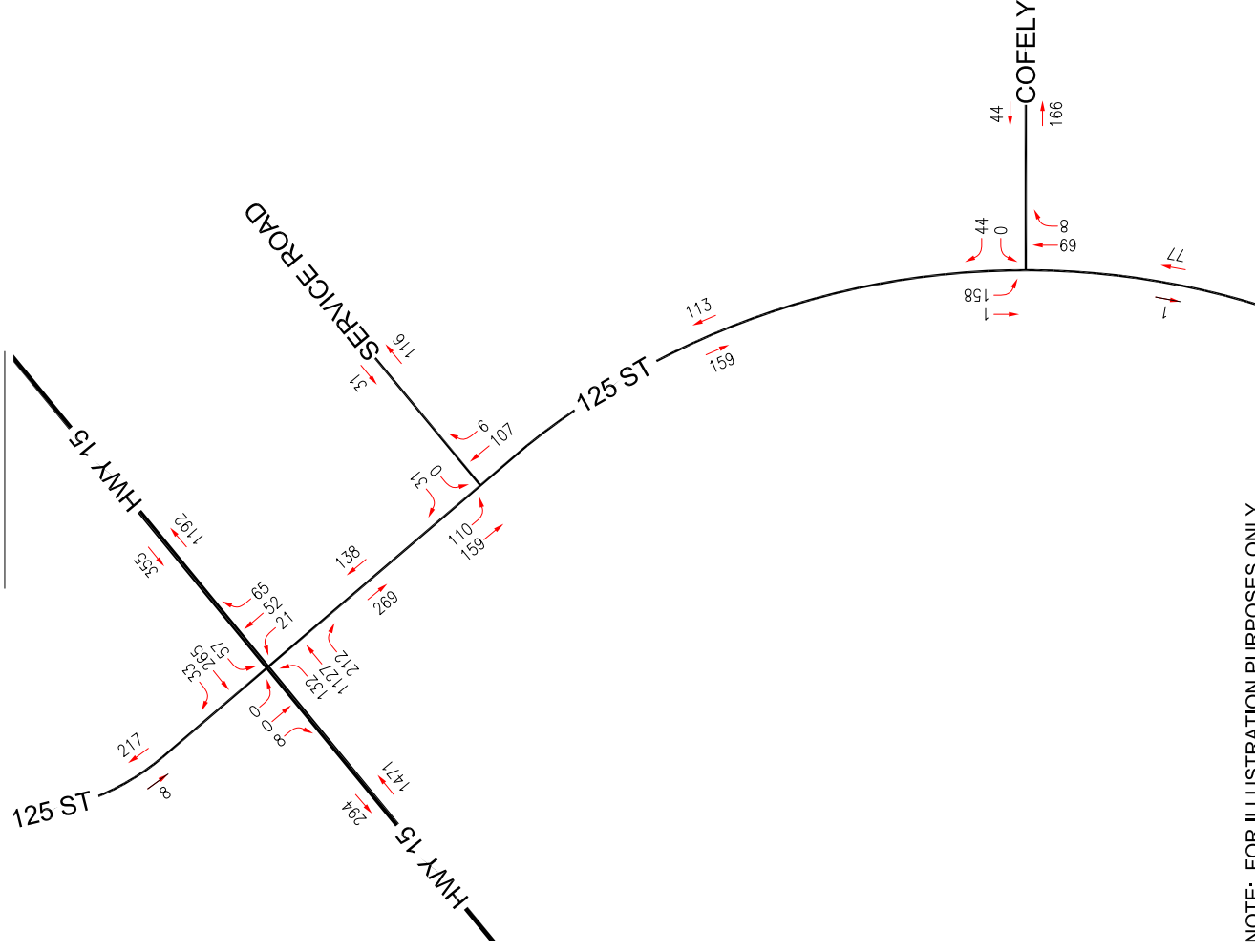
Exhibit 5

DATE July 22, 2014

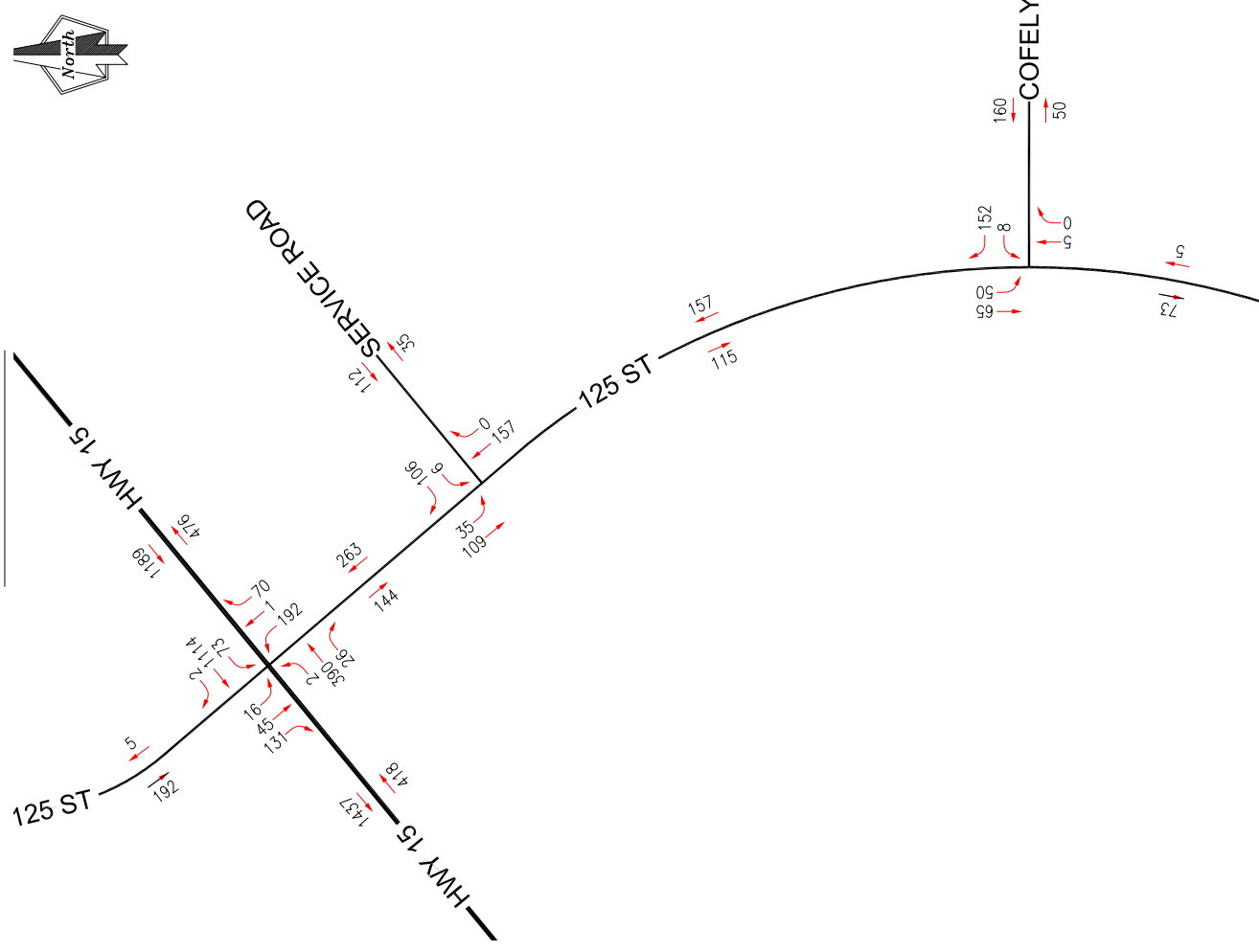
Highway 15/125 Street Intersection Review Site Generated Traffic Volumes - AM and PM Peak Hours



AM PEAK HOUR



PM PEAK HOUR



NOTE: FOR ILLUSTRATION PURPOSES ONLY

PROJECT 3060.18 - Fort Saskatchewan NE Industrial

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Highway 15/125 Street Intersection Review 2014 Total Traffic Volumes - AM and PM Peak Hours

TRANSPORTATION ASSESSMENT

Intersection Analysis Assumptions

The capacity analysis is based on the methods outlined in the Highway Capacity Manual 2000, using SYNCHRO 7.0 analysis software.

The intersection operations are typically rated by two measures: volume-to-capacity (v/c) ratio and Level of Service (LOS). The v/c ratio describes the extent to which the traffic volumes can be accommodated by the physical capacity of the road configuration and traffic control. A value (measured during the peak hour) less than 0.90 indicates that generally there is sufficient capacity and the projected traffic volumes can be accommodated at the intersection. A value between 0.90 and 1.0 suggests unstable operations may occur and volumes are nearing capacity conditions. A calculated value over 1.0 indicates that traffic volumes are theoretically exceeding capacity.

The second measure of performance, LOS, is based on the estimated average delay per vehicle among all traffic passing through the intersection. A low average delay merits a LOS A rating. Average delays greater than 80 seconds per vehicle at a signalized intersection generally produce a LOS F rating, while at unsignalized intersections a LOS F is reached when vehicles experience an average delay greater than 50 seconds. **Table 5** summarizes the levels of service and their respective delay ranges.

Table 5: Level of Service Delay Ranges

LOS	Control Delay per Vehicle (seconds)	
	Signalized Intersection	Stop-Control Intersection
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Typically, the peak hour level of service design objectives for signalized arterials is LOS D for suburban areas and LOS E for downtown areas. At signalized intersections, LOS D generally relates to v/c ratios between 0.75 and 0.90, while LOS E generally relates to v/c ratios greater than 0.9 and less than 1.0.

The methodology includes a number of assumptions that relate to the operating conditions present at the intersections. The following assumptions were used in the analysis:

- **Saturation Flow Rate** – 1,900 vphg
- **Minimum Lane Width** – 3.6 metres
- **Total Lost Time Adjustment Factor** – 0.5
- **Peak Hour Factor** – For existing traffic conditions, the measured peak hour factors for each movement have been applied. For total traffic conditions, a peak hour factor of 0.4 has been assumed for the outbound movements at the Cofely Fabricom access during the PM peak hour to account for the end-of-shift dump. A peak hour factor of 0.4 represents a 24-minute dump. Given that the beginning-of-shift rush at industrial sites typically occurs over a longer period, the peak hour factors during the AM peak hour were not adjusted.
- **% Heavy Vehicle** – Under existing conditions, the % heavy vehicle is based on the existing count information. Under total traffic conditions, the % heavy vehicle for movements associated with site traffic has been re-calculated based on the assumptions that the vast majority of the peak hour traffic associated with the industrial sites consists of passenger vehicles.

Intersection analyses were completed for the AM and PM peak hours at the following intersections:

- Highway 15 & 125 Street;
- 125 Street & Service Road; and,
- 125 Street & Cofely Fabricom Employee Parking Access.

Note that although two accesses to 125 Street are proposed, the analysis only considered one access: the access to the employee parking area. The other access to 125 Street is anticipated to primarily accommodate truck deliveries which are anticipated to occur outside of the peak hours of traffic for the adjacent street. All Synchro reports are included in **Appendix D**.

Highway 15/125 Street

The Highway 15/125 Street intersection is currently a four-legged signalized intersection and includes the following geometry:

- **West Approach** – one left turn bay, two through lanes, one right turn bay;
- **East Approach** – one left turn bay, two through lanes, one right turn bay;
- **South Approach** – one shared left/through lane, one shared through/right lane; and,
- **North Approach** – one shared left/through lane, one right turn lane.

Existing geometry was assumed under the total traffic scenario. **Tables 6 and 7** summarize the results of the intersection capacity analysis for the Highway 15/125 Street intersection for the AM and PM peak hours, respectively, based on existing and total traffic conditions.

Table 6: Highway 15 & 125 Street – AM Peak Hour

	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
2014 Existing – Signalized (assumed 90s Cycle Length, Pm + Pt EBL)												
Geometry	L/T/T/R			L/T/T/R			LT/TR			LT/R		
Volume (vph)	132	1127	0	1	265	33	10	41	12	0	0	8
v/c	0.20	0.42	-	0.01	0.13	0.06	0.40			-		0.03
LOS	A	A	-	A	A	A	C			-		A
95 th Queue (m)	9	46	-	0	17	1	11			-		0
2014 Total – Signalized (assumed 90s Cycle Length, Pm + Pt EBL)												
Geometry	L/T/T/R			L/T/T/R			LT/TR			LT/TR		
Volume (vph)	132	1127	212	57	265	33	21	52	65	0	0	8
v/c	0.21	0.47	0.33	0.43	0.14	0.06	0.65			-		0.03
LOS	A	A	A	B	A	A	C			-		A
95 th Queue (m)	12	60	0	11	19	1	17			-		0

During the AM peak hour, all intersection movements currently operate at LOS C or better with acceptable v/c ratios, as summarized in Table 6. Under total traffic conditions, all intersection movements are anticipated to continue to operate at LOS C or better.

Table 7: Highway 15 & 125 Street – PM Peak Hour

	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
2014 Existing – Signalized (assumed 90s Cycle Length)												
Geometry	L/T/T/R			L/T/T/R			LT/TR			LT/R		
Volume (vph)	2	390	5	18	1114	2	2	1	2	16	36	131
v/c	0.02	0.21	0.01	0.04	0.57	0.01	0.04			0.26		0.67
LOS	A	A	A	A	A	A	C			C		C
95 th Queue (m)	1	21	1	3	74	0	1			19		24
2014 Total – Signalized (assumed 90s Cycle Length, Pm + Pt NBL)												
Geometry	L/T/T/R			L/T/T/R			LT/TR			LT/TR		
Volume (vph)	2	390	26	73	1114	2	192	1	70	16	45	131
v/c	0.04	0.29	0.06	0.23	0.77	0.01	0.53			0.37		0.68
LOS	B	B	A	B	C	A	C			D		D
95 th Queue (m)	1	32	2	16	114	0	21			22		26

During the PM peak hour, all intersection movements are anticipated to operate at LOS D or better as summarized in Table 7. Given that the volume of northbound left turn traffic is considerably greater than the volume of northbound through traffic during the PM peak hour, the northbound shared left/through lane is anticipated to act as a de facto left turn lane.

It is noted that the reported 95th percentile queue length associated with northbound traffic of 21 metres is less than the reported 50th percentile queue length of 31 metres (see Appendix D). The 95th percentile queue is calculated by increasing the arrival rate to account for fluctuations in traffic. The volume is unadjusted by the peak hour factor because the 95th percentile volume adjustment accounts for traffic fluctuations. Therefore, the peak hour factors applied to several movements to reflect the PM dump period, which are significantly less than those typically applied, are assumed to cause the 50th percentile queue to be larger than the 95th percentile queue.

Queuing Analysis

Given the proximity of the 125 Street/Service Road intersection to the Highway 15/125 Street intersection, consideration must be given to the queue lengths associated with the northbound left turn at Highway 15 to ensure the upstream intersection operations are not impacted. The capacity analysis for the Highway 15/125 Street intersection projected a northbound left turn 50th percentile queue length of 31 metres and a 95th percentile queue length of 21 metres based on a peak hour factor of 0.52. To confirm these queue projections, a traffic model was prepared using SimTraffic, a microscopic simulation program. Given that

the dump period is of particular concern in terms of northbound queuing, SimTraffic simulations were only prepared for the PM peak hour scenario. The results are based on the average of five simulation runs.

Compared to Synchro, which calculates queue length using a series of equations based on traffic flow, SimTraffic observes the queues based on traffic flow within the model. SimTraffic provides the average queue, which is the average of observed maximum queues at each two-minute interval, and the 95th percentile queue, which is calculated based on standard deviation (the 95th percentile queue is equal to the average queue plus 1.65 standard deviations). The results of the SimTraffic queuing analysis, which is based on the average of five simulation runs, are summarized in **Table 8**. The SimTraffic Queuing and Blocking Report is included in **Appendix E**.

Table 8: SimTraffic Queuing Analysis Summary - Highway 15/125 Street, Northbound Left Turn - PM Peak Hour

Interval	Minutes	Queue (metres)			Upstream Block Time
		Maximum (Observed)	Average (Observed, 2-minute intervals)	95 th (plus 1.65 standard deviations)	
1 – Pre-Dump	15	32	19	34	-
2 – Dump	24	60	50	71	14%
3 – Post-Dump	21	51	21	45	1%
Average	60	60	33	64	6%

As summarized in Table 8, the maximum observed northbound left queue during the simulated PM peak hour is projected to be in the order of about 60 metres. It is important to note that SimTraffic cannot record a queue length that is longer than the roadway link (which, in this case, is about 60 metres).

To determine the full length of the queue, the upstream blocking time must be checked. The upstream blocking time describes the amount of time the queue blocks the upstream intersection. In this particular case, the upstream intersection (125 Street/Service Road) was blocked 14% of the time during the dump period. So, while the maximum queue was recorded as 60 metres, the queue actually extended back even further impacting the upstream intersection 14% of the time. Assuming a 24-minute dump and a 90-second signal cycle length, an upstream block time of 14% translates into about two cycles per dump.

The proposed concept plan would allow for about 55 metres of queuing along the northbound approach.

125 Street & Service Road

The 125 Street/Service Road intersection is anticipated to be developed as a three-legged intersection that is stop controlled along the service road. The intersection is assumed to include the following geometry:

- **East Approach** – one shared left/right lane;
- **South Approach** – one shared through/right lane; and,
- **North Approach** – one shared left/through lane, one through lane

Table 9 summarizes the results of the intersection capacity analysis for the 125 Street/Service Road intersection for the AM and PM peak hours based on total traffic conditions. It is noted that the Cofely Fabricom alternative access is not considered in the analysis as the access is anticipated to accommodate over-sized loads only, which will utilize the access outside of peak hours.

Table 9: 125 Street & Service Road – 2014 Total Traffic Conditions

	Westbound		Northbound		Southbound	
Movement	L	R	T	R	L	T
AM Peak Hour – Unsignalized (Stop-Controlled along East Approach)						
Geometry	LR		TR		LT/T	
Volume (vph)	0	31	107	6	110	159
v/c	0.04		0.07		0.08	
LOS	A		A		A	
95 th Queue (m)	1		0		2	
PM Peak Hour – Unsignalized (Stop-Controlled along East Approach)						
Geometry	LR		TR		LT/T	
Volume (vph)	6	106	157	0	35	109
v/c	0.20		0.23		0.05	
LOS	B		A		A	
95 th Queue (m)	6		0		1	

As summarized in Table 9, the 125 Street/Service Road intersection is anticipated to operate well during the AM and PM peak hours.

Cofely Fabricom 125 Street Access to Employee Parking Area

The Cofely Fabricom 125 Street access, is anticipated to be developed as a three-legged intersection that is stop controlled along the access approach and will serve as the access to the employee parking area. The intersection is assumed to include the following geometry:

- **East Approach** – one shared left/right lane;
- **South Approach** – one shared through/right lane; and,
- **North Approach** – one shared left/through lane, one through lane

Table 10 summarizes the results of the intersection capacity analysis for the Cofely Fabricom Access/125 Street intersection for the AM and PM peak hours based on total traffic conditions. As summarized in Table 10, the Cofely Fabricom/125 Street access is anticipated to operate at high levels of service with low v/c ratios.

Table 10: Cofely Fabricom Access & 125 Street – 2014 Total Traffic Conditions

	Westbound		Northbound		Southbound	
Movement	L	R	T	R	L	T
AM Peak Hour – Unsignalized (Stop-Controlled along East Approach)						
Geometry	LR		TR		LT/T	
Volume (vph)	0	44	69	8	158	1
v/c	0.05		0.05		0.11	
LOS	A		A		A	
95 th Queue (m)	1		0		3	
PM Peak Hour – Unsignalized (Stop-Controlled along East Approach)						
Geometry	LR		TR		LT/T	
Volume (vph)	8	152	5	0	50	65
v/c	0.38		0.00		0.04	
LOS	B		A		A	
95 th Queue (m)	14		0		1	

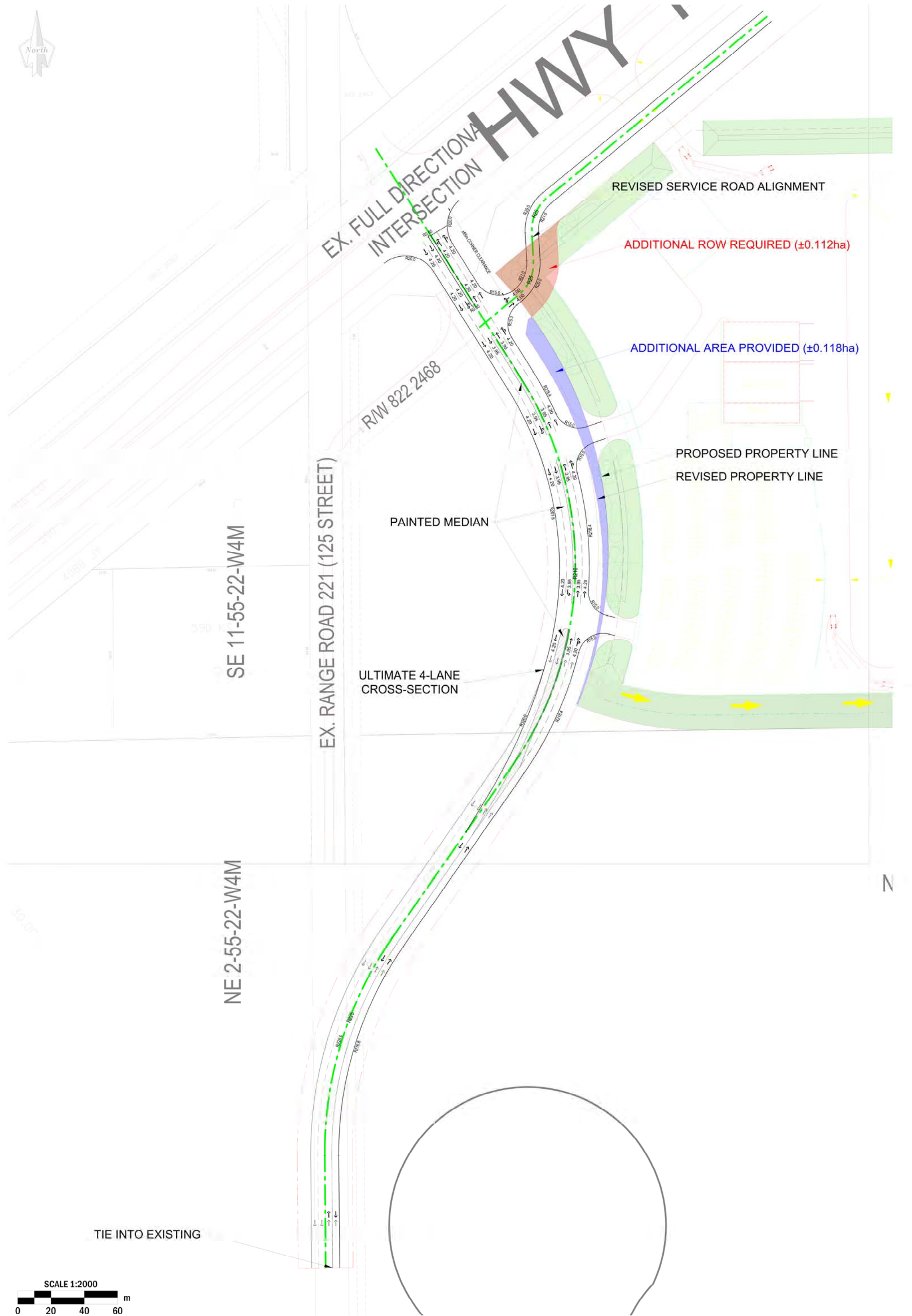
125 STREET CONCEPT PLAN

Ultimate Cross-Section

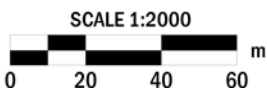
As previously mentioned, 125 Street is anticipated to be developed as a four-lane undivided road based on the daily traffic volume projections identified in the *Josephburg Road North Industrial ASP TIA*. Based on a review of the *City of Fort Saskatchewan's Engineering Standards for Roadways*, the undivided arterial standard is anticipated to represent an appropriate cross-section for this portion of 125 Street under the full build-out of the ASP area (Drawing Number G1.4). The standard includes a 15.8-metre roadway within a 33.0-metre right-of-way developed to an urban cross-section standard.

Staged Development

To accommodate the Cofely Fabricom development, Trans America Group would prefer to construct 125 Street through a staged-approach. Bunt & Associates recommends developing the portion of 125 Street from Highway 15 to the service road as a four-lane cross-section, generally comparable to the existing cross-section, and transitioning the road from four lanes to two lanes south of Cofely's south access. A high-level concept plan illustrating the 125 Street Stage 1 concept is illustrated in **Exhibit 7**.



TIE INTO EXISTING



PROJECT 3060.16 - Fort Saskatchewan NE Industrial

SHEET NO. Exhibit 7

DATE July 22, 2014

125 Street Concept Plan Stage 1



Based on discussions with City of Fort Saskatchewan representatives, the City requires the south leg of the Highway 15/125 Street intersection to be constructed with a raised median. Under Stage 1 development of the road, a raised median is proposed to extend from the Highway 15/125 Street intersection to the Service Road. Note that as the area develops and traffic volumes along 125 Street increase, consideration may be given to eliminating the service road. At such time, consideration could be given to extending the median further south.

ASP Lane Geometry along South Leg

Another consideration in the intersection design was to ensure the lane geometry identified in the ASP could be accommodated within the proposed right-of-way. The lane geometry identified in the ASP for the south approach of the intersection includes the following: two left turn lanes, one through lane, and one right turn bay. **Exhibit 8** illustrates the ultimate lane geometry associated with the south approach of the Highway 15/125 Street intersection based on the proposed 33.0-metre right-of-way and the proposed Stage 1 road alignment.

As illustrated in Exhibit 8, additional right-of-way is anticipated to be required in the vicinity of the Highway 15/125 Street intersection to accommodate the northbound dual left turns. To accommodate the ultimate geometry, an additional 110 m² of right-of-way may be required along the west side of the road. Note that under this lane geometry configuration the inside left turn lane is anticipated to align with the shared through/left lane along the north approach. As such, the lane geometry associated with the north approach will have to be reviewed when, if at all, consideration is given to upgrading the intersection to its ultimate configuration. It is also important to note that the intersection requirements, in terms of traffic control and lane geometry, will continue to be confirmed through the completion of development specific TIAs for future developments within the ASP area.

Conclusion

Study Synopsis

Proposed Land Use Concept

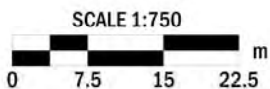
The proposed Cofely Fabricom development, which will encompass an area of about 60 acres, is proposed to be located south of Highway 15 east of the future 125 Street in Fort Saskatchewan NE industrial subdivision within the Josephburg Road North Industrial ASP. With the development of a 60-acre lot, a 41.9-acre parcel of land to the north of the proposed development will be orphaned and require access via a service road along Highway 15.



NORTH LEG GEOMETRY
TO BE REVIEWED WITH THE DEVELOPMENT
OF THE ASP GEOMETRY

ACCESS TO BE CLOSED WITH THE
ULTIMATE DEVELOPMENT
OF THE INTERSECTION

ADDITIONAL ROW POTENTIALLY
REQUIRED TO ACCOMMODATE
ASP INTERSECTION GEOMETRY



PROJECT 3060.18 - Fort Saskatchewan NE Industrial

SHEET NO.
Exhibit 8

DATE July 22, 2014

125 Street Concept Plan

ASP Intersection Geometry on South Leg



Proposed ASP Roadway Network

As the proposed 60-acre lot is anticipated to impact the planned ASP roadway network, Bunt & Associates reviewed the 125 Street realignment in terms of the potential impact on the ASP roadway network. To address the potential impacts the development of the 60-acre lot may have on the roadway network planned for the ASP area, Bunt & Associates prepared a series of internal roadway network options illustrating potential development concepts to provide the City of Fort Saskatchewan with a sense of the possibilities available regarding future development of the ASP.

As the connection to Highway 15 is not anticipated to be affected and comparable north-south and east-west links are provided for each option, a significant redistribution of the traffic projected to be generated by the ASP area is not anticipated. Therefore, it is assumed that for all options considered, the traffic operations projected in the ASP TIA for the Highway 15/125 Street intersection will continue to be valid.

Site Traffic Characteristics

A trip rate of 3.50 trips/acre for the AM and PM peak hours was used for the Cofely Fabricom and remnant parcel in this assessment. Combined, both sites are anticipated to generate in the order of 357 two-way trips during the AM and PM peak hours, which is approximately 72% and 46% of the trips projected in the ASP TIA during the AM and PM peak hours respectively. The trips were distributed based on the distribution of the existing traffic at the Highway 15/125 Street intersection.

Transportation Assessment

During the AM and PM peak hours, all intersection movements at the Highway 15/125 Street intersection currently operate at LOS C or better with acceptable v/c ratios. Under total traffic conditions, all intersection movements are anticipated to continue to operate at LOS D or better during the AM and PM peak hours. Given that the volume of northbound left turn traffic is considerably greater than the volume of northbound through traffic during the PM peak hour, the northbound shared left/through lane is anticipated to act as a de facto left turn lane.

Given the proximity of the 125 Street/Service Road intersection to the Highway 15/125 Street intersection, additional consideration was given to the queue lengths associated with the northbound left turn at Highway 15 to gauge the potential impact associated with the upstream intersection operations. Based on five simulation runs during the PM peak hour using SimTraffic traffic modelling software, the northbound left queue blocked the upstream intersection (125 Street/Service Road) about 14% of the time, or about two signal cycles, during the assumed 24-minute dump period.

All movements associated with the 125 Street/Service Road intersection and the Cofely Fabricom Access/125 Street intersection are anticipated to operate well during the AM and PM peak hours.

125 Street Concept

Based on a review of the City of Fort Saskatchewan's Engineering Standards for Roadways, the undivided arterial standard is anticipated to represent an appropriate cross-section for this portion of 125 Street under the full build-out of the ASP area. The standard includes a 15.8-metre roadway within a 33.0-metre right-of-way developed to an urban cross-section standard. Stage 1 development of 125 Street will include

constructing a four-lane cross-section from Highway 15 to the service road, generally comparable to the existing cross-section, and transitioning the road from four lanes to two lanes south of Cofely's south access to 125 Street.

Recommendations

The following recommendations are advanced:

- No geometry improvements have been identified at the Highway 15/125 Street intersection as the existing intersection configuration is anticipated to adequately accommodate the additional traffic projected to be generated by the Cofely Fabricom development and the development of the remnant parcel to the north;
- 125 Street should ultimately be constructed to a four-lane undivided road cross-section standard except the south approach of the Highway 15/125 Street intersection, which should be developed with a raised median that extends south to the Service Road;
- 125 Street should be developed in stages on an as-needed basis to accommodate future development; and,
- Intersection operations at the Highway 15/125 Street intersection should continually be reviewed when considering future ASP development to ensure that the traffic control and lane geometry associated with the Highway 15/125 Street intersection is capable of accommodating potential increases in traffic at the intersection.

APPENDIX A

2014 Intersection Turning Movement Summary



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Count Name: 3060.16 - Fort Saskatchewan
Site Code: Highway 15/RR 221
Start Date: 2014/03/13
Page No: 1

Turning Movement Data

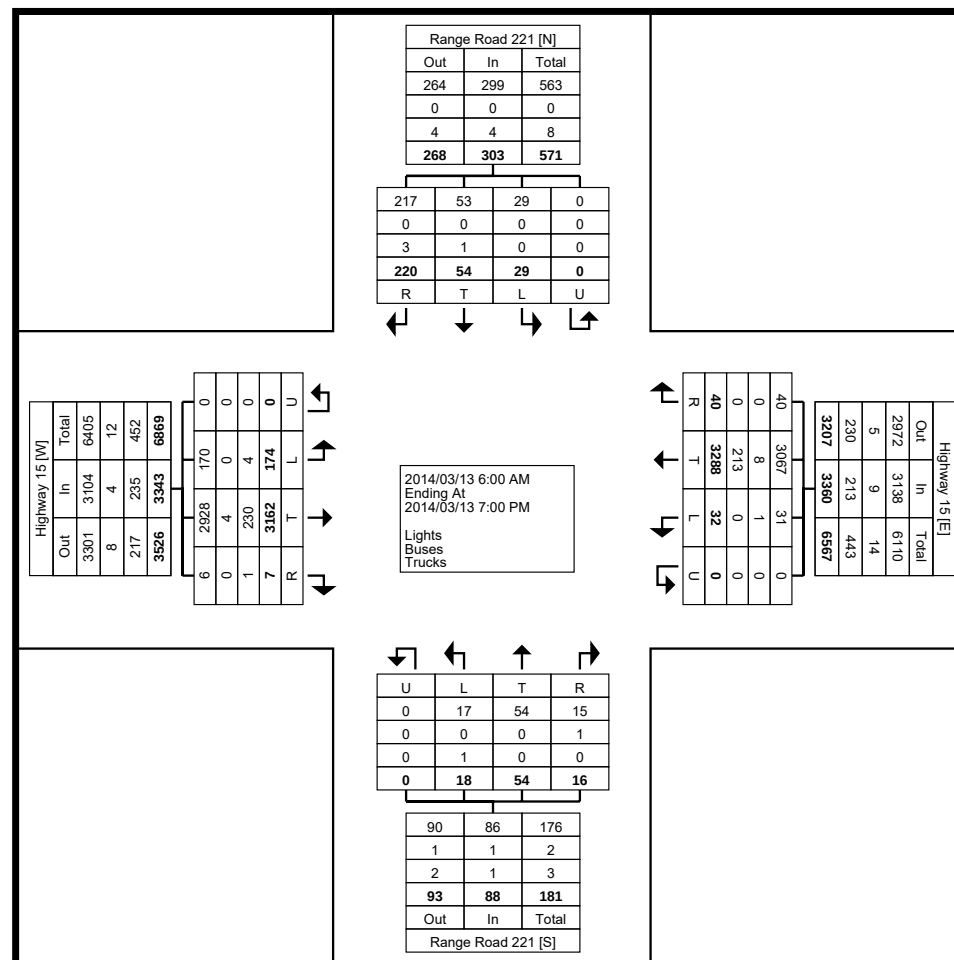
Start Time	Highway 15 Eastbound					Highway 15 Westbound					Range Road 221 Northbound					Range Road 221 Southbound					Int. Total
	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	
6:00 AM	22	251	0	0	273	0	55	1	0	56	1	5	1	0	7	0	0	3	0	3	339
6:15 AM	41	304	0	0	345	0	72	15	0	87	2	9	2	0	13	0	0	5	0	5	450
6:30 AM	44	281	0	0	325	0	75	15	0	90	5	15	7	0	27	0	0	0	0	0	442
6:45 AM	25	291	0	0	316	1	63	2	0	66	2	12	2	0	16	0	0	0	0	0	398
Hourly Total	132	1127	0	0	1259	1	265	33	0	299	10	41	12	0	63	0	0	8	0	8	1629
7:00 AM	9	244	0	0	253	0	65	1	0	66	0	0	1	0	1	0	0	0	0	0	320
7:15 AM	7	153	0	0	160	1	74	0	0	75	0	1	0	0	1	0	0	0	0	0	236
7:30 AM	7	155	0	0	162	0	57	0	0	57	0	3	0	0	3	0	0	0	0	0	222
7:45 AM	3	124	1	0	128	0	81	0	0	81	1	1	0	0	2	0	0	0	0	0	211
Hourly Total	26	676	1	0	703	1	277	1	0	279	1	5	1	0	7	0	0	0	0	0	989
8:00 AM	4	99	0	0	103	0	54	0	0	54	1	1	0	0	2	1	0	0	0	1	160
8:15 AM	4	63	0	0	67	0	72	0	0	72	0	2	0	0	2	0	0	0	0	0	141
8:30 AM	0	68	0	0	68	0	63	0	0	63	0	0	0	0	0	0	0	1	0	1	132
8:45 AM	2	62	0	0	64	0	69	0	0	69	1	1	1	0	3	0	0	2	0	2	138
Hourly Total	10	292	0	0	302	0	258	0	0	258	2	4	1	0	7	1	0	3	0	4	571
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	0	71	0	0	71	0	202	0	0	202	0	0	0	0	0	1	7	12	0	20	293
4:15 PM	1	81	0	0	82	4	252	0	0	256	0	1	0	0	1	2	7	9	0	18	357
4:30 PM	0	92	2	0	94	3	277	2	0	282	0	0	1	0	1	7	13	48	0	68	445
4:45 PM	0	98	2	0	100	6	258	0	0	264	2	0	0	0	2	1	5	15	0	21	387
Hourly Total	1	342	4	0	347	13	989	2	0	1004	2	1	1	0	4	11	32	84	0	127	1482
5:00 PM	1	119	1	0	121	5	327	0	0	332	0	0	1	0	1	6	11	59	0	76	530
5:15 PM	2	100	0	0	102	3	187	3	0	193	0	1	0	0	1	7	2	28	0	37	333
5:30 PM	2	109	0	0	111	6	323	1	0	330	0	0	0	0	0	2	4	15	0	21	462
5:45 PM	0	97	0	0	97	1	233	0	0	234	0	0	0	0	0	1	2	9	0	12	343
Hourly Total	5	425	1	0	431	15	1070	4	0	1089	0	1	1	0	2	16	19	111	0	146	1668
6:00 PM	0	87	1	0	88	1	126	0	0	127	2	0	0	0	2	1	2	10	0	13	230
6:15 PM	0	80	0	0	80	0	118	0	0	118	1	0	0	0	1	0	1	4	0	5	204
6:30 PM	0	70	0	0	70	0	108	0	0	108	0	1	0	0	1	0	0	0	0	0	179
6:45 PM	0	63	0	0	63	1	77	0	0	78	0	1	0	0	1	0	0	0	0	0	142
Hourly Total	0	300	1	0	301	2	429	0	0	431	3	2	0	0	5	1	3	14	0	18	755
Grand Total	174	3162	7	0	3343	32	3288	40	0	3360	18	54	16	0	88	29	54	220	0	303	7094
Approach %	5.2	94.6	0.2	0.0	-	1.0	97.9	1.2	0.0	-	20.5	61.4	18.2	0.0	-	9.6	17.8	72.6	0.0	-	-
Total %	2.5	44.6	0.1	0.0	47.1	0.5	46.3	0.6	0.0	47.4	0.3	0.8	0.2	0.0	1.2	0.4	0.8	3.1	0.0	4.3	-
Lights	170	2928	6	0	3104	31	3067	40	0	3138	17	54	15	0	86	29	53	217	0	299	6627
% Lights	97.7	92.6	85.7	-	92.9	96.9	93.3	100.0	-	93.4	94.4	100.0	93.8	-	97.7	100.0	98.1	98.6	-	98.7	93.4
Buses	0	4	0	0	4	1	8	0	0	9	0	0	1	0	1	0	0	0	0	0	14
% Buses	0.0	0.1	0.0	-	0.1	3.1	0.2	0.0	-	0.3	0.0	0.0	6.3	-	1.1	0.0	0.0	0.0	-	0.0	0.2

Trucks	4	230	1	0	235	0	213	0	0	213	1	0	0	0	1	0	1	3	0	4	453
% Trucks	2.3	7.3	14.3	-	7.0	0.0	6.5	0.0	-	6.3	5.6	0.0	0.0	-	1.1	0.0	1.9	1.4	-	1.3	6.4



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Count Name: 3060.16 - Fort Saskatchewan
Site Code: Highway 15/RR 221
Start Date: 2014/03/13
Page No: 3



Turning Movement Data Plot



Bunt & Associates - Edmonton
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Count Name: 3060.16 - Fort Saskatchewan
Site Code: Highway 15/RR 221
Start Date: 2014/03/13
Page No: 4

Turning Movement Peak Hour Data (6:00 AM)

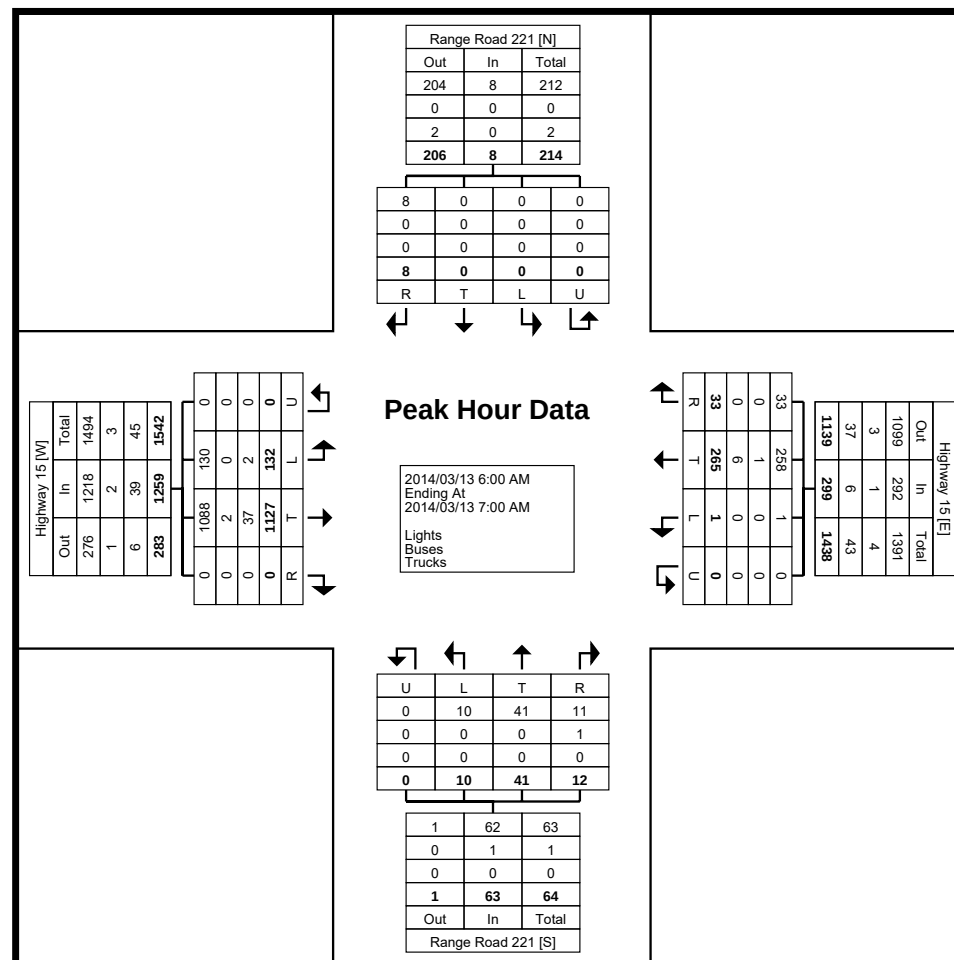
Start Time	Highway 15 Eastbound					Highway 15 Westbound					Range Road 221 Northbound					Range Road 221 Southbound					Int. Total
	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	
6:00 AM	22	251	0	0	273	0	55	1	0	56	1	5	1	0	7	0	0	3	0	3	339
6:15 AM	41	304	0	0	345	0	72	15	0	87	2	9	2	0	13	0	0	5	0	5	450
6:30 AM	44	281	0	0	325	0	75	15	0	90	5	15	7	0	27	0	0	0	0	0	442
6:45 AM	25	291	0	0	316	1	63	2	0	66	2	12	2	0	16	0	0	0	0	0	398
Total	132	1127	0	0	1259	1	265	33	0	299	10	41	12	0	63	0	0	8	0	8	1629
Approach %	10.5	89.5	0.0	0.0	-	0.3	88.6	11.0	0.0	-	15.9	65.1	19.0	0.0	-	0.0	0.0	100.0	0.0	-	-
Total %	8.1	69.2	0.0	0.0	77.3	0.1	16.3	2.0	0.0	18.4	0.6	2.5	0.7	0.0	3.9	0.0	0.0	0.5	0.0	0.5	-
PHF	0.750	0.927	0.000	0.000	0.912	0.250	0.883	0.550	0.000	0.831	0.500	0.683	0.429	0.000	0.583	0.000	0.000	0.400	0.000	0.400	0.905
Lights	130	1088	0	0	1218	1	258	33	0	292	10	41	11	0	62	0	0	8	0	8	1580
% Lights	98.5	96.5	-	-	96.7	100.0	97.4	100.0	-	97.7	100.0	100.0	91.7	-	98.4	-	-	100.0	-	100.0	97.0
Buses	0	2	0	0	2	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	4
% Buses	0.0	0.2	-	-	0.2	0.0	0.4	0.0	-	0.3	0.0	0.0	8.3	-	1.6	-	-	0.0	-	0.0	0.2
Trucks	2	37	0	0	39	0	6	0	0	6	0	0	0	0	0	0	0	0	0	0	45
% Trucks	1.5	3.3	-	-	3.1	0.0	2.3	0.0	-	2.0	0.0	0.0	0.0	-	0.0	-	-	0.0	-	0.0	2.8



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Count Name: 3060.16 - Fort Saskatchewan
Site Code: Highway 15/RR 221
Start Date: 2014/03/13
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Turning Movement Peak Hour Data Plot (6:00 AM)



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10339 124 St NW #504
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Count Name: 3060.16 - Fort Saskatchewan
Site Code: Highway 15/RR 221
Start Date: 2014/03/13
Page No: 6

Turning Movement Peak Hour Data (4:15 PM)

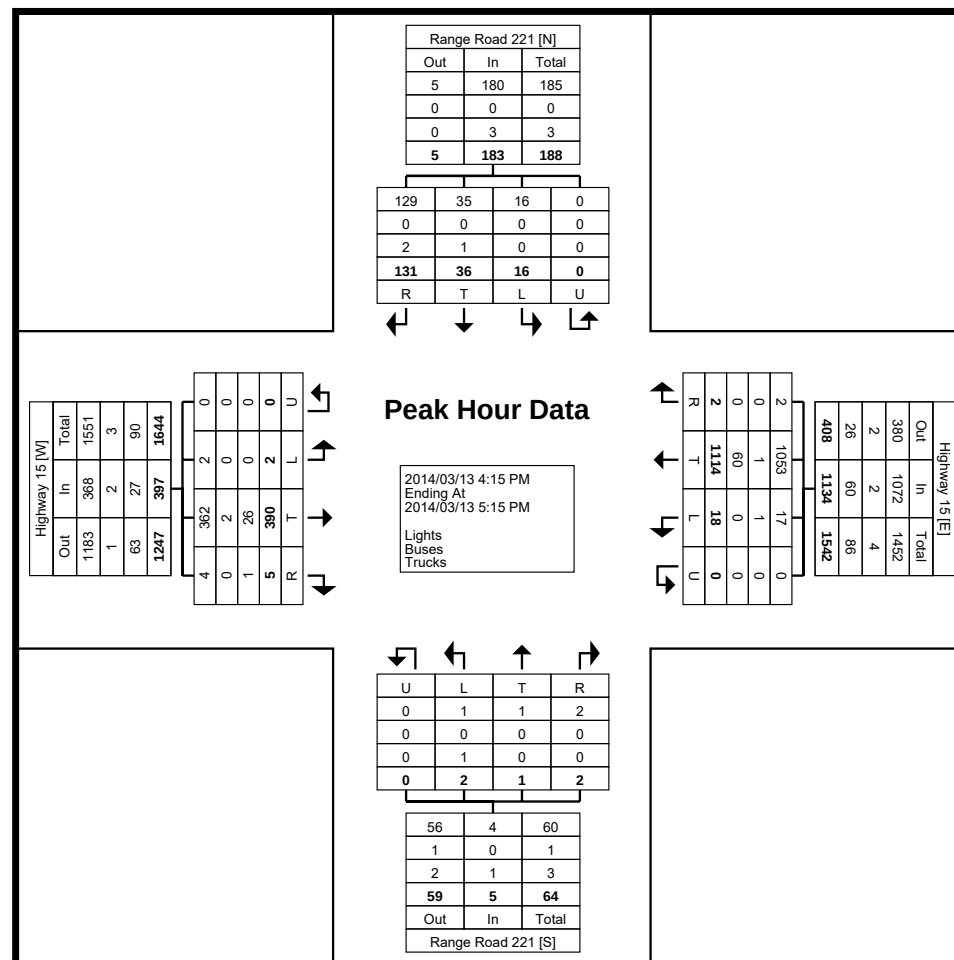
Start Time	Highway 15 Eastbound					Highway 15 Westbound					Range Road 221 Northbound					Range Road 221 Southbound					Int. Total
	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	Left	Thru	Right	U-Turn	App. Total	
4:15 PM	1	81	0	0	82	4	252	0	0	256	0	1	0	0	1	2	7	9	0	18	357
4:30 PM	0	92	2	0	94	3	277	2	0	282	0	0	1	0	1	7	13	48	0	68	445
4:45 PM	0	98	2	0	100	6	258	0	0	264	2	0	0	0	2	1	5	15	0	21	387
5:00 PM	1	119	1	0	121	5	327	0	0	332	0	0	1	0	1	6	11	59	0	76	530
Total	2	390	5	0	397	18	1114	2	0	1134	2	1	2	0	5	16	36	131	0	183	1719
Approach %	0.5	98.2	1.3	0.0	-	1.6	98.2	0.2	0.0	-	40.0	20.0	40.0	0.0	-	8.7	19.7	71.6	0.0	-	-
Total %	0.1	22.7	0.3	0.0	23.1	1.0	64.8	0.1	0.0	66.0	0.1	0.1	0.1	0.0	0.3	0.9	2.1	7.6	0.0	10.6	-
PHF	0.500	0.819	0.625	0.000	0.820	0.750	0.852	0.250	0.000	0.854	0.250	0.250	0.500	0.000	0.625	0.571	0.692	0.555	0.000	0.602	0.811
Lights	2	362	4	0	368	17	1053	2	0	1072	1	1	2	0	4	16	35	129	0	180	1624
% Lights	100.0	92.8	80.0	-	92.7	94.4	94.5	100.0	-	94.5	50.0	100.0	100.0	-	80.0	100.0	97.2	98.5	-	98.4	94.5
Buses	0	2	0	0	2	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	4
% Buses	0.0	0.5	0.0	-	0.5	5.6	0.1	0.0	-	0.2	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	-	0.0	0.2
Trucks	0	26	1	0	27	0	60	0	0	60	1	0	0	0	1	0	1	2	0	3	91
% Trucks	0.0	6.7	20.0	-	6.8	0.0	5.4	0.0	-	5.3	50.0	0.0	0.0	-	20.0	0.0	2.8	1.5	-	1.6	5.3



Bunt & Associates - Edmonton
10339 124 St NW #504

Edmonton, Alberta, Canada T5N 3W1
(780) 732-5373 abauditz@bunteng.com

Count Name: 3060.16 - Fort Saskatchewan
Site Code: Highway 15/RR 221
Start Date: 2014/03/13
Page No: 7



Turning Movement Peak Hour Data Plot (4:15 PM)

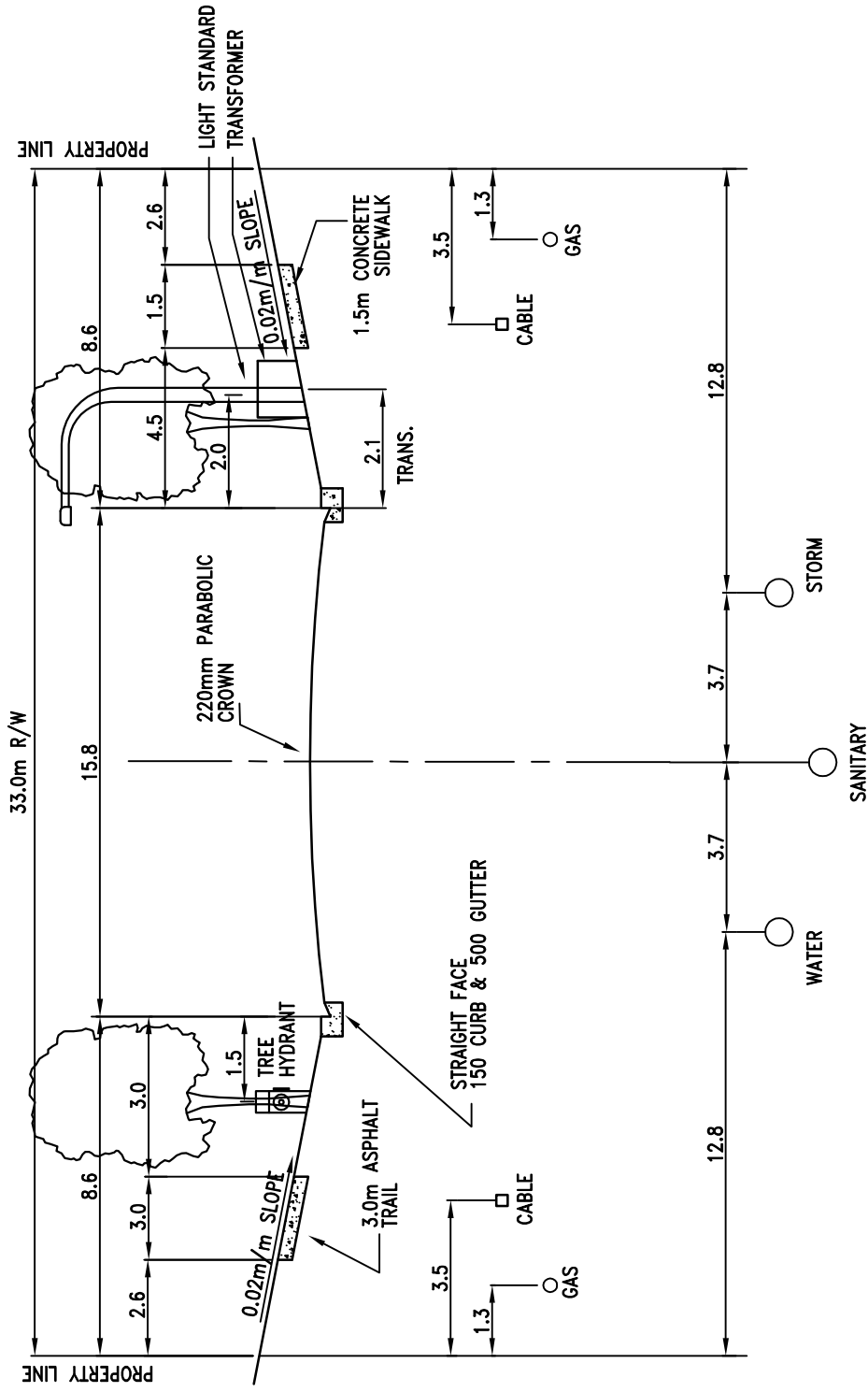


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Site Code: Highway 15/RR 221
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APPENDIX B

4-Lane Undivided Standard



33.0m RIGHT OF WAY - 15.8m UNDIVIDED ARTERIAL

ALL DIMENSIONS IN METRES
UNLESS OTHERWISE NOTED

Approved: GJ	Checked: BM	Dwg. No.
Revision Number: B	Date: July 2005	
Not To Scale	Drawn: GCA	

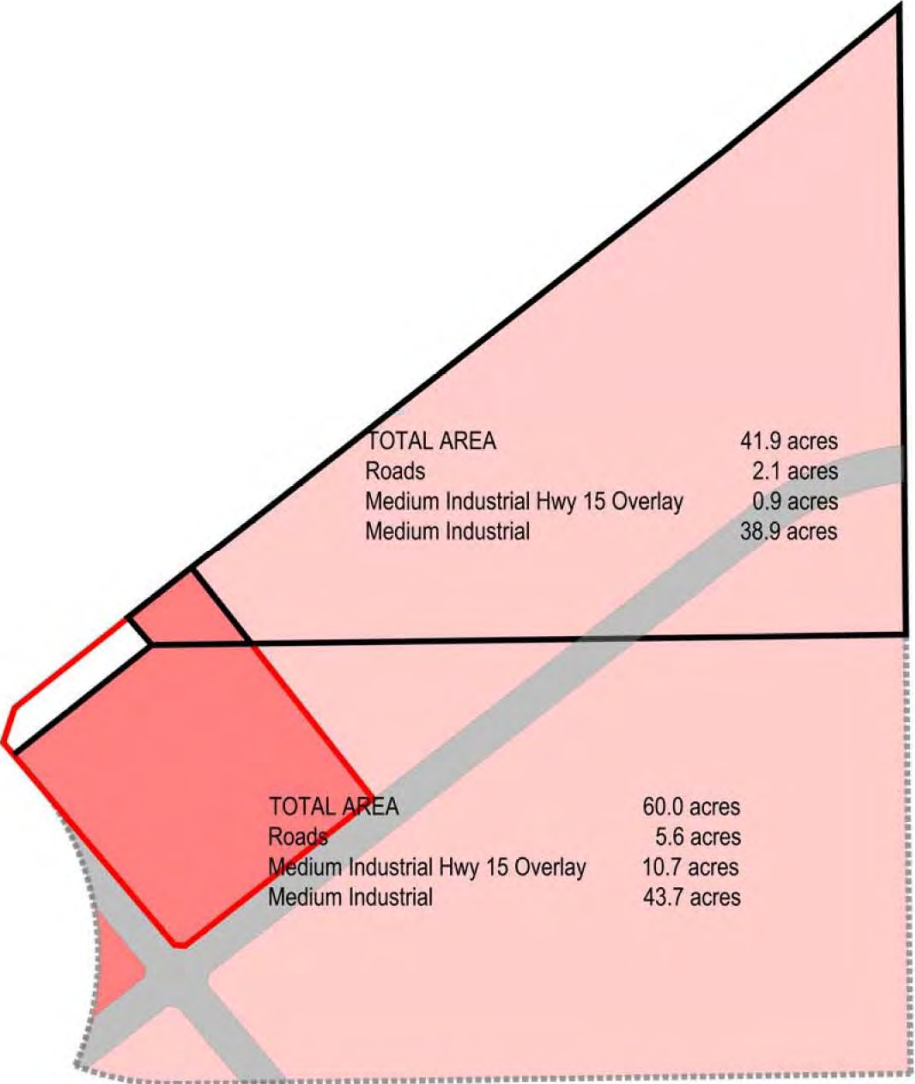
G1.4

APPENDIX C

Trip Generation Comparison Calculations

Trip Generation Characteristics based on ASP TIA Assumptions												
Land Use	Area	Variable	AM Peak Hour					PM Peak Hour				
			Rate	In		Out		Rate	In		Out	
Cofely Fabricom												
Light Industrial		acre	5.97	85%	0	15%	0	6.58	30%	0	70%	0
Medium Industrial	43.70	acre	4.75	85%	176	15%	31	4.71	30%	62	70%	144
Medium Industrial - Hwy 15 Overla	10.70	acre	8.97	50%	48	50%	48	32.67	50%	175	50%	175
Sub-Total	54.40			224		79			237		319	
				303		556						
Remnant Parcel												
Light Industrial		acre	5.97	85%	0	15%	0	6.58	30%	0	70%	0
Medium Industrial	38.90	acre	4.75	85%	157	15%	28	4.71	30%	55	70%	128
Medium Industrial - Hwy 15 Overla	0.90	acre	8.97	50%	4	50%	4	32.67	50%	15	50%	15
Sub-Total	39.80			161		32			70		143	
				193		213						
Total	94.20			385		111			307		462	
				496		769						

Trip Rate Comparison								
Area	AM Peak Hour				PM Peak Hour			
	Trips		Difference	% of ASP Trips	Trips		Difference	% of ASP Trips
	ASP	Projected			ASP	Projected		
Cofely Fabricom	303	210	93	69%	556	210	346	38%
Remnant Parcel	193	147	46	76%	213	147	66	69%
TOTAL	496	357	139	72%	769	357	412	46%



APPENDIX D

Synchro Reports

Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Background Traffic Conditions - AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	1127	0	1	265	33	10	41	12	0	0	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	130.0		110.0	130.0		110.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		1
Taper Length (m)	7.5		7.5	7.5		7.5	7.5		7.5	7.5		7.5
Satd. Flow (prot)	1863	3505	1863	1770	3505	1583	0	3320	0	0	1863	1583
Flt Permitted	0.533			0.232				0.902				
Satd. Flow (perm)	993	3505	1863	432	3505	1583	0	3022	0	0	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						60		28				631
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		808.1			830.0			80.4			354.7	
Travel Time (s)		41.6			42.7			5.8			25.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.75	0.93	0.92	0.25	0.88	0.55	0.50	0.68	0.43	0.92	0.92	0.40
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	3%	2%	2%	3%	2%	2%	2%	8%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	176	1212	0	4	301	60	0	108	0	0	0	20
Turn Type	pm+pt		Perm	Perm		Perm	Perm			Perm		Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Detector Phase	7	4	4	8	8	8	2	2		6	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0		22.0	22.0	22.0
Total Split (s)	17.0	68.0	68.0	51.0	51.0	51.0	22.0	22.0	0.0	22.0	22.0	22.0
Total Split (%)	18.9%	75.6%	75.6%	56.7%	56.7%	56.7%	24.4%	24.4%	0.0%	24.4%	24.4%	24.4%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Lost Time (s)	4.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	4.5	6.5	6.5	6.5
Lead/Lag	Lead			Lag	Lag	Lag						
Lead-Lag Optimize?	Yes			Yes	Yes	Yes						
Recall Mode	Min	C-Max	C-Max	C-Max	C-Max	C-Max	None	None		None	None	None
Act Effect Green (s)	74.5	73.3		60.7	60.7	60.7		7.3				7.3
Actuated g/C Ratio	0.83	0.81		0.67	0.67	0.67		0.08				0.08
v/c Ratio	0.20	0.42		0.01	0.13	0.06		0.40				0.03
Control Delay	2.6	3.8		7.0	6.4	2.2		33.1				0.1
Queue Delay	0.0	0.0		0.0	0.0	0.0		0.0				0.0
Total Delay	2.6	3.8		7.0	6.4	2.2		33.1				0.1
LOS	A	A		A	A	A		C				A

Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Background Traffic Conditions - AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		3.7			5.7			33.1				
Approach LOS		A			A			C				
Queue Length 50th (m)	5.1	31.1		0.2	9.8	0.0		7.3				0.0
Queue Length 95th (m)	8.5	46.4		0.4	16.8	1.2		10.7				0.0
Internal Link Dist (m)		784.1			806.0			56.4			330.7	
Turn Bay Length (m)	130.0			130.0		110.0						
Base Capacity (vph)	947	2854		291	2362	1086		544				795
Starvation Cap Reductn	0	0		0	0	0		0				0
Spillback Cap Reductn	0	0		0	0	0		0				0
Storage Cap Reductn	0	0		0	0	0		0				0
Reduced v/c Ratio	0.19	0.42		0.01	0.13	0.06		0.20				0.03

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 43 (48%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 55

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.42

Intersection Signal Delay: 5.7

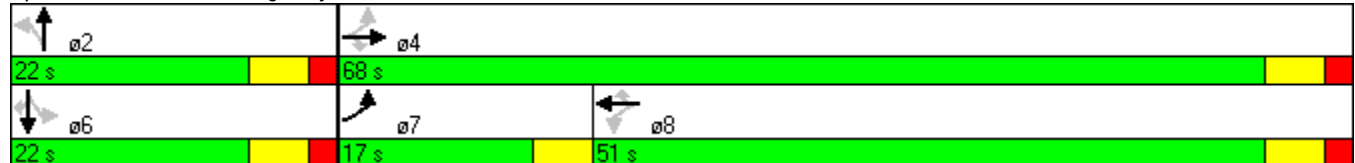
Intersection LOS: A

Intersection Capacity Utilization 54.1%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Highway 15 & 125 Street



Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	1127	212	57	265	33	21	52	65	0	0	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	130.0		110.0	130.0		110.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		1
Taper Length (m)	7.5		7.5	7.5		7.5	7.5		7.5	7.5		7.5
Satd. Flow (prot)	1863	3505	1583	1770	3505	1583	0	3113	0	0	1863	1583
Flt Permitted	0.530			0.232				0.905				
Satd. Flow (perm)	987	3505	1583	432	3505	1583	0	2840	0	0	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			424			60		100				606
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		808.1			830.0			80.4			354.7	
Travel Time (s)		41.6			42.7			5.8			25.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.75	0.93	0.50	0.50	0.88	0.55	0.50	0.68	0.43	0.92	0.92	0.40
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	3%	2%	2%	3%	2%	2%	2%	8%	2%	2%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	176	1212	424	114	301	60	0	269	0	0	0	20
Turn Type	pm+pt		Perm	Perm		Perm	Perm			Perm		Perm
Protected Phases	7	4			8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Detector Phase	7	4	4	8	8	8	2	2		6	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	10.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0		22.0	22.0	22.0
Total Split (s)	10.0	67.0	67.0	57.0	57.0	57.0	23.0	23.0	0.0	23.0	23.0	23.0
Total Split (%)	11.1%	74.4%	74.4%	63.3%	63.3%	63.3%	25.6%	25.6%	0.0%	25.6%	25.6%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Lost Time (s)	4.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	4.5	6.5	6.5	6.5
Lead/Lag	Lead			Lag	Lag	Lag						
Lead-Lag Optimize?	Yes			Yes	Yes	Yes						
Recall Mode	Min	C-Max	C-Max	C-Max	C-Max	C-Max	None	None		None	None	None
Act Effect Green (s)	69.1	66.6	66.6	55.2	55.2	55.2		10.4				10.4
Actuated g/C Ratio	0.77	0.74	0.74	0.61	0.61	0.61		0.12				0.12
v/c Ratio	0.21	0.47	0.33	0.43	0.14	0.06		0.65				0.03
Control Delay	3.7	5.7	1.2	16.9	8.2	2.7		30.7				0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0				0.0
Total Delay	3.7	5.7	1.2	16.9	8.2	2.7		30.7				0.1
LOS	A	A	A	B	A	A		C				A

Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		4.4			9.6			30.7				
Approach LOS		A			A			C				
Queue Length 50th (m)	6.4	37.7	0.0	10.0	11.1	0.0		15.4				0.0
Queue Length 95th (m)	11.5	60.2	0.0	11.4	18.8	1.4		17.3				0.0
Internal Link Dist (m)		784.1			806.0			56.4			330.7	
Turn Bay Length (m)	130.0		110.0	130.0		110.0						
Base Capacity (vph)	830	2595	1282	265	2151	995		602				785
Starvation Cap Reductn	0	0	0	0	0	0		0				0
Spillback Cap Reductn	0	0	0	0	0	0		0				0
Storage Cap Reductn	0	0	0	0	0	0		0				0
Reduced v/c Ratio	0.21	0.47	0.33	0.43	0.14	0.06		0.45				0.03

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 60

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.65

Intersection Signal Delay: 8.1

Intersection LOS: A

Intersection Capacity Utilization 54.9%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 1: Highway 15 & 125 Street



Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Background Traffic Conditions - PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	390	5	18	1114	2	2	1	2	16	36	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	130.0		110.0	130.0		110.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		1
Taper Length (m)	7.5		7.5	7.5		7.5	7.5		7.5	7.5		7.5
Satd. Flow (prot)	1863	3374	1346	1719	3438	1583	0	2690	0	0	1819	1583
Flt Permitted	0.169			0.480				0.855			0.892	
Satd. Flow (perm)	315	3374	1346	869	3438	1583	0	2357	0	0	1651	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			8			8		4				74
Link Speed (k/h)		70			70			50				50
Link Distance (m)		808.1			830.0			80.4				354.7
Travel Time (s)		41.6			42.7			5.8				25.5
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.50	0.82	0.63	0.75	0.85	0.25	0.25	0.25	0.50	0.57	0.69	0.56
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	7%	20%	5%	5%	2%	50%	2%	2%	2%	3%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%				0%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	4	476	8	24	1311	8	0	16	0	0	80	234
Turn Type	Perm		Perm	Perm		Perm	Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8		8	2			6		6
Detector Phase	4	4	4	8	8	8	2	2		6	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0		22.0	22.0	22.0
Total Split (s)	65.0	65.0	65.0	65.0	65.0	65.0	25.0	25.0	0.0	25.0	25.0	25.0
Total Split (%)	72.2%	72.2%	72.2%	72.2%	72.2%	72.2%	27.8%	27.8%	0.0%	27.8%	27.8%	27.8%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.5
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5	6.5	6.0	6.5	4.5	6.5	6.5	6.5
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	C-Max	C-Max	C-Max	C-Max	C-Max	C-Max	None	None		None	None	None
Act Effect Green (s)	60.5	60.5	60.5	60.5	60.5	60.5		16.5			16.5	16.5
Actuated g/C Ratio	0.67	0.67	0.67	0.67	0.67	0.67		0.18			0.18	0.18
v/c Ratio	0.02	0.21	0.01	0.04	0.57	0.01		0.04			0.26	0.67
Control Delay	6.0	6.2	3.2	5.9	9.3	3.0		24.4			33.1	32.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	6.0	6.2	3.2	5.9	9.3	3.0		24.4			33.1	32.7
LOS	A	A	A	A	A	A		C			C	C

Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Background Traffic Conditions - PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		6.1			9.2			24.4			32.8	
Approach LOS		A			A			C			C	
Queue Length 50th (m)	0.2	16.4	0.0	1.4	62.6	0.0		0.9			12.3	26.3
Queue Length 95th (m)	0.8	20.7	0.9	3.4	73.5	0.1		0.8			18.7	23.6
Internal Link Dist (m)		784.1			806.0			56.4			330.7	
Turn Bay Length (m)	130.0		110.0	130.0		110.0						
Base Capacity (vph)	212	2270	908	585	2313	1067		488			339	384
Starvation Cap Reductn	0	0	0	0	0	0		0			0	0
Spillback Cap Reductn	0	0	0	0	0	0		0			0	0
Storage Cap Reductn	0	0	0	0	0	0		0			0	0
Reduced v/c Ratio	0.02	0.21	0.01	0.04	0.57	0.01		0.03			0.24	0.61

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 55

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.67

Intersection Signal Delay: 12.1

Intersection LOS: B

Intersection Capacity Utilization 58.5%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Highway 15 & 125 Street



Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	390	26	73	1114	2	192	1	70	16	45	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Grade (%)		0%			0%			0%			0%	
Storage Length (m)	130.0		110.0	130.0		110.0	0.0		0.0	0.0		0.0
Storage Lanes	1		1	1		1	0		0	0		1
Taper Length (m)	7.5		7.5	7.5		7.5	7.5		7.5	7.5		7.5
Satd. Flow (prot)	1863	3374	1346	1719	3438	1583	0	3279	0	0	1822	1583
Flt Permitted	0.107			0.470				0.661			0.744	
Satd. Flow (perm)	199	3374	1346	850	3438	1583	0	2246	0	0	1376	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			41			8		65				65
Link Speed (k/h)		70			70			50			50	
Link Distance (m)		808.1			830.0			80.4			354.7	
Travel Time (s)		41.6			42.7			5.8			25.5	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.50	0.82	0.63	0.75	0.85	0.25	0.52	0.52	0.52	0.57	0.69	0.56
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	2%	7%	20%	5%	5%	2%	2%	2%	2%	2%	3%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	4	476	41	97	1311	8	0	506	0	0	93	234
Turn Type	Perm		Perm	Perm		Perm	pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8		8	2			6		6
Detector Phase	4	4	4	8	8	8	5	2		6	6	6
Switch Phase												
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	22.0	22.0	22.0	22.0	22.0	22.0	10.0	22.0		22.0	22.0	22.0
Total Split (s)	51.0	51.0	51.0	51.0	51.0	51.0	16.0	39.0	0.0	23.0	23.0	23.0
Total Split (%)	56.7%	56.7%	56.7%	56.7%	56.7%	56.7%	17.8%	43.3%	0.0%	25.6%	25.6%	25.6%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	0.0	2.0		2.0	2.0	2.0
Lost Time Adjust (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.5
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5	6.5	4.0	6.5	4.5	6.5	6.5	6.5
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Recall Mode	Max	Max	Max	Max	Max	Max	Max	Max		Max	Max	Max
Act Effect Green (s)	44.5	44.5	44.5	44.5	44.5	44.5		32.5			16.5	16.5
Actuated g/C Ratio	0.49	0.49	0.49	0.49	0.49	0.49		0.36			0.18	0.18
v/c Ratio	0.04	0.29	0.06	0.23	0.77	0.01		0.53			0.37	0.68
Control Delay	13.0	14.0	4.2	14.9	22.5	6.5		21.0			37.1	35.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0		0.0			0.0	0.0
Total Delay	13.0	14.0	4.2	14.9	22.5	6.5		21.0			37.1	35.9
LOS	B	B	A	B	C	A		C			D	D

Lanes, Volumes, Timings
1: Highway 15 & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		13.2			21.9			21.0			36.3	
Approach LOS		B			C			C			D	
Queue Length 50th (m)	0.4	25.5	0.0	9.6	97.8	0.0		30.8			15.0	28.8
Queue Length 95th (m)	1.2	32.1	2.4	15.8	113.8	0.1		21.3			22.1	26.0
Internal Link Dist (m)		784.1			806.0			56.4			330.7	
Turn Bay Length (m)	130.0		110.0	130.0		110.0						
Base Capacity (vph)	98	1668	686	420	1700	787		962			252	343
Starvation Cap Reductn	0	0	0	0	0	0		0			0	0
Spillback Cap Reductn	0	0	0	0	0	0		0			0	0
Storage Cap Reductn	0	0	0	0	0	0		0			0	0
Reduced v/c Ratio	0.04	0.29	0.06	0.23	0.77	0.01		0.53			0.37	0.68

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBTL, Start of Green

Natural Cycle: 65

Control Type: Pretimed

Maximum v/c Ratio: 0.77

Intersection Signal Delay: 21.8

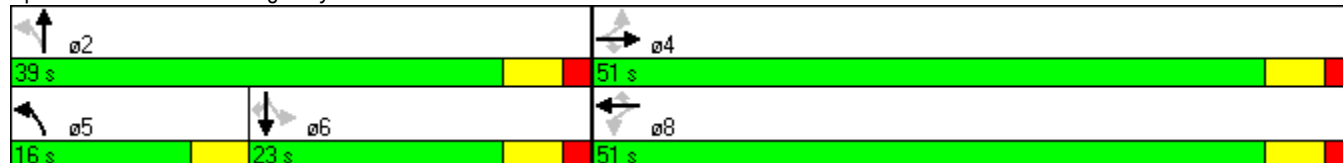
Intersection LOS: C

Intersection Capacity Utilization 67.7%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Highway 15 & 125 Street



HCM Unsignalized Intersection Capacity Analysis

2: Remnant Access & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - AM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	31	107	6	110	159
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	34	116	7	120	173
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)						80
pX, platoon unblocked						
vC, conflicting volume	445	120			123	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	445	120			123	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	96			92	
cM capacity (veh/h)	497	909			1462	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	34	123	177	115		
Volume Left	0	0	120	0		
Volume Right	34	7	0	0		
cSH	909	1700	1462	1700		
Volume to Capacity	0.04	0.07	0.08	0.07		
Queue Length 95th (m)	0.9	0.0	2.1	0.0		
Control Delay (s)	9.1	0.0	5.4	0.0		
Lane LOS	A		A			
Approach Delay (s)	9.1	0.0	3.3			
Approach LOS	A					
Intersection Summary						
Average Delay		2.8				
Intersection Capacity Utilization		23.6%		ICU Level of Service	A	
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

2: Remnant Access & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - PM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	6	106	157	0	35	109
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.41	0.92	0.92	0.92
Hourly flow rate (vph)	7	115	383	0	38	118
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)						80
pX, platoon unblocked						
vC, conflicting volume	518	383			383	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	518	383			383	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	81			97	
cM capacity (veh/h)	471	615			1172	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	122	383	78	79		
Volume Left	7	0	38	0		
Volume Right	115	0	0	0		
cSH	605	1700	1172	1700		
Volume to Capacity	0.20	0.23	0.03	0.05		
Queue Length 95th (m)	6.0	0.0	0.8	0.0		
Control Delay (s)	12.4	0.0	4.1	0.0		
Lane LOS	B		A			
Approach Delay (s)	12.4	0.0	2.1			
Approach LOS	B					
Intersection Summary						
Average Delay			2.8			
Intersection Capacity Utilization			30.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

3: Cofely Access & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - AM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	44	69	8	158	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	48	75	9	172	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)						268
pX, platoon unblocked						
vC, conflicting volume	424	79			84	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	424	79			84	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	95			89	
cM capacity (veh/h)	520	981			1513	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	48	84	172	1		
Volume Left	0	0	172	0		
Volume Right	48	9	0	0		
cSH	981	1700	1513	1700		
Volume to Capacity	0.05	0.05	0.11	0.00		
Queue Length 95th (m)	1.2	0.0	3.1	0.0		
Control Delay (s)	8.9	0.0	7.7	0.0		
Lane LOS	A		A			
Approach Delay (s)	8.9	0.0	7.6			
Approach LOS	A					
Intersection Summary						
Average Delay			5.7			
Intersection Capacity Utilization			26.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

3: Cofely Access & 125 Street

Fort Sask NE Industrial
2014 Total Traffic Conditions - PM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	8	152	5	0	50	65
Sign Control	Stop		Free		Free	Free
Grade	0%		0%			0%
Peak Hour Factor	0.40	0.40	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	20	380	5	0	54	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)					268	
pX, platoon unblocked						
vC, conflicting volume	185	5			5	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	185	5			5	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	65			97	
cM capacity (veh/h)	777	1078			1616	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	400	5	54	71		
Volume Left	20	0	54	0		
Volume Right	380	0	0	0		
cSH	1057	1700	1616	1700		
Volume to Capacity	0.38	0.00	0.03	0.04		
Queue Length 95th (m)	14.3	0.0	0.8	0.0		
Control Delay (s)	10.5	0.0	7.3	0.0		
Lane LOS	B		A			
Approach Delay (s)	10.5	0.0	3.2			
Approach LOS	B					
Intersection Summary						
Average Delay		8.6				
Intersection Capacity Utilization		26.8%		ICU Level of Service		A
Analysis Period (min)		15				

APPENDIX E

SimTraffic Reports

Queuing and Blocking Report
2014 Total Traffic Conditions

Fort Sask NE Industrial
2014 Total Traffic Conditions - PM Peak Hour

Intersection: 1: Highway 15 & 125 Street, Interval #1

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	T	LT	TR	LT	R
Maximum Queue (m)	3.1	27.4	36.3	13.8	22.4	218.3	84.9	32.1	7.4	14.6	22.8
Average Queue (m)	0.4	16.6	21.8	3.0	12.6	69.7	61.2	19.6	3.3	5.9	11.7
95th Queue (m)	3.5	28.9	41.0	12.1	25.8	284.7	93.4	33.6	8.8	14.9	23.4
Link Distance (m)		795.9	795.9			817.8	817.8	57.0	57.0	337.2	337.2
Upstream Blk Time (%)						0					
Queuing Penalty (veh)						0					
Storage Bay Dist (m)	130.0			110.0	130.0						
Storage Blk Time (%)							0				
Queuing Penalty (veh)							0				

Intersection: 1: Highway 15 & 125 Street, Interval #2

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	T	R	LT	TR	LT	R
Maximum Queue (m)	7.8	37.9	43.2	15.9	31.4	390.4	114.4	8.2	59.6	20.1	34.6	53.7
Average Queue (m)	1.2	19.6	24.6	4.2	16.8	91.3	77.2	1.1	50.4	8.7	16.6	26.5
95th Queue (m)	6.4	35.1	41.2	13.9	31.9	317.7	112.0	5.6	70.7	17.7	33.3	48.3
Link Distance (m)		795.9	795.9			817.8	817.8		57.0	57.0	337.2	337.2
Upstream Blk Time (%)						0			14			
Queuing Penalty (veh)						0			35			
Storage Bay Dist (m)	130.0			110.0	130.0			110.0				
Storage Blk Time (%)							1					
Queuing Penalty (veh)							0					

Intersection: 1: Highway 15 & 125 Street, Interval #3

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	T	LT	TR	LT	R
Maximum Queue (m)	1.5	25.7	35.1	14.0	21.6	228.6	233.9	50.6	12.4	18.2	21.9
Average Queue (m)	0.2	13.3	20.4	4.3	9.9	81.8	72.7	21.3	4.6	7.5	9.8
95th Queue (m)	1.9	24.1	34.5	13.8	23.6	332.6	251.2	44.7	11.6	17.4	21.0
Link Distance (m)		795.9	795.9			817.8	817.8	57.0	57.0	337.2	337.2
Upstream Blk Time (%)						0	0	1			
Queuing Penalty (veh)						0	0	1			
Storage Bay Dist (m)	130.0			110.0	130.0						
Storage Blk Time (%)							0				
Queuing Penalty (veh)							0				

Queuing and Blocking Report
2014 Total Traffic Conditions

Fort Sask NE Industrial
2014 Total Traffic Conditions - PM Peak Hour

Intersection: 1: Highway 15 & 125 Street, All Intervals

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	T	R	LT	TR	LT	R
Maximum Queue (m)	9.5	37.9	45.7	17.0	38.4	536.6	260.2	8.2	59.6	20.1	34.6	53.7
Average Queue (m)	0.7	16.7	22.5	4.0	13.4	82.8	71.8	0.4	32.9	6.0	10.9	17.2
95th Queue (m)	4.6	30.7	39.2	13.5	28.4	315.7	180.6	3.5	64.4	14.5	26.2	38.2
Link Distance (m)		795.9	795.9			817.8	817.8		57.0	57.0	337.2	337.2
Upstream Blk Time (%)						0	0		6			
Queuing Penalty (veh)						0	0		14			
Storage Bay Dist (m)	130.0			110.0	130.0			110.0				
Storage Blk Time (%)							0					
Queuing Penalty (veh)							0					



APPENDIX H

Josephburg Road North Industrial Stormwater Management Concept





Josephburg Road North Industrial Stormwater Management Concept

Final Report
October, 2011



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CORPORATE AUTHORIZATION

This document entitled **"Josephburg Road North Industrial Area Stormwater Management Concept"** was prepared by Sameng Inc. for the account of Trans America Group. The material in it reflects Sameng's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such parties. Sameng Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



PROFESSIONAL SEAL



COMPANY PERMIT

1.0 Introduction

1.1 Introduction

Trans America Group retained Sameng Inc. (Sameng) to review potential storm discharge options for the Josephburg Road North Industrial area, northeast of the Alsten Lands (Fort industrial Estates) [See Drawing A-1] development in Fort Saskatchewan. The existing servicing concept was found to be unfeasible for this area, so alternative servicing concepts were sought. The purpose of this review is to identify an appropriate servicing strategy that will cost less than the current concept.

1.2 Past Studies

The following is a brief history of the stormwater management challenges encountered within this development and some of the concepts that have been proposed to mitigate these issues.

1.2.1 North Josephburg Drainage Project (1985-1997)

In 1985 Samide Engineering (later Sameng) prepared designs for a drainage project along Josephburg Road. This project utilized a man-made drainage route that had been in place since 1905. The old channel had been used to redirect a portion of Josephburg Stream and allow the cultivation of adjacent lands. A bypass weir was constructed as part of the project that would allow overflow to discharge along the original path of Josephburg Stream.

In 1997, Samide Engineering investigated a flooding problem on Bartel's Land at Section 34-54-22W4, south of Josephburg Road. It was recommended that the culvert sizes along the drainage project be increased to reduce backwater effects in the channel.

1.2.2 Conceptual Servicing Study (2006)

A conceptual servicing study for the undeveloped land was completed by Stantec in June 2006¹. The concept study developed a stormwater management plan for the Josephburg Road North Industrial Area as well as for the Fort Industrial Estates to the southwest. A number of conceptual stormwater management facilities (SWMF) were proposed to accommodate drainage from both areas which were to be discharged to Ross Creek via a new storm trunk. The proposed outlet was to be located within the vicinity of an existing trunk outlet. It was noted in the study that further investigation would be required to determine if the existing outlet would be able to be used for the subject property. Drawing A-3 illustrates this concept.

¹ City of Fort Saskatchewan – Conceptual Servicing Study. Stantec. June 2006.

1.2.3 Hydrotechnical Analysis Josephburg Ditch (2008)

Northwest Hydraulic Consultants (NHC) was retained by Durrance Projects to conduct a hydrotechnical assessment of Josephburg Ditch at Fort Saskatchewan in 2008². The purpose of this study was to determine the effect of draining a small portion of Alsten Lands directly into the ditch. The study provided 100-year flood levels along the channel and found that the discharging additional runoff into Josephburg Ditch would have little impact on the ditch and adjacent lands. It was recommended that the size of several culverts be increased to improve the performance of the ditch.

1.2.4 Area Structure Plan (2009)

In 2009, an Area Structure Plan (ASP) was adopted for the Josephburg Road North Industrial Area³. The plan was prepared by Stantec and referred to the above Conceptual Servicing Study. The plan outlined the policies for utility servicing and land use. The plan also includes general transportation and utility networks. These networks were used in this study as a guideline for identifying potential pond locations. The ASP reiterated the use of a new storm trunk discharging into Ross Creek, but mentioned the possibility of utilizing the existing outfall.

1.2.5 Fort Industrial Estates Stormwater Management Plan (2010)

From 2008 to 2011, the stormwater management plan for the Fort Industrial Estates was developed and implemented. The plan includes two stormwater management facilities that utilize the existing storm trunk and outfall, instead of constructing a new trunk and outfall. The ponds were modified in the final design to include contingency for stormwater from Josephburg Road North Industrial Lands to discharge through them. A summary of this plan is provided in this report under Section 3.3.

1.2.6 NE Alsten Lands SWMP Review

In early 2011, Sameng prepared a technical memo reviewing the feasibility of using the existing outfall or Josephburg ditch in the stormwater management plan for the Josephburg Road North Industrial Area, which would avoid the need for a new storm trunk and outfall. Sameng concluded that it may be possible to use a combination of the existing trunk and Josephburg ditch to provide storm servicing for the area. This review is included as Appendix B of this report.

² Alsten Lands Hydrotechnical Analysis Josephburg Ditch and Off-Site Drainage Report, NHC, February 2008.

³ City of Fort Saskatchewan Bylaw C13-09: Josephburg Road North Industrial Area Structure Plan, Stantec, November 2009

1.3 Concept Development

Without the construction of a new trunk and outlet, there are two possible drainage routes from the Josephburg Road North Industrial Area to Ross Creek; Josephburg Ditch and the existing storm system in the Fort Industrial Area.

The following key considerations were used to develop an appropriate concept. The concept should:

- Provide reliable drawdown times for all SWMF.
- Avoid negatively impacting the downstream stormwater management system.
- Avoid increasing peak flow rates into Ross Creek
- Improve flow conditions in Josephburg Ditch above the existing condition
- Cost less than the original concept plan

Sameng Inc. was retained by Trans-America Group to investigate the option of utilizing the existing outlet and Josephburg Ditch. This report outlines our methodology, design criteria and proposed stormwater management recommendations for the Josephburg Road North Industrial Area.

2.0 Stormwater Modeling and Assessment Methodology

To assist in the development of the stormwater management concept for the Josephburg Road North Industrial Area a computer model for the existing and proposed development was created. The model created for the development of the Fort Industrial Estates stormwater plan was also used to model the response of the existing Fort Industrial Estates stormwater system.

2.1 Runoff Parameters

2.1.1 Basin Parameters

Catchments for the proposed developments were delineated following the general outline proposed in the Conceptual Servicing Strategy (Drawing A.3). Alterations were made in these areas to fit the proposed development plan found in the Area Structure Plan.

The basin parameters used in the SWMM model are as follows:

- Percent Impervious: 75%
- Manning's n
 - Impervious Surface: 0.015
 - Pervious Surface: 0.25
- Detention Storage
 - Impervious Surface: 1.0 mm
 - Pervious Surface: 5.0 mm
- Ground Infiltration (Horton Equation)
 - Initial Rate: 75 mm/hr
 - Final Rate: 3 mm/hr
 - Decay Rate: 4/hr

2.1.2 Storm Events

For the purpose of this concept study, the City of Edmonton's 1:100 year 24-hour (Huff) storm distributions was adopted. Typically, the 24-hour storm is used to design storage facilities because of its relatively long duration and large rainfall volume.

For analyzing the performance of facilities with long drawdown times, extended period events were used. For these events, average intensities for long periods were extrapolated from the City of Edmonton IDF tables. This method is rarely used by planners, as long term rainfalls are unpredictable, and may consist of several smaller events that compound into a single severe event.

2.2 Stormwater Management Facility Design

Design of the SWMFs was based on the City of Fort Saskatchewan's storm drainage system design standards. These parameters were used for the sizing of the concept ponds and establishment of normal water levels. The following provides a summary of a few of the key design criteria used for the SWMFs:

- Maximum outflow of 3.0 l/s/ha.
- Pond side slopes of 5H:1V.
- A side slope of 3H:1V was used from 1 meter below the normal water level to the pond bottom.
- Minimum depth of the pond at normal water level is 2 metres.
- The lowest manhole invert directly upstream of the SWMF is at or above the normal water level.
- Minimum water surface area of the pond at normal water level is 2 hectares.

For facilities that will not be allowed to discharge during storm events, the required volume was calculated as 120mm of runoff over the catchment area. This is a common standard for conceptual design of stormwater management facilities, and allows flexibility in the final outlet design.

2.3 Josephburg Ditch Performance

The response of the Josephburg ditch to the change in flows is inferred from previous studies. In 2008, Northwest Hydraulic Consultants (NHC) prepared a report on a Hydrotechnical Analysis of the Josephburg Ditch and Off-site drainage. This report details the existing peak flows in Josephburg Ditch, and gives hydraulic profiles for different storm events.

For the purpose of this analysis, post development performance of Josephburg ditch will be interpolated from the findings of the NHC report. The goal of this concept is to avoid increasing the flood risk along the Josephburg Drainage Channel.

3.0 Existing System

3.1 Overland Drainage

The Josephburg Road North Industrial Area covers about 590 hectares of agriculturally developed land. The topography of the area, shown in Drawing A-2, is generally flat, with several trapped lows. The elevation ranges from 624.1m in the west to 631.1m in the east, an average slope of 0.3%. Most of the area (450 hectares) drains southwest towards the North Josephburg Channel, which runs along the southern boundary of the area. The remaining area (about 90 hectares) drains into an isolated low area to the northeast corner. This low area is firmly bounded by Highway 15 to the north and does not appear to have any outlet.

A view of aerial photographs of the area reveals numerous low areas throughout. The presence of these areas indicates poor overland drainage throughout the area. Studying the topographical contours of the area confirms complicated drainage patterns that extend the travel time that runoff takes to get to Josephburg Ditch.

3.2 North Josephburg Drainage Project (Ditch)

Josephburg Stream is a tributary of Ross Creek, with a drainage basin of about 22 km². In 1905, settlers bypassed a portion of the stream along Josephburg Road to provide drainage and allow cultivation of the stream floodplain, creating Josephburg Ditch.

In the late 1980's, the North Josephburg Drainage Project constructed upgrades to the stream and ditch to reduce the risk of flooding along the channel. Works included widening the channel, and providing overflow points that would minimize flooding during high runoff events. At the time of construction, and afterwards, it has been recommended that downstream culverts be upgraded to reduce backflow effects along the stream.

The historic flow rates in Josephburg Ditch and Josephburg Stream have never been measured. The hydrotechnical analysis done by NHC in 2008 presents the peak flows in Josephburg Stream and Ditch inferred from peak flows found in similar creeks in the vicinity. The 100 year flow rate where Josephburg Ditch starts was calculated to be 11.5 m³/s. At this location there is a bypass structure that will redirect about half of these flows to the south, through the original stream path.

Previous reports on the Josephburg Ditch Performance have concluded that the Ditch is subject to flooding in several areas. Peak flows from rainfall and snow melt runoff may cause frequent flooding along the channel. Upgrades have since been made to reduce the risk of damage from flooding.

The area north of the Ditch was calculated to contribute an additional 1.5m³/s. The total 100 year peak flow rate in Josephburg Ditch is calculated to be 6.82 m³/s. At this flow rate, two culverts were identified as undersized. These culverts are located downstream on the property of Sherritt International Corp.

3.3 Fort Industrial Area

The new Fort Industrial Estates stormwater management configuration is shown in Drawing A-4. The stormwater management configuration consists of 2 SWMF connected hydraulically and discharging into the existing storm trunk system. During rainfall events, stormwater is conveyed to the south pond from the center SWMF via the hydraulic connection

The center SWMF outlets through the existing 1200 mm storm sewer located on 85th Avenue. A 270 mm orifice is provided downstream of the facility to control the pond's discharge at the pre-developed rate of 3.0 l/s/ha. The south SWMF outlets through the existing 1500 mm storm sewer that is located on 84th Avenue. Discharge out of the facility is controlled at the pre-developed rate via a 230 mm orifice located in the control manhole directly downstream of the facility. Table 3-3 summarizes the ponds stormwater performance during the 1:100 24-hour event. Stage-storage curves of both proposed stormwater facilities are provided in Figures 3-3 and 3-4.

Table 3-1: Center and South SWMFs Performance – 1:100 Year 24-Hour Event

Facility	Pond Bottom (m)	Design NWL (m)	Design HWL (m)	100 Year HWL (m)	Design Dead Storage (m ³)	Design Live Storage (m ³)	Drawdown to 90% Capacity (hrs)
Center SWMF	618.20	620.20	622.97	622.65	17,990	47,500	68.8
South SWMF	617.74	619.74	622.95	622.64	32,456	73,200	105.5

Figure 3-1: Center SWMF Stage-Storage Curve

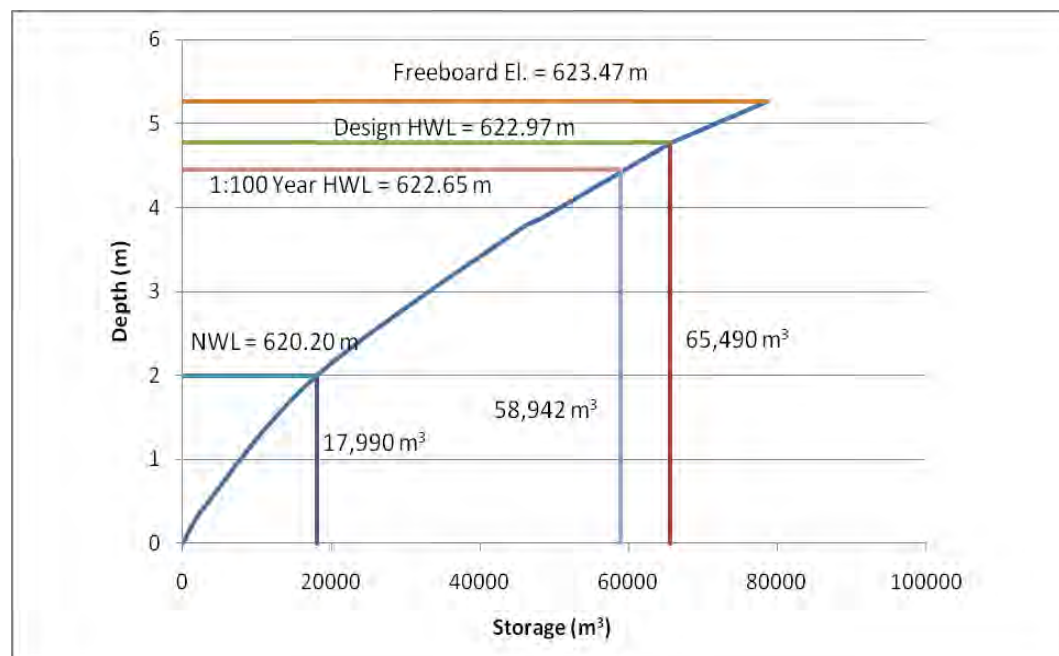
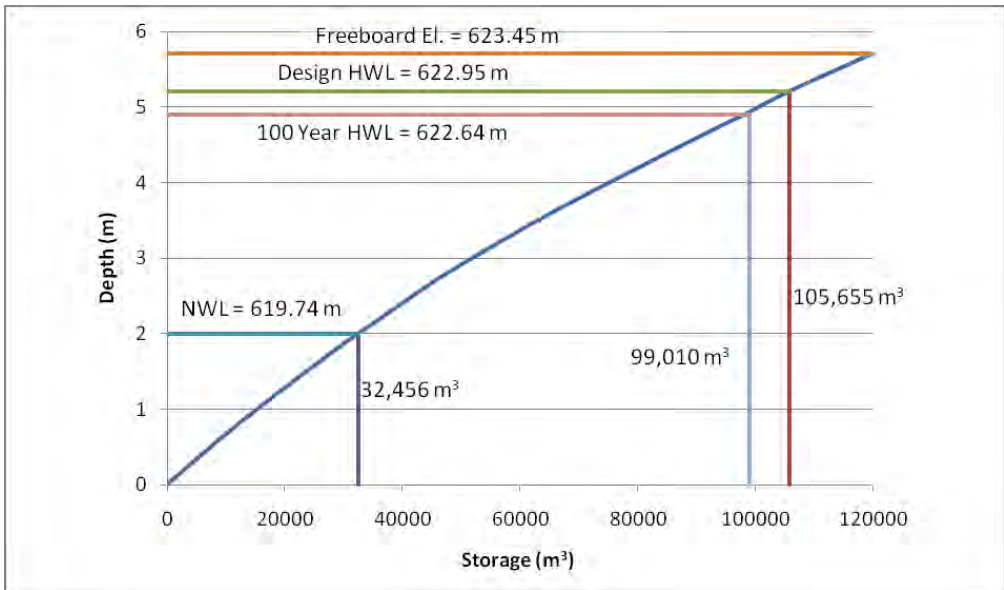


Figure 3-2: South SWMF Stage-Storage Curve



The pond hydrographs in Figures 3-5 and 3-6 show the relationship between inflow and storage during the 1:100 year 24-hour storm event. The amount of time that it takes to drawdown the facilities to 90% of their maximum live storage capacity is also indicated in the Figures. It should be noted that drawdown time is determined once the storm has passed or in this case after 24 hours.

Figure 3-3: Center SWMF Hydrograph

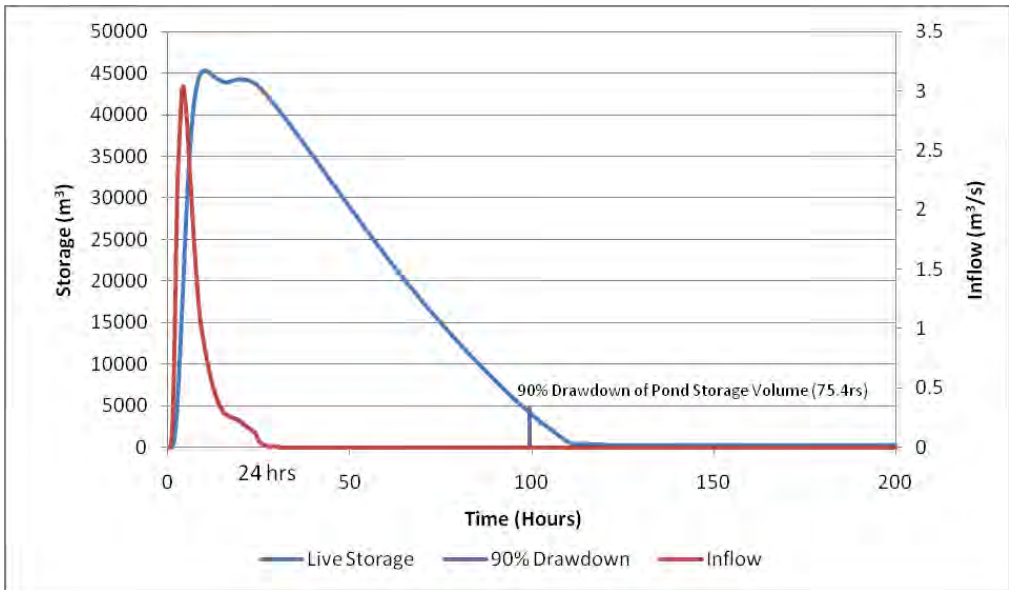
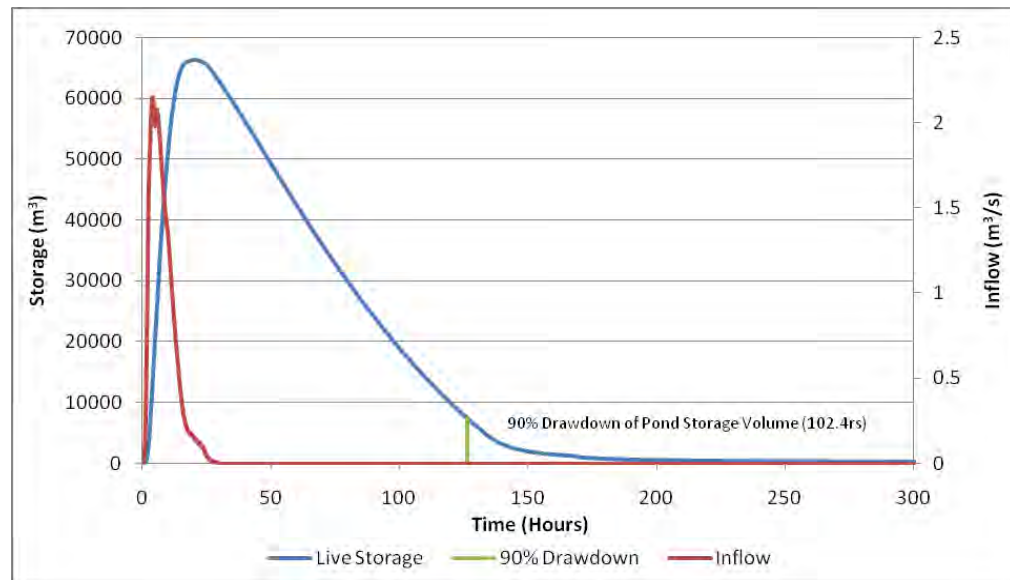


Figure 3-4: South SWMF Hydrograph



It should be noted that an additional SWMF west of these new ponds was modeled with a catchment area of 28 hectares. This area comprises the remainder of the undeveloped area west of Fort Industrial Estates. The SWMF's discharge was controlled to the 3.0 l/s/ha pre-development discharge rate and was discharged into the existing manhole DMH 14. It is not known at this time if SWMF 1A will be implemented, but it was modeled in this study to provide completeness.

3.4 Other Design Considerations

Downstream of Fort Industrial Estates, flows in the storm trunk are controlled by a Detention pond and a 525 mm diameter pipe that restricts flows to less than the pipe-full capacity of the downstream trunk.

This detention pond has a top level of 622.44m. If flows from Fort Industrial Estates controlled by orifice to 320l/s, the high water level in the downstream system is 621.55m, allowing a freeboard of 0.89m below grade. The peak discharge through the 525mm pipe is restricted to 610l/s.

A scenario was modeled that removes orifice control from the ponds in Fort Industrial Estates. It was found that without these controls, the downstream water level is increased to 621.81m. However, the peak flow through the 525mm pipe is increased to only 630l/s. Drawing A-5 illustrates the effect of orifice controls on the downstream system.

The lack of orifice control also decreases the modeled high water level in the center and south ponds. During the simulated 100-year 24 hour event, the high water level in both ponds was reduced by 0.13m. This equates total volume of about 4,000m³. The drawdown time of both ponds is also reduced. The Center Pond will discharge to 90% in approximately 48 hours, while the South Pond will discharge in about 72 hours. The effect of orifice controls on peak discharges to Ross Creek is judged to be negligible.

4.0 Proposed System

4.1 Drainage Strategy

The proposed storm water management concept shown in Drawing A-6 uses six SWMF to control runoff, generally distributed as shown in the Area Structure Plan. Some of these facilities will discharge into Josephburg Ditch, while others are conveyed into the Fort Industrial Estates storm system, through the Center SWMF. Discharge from the proposed ponds will need to be controlled to avoid impacting downstream service levels. Table 4-1 summarizes the required volumes and surface areas of each facility, as well as their proposed normal water levels.

Table 4-1: Summary of Proposed SWMFs

Facility	2B	2C	2D	2E	2F	2G
Catchment Area (ha)	125	62	175	92	105	24
Ground Elevation (m)	626.15	625	625.2	626.6	628.8	627.05
Required Storage (m ³)	91,000	75,000	210,000	67,000	126,000	17,000
Normal Water Level (m)	623.9	622.7	622.9	624.8	624.8	625.25
High Water Level (m)	625.9	624.7	624.9	626.8	627.3	626.1
NWL Area (ha)	3.9	3.3	9.8	2.2	4.5	2
HWL Area (ha)	5.1	4.4	11.2	3.2	5.6	2.8

Drawing A-7 illustrates the operational concept for this system. Ponds 2C, 2D and 2F will discharge through a storm trunk into the new storm system in the Fort Industrial Estates area. They will be sized to hold 100% of the runoff from a design storm event. The outer facilities (2B, 2E, and 2G) will be allowed to discharge into Josephburg Ditch at a rate of 3.0 l/s/ha.

The center facilities (2C, 2D & 2F) will be controlled to retain 100% runoff until the Fort Industrial Estates ponds have discharged to a safe level. This will help prevent flooding in the case of a high runoff event while the ponds are still discharging.

During runoff events, these three ponds will not discharge. When the Central SWMF in the Fort Industrial Estates has drawn down to an acceptable level, Control gates will allow the ponds to discharge at a rate of 1.5l/s/ha, for a total of 520l/s. The discharge of each pond will be proportional to size.

4.2 Josephburg Ditch

Three ponds will be allowed to discharge into Josephburg Ditch: SWMFs 2B, 2E and 2G. The area served by these ponds totals about 241 hectares. The allowable discharge into Josephburg channel will total 0.72m³/s, a reduction of 55% from the predevelopment peak runoff rate of 1.6m³/s. This will reduce the total peak flow in Josephburg Ditch by 13%, to 6.04 m³/s.

The normal water level of these ponds is below the 100-year flood level of Josephburg Channel. This may impact the performance of the ponds if the water level in the

channel rises above the water level of the ponds, preventing discharge. The impact of high water levels in the ditch was considered in the sizing of these ponds.

The high water levels of ponds 2C and 2D are below the 100-year flood levels of Josephburg Ditch. This precludes the option of allowing overflow from these ponds to the ditch. Also, flooding in the ditch has the potential of causing overflow into the ponds. Major drainage paths around these ponds should be designed to prevent ditch overflow from entering the ponds.

4.3 Fort Industrial Estates

The addition of the Josephburg Road North Industrial Area drainage flows into the Fort Industrial Estates system requires slight modifications to the system. The downstream system has internal restrictions that limit the total maximum outflow to $0.6\text{m}^3/\text{s}$. The maximum discharge rate that can be consistently maintained through Fort Industrial Estates is $0.52\text{m}^3/\text{s}$.

4.3.1 Control Measures

A water level sensor will be added to the Center SWMF in Fort industrial Estates. It is proposed that Ponds 2C, 2D, & 2F not be allowed to discharge while the center SWMF is above 621.2m. Below this point, the ponds have sufficient available storage for the 100-year 24-hour storm event.

After a storm event, control gates will prevent discharge from SWMFs 2C, 2D, & 2F. These gates will be programmed to open when the water level in the Center SWMF in Fort Industrial Estates is below its control point (621.2m). Discharge from the ponds will be limited to a total of 510l/s . This is the natural discharge rate of the Fort Industrial Estates at the control water level. This level will be maintained for as long as the Josephburg Ponds are discharging.

4.3.2 Storm Trunk

Pond 2C will discharge into the storm trunk system in Fort Industrial Estates. The closest point of connection is storm manhole R-152, located on Josephburg Road in the NE corner of Fort industrial Estates. The linear distance from SWMF-2D to this manhole is approximately 2.3 km, with a vertical drop of about 1.3m. This equates to a possible slope of 0.06%, which is slightly less than conventional trunk slopes. A small slope may lead to performance issues over time, so steps should be taken in the design of this trunk that will address these issues. The use of design options such as larger diameters and cleanout structures will ensure that the level of service can be maintained for the life of the pipe.

4.4 Performance Analysis

The performance of the proposed system and the effect of existing infrastructure was analyzed for the 100-year, 24 hours storm event, under the following assumptions.

1. Ponds discharging to Josephburg Ditch can discharge at a rate of 3 litres per second per hectare during the storm event, and afterwards.
2. Ponds discharging through Fort Industrial Estates will not discharge during the storm event, storing 100% of runoff from the event.
3. The trunk from the Josephburg North ponds will be designed to maintain a flow rate of 510 l/s.

4.4.1 Josephburg Ditch Performance

Approximately 240 hectares are removed from the catchment area of Josephburg Ditch. This will reduce peak discharges into the channel by about 800l/s. This reduction in flow will reduce the peak flow depth in the downstream channel by about 0.14m.

The ponds discharging into Josephburg ditch will be designed to maintain a constant discharge rate of 3 l/s/ha. At this rate, each pond will discharge 90% in 60.6 hours (2.5 days) after a storm event.

The water level in Josephburg Channel may affect the performance of those ponds discharging into it. The 100-year water level in the channel is above the normal water levels of these ponds, though the high water level in the ponds will allow discharge. The worst case scenario would be a design-level event occurring in the Josephburg North area at a time when the Josephburg Channel is already at flood levels. In this case, the ponds will not be able to discharge for part of the event, decreasing the effective service level. Further analysis of Josephburg Channel would be needed to evaluate the risk of this scenario. It may be beneficial to increase these ponds to hold a greater percentage of the design event runoff.

In the event of the design high water level in the ponds being exceeded, the ponds will overflow into Josephburg Channel. Pond 2B can overflow at a rate of up to 1.2 m³/s without increasing the risk of flooding along the Josephburg channel.

4.4.2 Fort Industrial Estates

To protect Fort Industrial Estates, discharge from Josephburg Road North Industrial will not be allowed during storm events. Control gates on the Josephburg ponds will prevent discharge until the water level in the Center Fort Industrial Estates Pond has dropped below 621.2m. At this time, the ponds will discharge at a rate of 1.5l/s/ha, or a total of 510l/s.

At a discharge rate of 510l/s, the ponds in Fort Industrial estates will maintain a level of 621.2m. At this level, a design 100-year, 24-hour storm event will fill the

ponds to their design high water levels.

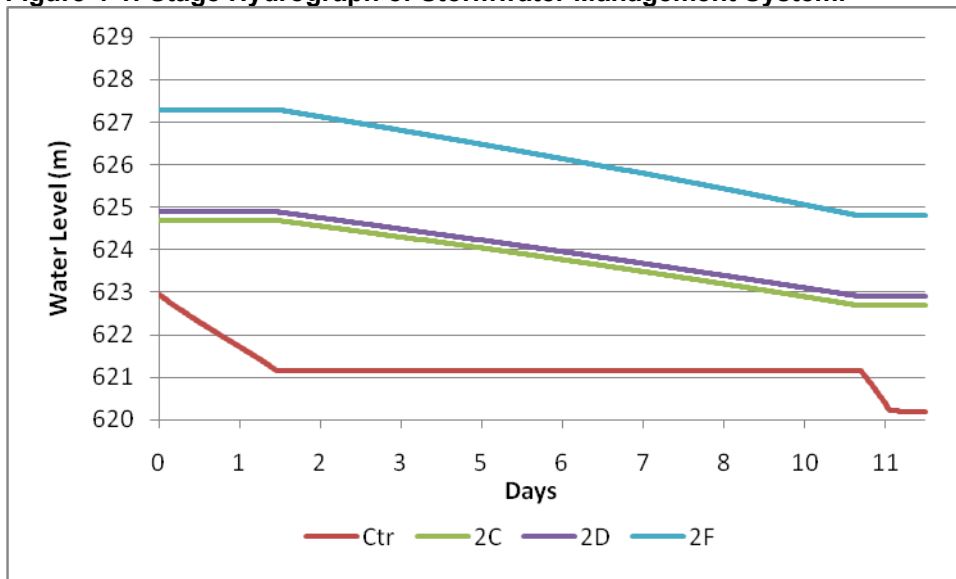
The peak hydraulic grade line in the downstream storm system is unchanged from the pre-development condition. However, the downstream system will maintain a water level of 620.2m for the duration of the drawdown of Josephburg North. This sustained water level will not affect the service level of the downstream system.

4.4.3 Discharge Times

A scenario was developed in which all ponds in both Fort Industrial Estates and Josephburg Road North Industrial start at high water level. All control gates start in the closed position. The ponds are allowed to drain to normal water level.

The drawdown of ponds 2C, 2D and 2F, as well as the Center SWMF of Fort Industrial Estates is illustrated in Figure 4-1. As seen in the drawing, the Fort Industrial estates SWMFs will drain the control level in 1.5 days, after which the North Josephburg ponds will be allowed to discharge at a combined rate of 510l/s. All ponds will be back to normal water levels after a total of 11 days post storm.

Figure 4-1: Stage Hydrograph of Stormwater Management System.



The extended period in which the ponds are maintained at a higher water level presents some risk for flooding from subsequent storm events. An analysis was done to determine whether the 120mm storage criterion for these ponds was sufficient for the extended drawdown time in these ponds. .

The level of protection offered by the ponds during the retention time can be calculated by extrapolating rainfall volumes from the standard IDF tables. For the Josephburg ponds, the critical time was found to be 100 hours (4.2 days). For a 100-year event of this duration, the ponds will store 133mm of runoff. This volume can be stored in the freeboard range of the ponds, or the size of the ponds can be increased by 11% to account for the increased volume.

4.4.4 Additional Options

Additional upgrades to the system may increase performance and decrease costs. The following options should be considered as further work is done to develop the system.

- Upgrading the 525 mm diameter pipe downstream of Fort Industrial Estates will increase the maximum discharge rate for all upstream ponds. This will decrease both the required storage volumes and discharge times.
- Intelligent lake level controls will allow greater flexibility in the discharge control in the lakes. The ability to vary the discharge rate from each pond will make it possible to balance the level of protection of each lake.
- Building SWMF 2D as a wetland may provide additional storage, as well habitat for plants and wildlife. This may also allow a portion of the land to be designated as Municipal or Environmental Reserve and qualify as wetland compensation.
- The pond layouts presented in this report are conceptual and larger than typical SWMFs. Large ponds (lakes) use less area per storage volume than multiple ponds, but carry large construction costs. Detailed stormwater management plans should maintain the recommended storage volumes, but this can be divided into smaller facilities as appropriate for development.

5.0 Cost Estimates

The cost of the proposed system is compared to the Conceptual Servicing Strategy report. In that report, the construction cost estimate for the ponds and trunk network of the area was estimated at \$18.6 million in 2006 dollars. Using updated unit rates on the same system, this estimate is revised to be \$42 million in 2011 dollars. A 15% engineering surcharge and a 30% contingency is added to the construction cost estimate.

The largest cost of the system is the construction of the Storm Water Management Facilities. The cost of excavating the six proposed ponds is estimated to be \$21.3 million. Table 5-1 summarizes the construction cost estimates for each facility.

Table 5-1: SWMF Construction Estimates

SWMF	Excavation (m ³)	Cost
1B	160,000	\$ 5,249,000
1C	120,000	\$ 3,973,000
1D	320,000	\$ 10,353,000
1E	100,000	\$ 3,335,000
1F	190,000	\$ 6,206,000
1G	50,000	\$ 1,740,000
Total	940,000	\$ 30,856,000

The trunk cost estimates includes all outlets, control structures, and mechanical components. Table 5-2 summarizes the trunk estimates for this concept.

Table 5-2: Trunk Construction Estimates

U/S	D/S	Length (m)	Cost
1B	Josephburg Ditch	400	\$ 362,500
1C	Fort Industrial Estates	1600	\$ 725,000
1D	1C Outlet	800	\$ 725,000
1E	Josephburg Ditch	100	\$ 253,750
1F	1D Outlet	1500	\$ 725,000
1G	Josephburg Ditch	100	\$ 253,750
Total		4500	\$ 3,045,000

The total cost for the trunk and ponds is summarized below.

Table 5-3: Total Cost Estimate

	This Concept	Servicing Study
SWMF	\$ 30,856,000	\$ 26,230,000
Trunk	\$ 3,045,000	\$ 15,791,000
Total	\$ 33,901,000	\$ 42,021,000

The estimated construction cost for this concept is \$8.1 million less than that of the original concept outlined in the Conceptual Servicing Study (Stantec 2006).

The concept requires a typical amount of land for Stormwater Management Facilities. Approximately 35 hectares of land will be occupied by these facilities. This is equal to about 6.6% of the gross developable area, slightly more than the minimum 6% usually required for this type of development.

Using multiple smaller ponds will avoid some large costs associated with the larger facilities, but will require more land and capital in total. Using the smallest allowable ponds, each pond will cost about \$4 million. This will increase the total cost by up to \$3 million, and require 10% more land.

6.0 Conclusions & Recommendations

6.1 Conclusions

- Approximately 40% (241 hectares) of the Josephburg Road North Industrial Area can be controlled and discharged to Josephburg Ditch and reduce the peak runoff to the ditch by 1,000 l/s. This will reduce the 100-year flood level in the channel by about 0.14m
- Storm runoff from the remainder of the Josephburg Road North Industrial Area (342 hectares) can discharge through Fort Industrial Estates at a combined rate of 520l/s.
- At this rate, the proposed storm water management facilities will discharge within 11 days following the design storm event.
- The three facilities that will discharge through Fort Industrial Estates will be controlled by real-time-control. These ponds will only discharge once the downstream facilities have discharged down to a safe level.
- A trunk will be constructed from three facilities in Josephburg Road Area North (2C, 2D, and 2F) to the storm trunk in Fort Industrial Estates. This slope of this trunk will be somewhat flat in places, but this will not hinder flows and drawdown as long as the pipe is designed, constructed and maintained with this in mind.
- Under the concept discharge strategy, the SWMFs will provide a 100-year level of service.
- The level of service in proposed SWMF 2D can be improved by over-sizing the pond by 20%, or by increasing the rates of discharge.
- The rate of discharge through Fort Industrial Estates can be increased by upgrading the downstream trunk. There is a 525mm diameter section of the trunk that currently restricts flows to about 650l/s. Replacing or twinning this pipe could increase peak discharge rates by up to 50%.
- No adverse effects on the existing system and development are anticipated as a result of the proposed Josephburg Road North Industrial stormwater connection.
- Additional investigation will be required to optimize the stormwater system. This would be done just prior to detailed design of the storm system.

6.2 Recommendations

- Oversize the trunk to Fort Industrial Estates to compensate for the relatively flat slope. Also consider including features such as cleanout structures and friction reducers to facilitate the maintenance of this long trunk.
- Confirm the alignment of the trunk early so that the appropriate utility right-of-ways can be established. This will reduce possible conflicts with future construction.
- Proceed with more detailed engineering optimization when ready for development.
- Do not install orifice control on the new ponds in Fort Industrial Estates.
- Consider upgrading the 525mm diameter pipe downstream from the PUL. Increasing the size of this pipe will decrease the drawdown times in the upstream ponds by allowing a higher discharge rate. This option would also reduce the required storage volume of the Josephburg Ponds.
- Monitor Josephburg Channel to define actual flood risks.

Appendix A – Drawings

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Legend



Ross Creek



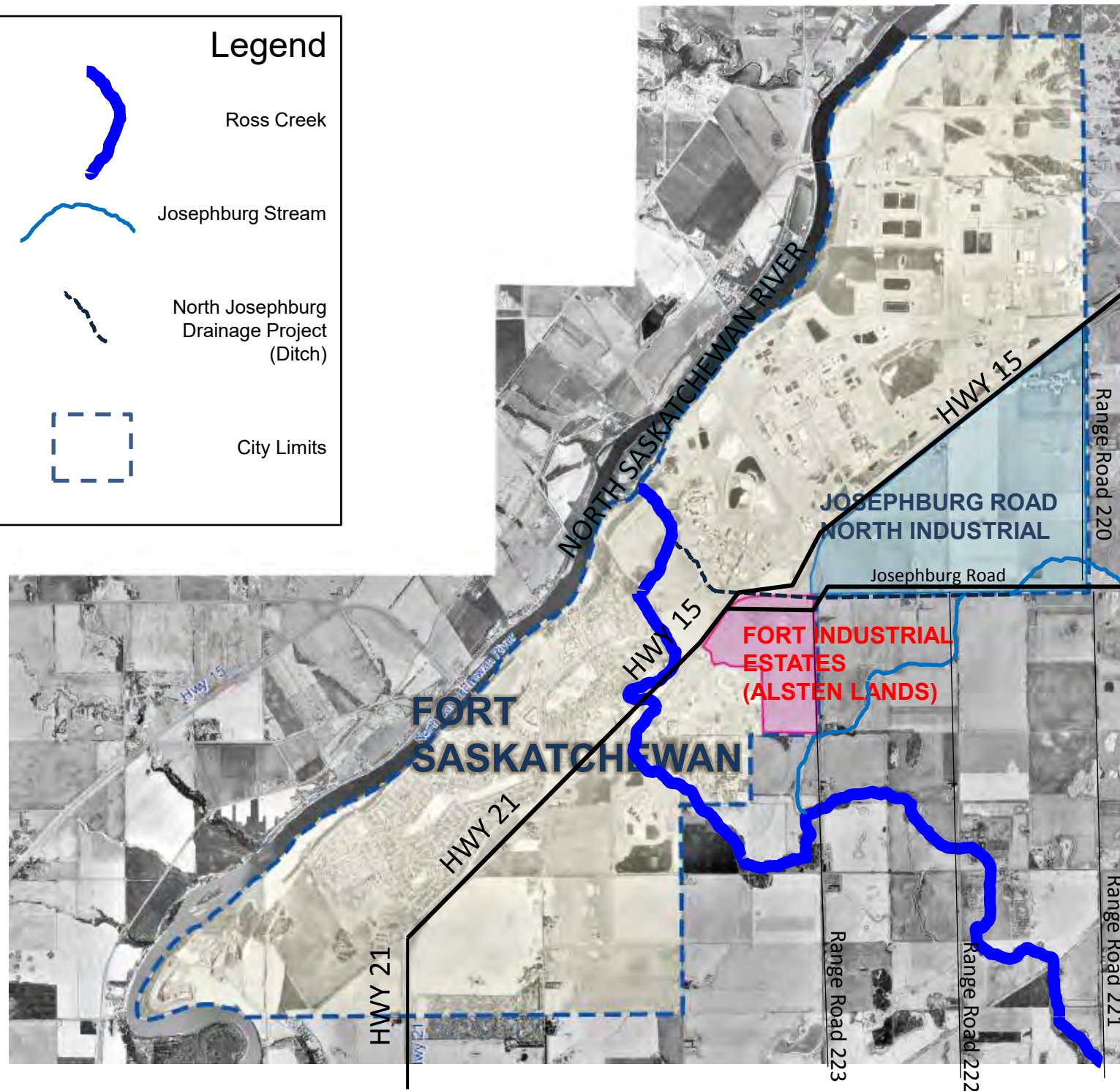
Josephburg Stream



North Josephburg
Drainage Project
(Ditch)



City Limits



PREPARED BY



1500 Baker Center, 10025-106 Street, Edmonton, Alberta, Canada T5J 1G4
Ph. 780-482-2557 * Fax 780-482-2538

CLIENT



SCALE

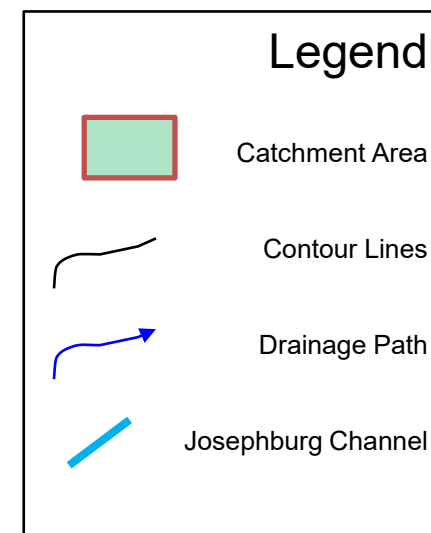
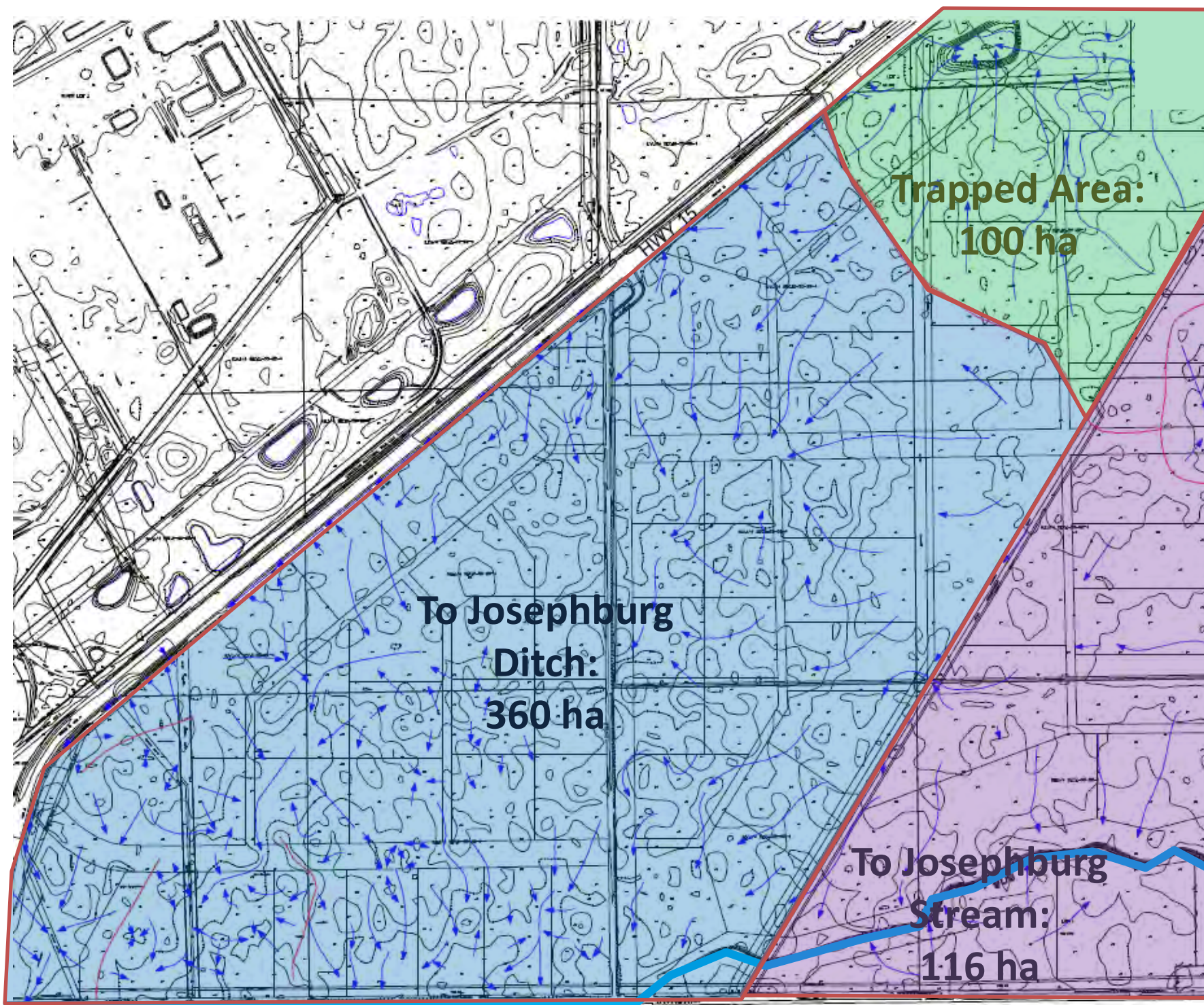
NTS

PROJECT

**JOSEPHBERG
ROAD NORTH
INDUSTRIAL
STORMWATER
MANAGEMENT**

DRAWING A.-1

LOCATION PLAN



PREPARED BY



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CLIENT



SCALE

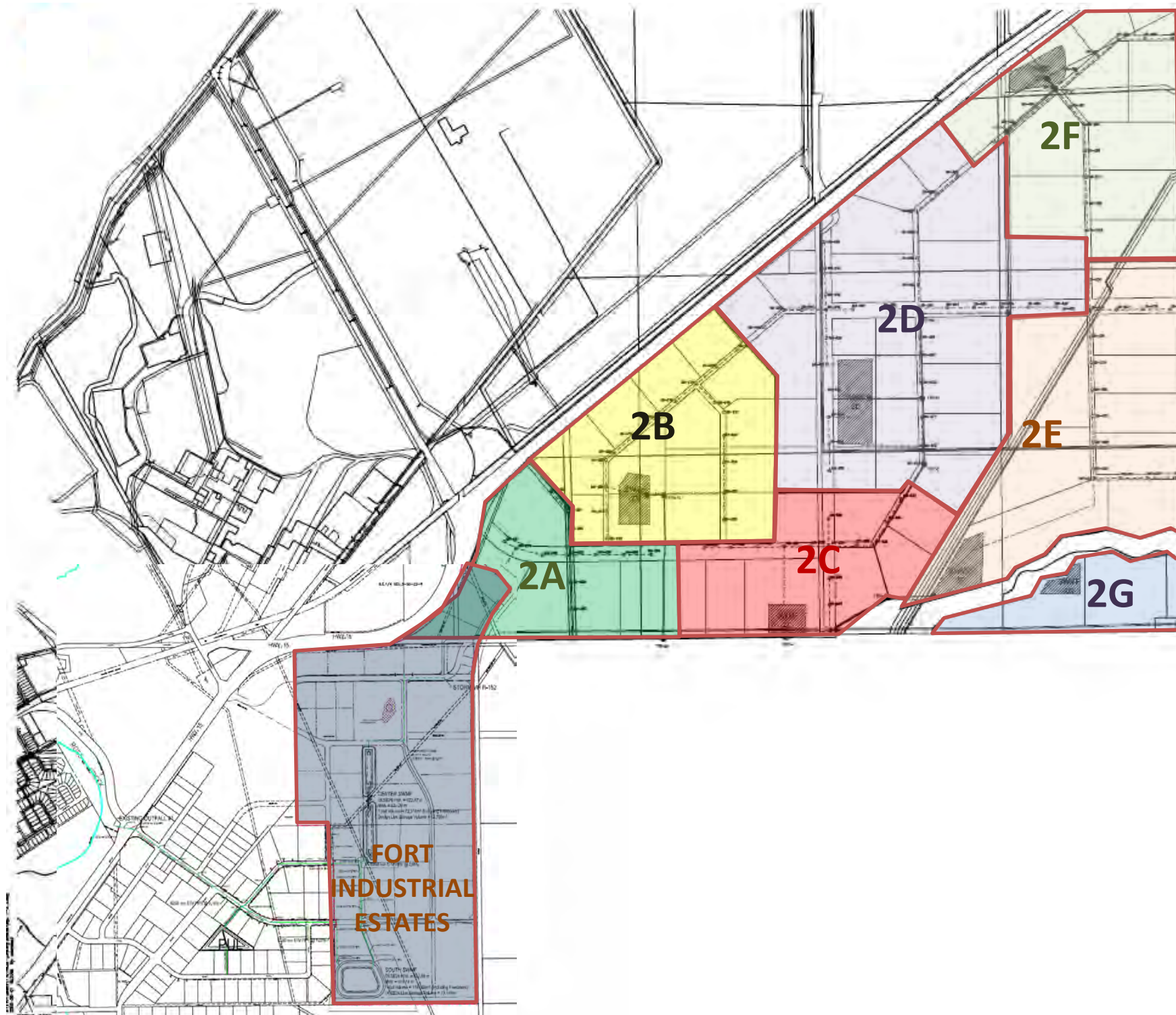
NTS

PROJECT

**JOSEPHBERG
ROAD NORTH
INDUSTRIAL
STORMWATER
MANAGEMENT**

DRAWING A-2

**EXISTING
TOPOGRAPHY
AND DRAINAGE**



PREPARED BY



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CLIENT



SCALE

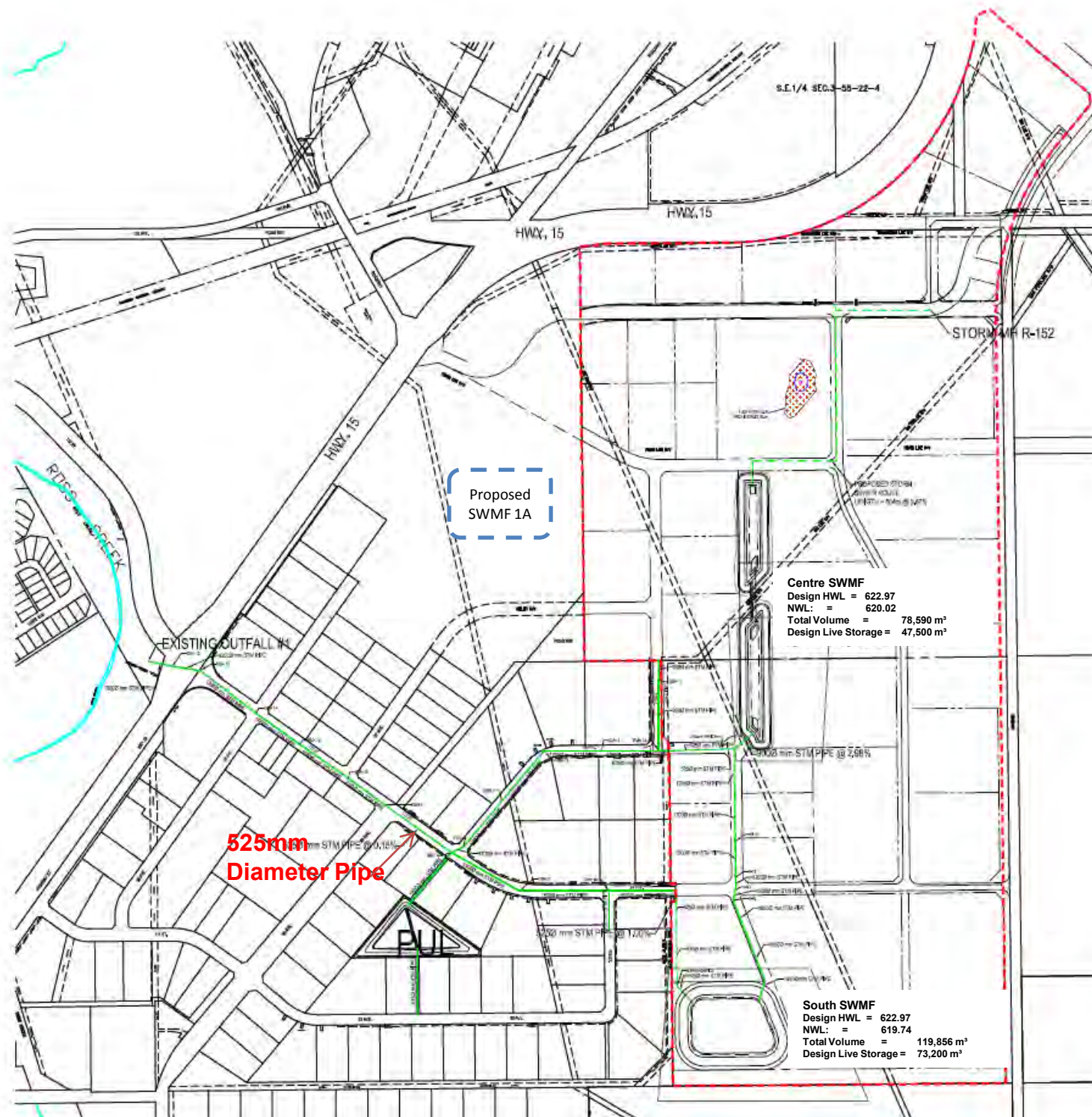
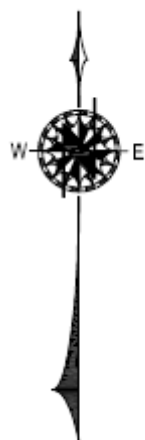
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**JOSEPHBERG
ROAD NORTH
INDUSTRIAL
STORMWATER
MANAGEMENT**

DRAWING A-3

**CATCHMENT AREAS –
STANTEC CONCEPT**



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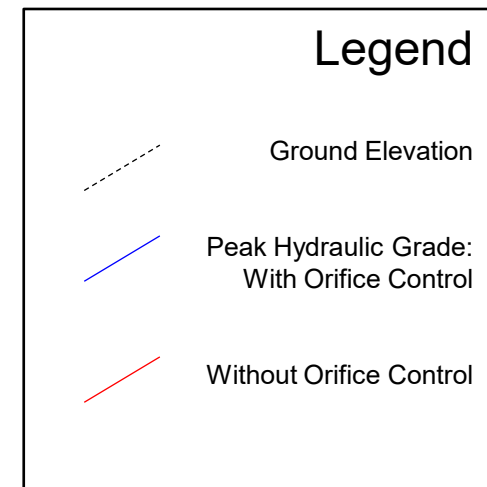
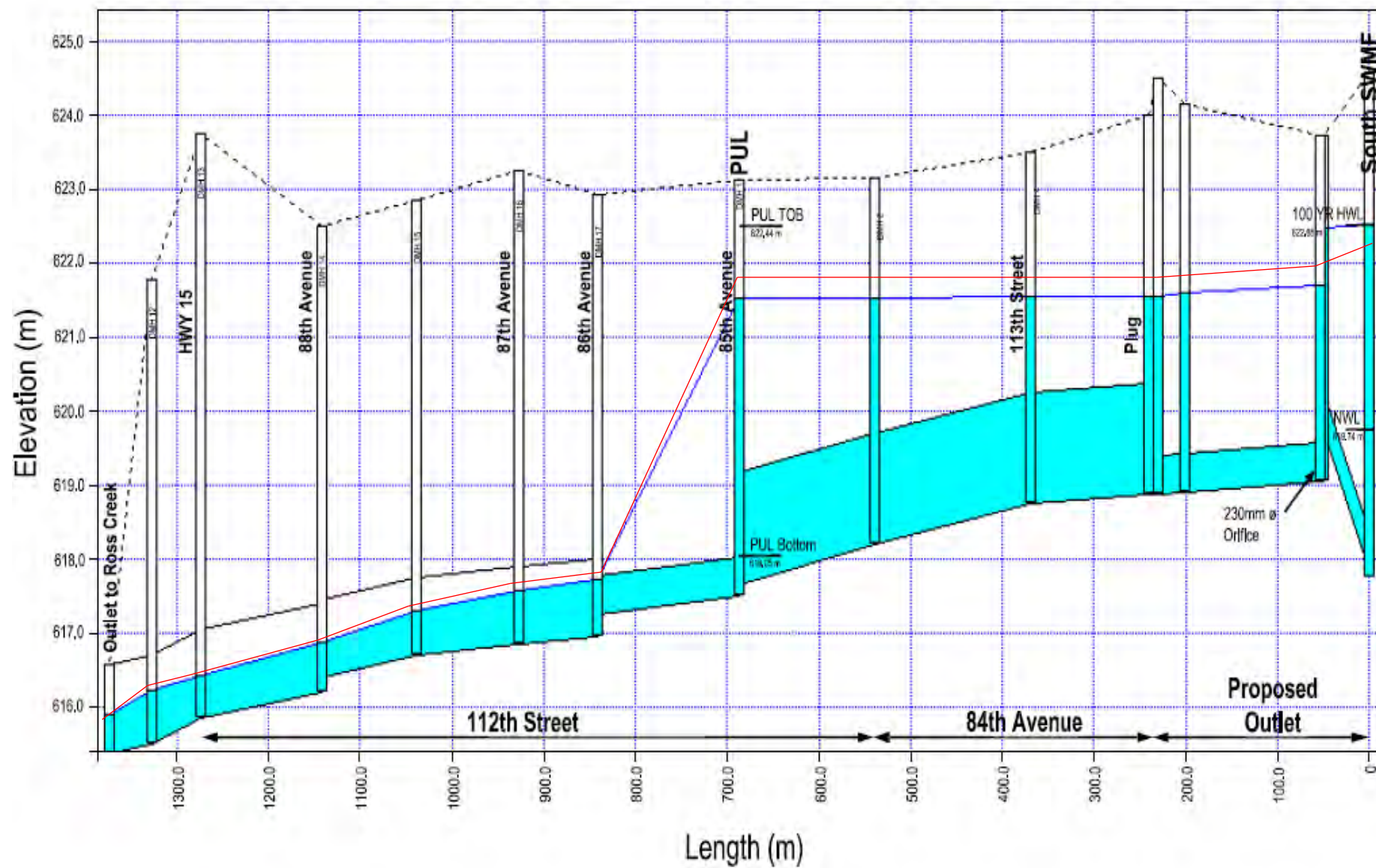
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**JOSEPHBERG
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 STORMWATER
 MANAGEMENT**

DRAWING A-4

**FORT INDUSTRIAL
 ESTATES
 STORM SYSTEM**



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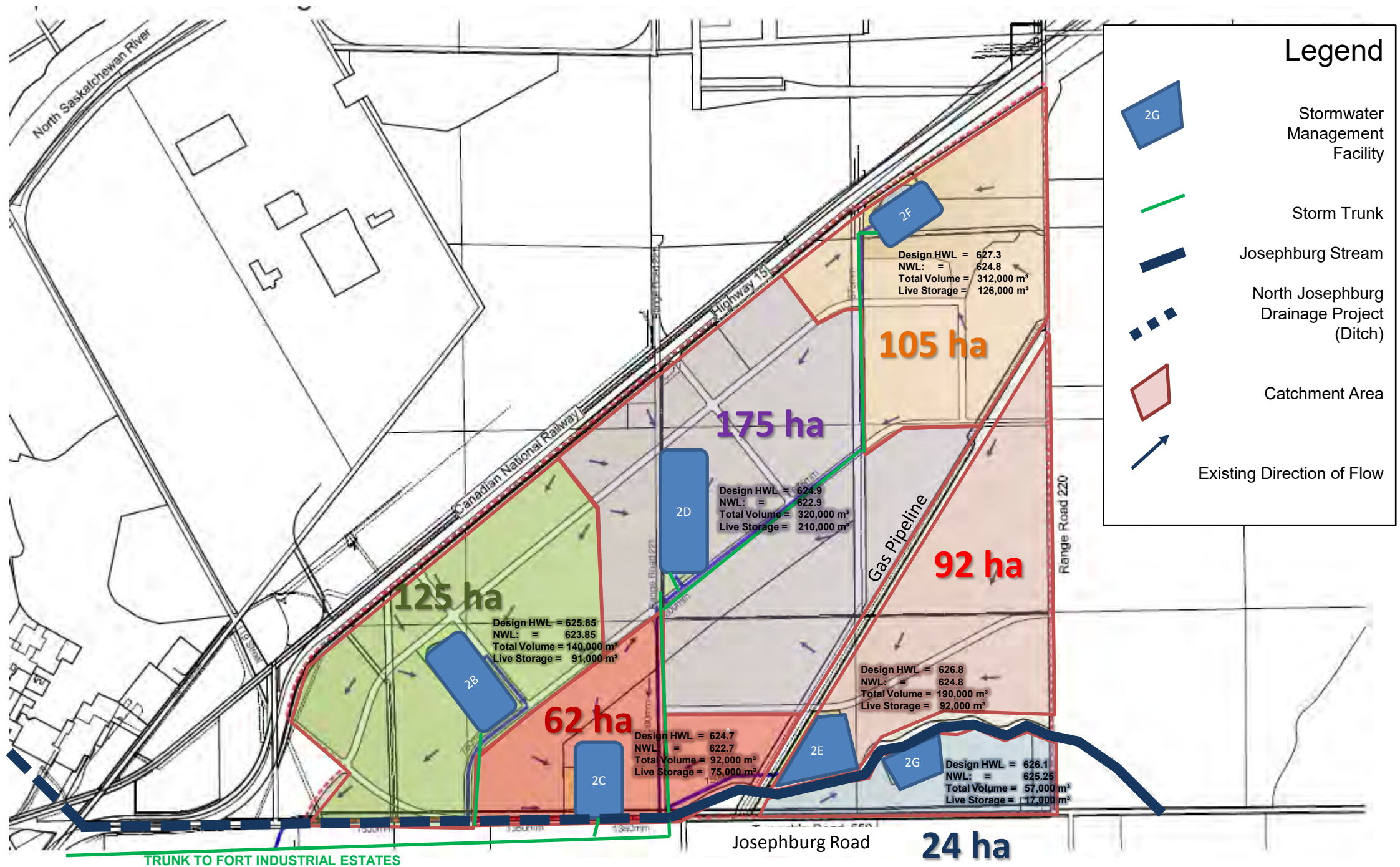
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PROJECT

**JOSEPHBERG
ROAD NORTH
INDUSTRIAL
STORMWATER
MANAGEMENT**

DRAWING A-5

**100-YEAR 24-HOUR
HYDRAULIC PROFILE
FORT INDUSTRIAL
ESTATES
SOUTH SWMF TO OUTLET**



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SCALE

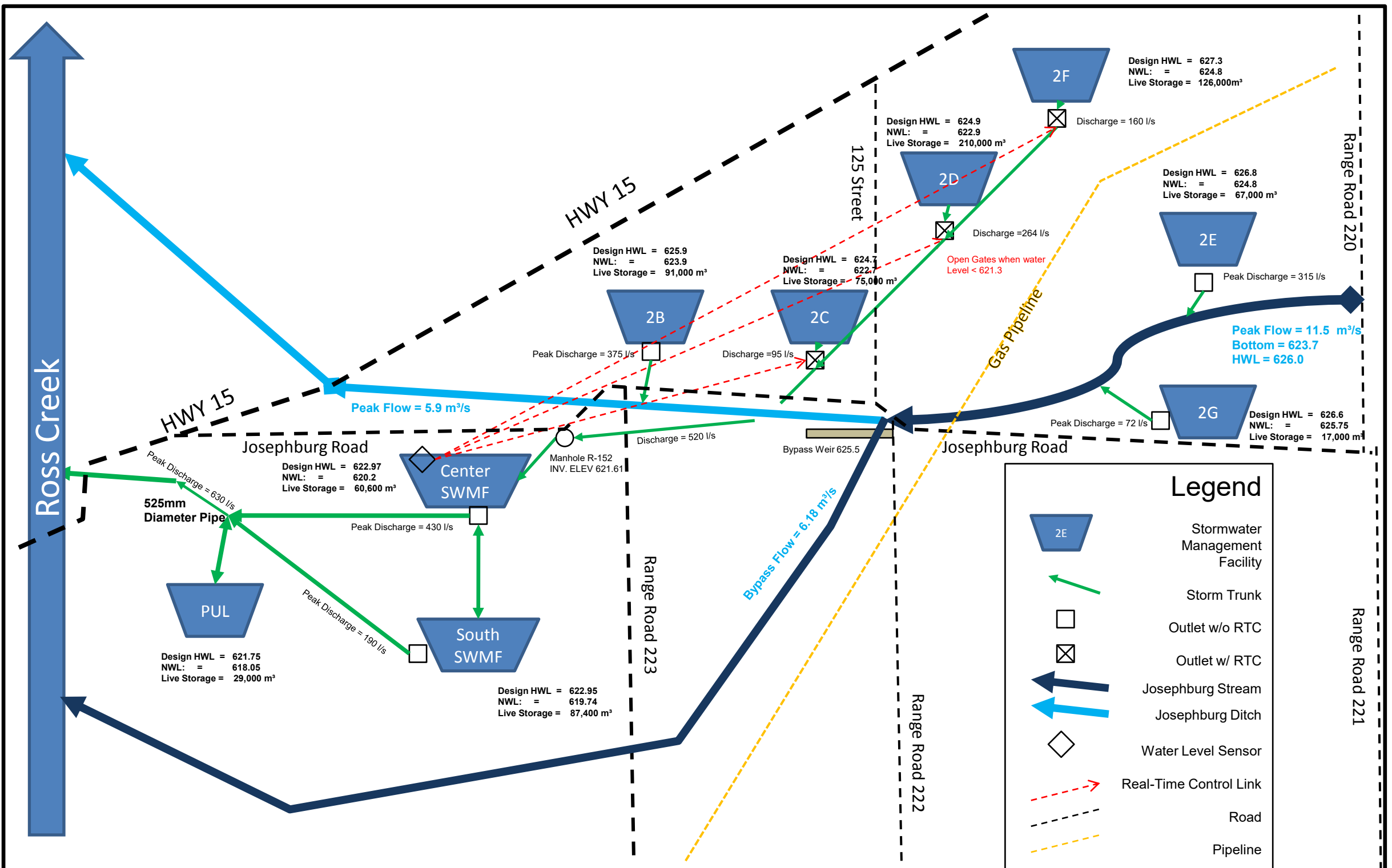
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PROJECT

**JOSEPHBERG
ROAD NORTH
INDUSTRIAL
STORMWATER
MANAGEMENT**

DRAWING A.6

**REVISED
STORMWATER
MANAGEMENT
CONCEPT**



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**JOSEPHBERG
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INDUSTRIAL
STORMWATER
MANAGEMENT**

DRAWING A.7

**STORMWATER
CONTROL CONCEPT
DIAGRAM**

Appendix B – NE Alsten Lands SWMP Review (Sameng, April 2011)

better water | better world



January 28, 2011

Our File: 1055

Bob Horton

Trans America Group
#400, 10240-124 Street
Edmonton, Alberta
T5N 3W6

Dear Mr. Horton:

Re: Northeast Alsten Lands SWMP Review

Trans America Group retained Sameng Inc. (Sameng) to review potential storm discharge options for the Josephburg Road North Industrial area, northeast of the Alsten Lands development in Fort Saskatchewan. Included is a review of previous concepts for both the Alsten Lands and the Fort Industrial drainage plan, as well as the existing drainage of these lands. The following reports were reviewed:

- Alsten Lands Outline Plan (July 2007) by Trans America Group
- Josephburg North Industrial Area Structure Plan (November 2009) by Stantec Consulting Ltd.
- Alsten Lands Hydrotechnical Analysis: Josephburg Ditch and Offsite Drainage Report (February 2008) by Northwest Hydraulic Consultants
- City of Fort Saskatchewan Conceptual Servicing Strategy (June 2006) by Stantec Consulting Ltd.
- Fort Industrial Estates Stormwater Management Concept (April 2010) by Sameng Inc.

Most of the existing lands drain through the Josephburg Ditch, a man-made drainage ditch that conveys stormwater from the area between the community of Josephburg and Ross Creek in Fort Saskatchewan. The hydrology of the undeveloped lands includes natural wetlands and sloughs that convey runoff to Josephburg Ditch.

Background Information

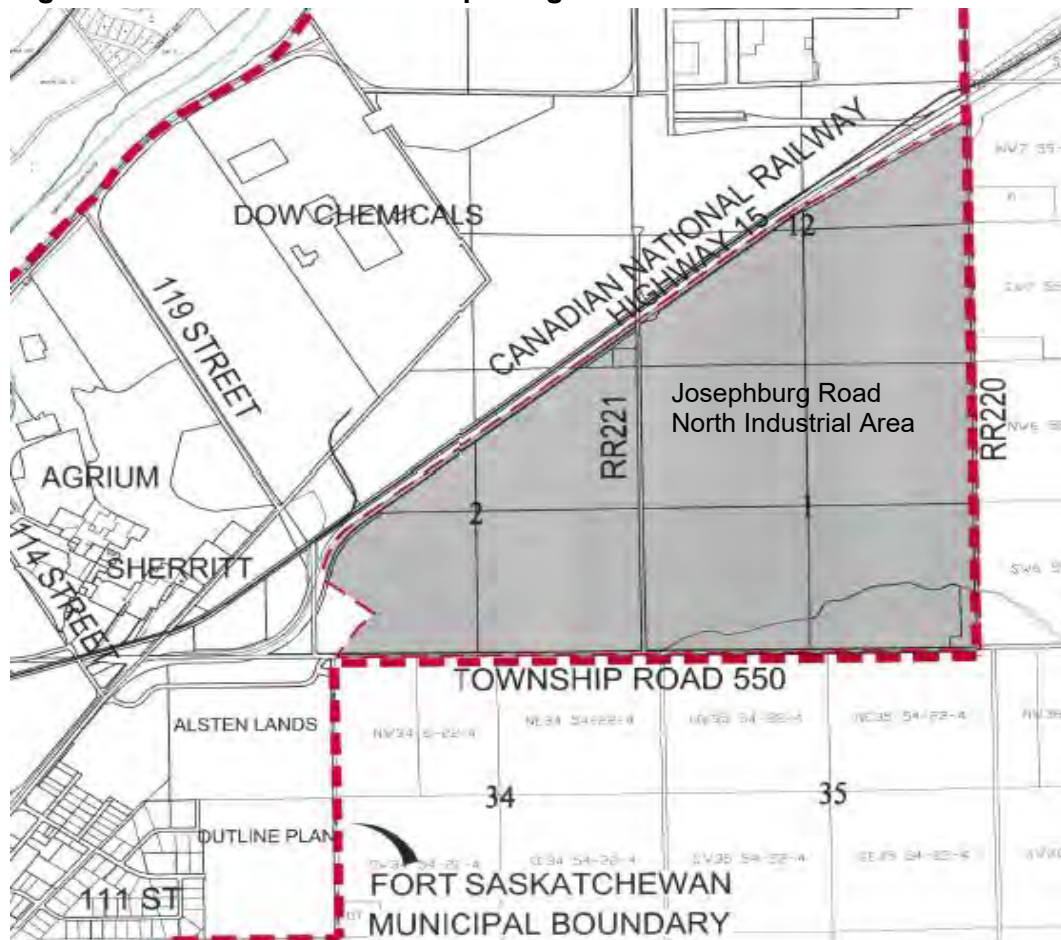
There are two principle areas of consideration in this SWMP review; the Alsten Lands Area and the Josephburg Road North Industrial Area, as shown in Figure 1. These two areas form part of the developing Fort Saskatchewan Industrial area.

The Alsten Lands area is bounded by Highway 15 and TWP Road 550 to the north, Section 34-54-22-W4 on the east, 115 Street on the west and Section NE24-54-22-W4

on the south. This area comprises about 123 hectares and is currently under development. The Josephburg Road North industrial area is located directly northeast of the Alsten Lands and is bounded by Highway 15 on the north and west, RR220 on the east, and TWP Road 550 on the south. This area covers approximately 590 hectares. A Stormwater management plan was developed for the Alsten Lands area by Sameng in 2010. This SWMP consisted of two stormwater management facilities that discharge to Ross Creek by trunk outlet.

This study involves determining the feasibility of various drainage options for the Josephburg Road North Industrial Area to assist in creating an overall SWMP. Runoff will be controlled using Stormwater Management Facilities (SWMF) throughout the area. The focus of this review is to identify feasible outlets for these facilities.

Figure 1: Alsten Lands and Josephburg Road North Industrial Area



Design Constraints

The design constraints are taken to be the same as the preceding reports. These constraints are standard for the design of stormwater management facilities in Fort Saskatchewan. Please refer to the Fort Industrial Estates Stormwater Management Concept prepared by Sameng for detailed design parameters for this area.

Concept SWMF

The Conceptual Servicing Study recommended the construction of seven (7) SWMF in the Josephburg Road North industrial Area as shown in Figure 2. Table 1 summarizes the characteristics of these ponds.

Figure 2: Conceptual Servicing Study; Proposed Sewer System Layout

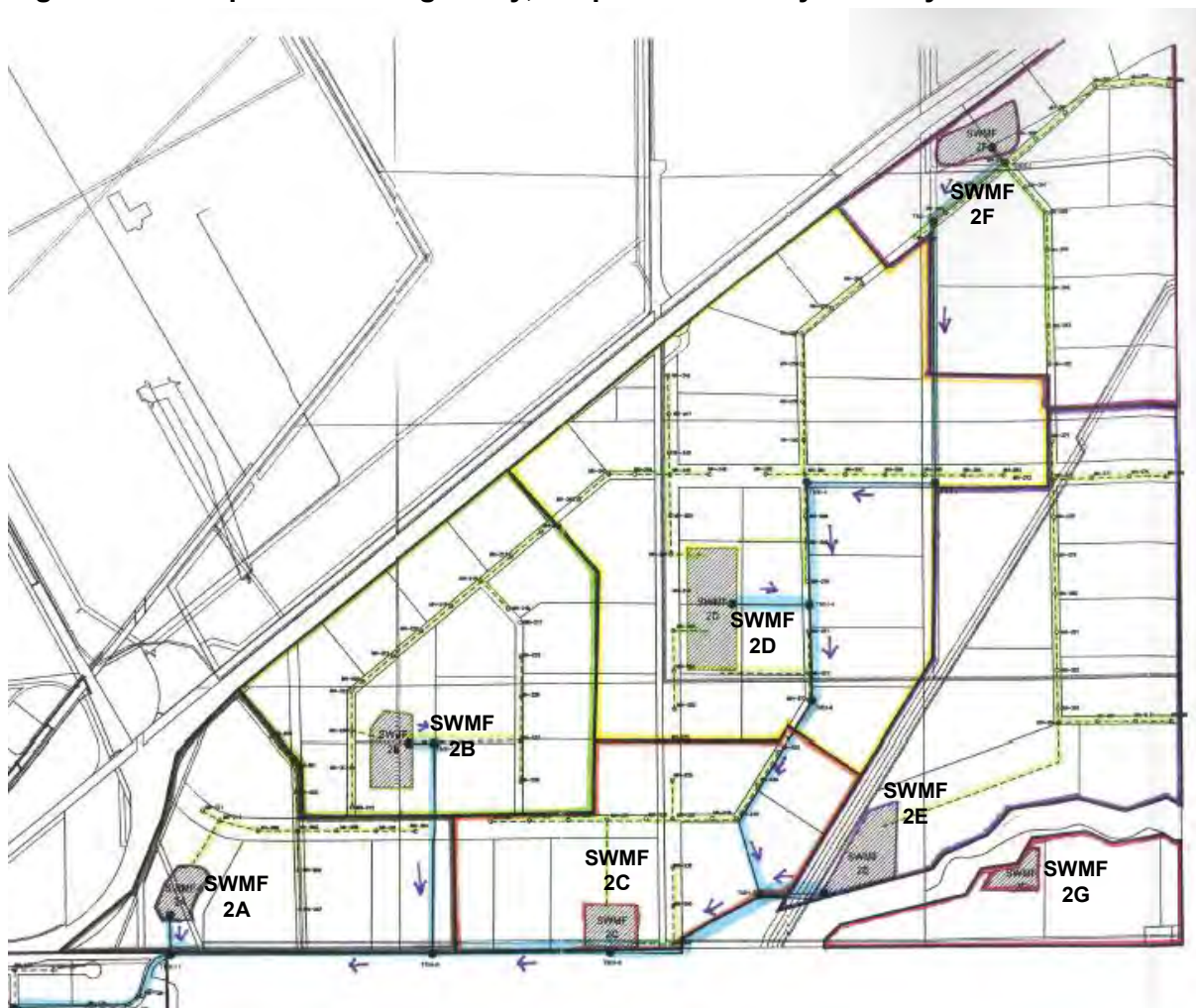


Table 1: Conceptual Pond Characteristics

Facility	2A	2B	2C	2D	2E	2F	2G
Catchment Area (ha)	53.66	85.76	61.82	174.16	105.6	92.18	23.66
Ground Elevation (m)	624.05	626.15	624.6	625.12	626.6	627.64	627.05
Required Storage	32,200	62,400	44,900	127,000	78,700	67,000	17,000
Normal Water Level	619.29	623.35	621.8	622.32	623.8	624.84	625.25
HWL Area	1.65	3.01	2.1	5.8	3.64	3.2	1.32

These ponds are required to control the runoff in this area. The required storage is taken to be appropriate for this development.

Conveyance Alternatives

Three alternatives have been reviewed for the conveyance from the proposed storm ponds.

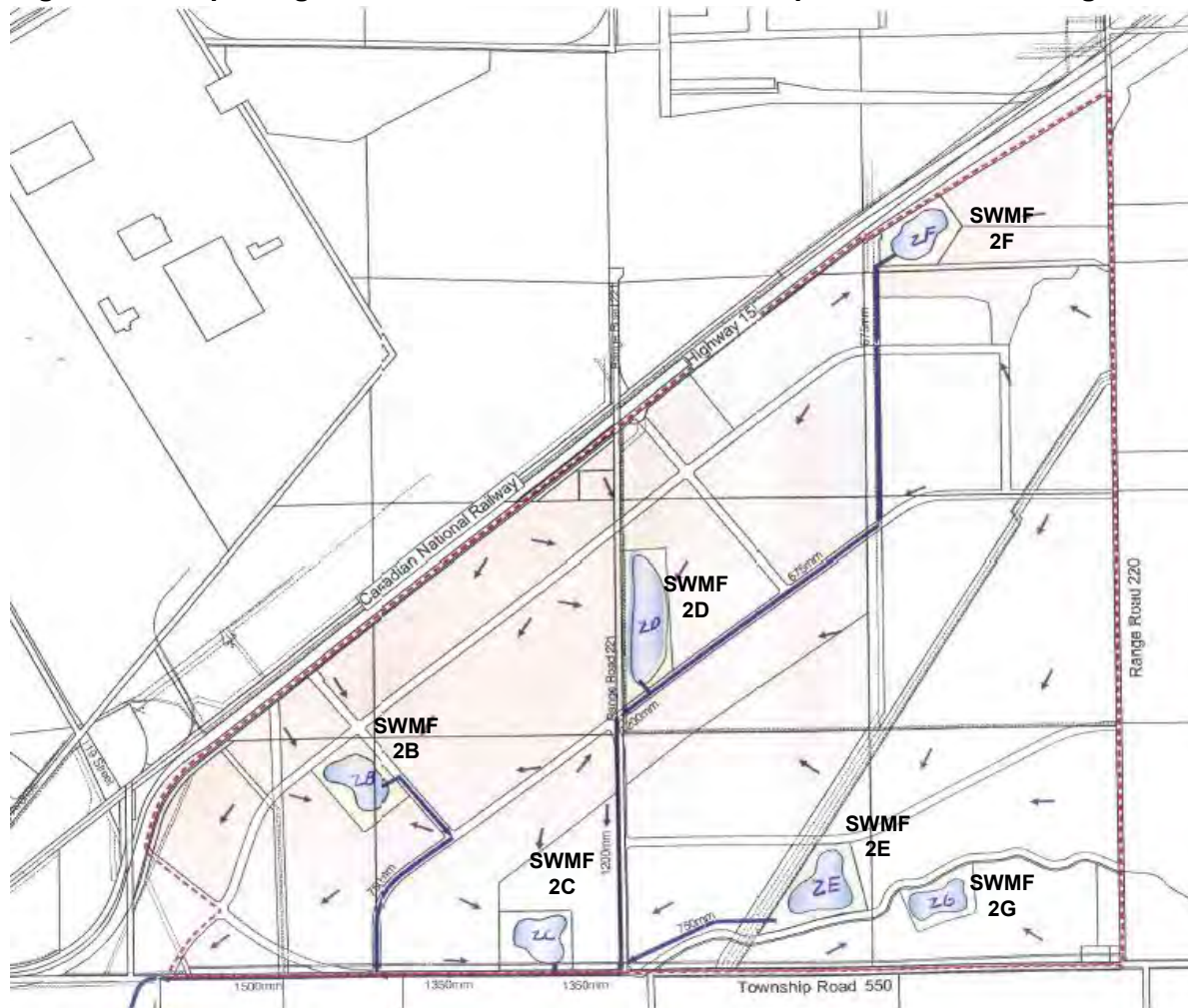
1. Drain by storm trunk through the Alsten Lands area as outlined in the Conceptual Servicing Study.
2. Drain or pump into the Josephburg Ditch.
3. Drain by series into the SWMF in the Alsten Lands development.

Drain by Storm Trunk

This alternative is outlined in the conceptual servicing study performed by Stantec. A storm trunk would be constructed from the Northeast Industrial Area to Ross Creek, through the Alsten Lands development. This trunk will be independent of the storm system for that area.

An updated concept of the storm system was presented in the Josephburg Road North Industrial Area Structure Plan, as seen in Figure 3. This concept omits SWMF 2A, however it is assumed that this facility will still be required for control of runoff in the southwest corner of the development

Figure 3: Josephburg Road North Industrial ASP; Conceptual Storm Servicing



Drain into Josephburg Ditch

The Josephburg Ditch study recommended the replacement of two culverts but otherwise found that the ditch has sufficient capacity to drain the fully developed area. However, the flat terrain of this area precludes draining the SWMF into the existing Josephburg ditch. From the concept design of the SWMF, the discharge would have to be pumped into the ditch. Alternately, the elevation of the ponds NWL could be raised and the area of the ponds increased to maintain the same level of storage.

Table 2 below summarizes the pumping elevation or the area increase that will be required to discharge into Josephburg ditch. Based on the parameters shown, a recommendation is made to either raise the normal water level (Raise), pump into Josephburg ditch (Pump), or leave as is (Leave).

Table 2: Summary of Josephburg Ditch Elevation

SWMF	2A	2B	2C	2D	2E	2F	2G
Ground Elevation (m)	624.8	626.15	624.6	625.12	626.6	627.64	627.05
Distance to Ditch (m)	100	800	0	800	0	2700	0
Normal Water Level	621.25	623.35	621.8	622.32	623.8	624.84	625.25
Drop in Invert	0.1	0.8	0	0.8	0	2.7	0
Invert at Ditch	621.15	622.55	621.8	621.52	623.8	622.14	625.25
Ditch Bottom	622.6	623.1	623.3	623.3	623.8	623.3	623.8
Required Pump Head	1.45	0.55	1.5	1.78	0	1.16	0
Concept Area (ha)	1.96	3.01	2.1	5.8	3.64	3.2	1.32
Required Area (ha)	2.7	3.8	5.3	20.1	3.6	6	1.32
Recommendation	Raise	Raise	Pump	Pump	Leave	Pump	Leave

Ponds 2E and 2G can be made to discharge to Josephburg ditch without significant modifications to the conceptual plan. Ponds 2A and 2B can have their normal water levels raised to discharge into Josephburg ditch.

Raising the normal water levels of the other ponds would require converting facility 2D into a large wetland occupying more than 20 hectares of the center of the development area. It is considered more feasible to provide a lift station to pump the discharge from these ponds into Josephburg ditch.

Drain Via Alsten Lands SWMF

The Fort Industrial Estates Stormwater Management Concept report, prepared by Sameng for Trans America Group in 2010, recommends two SWMF ponds to control runoff. The center pond is located approximately 800 meters southwest of SWMF 2A discussed above. The concept has the normal water level of this pond at 621.0 meters, which is only 0.25 meters below SWMF 2A. In order for the Josephburg lands to drain through this facility, discharge from the SWMF would have to be controlled.

Cost Estimates

To compare the relative cost of each alternative as simply as possible, only the cost of pipe and excavation were considered. A total construction cost of \$8.1 million was obtained from the conceptual servicing study and scaled to 2011 dollars for the trunk running along Josephburg ditch to the outlet. The identified alternatives may eliminate all or some of this trunk cost. Table 3 summarizes the cost of each alternative based on the difference from the conceptual servicing study.

Table 3: Alternative Cost Summary

Alternative	Drain to Josephburg Ditch	Drain to Alsten Lands SWMF
Additional Excavation (m³)	47,500	0
Trunk Eliminated (m)	4,040	1,570
Additional Costs	\$ 3,500,000	\$ -
Trunk Savings	\$ 8,800,000	\$ 4,700,000
Total Savings	\$ 5,300,000	\$ 4,700,000

Although draining to Josephburg ditch will eliminate the need to construct the proposed trunk, additional costs will be required. Modification of the proposed SWMF 2A and 2B would cost an estimated \$0.8 million. A lift station is also required for this alternative. The cost of this lift station is estimated to be \$2.7 million (including engineering and contingencies), with an operating cost of about \$12,000 per year.

Although discharging to the SWMF in Alsten lands only eliminates a portion of the proposed trunk, this alternative does not require a pumpstation.

Conclusions and Recommendations

Based on this assessment, it may be hydraulically possible to discharge from the Josephburg Road North Industrial Area to either Josephburg Ditch or the Alsten Lands system with some redesign of the system.

Some of the proposed SWMF can be made to discharge directly into Josephburg ditch while providing the same amount of storage capacity. The remaining facilities may be pumped into Josephburg ditch through a liftstation.

It is possible to route runoff from the Josephburg Road North Industrial Area into the system for Alsten Lands. This will require lowering the normal water level of both SWMF

in the southwest area, and discharging SWMF 2A into Josephburg ditch. Further analysis on the hydraulics of this alternative is required to develop a concept plan.

A cost analysis was performed to determine the benefit of these alternatives over the concept design. Discharging to Josephburg ditch will save \$8.8 million in trunk costs, but will require a lift station to drain much of the development area. The cost of this lift station is estimated at \$2.7 million plus operating costs.

Discharging to the Alsten Lands system will save \$4.7 million in trunk costs and does not require a liftstation.

Either option eliminates the need for a dedicated trunk through Alsten Lands, saving at least \$4.7 million in proposed trunk costs.

Should you have any questions or concerns, please do not hesitate to contact me at (780) 482-2557.

Sincerely,

SAMENG INC.
David Yue, P.Eng.