REGIONAL MUNICIPALITY OF WOOD BUFFALO

August 03, 2013

IBI Group
Suite 300 - 10830 Jasper Avenue
Edmonton AB T5J 2B3 Canada

Attention: Cathryn Chopko Beck RPP, MCIP, AALA, CSLA
Associate, IBI Group

Re: **Approval of Rickard Industrial Lands Outline Plan, January 2009**

Thank you for submitting the Rickard Industrial Lands Outline Plan, January 2009, Design Brief and associated technical documents. We appreciate your patience and co-operation in completing the process.

After an extensive review by internal and external agencies the Community Development Planning Branch of the Regional Municipality of Wood Buffalo accepts that the plan meets the requirements of the Highway 63 / 881 Corridor Area Structure Plan Bylaw No 07/050.

The Community Development Planning branch of the Regional Municipality of Wood Buffalo hereby approves the Rickard Industrial Lands Outline Plan dated January 2009.

Thank you,

Bradley Evanson,
Manager, Community Development
Planning & Development
Regional Municipality of Wood Buffalo

cc: Felice Mazonni, Director, Planning and Development
Wayne Macintosh, Manager, Development Services, Engineering Services
Greg Evangelatos, Manager, Comprehensive Planning
Margaretha Bloem, Supervisor, Community Development Planning
Tom Schwerdtfeger, Supervisor, Community Development Planning
Pankaj Nalavde, Supervisor, Community Development Planning

Regional Municipality of Wood Buffalo

RICKARD INDUSTRIAL LANDS OUTLINE PLAN

REVISED JANUARY 2009

IBI GROUP

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

List of Exhibits

List of Tables

1.0 INTRODUCTION

1.1 Purpose

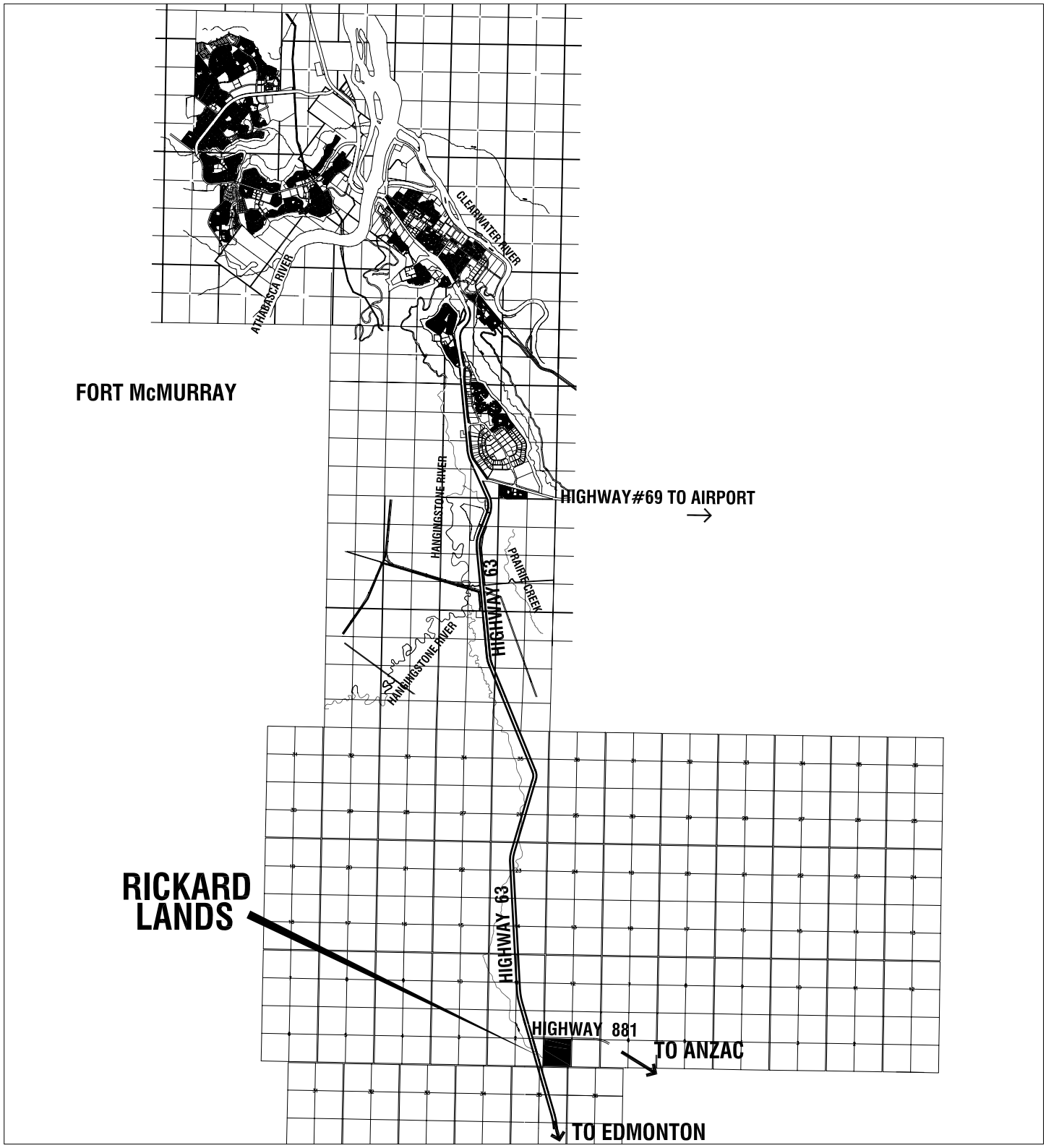
The purpose of this Outline Plan is to describe in detail a land use framework for the development of an industrial land development located within the Regional Municipality of Wood Buffalo (RMWB).

The purpose of this Outline Plan is to provide a land use and infrastructure concept for the lands that are located within the bounds of the Highway 63/881 Corridor Area Structure Plan. A location plan is included as **Exhibit 1**.

1.2 Proponent

IBI Group has prepared this Outline Plan on behalf of Mr. Donald Rickard, the owner of subject lands.

CSM Engineering has prepared the engineering and site development components of this report and has provided other key inputs into this Outline Plan.



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Location Plan

Exhibit 1

JANUARY 2009

J:\19958 Hgwy63-88ICL\5.9 Drawings\59planning\current\Outline Plan\master exhibits Nov 13.08.dwg November 17 2008 4:48pm bdibben

2.0 DEVELOPMENT CONTEXT

2.1 Location & Area

The subject lands are located approximately 14 km south of the Fort McMurray Urban Service Area boundary as shown in **Exhibit 2 – Context Plan**. The parcel of land is located east of Highway 63 and south of Secondary Highway 881. The land area totals approximately 64.4 ha.

The lands included in this Outline Plan are legally described as Lot A, Plan 7620627 located in parts of SW ¼ Section I-87-9-W4 and part of NW ¼ Section I-87-9-W4.

2.2 Land Ownership

The lands in the Outline Plan area are owned by Mr. Donald Rickard and are delineated in **Exhibit 3 – Land Ownership**.

2.3 Access

A direct vehicular access point from Secondary Highway 881 exists in the northwest corner of the site. Access to these lands is shared with the AIT Weigh Station site to the west.

2.4 Site Features

The majority of the site is presently vacant and covered with trees as shown in the air photo attached as **Exhibit 4 – Site Features**. There is an existing north access from Highway 881, with a gravel road leading to a residence with a workshop, equipment yard, and several smaller buildings, located in the west sector of Lot A Plan 762 0627.

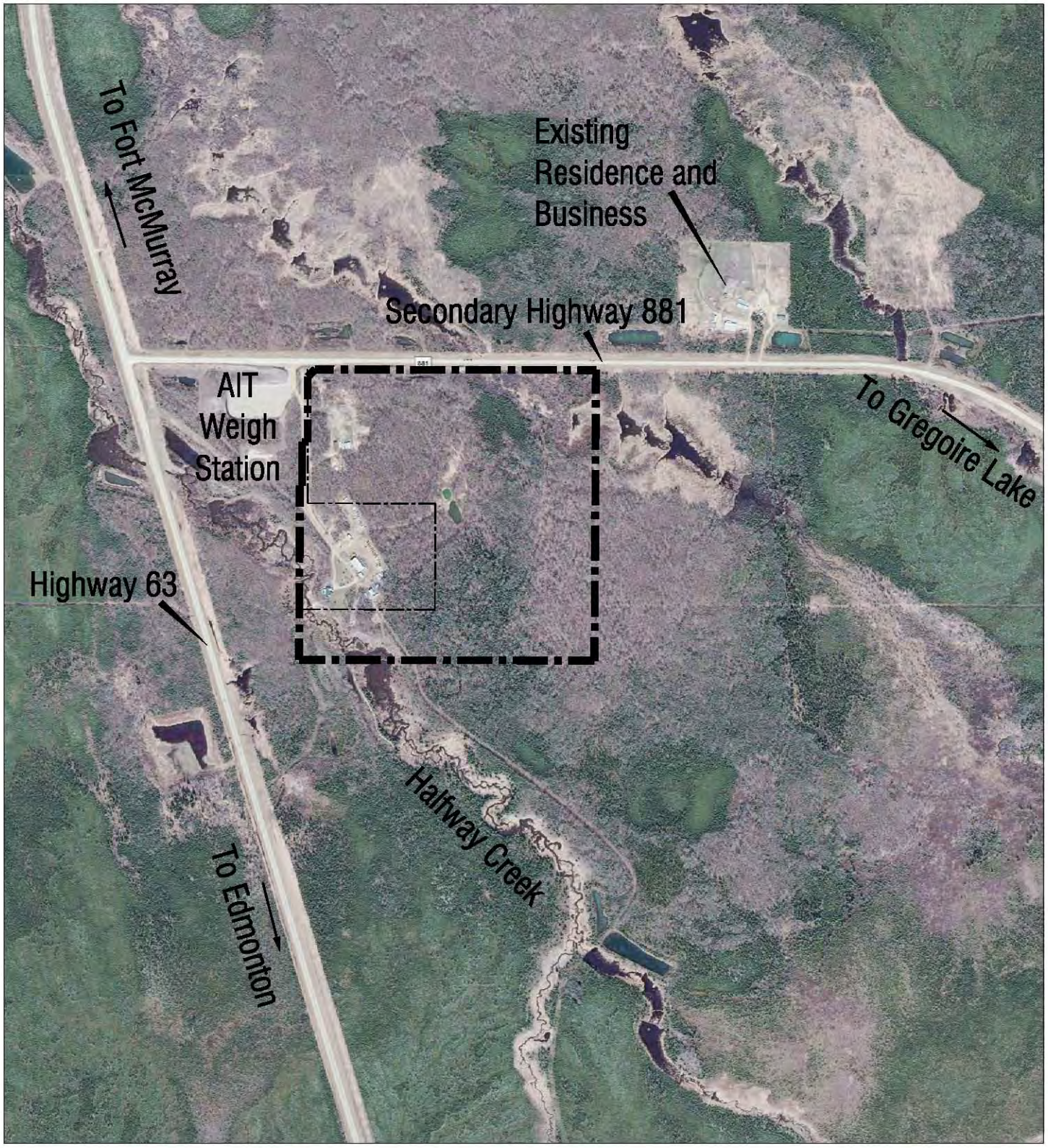
Halfway Creek runs through the southwest corner of the site with a trail following along the north side of the creek. The general topography of the site slopes to the north dropping 7.5 m over a distance of 700 m. A small pond, which is likely man-made, is located in the centre of the site. A topography plan is included as **Exhibit 5 - Contours.**

2.5 Surrounding Land Uses

The surrounding lands are mostly vacant. An Alberta Infrastructure and Transportation (AIT) weigh station is located immediately west at the corner of Highway 881 and Highway 63.

The lands located across Highway 881, directly northwest of the site, are planned for business industrial uses. These adjacent lands are presently identified as the 881/63 Crossroads Site in the Highway 63/881 Corridor Area Structure Plan.

A greenhouse is located across Highway 881 to the north and a country residential site with an associated light industrial business is located to the northeast of the Rickard Lands.



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Local Context Plan

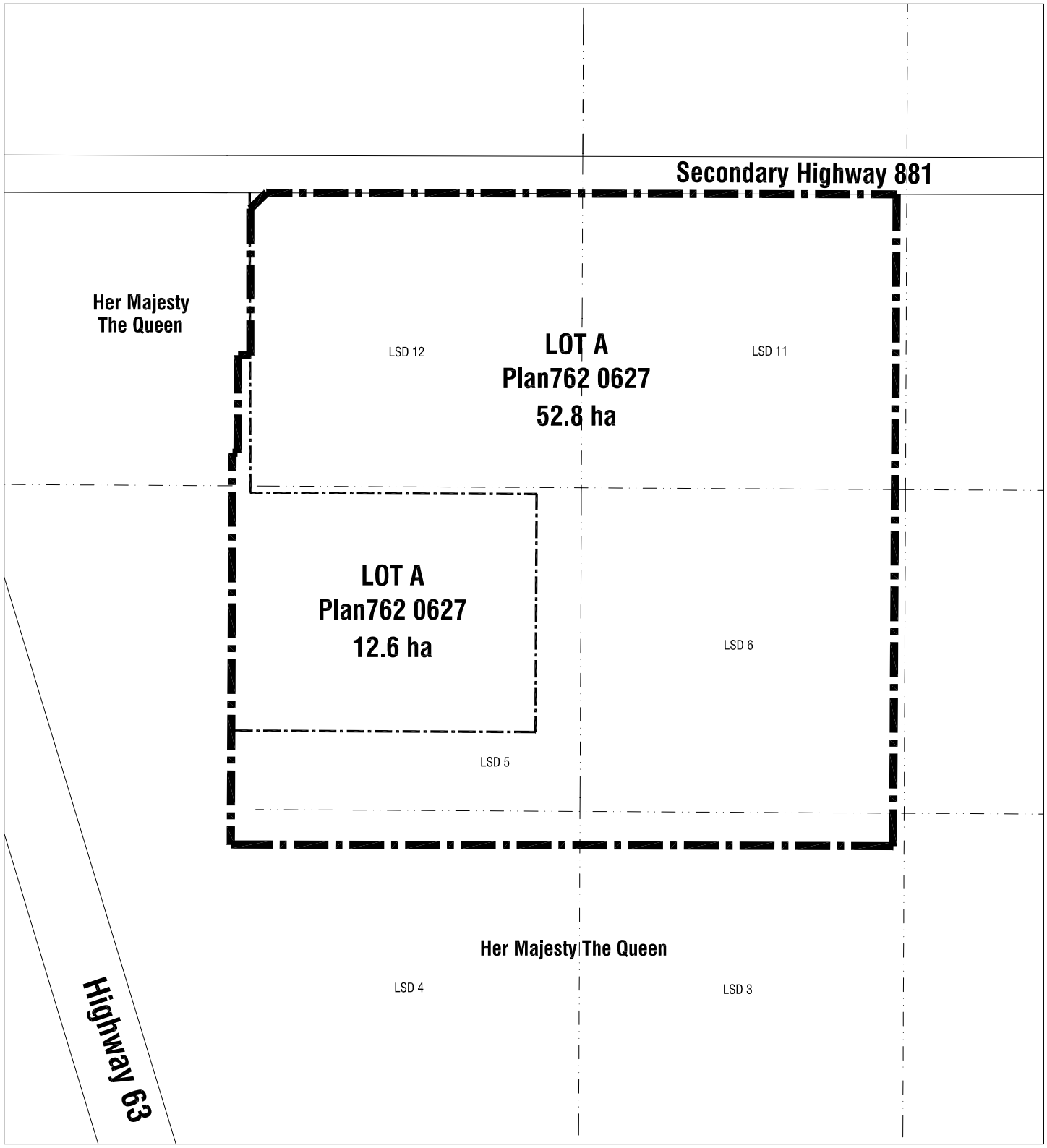
Exhibit 2

IBI GROUP

JANUARY 2009

J:\\9956 Hwy63-88CL\5.0 Drawings\59planning\current\Outline Plan\master exhibits Nov 13.08.dwg November 17 2008 4:48pm bdbbtn

Photo Courtesy Google Earth Pro 2008



RICKARD INDUSTRIAL LANDS

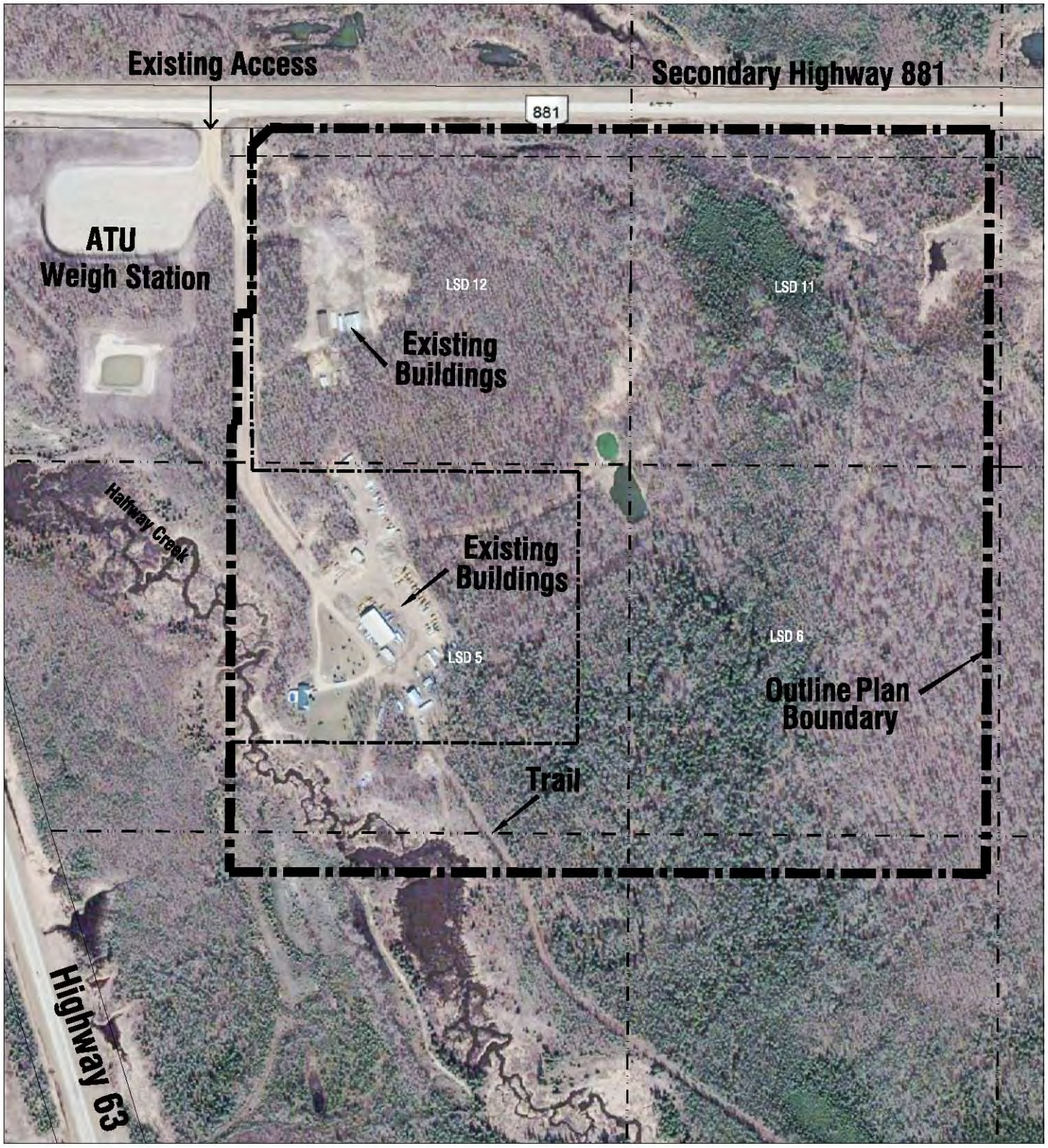
OUTLINE PLAN

Ownership Plan

Exhibit 3

JANUARY 2009

J:\19958 Hgwy63-88ICL\5.9 Drawings\59planning\current\Outline Plan\master exhibits Nov 13.08.dwg November 17 2008 4:48pm bdibben



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

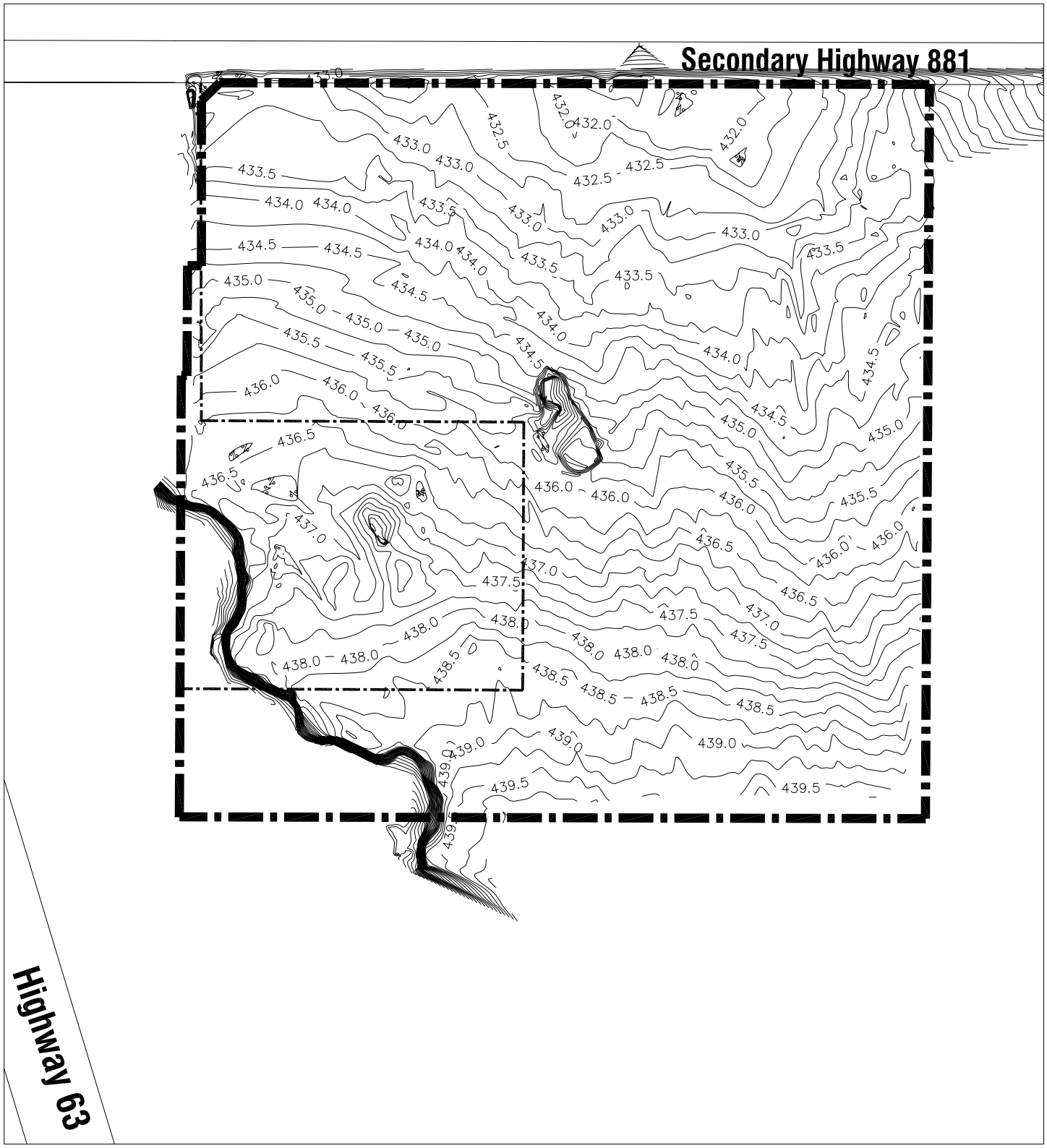
Site Features

Exhibit 4

N

IBI GROUP

JANUARY 2009



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Site Contours

Exhibit 5

JANUARY 2009

3.0 PLAN & POLICY CONTEXT

The following is an overview of relevant Municipal policies, bylaws and objectives related to this proposed Outline Plan.

3.1.1 REGIONAL MUNICIPALITY OF WOOD BUFFALO MUNICIPAL DEVELOPMENT PLAN – BYLAW 00/005

The purpose of the Municipal Development Plan (MDP) is to satisfy the needs of present and future residents of the Regional Municipality of Wood Buffalo. The Plan is being developed to set out a clear, collective vision for the region, to respond to change and to manage growth.

According to the MDP "an Outline Plan is an intermediate planning document, required in specific circumstance, in order to bridge the gap between a large scale ASP and an individual plan of subdivision".

The following Goals, Objectives and Policies of the MDP have been followed in this Outline Plan:

Attractive Business Environment

Assist and facilitate business development by:

2.3.3 Supporting industrial and commercial uses that provide economic benefit and long term viability of the hamlets;

- Business Industrial uses at this proposed location could help support employment opportunities in Fort McMurray and the nearby Hamlet of Anzac.

2.5 Facilitate business opportunities that are not dependent on, or supplementary to, primary resource industries.

- With easy access to major trucking routes there are opportunities to develop varying types of business and industrial businesses.

General Land Development and Efficient Development Practices

3.1 Ensure, through cooperation and consultation with business and industry, an adequate and appropriate supply of land zoned for residential, commercial and industrial uses, to accommodate the expected population and economic growth over the life of this Plan.

- There is an immediate demand for industrial land in the Fort McMurray area. The proposed development of these lands into business industrial land uses will help alleviate this demand.

3.2 Ensure growth is focused in appropriate areas to minimize municipal investment and provision of services.

- The development does not require significant municipal investment in services.

3.5 Support environmentally friendly development patterns that use land efficiently.

- The proposed lands are planned efficiently in the development concept, with minimal amount of roadways used to circulate traffic.

3.7 Regulate subdivision and other development to minimize the impact on the natural environment and risks from natural hazards, such as floods and unstable slopes. Refer to Environmental Guidelines for Review of Subdivisions in Alberta, 1998

- A 60 m buffer from Halfway Creek is shown on the development concept to reduce impact of development on the natural habitat and drainage course.

3.13 Require new subdivisions to respect The Woodland/Urban Interface Plan for Fort McMurray(1998) for forest fire abatement and employ forest fire defense strategies for rural developments.

- Firesmart strategies will be incorporated into this development.

3.15 Ensure that future outlying residential, industrial and commercial development is situated in a manner that minimizes major municipal servicing costs and/or reduces conflicts with adjacent land uses.

- The development proposes minimal municipal services, thus reducing long-term maintenance requirements for RMWB.

- Measures will be put in place to minimize impacts and conflicts with adjacent land uses such as future residential.

3.16 Ensure compatibility with the Provincial Land Use policies, the Land Use Bylaw and any other Statutory Plans and Bylaws.

- This proposed Outline Plan is in conformance with the Municipal Government Act, The Highway 63/881 Corridor Area Structure Plan and the RMWB Land Use Bylaw.

Allocation of Municipal and Environmental Reserve

3.23 Establish Environmental Reserve, lands where it can be defined for that purpose in Section 664 of the Municipal Government Act. In some circumstances, the Municipality may consider using an environmental reserve easement in place of Environmental Reserve denotation.

- The lands around and including Halfway Creek may be dedicated as environmental reserve or as an ER easement, as indicated in the development concept.

Neighbourhood Design

3.39.1 Preservation of sensitive environmental features such as ravines, streams and wetlands through the dedication of Environmental Reserve;

- A 60 m environmental buffer is proposed between Halfway Creek and the proposed development.

Industrial Development and Location of Industrial Lands

3.45 Investigate the creation of additional unserviced industrial land adjacent to Fort McMurray, where appropriate.

- These lands are situated approximately 14 km south of the urban area of Fort McMurray, creating an industrial land opportunity that is positioned to meet local demand.

3.1.2 HIGHWAY 63/881 CORRIDOR AREA STRUCTURE PLAN – BYLAW 07/050

The Highway 64/881 Corridor Area Structure Plan (ASP) was initiated by the Municipality to identify future growth areas and ensure the orderly development of the Highway 63/881 Corridor to the south of the urban area of Fort McMurray.

The main goal of this ASP is "*to ensure orderly, efficient, compatible, economically and environmentally sound land uses within the Plan area, while avoiding land use conflicts and co-ordinating future land uses with transportation plans*".

The subject lands are located in Plan Area 'A' in the ASP. The lands located to the north of the pipeline corridor are identified as Business/Industrial and future Urban Expansion Area. The lands located to the south of pipeline corridor are identified as Rural Policy Area. Rural Policy Area is defined as *"any area along the Highway 63/881 Highway Corridor plan area that is located outside of the future development areas proposed in maps 2a – 2g of the Highway 63/881 Corridor Area Structure Plan"*.

The ASP carries policies related to industrial development as follows:

Industrial Policy

Policy 1.3.2 Prior to Municipal consideration of rezoning and subdivision applications, an outline plan shall be prepared according to Policy 3.1.1

Outline Plans must consider development criteria including (but not limited to):

a) a detailed site-specific biophysical assessment is required, including documentation that habitat and riparian areas along watercourses remain intact and be dedicated as open space through municipal or environmental reserves, conservation easements or environmental reserve easements;

- A biophysical study has been completed and submitted to the RMWB.

b) the areas deemed as being developable shall be confirmed with a geotechnical study prepared by a qualified professional;

- A Geotechnical Study has been prepared by Thurber Engineering and will be submitted under separate cover.

c) a minimum 60 meters (200 feet) buffer/environmental setback from the top of the bank of watercourses will be required, subject to the approval of Alberta Sustainable Resource Development and the Regional Municipality of Wood Buffalo;

- A 60 metre setback is proposed as a buffer from the edge of Halfway Creek to the development area.

d) the overall allowable density for the area shall not exceed one (1) industrial unit per developable hectare (2.47 acres). A net developable hectare is defined as a gross developable hectare minus areas deemed to be Environmental Reserve in Section 664 of the Municipal Government Act;

- The proposed density for the Subject Lands is 1 unit per 1.66 developable hectares (4.05 acres).

e) access by an internal roadway is required;

- An internal collector road is proposed on **Exhibit 6 - Development Concept**.

f) the minimum parcel size shall be 0.4 hectares (1 acre) if lots are to be serviced by a private potable water source and sewage disposal system. The minimum lot size may be reduced to 0.2 hectares (0.5 acres) if the subdivision can be serviced with a communal sewer and water system acceptable to the Regional Municipality of Wood Buffalo;

- Proposed lot sizes range from 0.96 ha (2.4 acres) to 6.8 ha (16.8 acres).

g) showing all federal and provincial regulations are adhered to, including provincial policies and regulations concerning wetlands; and

- A biophysical study has been completed for the plan area.

h) any on-site and off-site development costs associated with development of the subdivision will be borne by the developer.

Policy 1.3.3 All industrial development shall also meet the locational criteria listed in Part III of this ASP, in addition to providing evidence of:

a) proximity to resource development requiring complementary industrial uses;
b) proximity to suppliers, service providers and urban centres;
c) proximity to labour market;
d) suitable separation distance/buffer from residential land uses to avoid conflict.

Policy 1.3.4 The Municipality shall require through the provisions of the Land Use Bylaw and other municipal bylaws, that industrial developments mitigate offsite nuisances (i.e. noise, odour, dust) and ensure quality development.

Rural Policy

Policy 1.5.2 Notwithstanding policy 1.5.1, limited residential, commercial, industrial and recreational development shall be permitted in the Rural Policy Area, according to policies 1.5.3 through 1.5.11.

Policy 1.5.7 Industrial uses including natural resource extraction and processing, oil sands mining, extraction and upgrading, oil sands pilot projects, industrial facilities related to oil sands production, storage facilities, and waste management facilities shall be permitted throughout the Rural Policy Area.

Transportation Policy

Policy 1.10.7 In addition to policies 1.10.1 – 1.10.6, all new developments along the Highway 63 and 881 Corridor shall conform to Alberta Infrastructure and Transportation development setback regulations.

Municipal Services Policy

Policy 1.11.1 The Municipality shall require the use of private wells or trucked-in water supply with cisterns to supply potable water to new developments. Construction and operation must be consistent with Alberta Environment and Regional Municipality of Wood Buffalo Standards.

Policy 1.11.2 The Municipality shall require all developers within the Plan area to provide either individually or collectively, a water supply that meets Alberta Building Code standards for firefighting purposes. The Regional Municipality of Wood Buffalo may consider alternative means of providing fire protection (e.g. sprinkler systems) as long as minimum standards are achieved and approved by Alberta Building Code.

Policy 1.11.4 The Municipality shall require either truck haul sewage disposal systems, or where soil conditions are favourable, a private sewage disposal system that complies with Alberta Environment's Private Sewage Systems Standards of Practice.

This type of industrial land use is appropriate for these lands as they generally conform to the Highway 63/881 Highway Corridor ASP policies as follows:

- appropriate setbacks have been proposed to reduce land use conflicts;
- the proposed industrial development mode meets the locational criteria set out in the ASP;
- the proposed development is located near to complementary industrial uses; proximate to the Fort McMurray urban area and its labour market
- a road access has been developed in consultation with Alberta Infrastructure and Transportation;
- servicing systems will be developed in accordance with applicable provincial and municipal regulations, standards and policies.

Environmental Protection Policy

Policy 1.7.6 All development requires a minimum 60 metres (200 feet) buffer strip measured from the top of the bank of a river, creek, or stream in such a case that a river, creek or stream is present. The top of the bank is to be determined through a geotechnical study conducted by a qualified professional.

A 60 metre buffer strip is proposed at the top-of-bank. The top-of-bank study will be determined through a geotechnical study.

Aesthetics and Gateway Function

The main goal is to control the appearance and quality of development along Highway 63 and Highway 881 to recognize their importance as gateways to the Urban Service Area – Fort McMurray, and Hamlets of Anzac, Janvier South and Conklin.

This development is proposed to conform to the policies of the Aesthetics and Gateway Function section of the Highway 63/881 Corridor Area Structure Plan.

4.0 DEVELOPMENT CONCEPT

4.1 Proposed Land Use

As shown in **Exhibit 6** - **Land Use Concept**, the lands in the Plan area are proposed as highway commercial and business industrial to accommodate a wide range of commercial, business and general industrial uses. Two stormwater management ponds are also planned for these lands to accommodate stormwater drainage and to provide fire flow storage for these lands.

4.2 Land Use Statistics

The land use statistics for the Plan area are as follows:

TABLE 1

Land Use	Area (ha)
Business Industrial	31.1
Highway Commercial	9.1
Future Redevelopment	8.0
Storm Ponds/Servicing Sites	2.2
Creek Buffer (Environmental Easement)	7.2
Service Road	1.8
Internal Collector Road	5.1
Emergency Access	0.2
Total Plan Area	**64.7**

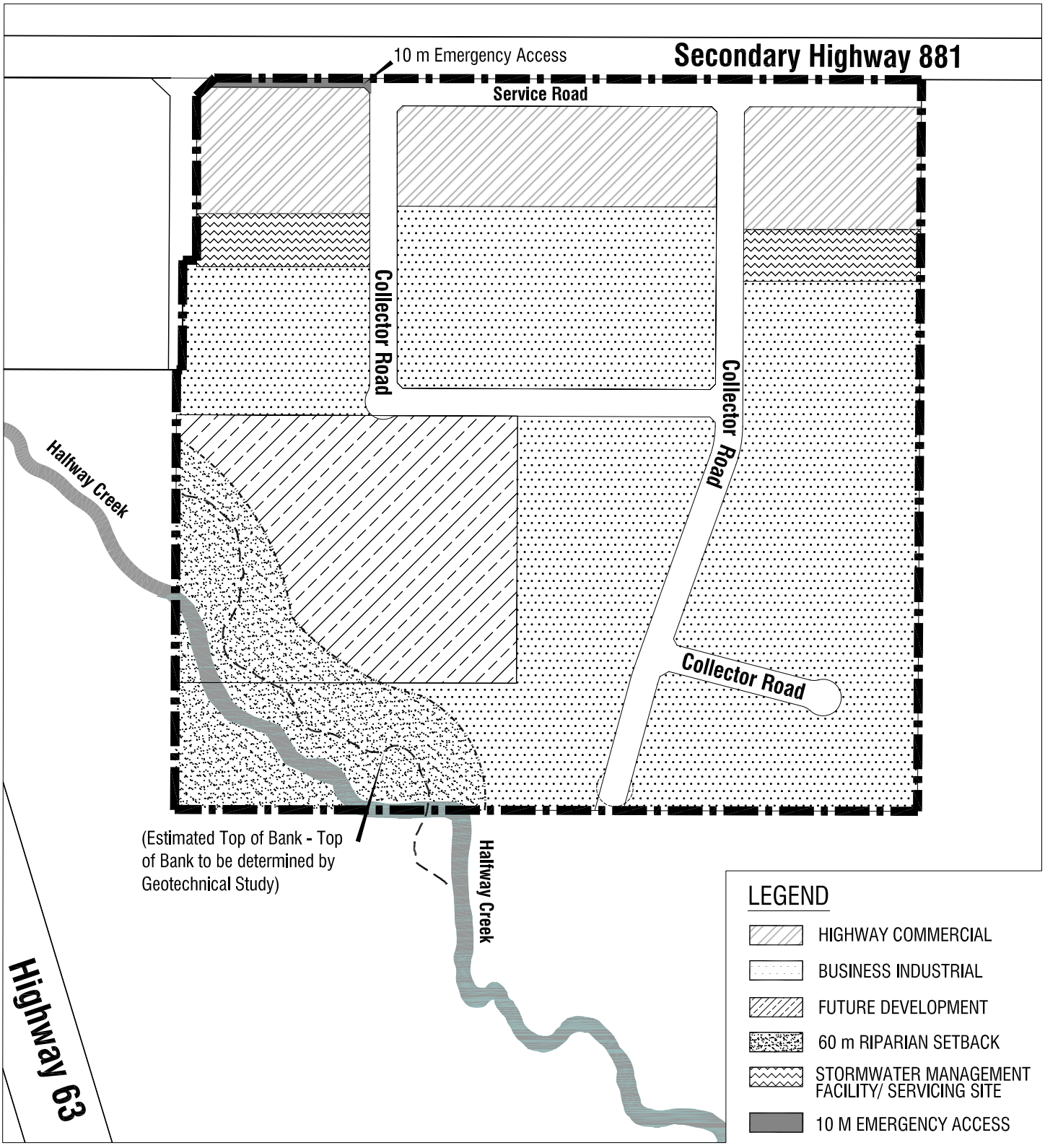
4.3 Environmental Features

A 60 metre development setback/buffer from Halfway Creek is proposed. Most of the lands are covered with natural trees and low lying areas. This buffer is proposed as an environmental easement for the protection of this area.

A biophysical study will be completed by EBA Engineering Consultants Ltd. and has been submitted under separate cover.

4.4 Geotechnical

A geotechnical study has been completed for this area. Detailed geotechnical information will be provided to RMWB at the time of Development Permit application.



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Development Concept

Exhibit 6

JANUARY 2009

IBI GROUP

5.0 UTILITY SERVICES

5.1 Water System

5.1.1 EXISTING CONDITIONS

The proposed development is outside the urban servicing boundary and has not been considered in the overall servicing strategy for RMWB. The current policy is to provide onsite water storage or private wells consistent with RMWB Rural Development Standards.

5.1.2 PROPOSED SYSTEM

Individual land owners will be responsible for providing water for their property.

The preferred method of water supply would be the use of water holding tanks. Water would be trucked from either Fort McMurray or Anzac, subject to RMWB approval. Tank sizing will be dependent on specific uses and will be the responsibility of the property owner.

If technically feasible, individual water wells, in accordance with Alberta Environment Protection Guidelines, may be an option for water supply. The individual property owners will be responsible for all costs associated with developing a private well and for all Provincial and Municipal licenses and permits.

5.1.3 FIRE PROTECTION

RMWB's Fire Marshall indicated that water volumes for fire protection in rural areas are calculated in accordance with the Alberta Building Code and are generally determined at Development Permit Application. The current practice is to provide onsite water storage facilities for fire protection; either tanks or storage ponds, that are accessible, maintained and that provide the minimum required storage.

The proposed system for this development would be to utilize the stormwater management facilities by making an allowance in the design to accommodate the required fire flow storage. RMWB's Fire Marshall has indicated that this system would be an acceptable approach and suggested that 2 ponds would be desirable to reduce the travel time from the water source to the fire.

Fire flow storage requirements are calculated as follows:

1. Equivalent population for 60 hectares of industrial is 1950 people.

2. Average daily water demand is 760.5 m^3 per day.

3. Peak daily demand at 2 times the average daily demand is 1521 m^3 per day.

4. Fire flow storage requirements are based on RMWB fire flows (14 m^3/min X 4 hours or 3360 m^3, plus 25% of the peak day demand (380 m^3) plus 15% of the average daily demand (114 m^3) for a total storage requirement of 3,854 m^3.

The stormwater management facilities will be designed to accommodate the required fire flow storage plus an allowance for 1 meter of ice.

5.2 Sanitary Sewer System

5.2.1 EXISTING CONDITIONS

The proposed development is outside the urban servicing boundary and has not been considered in the overall servicing strategy for RMWB. The current policy is to provide onsite sanitary sewage services consistent with RMWB Rural Development Standards.

5.2.2 PROPOSED SYSTEM

Individual property owners will be responsible for providing sanitary sewer services and will be responsible for acquiring all Provincial and Municipal licenses and permits.

Consistent with RMWB Engineering Standards, sanitary sewer services are to be provided by onsite storage tanks (truck evacuation). If technically feasible, septic fields may be developed on individual sites. Onsite mechanical treatment may also be an option depending on specific site requirements and opportunities.

5.3 Stormwater System

Two storm ponds are proposed for the site at 1.1 ha size each.

5.3.1 EXISTING CONDITIONS

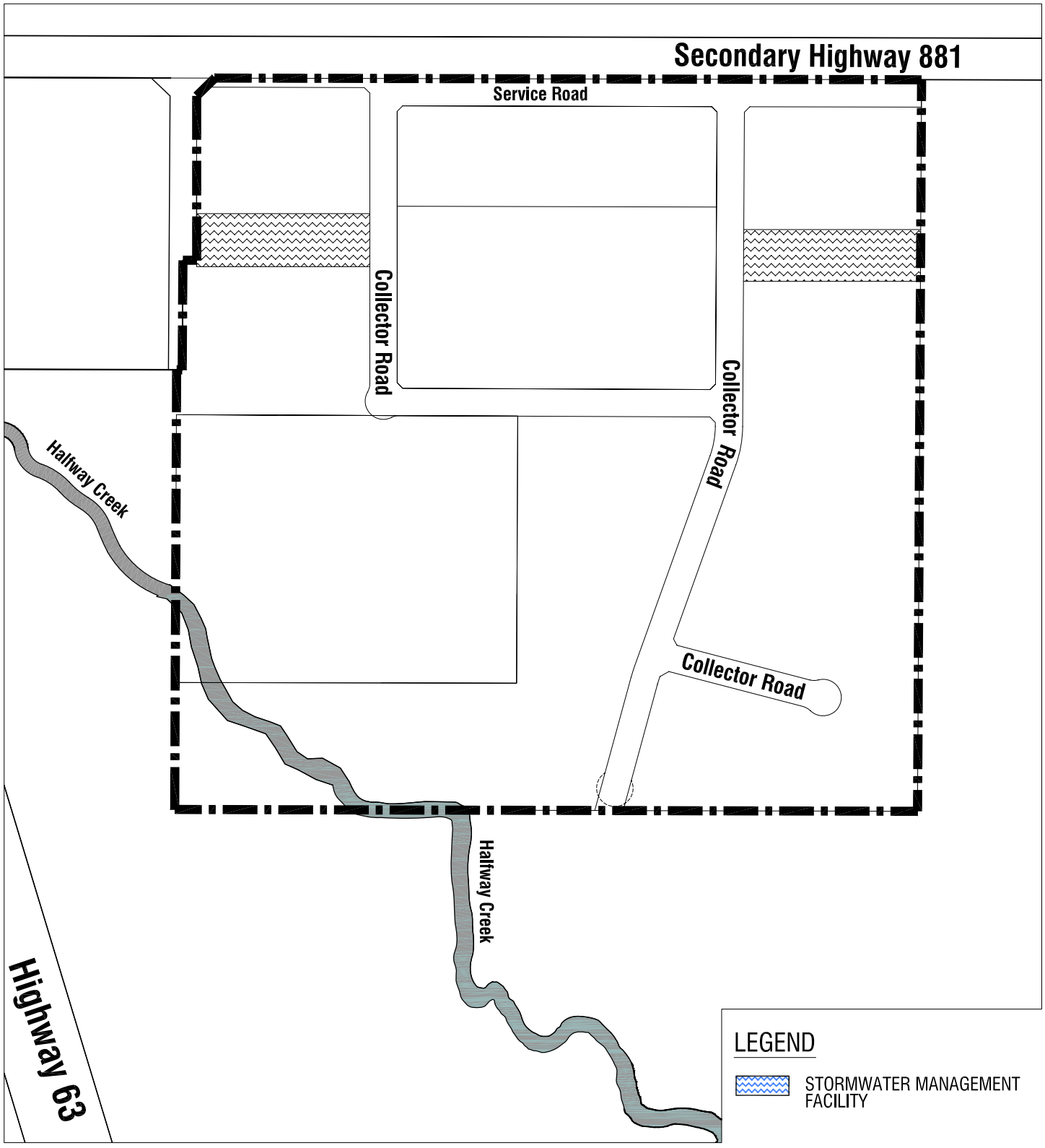
The proposed development area is generally covered by topsoil consisting of silty clay loam that turns to clay loam and heavy clay at depths of 0.5 to 1 metre.

The site is bounded by a creek to the south, a government road allowance to the west, Highway 881 to the north, and undeveloped (SRD) land to the east. A small natural drainage channel that starts in the muskeg lands to the east crosses the northeast corner of the property and drains to the northwest via a culvert that crosses the highway. The property generally slopes from the south to the north/northeast at an average of a 1% slope. A contour plan is included as **Exhibit 5 – Site Contours**.

5.3.2 PROPOSED STORMWATER MANAGEMENT

Two stormwater ponds will be constructed as shown on **Exhibit 7 – Stormwater Management Plan**. The ponds will serve as stormwater ponds to manage the runoff and as storage ponds for fire flow. The top 2 meters plus 0.5 meter freeboard will be utilized to control site runoff and the bottom 2 meters will be used for fire flow storage (includes 1 meter for ice).

The ponds will discharge to the natural drainage course and culvert that crosses Highway 881.



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Storm Water Management

Exhibit 7

JANUARY 2009

IBI GROUP

5.3.3 DESIGN CRITERIA

Exhibit 7 - Stormwater Management Plan shows the existing drainage patterns.

The following design parameters have been used in determining the pond size:

1. Drainage area is 60 hectares.

2. The site will be 20% impervious (buildings and pavement), 70% gravel and 10% grass.

3. The allowable 1:100 year release rate is 5l/s/ha.

4. The critical storm event is the 1:100 year, 24 hour storm event.

5. The computed 1:100 year runoff volume for the site is 33,100 cubic meters.

6. The required pond storage volume is 22,300 cubic meters. This would require a pond with a High Water Level dimension of 120 meters by 120 meters or top dimension of 127 meters by 127 meters (based on 0.5 meter freeboard). Two ponds would require slightly more area than one pond, so we have allowed 2 hectares (1 hectare for each pond) verses the 1.61 hectares required for 1 pond.

7. The peak 1:100 year outflow is 300 l/s and would be controlled by a 360 mm diameter orifice plate.

8. Fire flow storage will be stored below the Normal Water Level. The required volume of 3854 cubic meters, as outlined in Item 5.1.3 will require an additional depth of 1.8 meters (includes 1 meter allowance for ice).

6.0 TRANSPORTATION SYSTEM

The proposed development area encompasses approximately 64.7 hectares of land in Area A of the Highway 63/881 Corridor Area Structure Plan.

6.1 Existing Conditions

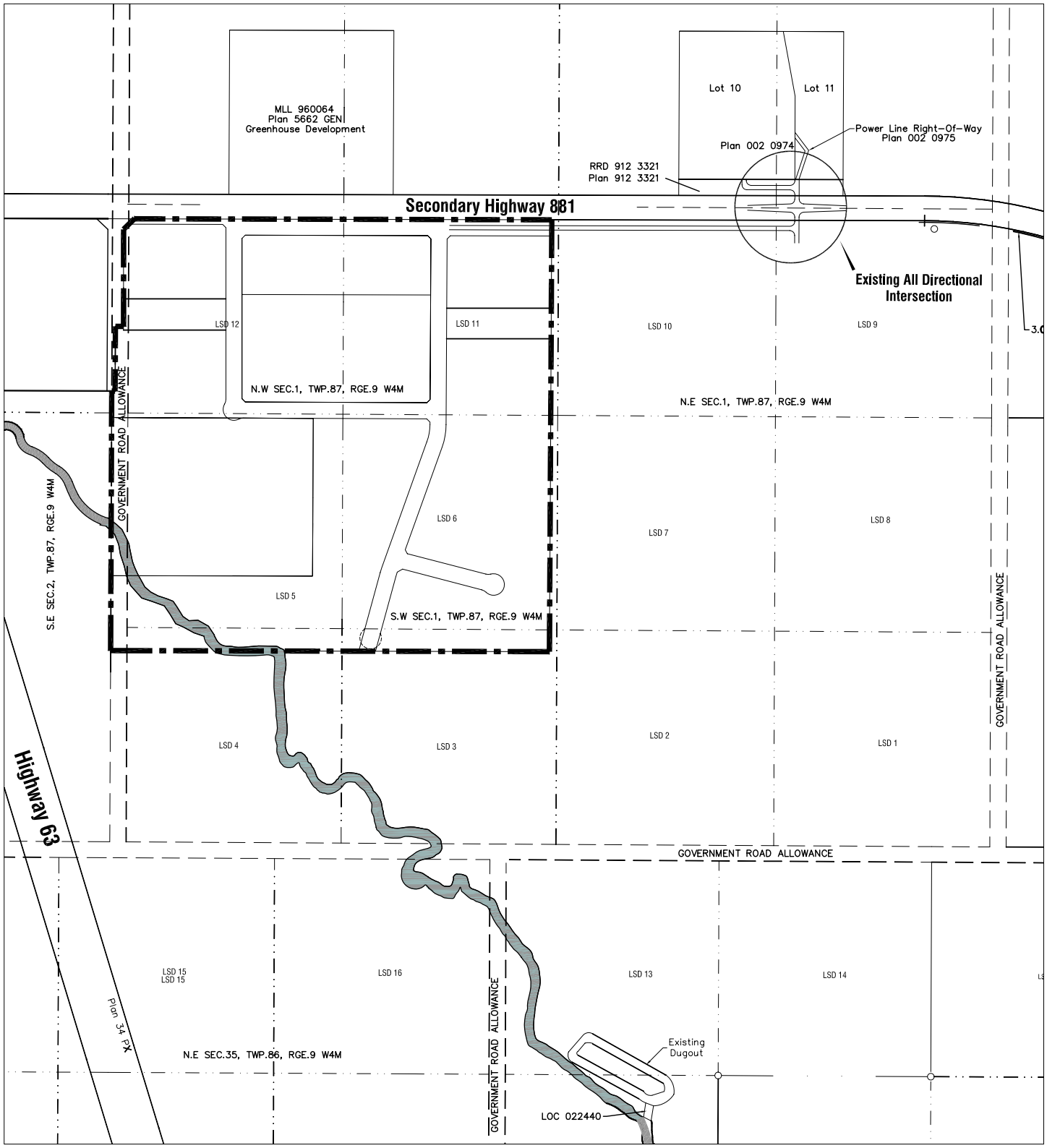
Alberta Infrastructure has installed an access onto Highway 881, complete with acceleration and deceleration lanes, approximately 600 meters east of the east property line. The access was constructed to provide access to NE ¼ sec 1-87-9-W4. Access to the proposed development would require a service road to be constructed as shown on **Exhibit 8 – Transportation Access**.

6.2 Proposed System

The service road will be constructed in accordance with RMWB Engineering Standards for Rural Industrial Developments. A rural paved cross-section in a 30 meter right-of-way will be used. The service road is proposed to be connected to the access located west of the lands (ATU access) for emergency access use only. This emergency access is proposed to have a 10 m right-of-way.

Internal roads will have a rural paved cross-section and 30 meter right-of-ways.

A Traffic Impact Assessment was submitted to Alberta Infrastructure for the construction of the existing access.



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Transportation Access

Exhibit 8

JANUARY 2009

J:\19958 Hgwy63-88ICL\5.9 Drawings\59planning\current\Outline Plan\master exhibits Nov 13.08.dwg November 17 2008 4:48pm bdibben

7.0 SITE DEVELOPMENT AND GRADING

7.1 Existing Conditions

The proposed development area contains a residence with a shop and equipment yard that will be integrated into the new development. The balance of the lands has been cleared of natural vegetation and will require stripping.

The site generally drains toward Highway 881 in a northerly and northeasterly direction.

7.2 Design Criteria

The roadways and ditches will be designed to carry the 1:100 year storm event to the proposed stormwater management systems. Approaches, completed with culverts, will be installed for each property.

Lot grades will be set to direct drainage to the roadway ditches and to ensure that cross-property drainage does not occur.

8.0 RATIONALE

This Outline Plan is being brought forward to enable industrial development opportunities that are not presently available in the Fort McMurray area. The demand for industrial lands is significant and urgent in the Fort McMurray region.

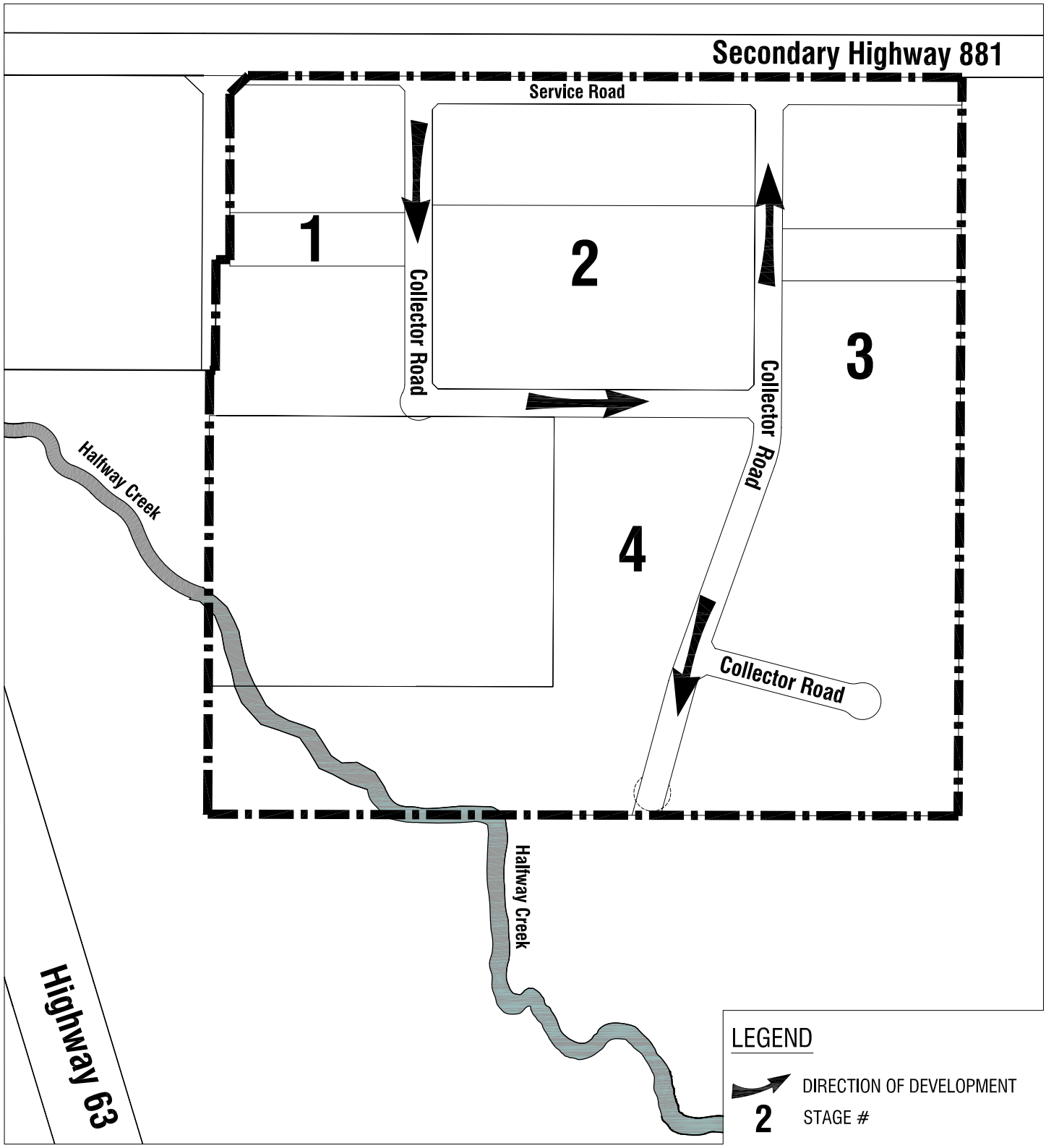
These lands are positioned to help relieve the demand for unserviced industrial land uses, such as storage yards, equipment storage, aggregate stockpiles, heavy equipment parking, site offices and logistics operations.

9.0 IMPLEMENTATION

A redistricting application for Business Industrial Unserviced District (BIU) and an ASP amendment to the Highway 63/881 Corridor ASP for these lands have been previously submitted. This Outline Plan has been submitted to facilitate the timely development of these industrial parcels.

Due to the significant demand for industrial land in the Fort McMurray area, it is anticipated that the lands will be developed immediately following the necessary approvals.

Development staging will generally follow the sequence shown in **Exhibit 9 - Staging Plan.**



RICKARD INDUSTRIAL LANDS

OUTLINE PLAN

Staging Plan

Exhibit 9

JANUARY 2009

J:\19958 Hgwy63-88ICL\5.9 Drawings\59planning\current\Outline Plan\master exhibits Nov 13.08.dwg November 17 2008 4:48pm bdibben

Table of Contents

1 Introduction

1.1 BACKGROUND

Wood Buffalo South Industrial Ltd retained CSM Engineering Ltd to complete the detailed design for the Industrial Subdivision on W1/2-1-87-9-4.

Wood Buffalo South Industrial Ltd plan to develop a new rural industrial subdivision that will meet the requirements of the amended Highway 63/881 Corridor Area Structure Plan.

An approved Tentative Plan of Subdivision currently exists and this design brief is intended to provide design information as it applies to the plan of subdivision.

1.2 PURPOSE

The purpose of this engineering design brief is to provide a summary of the design standards and concepts that have been used in the detailed design of the subdivision.

1.3 LOCATION

As shown in the Key Plan, the subdivision is located adjacent to the Alberta Transportation truck weigh station near the junction of Highway 881 and Highway 63.

The proposed subdivision is bounded by Highway 881 to the north, undeveloped SRD lands to the south and east, and the Alberta Transportation truck weigh station to the west.

1.4 EXISTING AREA CONDITIONS

The site has been cleared and stripped in preparation for the site development component of the project.

2 Design Criteria

The guidelines outlined in the RMWB Engineering Services Standards will be referenced for the design of the design of the water system, sanitary sewer system, storm water management system, and roadways. Generally, these guidelines are as stated in the sections below.

This is a rural industrial subdivision and will be serviced with power, telephone, roadways, applicable storm water drainage systems, and fire flow storage. Individual property owners will be responsible for providing holding tanks for water and sanitary sewer.

2.1 TRANSPORTATION

- Minimum pavement structure (Rural Residential)
  - Collector Road:
    - Asphalt Concrete Pavement 120 mm
      - Staged Paving – 70 mm Base
        50 mm Final
    - Granular Base Course 300 mm
    - Granular Sub-base 300 mm
    - Subgrade Preparation 300 mm
    - All roads will be constructed to the above standard.
- Right of Way Width – 30 m
- Max/Min Gradient
  - Collector Road – 8 – 10%/0%
  - Local Road – 10-13%/0%
- Minimum Culvert Size
  - Across Roadway 500 mm
  - Across Industrial Driveway 400 mm

2.2 WATER SYSTEM

- Individual owners will be required to supply their own storage of water in the form of holding tanks. Minimum size of tanks will be 4,500 liters.

2.3 SANITARY SEWER SYSTEM

- Individual owners will be required to supply their own storage of sewage in the form of holding tanks. Minimum size of tanks will be 9,000 liters.

2.4 STORMWATER MANAGEMENT SYSTEM

- Stormwater runoff generated from within the subdivision shall be routed through two stormwater management facilities as required to regulate the rate of outflow and provide cleansing prior to discharge.
- The Minor System will consist of open channels (ditches) and water courses that convey flows of 5 year return frequency without surcharging.
- The Major System will consist of surface flood paths, roadways, parkways and water courses which convey flows of a 100 year return frequency.
- The coefficient of runoff “c” for a 1:5 year event return period shall be:
    - 0.15 for Low Density Rural Industrial and 0.95 for asphalt, concrete and roofs.
- Stormwater Management Facility Design will:
    - Provide adequate storage to control flows from the development area to pre-development flows.
    - Provide retention for water quality control.
    - Reduce the potential for downstream flooding and erosion.
    - The bottom 2 meters of each pond will store water for fire flow protection.

3 Design

3.1 SITE GRADING

3.1.1 General

In general the existing topography and drainage patterns will not be severely altered in order to provide drainage. The intent of the subdivision is to provide a variety of lots sizes for industrial uses. Lot grading has been set for each lot to ensure that overland flow patterns are established.

3.2 TRANSPORTATION

3.2.1 General

The transportation network within the subdivision will consist of a main collector roadway (service road running parallel to Highway 881) from the Highway 881 access to the subdivision and internal local roads to provide access to the individual properties.

The roadway right of way will be 30 meters for the collector and local roads. All roads are designed to RMWB rural cross-section requirements with the exception of the ditch bottom which has been reduced to 2.75 meters from the RMWB standard of 3.0 meters..

3.2.2 Collector Road (Service Road)

The service road will be a rural cross-section with a 9 meter paved surface. The ditch cross section has been reduced to 2.75 meters from 3 meters to ensure that the road cross section fits within the 30 meter right of way.

3.2.3 Local Roads

The local roads will have a rural cross-section with an 8 meter paved surface. The ditch cross section has been reduced to 2.75 meters from 3 meters to ensure that the road cross section fits within the 30 meter right of way.

3.2.1 Approaches

Approaches typically will have a 10 meter paved surface and 10 meter turning radii. All approaches will be paved to property line. Currently we have allowed for 1 approach per lot that will be located at the middle of the lot. Locations may change at the individual development permit application phase.

3.3 WATER SYSTEM

3.3.1 General

Water service will be provided by storage tanks. Each property owner will be responsible for supplying and installing storage tanks to RMWB standards and specifications.

3.4 SANITARY SEWER SYSTEM

3.4.1 General

Sanitary sewer service will be provided by storage tanks. Each property owner will be responsible for supplying and installing storage tanks to RMWB standards and specifications.

3.5 STORMWATER MANAGEMENT and FIRE FLOW STORAGE

3.5.1 Storm Water Management

The project has been split into two drainage basins. The storm retention ponds will store water for the 1:100 year storm events and will also store water for fire protection. RMWB Fire Protection Services indicated that they would require 2 locations to service the development with fire protection.

BK Hydrology will be providing a detailed report and design recommendations for the storm water management and will be submitting the report to Alberta Environment for approval.

3.5.2 Fire Flow Storage

Fire flow storage requirements are calculated as follows:

1. Equivalent population for 60 hectares of industrial is 1950 people.
2. Average daily water demand is 760.5 m^3 per day.
3. Peak daily demand at 2 times the average daily demand is 1521 m^3 per day.
4. Fire flow storage requirements are based on RMWB fire flows (14 m^3/min X 4 hours or 3360 m^3, plus 25% of the peak day demand (380 m^3) plus 15% of the average daily demand (114 m^3) for a total storage requirement of 3,854 m^3.

The storm water management facilities will be designed to accommodate the required fire flow storage plus an allowance for 1 meter of ice.

Each pond will have 2,446 cubic meters of storage from the bottom of the ice to the bottom of the pond. Each pond will have a clay liner compacted to 100% SPD.

3.5.3 South Drainage Basin

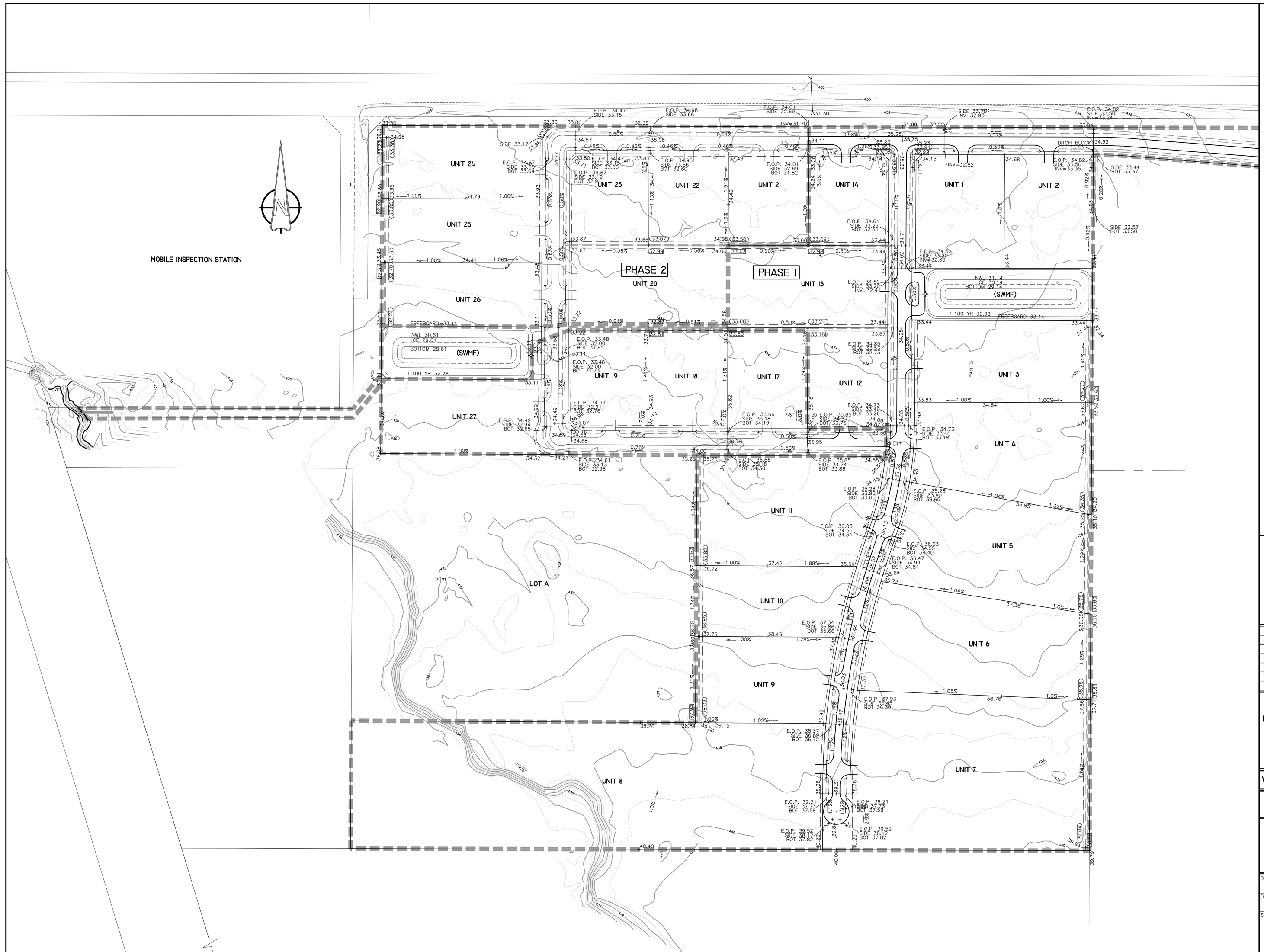
Stormwater from the south drainage basin will be conveyed through grassed ditches to discharge channels as shown on Drawing LG01. The discharge channels will have a series of ditch blocks to reduce the flow velocity and to provide storage for the 1:100 year event. The discharge rate is set at the 1:5 pre-development flows.

4 Summary of Deviation

The following is intended to summarize the locations where deviations from the RMWB standards are sought.

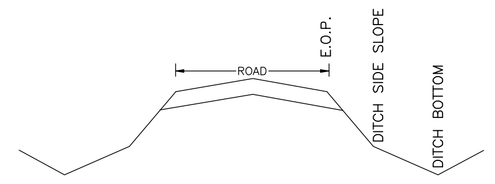
4.1 Transportation

A deviation is requested to reduce the ditch bottom from 3 meters to 2.75 meters. The deviation is required to ensure that the road cross section fits within the 30 meter road right of ways.



NOTE:
1. DISTANCES ARE SHOWN IN METERS AND DECIMALS THEREOF
2. ELEVATIONS ARE SHOWN IN METERS AND DECIMALS THEREOF
3. ORIGINAL GROUND CONTOURS ARE AT 0.50m INTERVALS
4. E.O.P. DENOTES EDGE OF PAVEMENT
5. BACK SLOPES TO BE SEEDED AS PER RMWB STANDARDS

STORM CATCHBASINS SHOWN THUS
ROAD SURFACE DRAINAGE DIRECTION SHOWN THUS
LOT GRADING ELEVATIONS SHOWN THUS XX.XX
DITCH BOTTOM ELEVATIONS SHOWN THUS XX.XXX
DITCH SIDE SLOPE ELEVATIONS SHOWN THUS XX.XXX



DEFINITIONS DETAIL
N.T.S.

PROFESSIONAL ENGINEER ALBERTA C.L. MARSH P.ENG.

PERMIT TO PRACTICE
NUMBER: P8382
PERMIT

NO.	REVISION	DATE	BY	CHKD
1	FIRST SUBMISSION	28/08/09	DH	CM
2	REVISED AS PER RMWB COMMENTS	22/09/09	LW	CM
3				
4				
5				
6				

CSM ENGINEERING LTD.
102–9908 FRANKLIN AVE, FORT McMURRAY, AB T9H 2K5
PHONE: (780) 790–1034 FAX: (780) 790–1790

WOOD BUFFALO SOUTH INDUSTRIAL PARK LTD.

RICKARDS LANDING

OVERALL PLAN SHOWING DITCH, ROAD AND LOT GRADING

DESIGN:	APPROVED:	DATE:
LW	CM	04/08/09
DRAWN:	CHECKED:	CSM PROJECT No.:
DH	CM	08001
SCALE: HOR 1:2000 0 20 40 60 80		DRAWING NUMBER: LG01

CSM ENGINEERING LTD.

May 2, 2010

Our ref: 8001

Alberta Environment, Northern Region
4999 – 98 Avenue
Edmonton, Alberta
T6B 2X3

Attention: Mr. Terrence Ko, E.I.T.

Dear Sir:

Reference: Rickards Landing Stormwater Application

As per your email of January 7, 2010, please find enclosed the following information for your review and approval:

1. Completed application form
2. Supporting documentation for the application
3. EPEA Application letter
4. Email from Dale Adams
5. Email from RMWB confirming approval of drawing package
6. Storm runoff calculations by BK Hydrology Service
7. Design Brief as submitted to RMWB.
8. PDF file of drawings as previously submitted.

We will be sending the originals by courier on Monday, May 3, 2010.

Please contact the writer if you require additional information.

Sincerely,

Cliff Maron, P.Eng.
Manager

102 – 9908 Franklin Avenue, Fort McMurray, Alberta, T9H 2K5
Phone: (780) 790-1034 Fax: (780) 790-1790
csm@csmengineering.ca

APPLICATION FORM AND GUIDE FOR REGISTRATION TO CONSTRUCT AND OPERATE A MUNICIPAL STORM DRAINAGE SYSTEM

1.0 Administrative Information

1.1 Name of stormwater system: Rickards Landing

1.2 Corporate Name/Address/Phone of person/owner responsible for this stormwater system:

Corporate Name:	Wood Buffalo South Industrial Park Ltd.		
Address:	133 Ash Way, Fort McMurray, Alberta T9K 0E8		
Contact Person:	Mike Walsh	*Position:*	Director
Telephone:	780- 791-9000	*Fax:*	780 – 791-9047
Email Address:	Mike.Walsh@mnp.ca		

1.3 Proposed date for construction: May 22, 2010

Master Drainage Plan

1.4 Do you have a Master Drainage Plan for the area: Yes ☐ No X
If yes, submit the Master Drainage Plan in support of this storm application.
If no, what is the timeline for creation of a Master Drainage Plan? The Regional Municipality of Wood Buffalo has not requested a Master Drainage Plan. It is unknown if they have a plan completed for this location.

Stormwater Management Plan

1.5 Do you have a Stormwater Management Plan for this development? Yes X No ☐
If yes, submit the Stormwater Management Plan in support of this storm application.
If no, what is the timeline for creation of a Stormwater Management Plan?

1.6 Are there any bylaws or other measures to control the quantity and/or quality of discharges into the stormwater system? Yes ☐ No X
If yes, provide a copy of bylaw(s).

2.0 Proposed Stormwater System Description

Surficial Drainage Collection System

2.1 Description (include map of surficial drainage):

Drainage will be surface drainage by ditches and culverts to stormwater ponds.

Piped Storm Drainage Collection System

2.2 Description (include engineering drawings of storm piping layout):

Piped systems will include the connection between the ponds and the outfall to Half Way Creek.

3.0 Stormwater Treatment

3.1 Storm Ponds:

Facility Designation / Name	Land Location			Name of the drainage course to which the stormwater is discharged
	LSD	GPS Coordinates		
Rickards Landing		Lat	6266043	Half Way Creek
		Long	480979	
		Lat		
		Long		
		Lat		
		Long		
		Lat		
		Long		

3.2 Storm Outfalls:

Facility Designation / Name	Land Location			Name of the drainage course to which the stormwater is discharged
	LSD	GPS Coordinates		
Rickards Landing		Lat	6266043	Half Way Creek
		Long	480979	
		Lat		
		Long		
		Lat		
		Long		
		Lat		
		Long		

3.3 Permanent Snow Storage Sites:

Facility Designation / Name	Land Location			Name of the drainage course to which the stormwater is discharged
	LSD	GPS Coordinates		
		Lat		
		Long		
		Lat		
		Long		
		Lat		
		Long		
		Lat		
		Long		

3.4 Storm Pumping Stations:

Does this storm system use any storm pumping stations? Yes ☐ No ☐
If yes, submit the land locations or street address(es) in support of this storm application.

Land location_____SEC_____TWP_____RG_____M_____
Land location_____SEC_____TWP_____RG_____M_____
Street address:_____
Street address:_____

3.5 Chemical Use:

Are any chemicals used in the stormwater collection or in the storm ponds:
Yes ☐ No ☐
If yes, submit the chemical name and MSDS in support of this storm application.

3.6 Stormwater Security:

Are any storm ponds fenced: Yes x No ☐
If yes, submit a list of fenced storm ponds, the ponds location (land locations or street address(es) and a description of the fencing used in support of this storm application.

Land location_____SEC 1_____TWP 87____RG 9____M 4____
Land location_____SEC 1_____TWP 87____RG 9____M 4____
Street address: N/A_____
Street address: N/A_____

Fencing details included with engineering drawings,

5.0 Signature Page

5.1 The *Environmental Protection and Enhancement Act* and Regulations, provide a specific definition for the "owner" and "person responsible for a wastewater system or storm drainage system". Therefore, the person(s) responsible/person signing this document should be well familiar with the *Environmental Protection and Enhancement Act* and the Regulations.

5.2 The sections of the *Environmental Protection and Enhancement Act* and Regulations that are of particular relevance to wastewater system and storm drainage system are:

a) *Environmental Protection and Enhancement Act*, Part 2, Division 2 (Approvals and Certificates); Part 4 (Release of Substances; Part 10 (Enforcement);

b) Wastewater and Storm Drainage Regulation 119/93;

c) Wastewater and Storm Drainage (Ministerial) Regulation 120/93;

d) Approvals Procedure Regulation 113/93.

5.3 I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief, such information is true, complete and accurate.

Corporate Name:	Wood Buffalo South Industrial Park Ltd.		
Position:	Director		
Corporate Address:	133 Ash Way, Fort McMurray, Alberta		
Postal Code:	T9K 0E8		
Corporate Telephone:	780-791-9000	*Fax:*	780-791-9047
Date of Application:	May 2, 2010		
Signature:			

EPEA APPLICATION

WATERWORKS, WASTEWATER, OR STORM DRAINAGE SYSTEM

Project Name/Type RICKARDS LANDING (Stormwater)

Location 1-87-9-W4.

Municipality Regional Municipality of Wood Buffalo.

I acknowledge that I have reviewed the *Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems*, January 2006, and certify that the design of the above noted project complies with all of the requirements specified for the construction of the water distribution, wastewater collection and storm water collection systems.

SIGNED AND STAMPED by a professional engineer.
NAME CLIFFORD MARON
COMPANY CSM Engineering Ltd. Permit # P08382.

May 7/10.

Submissions that are found to not be in accordance with the Standards and Guidelines may result in enforcement action and/or referral toAPEGGA.
For projects that do not comply with all of the Standards and Guidelines please submit a detailed explanation of the deficiency and why it is necessary.

Cliff Maron

From: Bernie Kallenbach [bkhydrology@yahoo.com]
Sent: Monday, September 28, 2009 11:34 AM
To: Dawn Harrison; Cliff Maron; Liz Wilson
Subject: Fw: Wood Buffalo South Industrial Ltd. - Storm Water

FYI

--- On **Mon, 9/28/09, Dale Adams <*Dale.Adams@gov.ab.ca*>** wrote:

From: Dale Adams <Dale.Adams@gov.ab.ca>
Subject: Wood Buffalo South Industrial Ltd. - Storm Water
To: bkhydrology@yahoo.com
Cc: "Tanya Berube" <Tanya.Berube@gov.ab.ca>, "Larry Kuchmak" <Larry.Kuchmak@gov.ab.ca>
Date: Monday, September 28, 2009, 10:50 AM

September 28, 2009
AENV File: 00263441
To: Bernie Kallenbach, M.Eng., P.Eng.
Re: Wood Buffalo South Industrial - Storm Water Ponds and Outfall - SW, NW, NE 01-087-09-W4M, NE 1/4 02-087-09-W4
Bernie;
This is further to our recent conversation. Based on our review of the application we have determined that a *Water Act* approval is not required for the storm water drainage works.
The storm water outfall will recorded as a notification under the *Code of Practice for Outfall Structures on Water Bodies (Water Act)*. All work related to the outfall shall be carried out in accordance with the various schedules of the Code.
Alberta Environments file reference for this notification is 00263441.
The notification expires on September 15, 2010.

Dale Adams
Alberta Environment
Environmental Management
Northern Region - Edmonton
Twin Atria
#111, 4999 - 98 Avenue
Edmonton, Alberta T6B 2X3
Phone: (780) 427-7556
Fax: (780) 427-7824

Cliff - the RM is looking for LC's for both landscaping and servicing.

Mike Walsh, CA

PH. 780.791.9000
FAX 780.791.9047
CELL 780.880.7937
9707 Main Street
Fort McMurray, AB T9H 1T5
mike.walsh@mnp.ca
mnp.ca

MEYERS NORRIS PENNY LLP
Member Horwath International

----- Forwarded by Mike Walsh/FtMcMurray/mnp on 26/04/2010 05:46 PM -----

From: "Christy Fong" <Christy.Fong@woodbuffalo.ab.ca>
To: "Mike Walsh" <Mike.Walsh@mnp.ca>
Cc: "Stephen Bordignon" <Stephen.Bordignon@woodbuffalo.ab.ca>, "Jody Soper" <Jody.Soper@woodbuffalo.ab.ca>
Date: 22/04/2010 01:39 PM
Subject: RE: Bareland Condominium: 2009-WB-RS-006

Hi Mike,

I have confirmation from Engineering today that the 3rd submission drawing is acceptable.

The required LOC for:
Landscaping - $ 558,878.00
Servicing - $ 1,066,806.57

The required amount for the MR cash in lieu is $ 1,343,265.00

Please be advise that we are currently working with the municipal lawyer for the new development agreement template. I will expect the template be ready on April 30, 2010. I will contact you if the template is ready for review. In our phone conservation today, we also discussed the introduction of cost estimate recording form that you have to fill out as the preparation of the agreement. I will work with you on the form as we set up the meeting to review the development agreement.

Should you have any further inquires, please call me directly.

Regards,

Christy Fong
Acting Planner
Subdivision and Development Agreements
Christy.Fong@woodbuffalo.ab.ca

From: Mike Walsh [mailto:Mike.Walsh@mnp.ca]
Sent: Wednesday, April 14, 2010 3:56 PM
To: Christy Fong
Subject: RE: Bareland Condominium: 2009-WB-RS-006

CSM ENGINEERING LTD.

WOOD BUFFALO INDUSTRIAL PARK SOUTH

STORM WATER MANAGEMENT SYSTEM

INFORMATION REQUIREMENTS

May 2, 2010

Item 1 General Description of Storm Drainage System

The industrial subdivision (1-87-9-W4) is located approximately 300 meters east of Highway 63 and directly south of Highway 881. There is an existing Mobile Weigh Station located directly west of the proposed subdivision and an existing light industrial development in the south west corner of the subject property.

Half Way Creeks runs across the southwest corner of the development area and is protected by a 60 meter set back from top of bank. Half Way Creek crosses Highway 63 with a 3.8 meter culvert.

To the best of our knowledge, there are no other storm water facilities in the near proximity. There is some minor industrial development directly north of Highway 881 that does not appear to have a storm water management plan in place.

The general drainage on the site is from south to north. Drainage will be channeled on site using ditches to the storm water ponds. The storm water ponds are designed to provide fire water storage as well as storage for a 1:100 year event, hence the two ponds as required by the Regional Fire Marshall.

The storm ponds will discharge into Half Way Creek through a dedicated outfall line and outfall structure. The two ponds are connected by pipe. In the event that the 1:100 year event is breached, the ponds will discharge overland to the existing culvert at Highway 881.

Item 2 Detailed Description of Storm Drainage System

Detailed engineering drawings, signed and stamped, have been submitted under separate cover. Signed pdf's are included with this submission.

A design report by BK Hydrology is included that outlines the storage capacities and inflow and outflow rates.

Item 3 Description of Operation and Maintenance

The storm water management system will be turned over to the Regional Municipality of Wood Buffalo upon the completion of the 2 year warranty and maintenance period.

102 – 9908 Franklin Avenue, Fort McMurray, Alberta, T9H 2K5
Phone: (780) 790-1034 Fax: (780) 790-1790
csm@csmengineering.ca

All drainage ditches used for conveying water to the storm ponds will be seeded and/or rip rapped to reduce the amount of sediment that is introduced into the ponds. Silt fencing will be used during construction and until the grass has matured to reduce the amount of sediment being introduced into the ponds.

The ponds will function as storm water retention ponds and as fire water storage ponds. The pond depth is deeper than normal storm ponds because of the fire water storage requirements and hence will provide additional time for sediment to settle out.

Regular maintenance of the inlets and outlets will be required which will generally involve cleaning and repair of any damaged components.

Item 4 Description of Quantity and Quality of Stormwater Discharge

This subdivision will not have a pipe municipal water or sanitary sewage system, hence these services will be provided by truck haul. As a result, property owners will be encouraged to use water recycling for wash bays and make up water from roof leaders. This will reduce the amount of water being conveyed to the storm system.

The two ponds have a combined capacity of 34,700 cubic meters at the 1:100 year storage elevation. Storm pond 2 has a detention time of 53 hours and a maximum outflow rate of 275 l/sec which is slightly less than the allowable rate of 280 l/sec. It is anticipated that the sediment removals will meet or exceed Alberta Environments requirements.

Item 5 Statement of Compliance by Engineer

A statement of compliance stamped by a professional engineer is attached as a separate letter.

Item 6 Emergency Response Plans

The applicant will be responsible for the warranty and maintenance of the system for the first 2 years. The Regional Municipality of Wood Buffalo will be responsible for all operations and maintenance after this time and their emergency response plan will take effect.

The applicant will provide equipment and pumps necessary to control flooding of properties should a breach or failure of the drainage system occur.

Item 7 Potential Environmental Related Objections or Concerns

To the best of our knowledge, there are no known or perceived objections regarding the drainage system.

August 31, 2009

Our File: 339

Your File: 8001

CSM Engineering Ltd.
102 - 9908 Franklin Avenue
Fort McMurray, Alberta
T9H 2K5

Attention: Cliff Maron, P.Eng.

Re: **Rickards Landing - Within Section 1-87-9-W4M**
Storm Runoff Calculations

1.0 Introduction

This letter provides stormwater calculations for Rickards Landing. This industrial development is located about 300 metres east of Highway 63 and immediately south of Secondary Highway 881. The attached plans shows the general layout for the proposed 64 ha development. A creek cuts through the southwest corner of the site and continues northwest for about 400 metres to a 3.8 metre diameter culvert under Highway 63. There is some off-site drainage from the south and east of the site. This will be intercepted by berms and ditches and will be redirected around the site.

The general drainage on the site is from south to north. Near the creek channel located in the southwest corner of the site, the local drainage is towards the creek. An environmental setback has been established to preserve the vegetation within the creek valley. The internal site drainage will be handled by a combination of ditches, swales and culverts. The majority of the site drainage is directed to two stormwater management ponds (see attached plans). The Phase 1 pond controls the drainage from an area of about 30.1 ha. The Phase 2 pond controls the drainage from an area of about 26.0 ha. Therefore, the total area draining to the two ponds is about 56.1 ha.

A small area of about 1.5 ha near the north end of the site will drain to a 300 mm culvert under the service road. During a 1:100 year storm event, this culvert will slow the release from this area and pond water in the road ditch to a depth of about 0.4 metres. The grassed ditches and this slow release through the culvert should provide adequate sediment control to meet Alberta Environment requirements.

The local drainage area to the creek within the southwest corner of the site will not be developed. Therefore, the runoff from this area is the same as predevelopment conditions.

Outflow from the Phase 1 pond will flow to the Phase 2 pond through a 450 mm storm sewer. The hydraulic characteristic of this 450 mm pipe will control the Phase 1 pond outflow. The Phase 2 pond outflow will be controlled by a 345 mm diameter orifice with the orifice invert at 30.61 m, the NWL in the Phase 2 pond. Downstream of this orifice, a 600 mm storm sewer will direct this flow to the creek a short distance upstream of the Highway 63 culvert.

Within the region around Fort McMurray, the peak 1:100 year predevelopment flow is about 5 l/s/ha. Based on a drainage area of about 56 ha to the two ponds, the allowable 1:100 year peak outflow is 280 l/s.

2.0 Storm Drainage Model

The SWMM Program, Version 4.30, was used for the storm drainage modelling. The 1:100 year, 24 hour duration storm for the City of Fort McMurray was used to compute storm runoff. Model parameters are summarized in Table 1. The elevation-area- volume curve for the two ponds are listed in Tables 2 and 3. It is assumed that the industrial site landuse is 30% impervious (buildings, paved roads, paved parking, etc.), 60% gravel (storage areas, gravel parking, etc.), and 10% grass (road ditches, landscape areas, etc.).

3.0 Modelling Results

Modelling of the storm drainage system was conducted for the 1:100 year, 24 hour duration storm. Table 4 lists the peak water elevation, the peak outflow, and time required after the end of the design storm to drain the pond to within 0.10 metes of the normal water level.

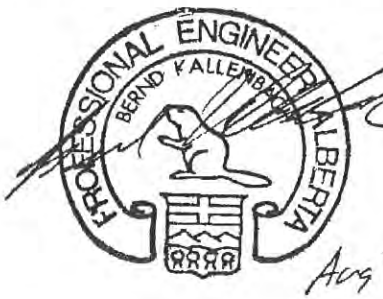
The peak 1:100 year water level in the Phase 1 pond is 32.93 metres. This provides a 0.51 metre freeboard. The peak 1:100 year outflow from the Phase 1 pond is 125 l/s. The pond takes about 33 hours after the end of the design storm event to drain to within 0.10 metres of the normal water level. Therefore, this pond has adequate capacity to handle subsequent storm events. This long retention time will allow this pond to easily meet the sediment removal requirements set by Alberta Environment.

The peak 1:100 year water level in the Phase 2 pond is 32.28 metres. This provides a 0.83 metre freeboard. The peak 1:100 year outflow is 275 l/s which is slightly below the allowable release rate of 280 l/s. The pond takes about 53 hours after the end of the design storm event to drain to within 0.10 metres of the normal water level. Therefore, this pond has adequate capacity to handle subsequent storm events. This long retention time will allow the pond to easily meet the sediment removal requirements set by Alberta Environment.

4.0 Closure

I appreciate the opportunity to undertake this work for you. Please call if you have any questions about the above material.

Sincerely,



Aug 31, 2009

Bernie Kallenbach, M.Eng., P.Eng.
President

TABLE 1
SWMM Model Parameters

Parameter	Value
Percent Imperviousness	
Industrial	30%
Manning's n	
Impervious Surface	0.015
Pervious Surface	0.25
Detention Storage	
Impervious Surface	1.0 mm
Pervious Surface (Grass)	5.0 mm
Pervious Surface (Gravel)	10.0 mm
Ground Infiltration (Horton Equation)	
Landscaped areas and ditches (grass)	
Initial Rate	75 mm / hr
Final Rate	3 mm / hr
Decay Rate	.00115 / sec.
Industrial (gravel)	
Initial Rate	25 mm / hr
Final Rate	1.5 mm / hr
Decay Rate	.00115 / sec.

BK HYDROLOGY SERVICE
5610 - 56A Street, Beaumont, Alberta, T4X 1A7
Phone (780) 929 8325

TABLE 2
Phase 1 Pond Elevation-Area-Volume Curve

Elevation (m)	Area (ha)	Volume (m^3)
29.14 (Bottom)	0.16	0
30.14	0.32	2,400
31.14 (NWL)	0.50	6,500
32.14	0.69	12,500
32.93 (1:100 Year)	0.85	18,600
33.14	0.92	20,500
33.44 (Freeboard)	0.96	23,300

TABLE 3
Phase 2 Pond Elevation-Area -Volume Curve

Elevation (m)	Area (ha)	Volume (m^3)
28.61 (Bottom)	0.16	0
29.61	0.29	2,300
30.61 (NWL)	0.45	6,000
31.61	0.63	11,400
32.28 (1:100 Year)	0.78	16,100
32.61	0.84	18,700
33.11 (Freeboard)	0.95	23,200

BK HYDROLOGY SERVICE
5610 - 56A Street, Beaumont, Alberta, T4X 1A7
Phone (780) 929 8325

TABLE 4
1:100 Year Storm Runoff Results

	Phase 1 Pond	**Phase 2 Pond**
Peak Water Elevation (m)	32.93	32.28
Peak Outflow (l/s)	125	275
Time to Drain to within 0.10 metres of NWL after the End of the Storm (hrs)	33	53

BK HYDROLOGY SERVICE
5610 - 56A Street, Beaumont, Alberta, T4X 1A7
Phone (780) 929 8325

Table of Contents

1 Introduction

1.1 BACKGROUND

Wood Buffalo South Industrial Ltd retained CSM Engineering Ltd to complete the detailed design for the Industrial Subdivision on W1/2-1-87-9-4.

Wood Buffalo South Industrial Ltd plan to develop a new rural industrial subdivision that will meet the requirements of the amended Highway 63/881 Corridor Area Structure Plan.

An approved Tentative Plan of Subdivision currently exists and this design brief is intended to provide design information as it applies to the plan of subdivision.

1.2 PURPOSE

The purpose of this engineering design brief is to provide a summary of the design standards and concepts that have been used in the detailed design of the subdivision.

1.3 LOCATION

As shown in the Key Plan, the subdivision is located adjacent to the Alberta Transportation truck weigh station near the junction of Highway 881 and Highway 63.

The proposed subdivision is bounded by Highway 881 to the north, undeveloped SRD lands to the south and east, and the Alberta Transportation truck weigh station to the west.

1.4 EXISTING AREA CONDITIONS

The site has been cleared and stripped in preparation for the site development component of the project.

2 Design Criteria

The guidelines outlined in the RMWB Engineering Services Standards will be referenced for the design of the design of the water system, sanitary sewer system, storm water management system, and roadways. Generally, these guidelines are as stated in the sections below.

This is a rural industrial subdivision and will be serviced with power, telephone, roadways, applicable storm water drainage systems, and fire flow storage. Individual property owners will be responsible for providing holding tanks for water and sanitary sewer.

2.1 TRANSPORTATION

- Minimum pavement structure (Rural Residential)
  - Collector Road:
    - Asphalt Concrete Pavement 120 mm
      - Staged Paving – 70 mm Base
        50 mm Final
    - Granular Base Course 300 mm
    - Granular Sub-base 300 mm
    - Subgrade Preparation 300 mm
    - All roads will be constructed to the above standard.
- Right of Way Width – 30 m
- Max/Min Gradient
  - Collector Road – 8 – 10%/0%
  - Local Road – 10-13%/0%
- Minimum Culvert Size
  - Across Roadway 500 mm
  - Across Industrial Driveway 400 mm

2.2 WATER SYSTEM

- Individual owners will be required to supply their own storage of water in the form of holding tanks. Minimum size of tanks will be 4,500 liters.

2.3 SANITARY SEWER SYSTEM

- Individual owners will be required to supply their own storage of sewage in the form of holding tanks. Minimum size of tanks will be 9,000 liters.

2.4 STORMWATER MANAGEMENT SYSTEM

- Stormwater runoff generated from within the subdivision shall be routed through two stormwater management facilities as required to regulate the rate of outflow and provide cleansing prior to discharge.
- The Minor System will consist of open channels (ditches) and water courses that convey flows of 5 year return frequency without surcharging.
- The Major System will consist of surface flood paths, roadways, parkways and water courses which convey flows of a 100 year return frequency.
- The coefficient of runoff "c" for a 1:5 year event return period shall be:
    - 0.15 for Low Density Rural Industrial and 0.95 for asphalt, concrete and roofs.
- Stormwater Management Facility Design will:
    - Provide adequate storage to control flows from the development area to pre-development flows.
    - Provide retention for water quality control.
    - Reduce the potential for downstream flooding and erosion.
    - The bottom 2 meters of each pond will store water for fire flow protection.

3 Design

3.1 SITE GRADING

3.1.1 General

In general the existing topography and drainage patterns will not be severely altered in order to provide drainage. The intent of the subdivision is to provide a variety of lots sizes for industrial uses. Lot grading has been set for each lot to ensure that overland flow patterns are established.

3.2 TRANSPORTATION

3.2.1 General

The transportation network within the subdivision will consist of a main collector roadway (service road running parallel to Highway 881) from the Highway 881 access to the subdivision and internal local roads to provide access to the individual properties.

The roadway right of way will be 30 meters for the collector and local roads. All roads are designed to RMWB rural cross-section requirements with the exception of the ditch bottom which has been reduced to 2.75 meters from the RMWB standard of 3.0 meters..

3.2.2 Collector Road (Service Road)

The service road will be a rural cross-section with a 9 meter paved surface. The ditch cross section has been reduced to 2.75 meters from 3 meters to ensure that the road cross section fits within the 30 meter right of way.

3.2.3 Local Roads

The local roads will have a rural cross-section with an 8 meter paved surface. The ditch cross section has been reduced to 2.75 meters from 3 meters to ensure that the road cross section fits within the 30 meter right of way.

3.2.1 Approaches

Approaches typically will have a 10 meter paved surface and 10 meter turning radii. All approaches will be paved to property line. Currently we have allowed for 1 approach per lot that will be located at the middle of the lot. Locations may change at the individual development permit application phase.

3.3 WATER SYSTEM

3.3.1 General

Water service will be provided by storage tanks. Each property owner will be responsible for supplying and installing storage tanks to RMWB standards and specifications.

3.4 SANITARY SEWER SYSTEM

3.4.1 General

Sanitary sewer service will be provided by storage tanks. Each property owner will be responsible for supplying and installing storage tanks to RMWB standards and specifications.

3.5 STORMWATER MANAGEMENT and FIRE FLOW STORAGE

3.5.1 Storm Water Management

The project has been split into two drainage basins. The storm retention ponds will store water for the 1:100 year storm events and will also store water for fire protection. RMWB Fire Protection Services indicated that they would require 2 locations to service the development with fire protection.

BK Hydrology will be providing a detailed report and design recommendations for the storm water management and will be submitting the report to Alberta Environment for approval.

3.5.2 Fire Flow Storage

Fire flow storage requirements are calculated as follows:

1. Equivalent population for 60 hectares of industrial is 1950 people.
2. Average daily water demand is 760.5 m^3 per day.
3. Peak daily demand at 2 times the average daily demand is 1521 m^3 per day.
4. Fire flow storage requirements are based on RMWB fire flows (14 m^3/min X 4 hours or 3360 m^3, plus 25% of the peak day demand (380 m^3) plus 15% of the average daily demand (114 m^3) for a total storage requirement of 3,854 m^3.

The storm water management facilities will be designed to accommodate the required fire flow storage plus an allowance for 1 meter of ice.

Each pond will have 2,446 cubic meters of storage from the bottom of the ice to the bottom of the pond. Each pond will have a clay liner compacted to 100% SPD.

3.5.3 South Drainage Basin

Stormwater from the south drainage basin will be conveyed through grassed ditches to discharge channels as shown on Drawing LG01. The discharge channels will have a series of ditch blocks to reduce the flow velocity and to provide storage for the 1:100 year event. The discharge rate is set at the 1:5 pre-development flows.

4 Summary of Deviation

The following is intended to summarize the locations where deviations from the RMWB standards are sought.

4.1 Transportation

A deviation is requested to reduce the ditch bottom from 3 meters to 2.75 meters. The deviation is required to ensure that the road cross section fits within the 30 meter road right of ways.

ISL Engineering and Land Services

Inspiring sustainable thinking

Wood Buffalo South Industrial Park Ltd.

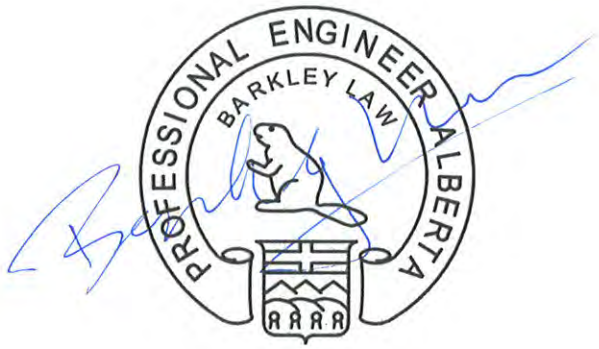
Final Report

Rickards Landing Traffic Impact Assessment

February, 2011

Corporate Authorization

This document entitled "Rickards Landing Traffic Impact Assessment" has been prepared by ISL Engineering and Land Services (ISL) for the use of Wood Buffalo South Industrial Park Ltd. The information and data provided herein represent ISL's professional judgment at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without the express written consent of ISL.



February 18, 2011

Barkley Law, P.Eng.

PERMIT TO PRACTICE

ISL Engineering and Land Services Ltd.

Signature _____

Date Feb 23, 2011

PERMIT NUMBER: P 4741

The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Table of Contents

Exhibits

Tables

Appendices

1.0 Introduction

ISL Engineering & Land Services Ltd. was retained by Wood Buffalo South Industrial Park Ltd. to undertake a Traffic Impact Assessment (TIA) in support of the proposed Rickards Landing light industrial development in the Regional Municipality of Wood Buffalo (RMWB). Rickards Landing is located at the southeast corner of the Highway 881 / Highway 63 intersection on Sec.1 Twp.87 Rge.9 W.4 south of Fort McMurray, Alberta. As shown in the site plan in Exhibit 1.1, the proposed development consists of 25 lots with a total area of 130 acres. 14 lots (approximately 70 acres) are anticipated to be built in Phase 1 (2011) and the remaining 11 lots will be completed in Phase 2 (2012). Access to the proposed development is via an existing access road off Highway 881 located approximately 1.7 km east of Highway 63. The access road currently services the residential development located to the north of Highway 881.

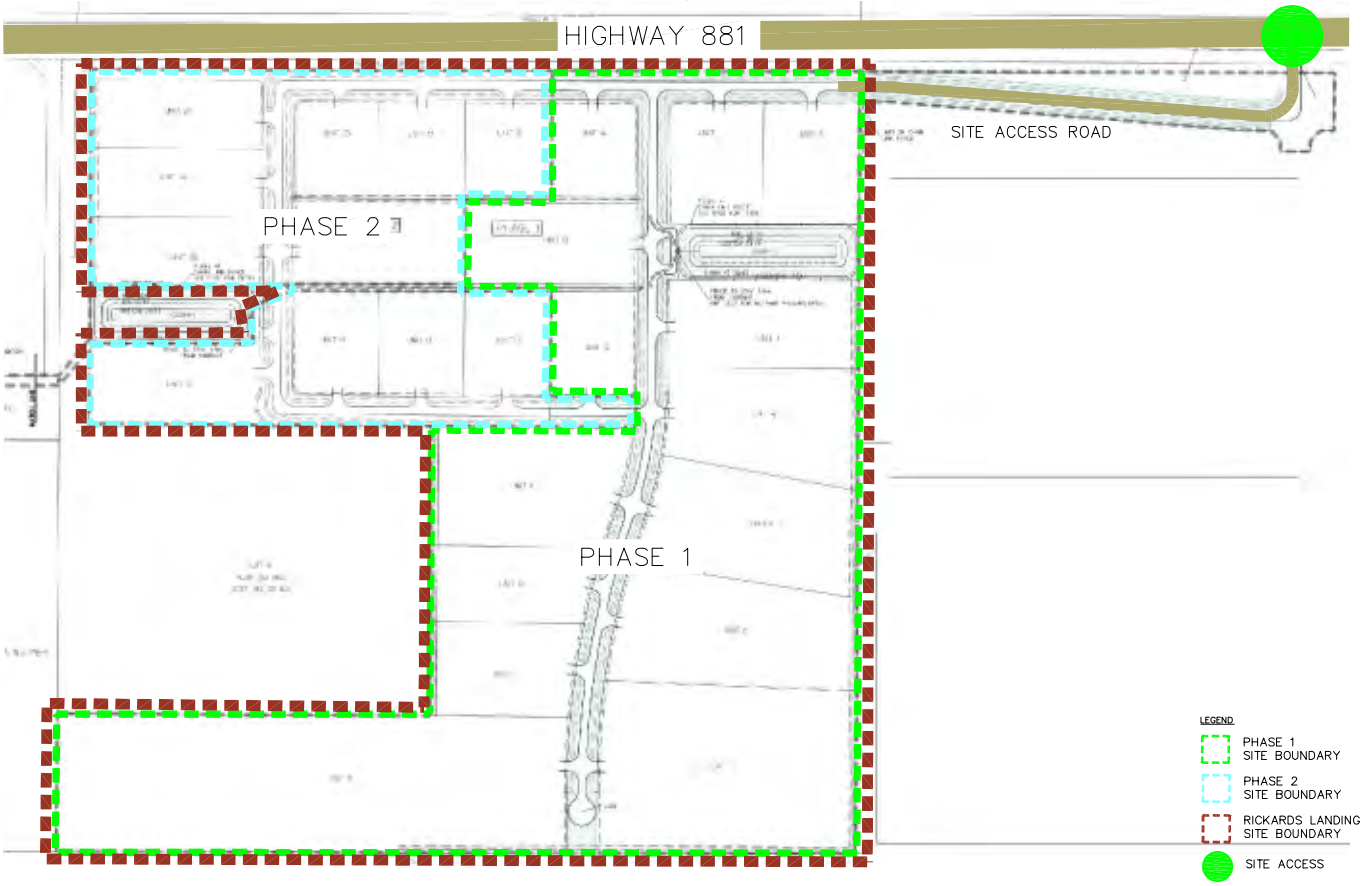
1.1 Study Objectives

The objectives of this study were to analyze the intersections of Highway 881 / Highway 63 and Highway 881 / Access Road in the 2011, 2012, and 20-year (2032) horizons with and without the traffic generated by Rickards Landing. Traffic signal, right turn, left turn and illumination warrants were also performed at both intersections in all three horizons. From the analyses, any road network improvements required to accommodate traffic demand were identified.

1.2 Study Methodology

The scope of work and methodologies of the study were confirmed with Alberta Transportation (AT) in emails dated November 29, 2010 and February 3, 2011 (refer to Appendix A) and included the following tasks:

- Review of background information within the study area.
- Conduct a traffic count at Highway 881 / Highway 63 in the AM, Noon and PM peak hours.
- Apply a highway growth factor of 15% per year (linear) obtained from the AT's website to forecast future background traffic volumes in all three horizons.
- Estimate the trip generation from the development using the trip rates from a light industrial trip generation study in Grande Prairie, Alberta.
- Analyze Scenario 1: 2011 horizon background
- Analyze Scenario 2: 2011 horizon background and Phase 1 Rickards Landing
- Analyze Scenario 3: 2012 horizon background
- Analyze Scenario 4: 2012 horizon background and Phase 1+2 Rickards Landing
- Analyze Scenario 5: 20 year (2032) horizon background
- Analyze Scenario 6: 20 year (2032) horizon background and Phase 1+2 Rickards Landing
- Analyze proposed intersection operations and establish appropriate geometry based on warrant analyses.
- Perform signalization, channelization, and illumination warrants.
- Document and report on the study findings.



ISL Engineering and Land Services

RICKARDS LANDING TIA

EXHIBIT 1.1

PROPOSED SITE PLAN

ISL referred to the information provided in the following resource documents:

- Alberta Transportation's (AT), "Highway Geometric Design Guide ", 1999
- AT, "Traffic Impact Assessment Guideline", 2005
- AT website
- RMWB, "Highway 63 / 881 Corridor Area Structure Plan", 2007
- Transportation Association of Canada (TAC), "Canadian Traffic Signal Warrant Matrix Procedure 2007"
- Transportation Association of Canada (TAC) "Illumination of Isolated Rural Intersections 2001"

The "Highway 63 / 881 Corridor Area Structure Plan" is a study that was commissioned by the Regional Municipality of Wood Buffalo in 2007. The study identified locations along Highways 63 and 881 (from the south of Fort McMurray to Conklin) where future industrial, residential, and commercial, recreation, and tourism growth could be developed. As identified in the study (refer to Appendix B), business industrial lands and commercial crossroads were identified at the northeast corner of the Highway 881 / 63 intersection, across from the subject development. In addition to the preceding development growth, the study also identified an interchange at the Highway 63 / Highway 881 intersection. The interchange has also been confirmed with AT, but no construction timeline was identified.

2.0 Design Traffic Volumes and Road Network

2.1 2011 and 2012 Road Network

For the 2011 and 2012 horizon analyses, the existing lane configurations on Highways 881 and 63 were used and were assumed to be unchanged.

Currently, the Highway 881 / Highway 63 intersection is an unsignalized T-intersection with stop sign control on the east leg. Highway 63 is a four-lane divided highway, while Highway 881 is a two-lane highway. There is a southbound left turn bay, a westbound right turn bay with acceleration lane and a northbound right turn bay with acceleration lane at the intersection. The posted speed limits of Highway 63 and Highway 881 are 110 km/h and 100 km/h, respectively.

The Highway 881 Access is an unsignalized intersection with Type IIIb treatment in the westbound direction and Type IIb treatment in the eastbound direction. There are also an eastbound right turn bay and a westbound left turn bay at the intersection. The north and south approaches are stop-controlled.

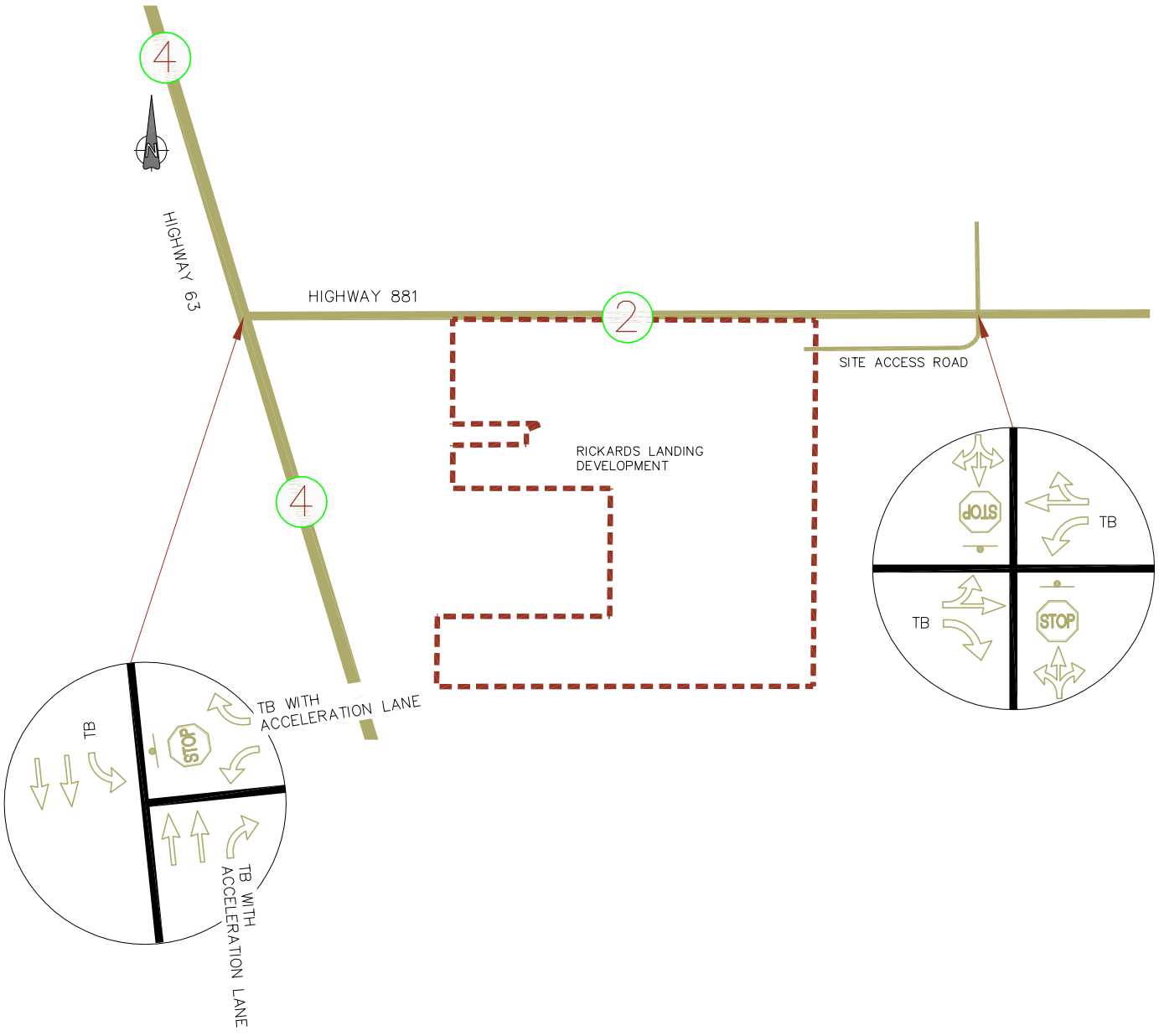
The existing lane configurations and traffic controls are shown in Exhibit 2.1.

2.2 2011 and 2012 Background Traffic Volumes

Manual traffic counts at Highway 881 / Highway 63 and the Highway 881 Access were conducted by CSM Engineering Ltd. Traffic counts at Highway 881 / Highway 63 for the AM and Noon peak hours were conducted on Monday, November 29, 2010, while traffic counting of the PM peak hours was conducted on Tuesday, November 30, 2010. Furthermore, traffic counts at the Highway 881 Access were conducted at the AM, Noon and PM peak hours on Tuesday, January 11, 2011. The traffic volumes obtained from the Highway 881 / Highway 63 intersection were used as the 2010 background traffic volumes and the traffic volumes obtained from the Highway 881 Access were used as the 2011 background traffic volumes. It is noted that, while Monday is not a typical traffic counting day in urban environments, the Monday morning count in this case represents the time period when oil sands workers travel to commence their weekly work shift. Thus the counts are conservative and adequately reflect the Highway's peak traffic event.

During the six hour traffic counts at the Highway 881 Access, only 2 inbound trips and 1 outbound trip in the PM peak were observed to/from the north leg. Also, since there is a weigh scale site between the Highway 881 Access and Highway 63, no adjustment was made to balance traffic volumes between the two intersections, with the difference between the two being minor.

To forecast the 2011 and 2012 background traffic volumes, a highway growth rate of 15% per year (linear) was applied to the 2010 background traffic volumes. This growth rate was obtained from the 10 year traffic volume data at Highway 881 / Highway 63 and was also confirmed by AT in the scope of work. The 2011 and 2012 background traffic volumes are shown in Exhibit 2.2. It is noted that, in 2011 and 2012, the commercial crossroad and business industrial growth areas (located at the northeast corner of Highway 881 / 63) as identified in the ASP were assumed to remain undeveloped.



LEGEND

TB = TURN BAY

= SITE BOUNDARY

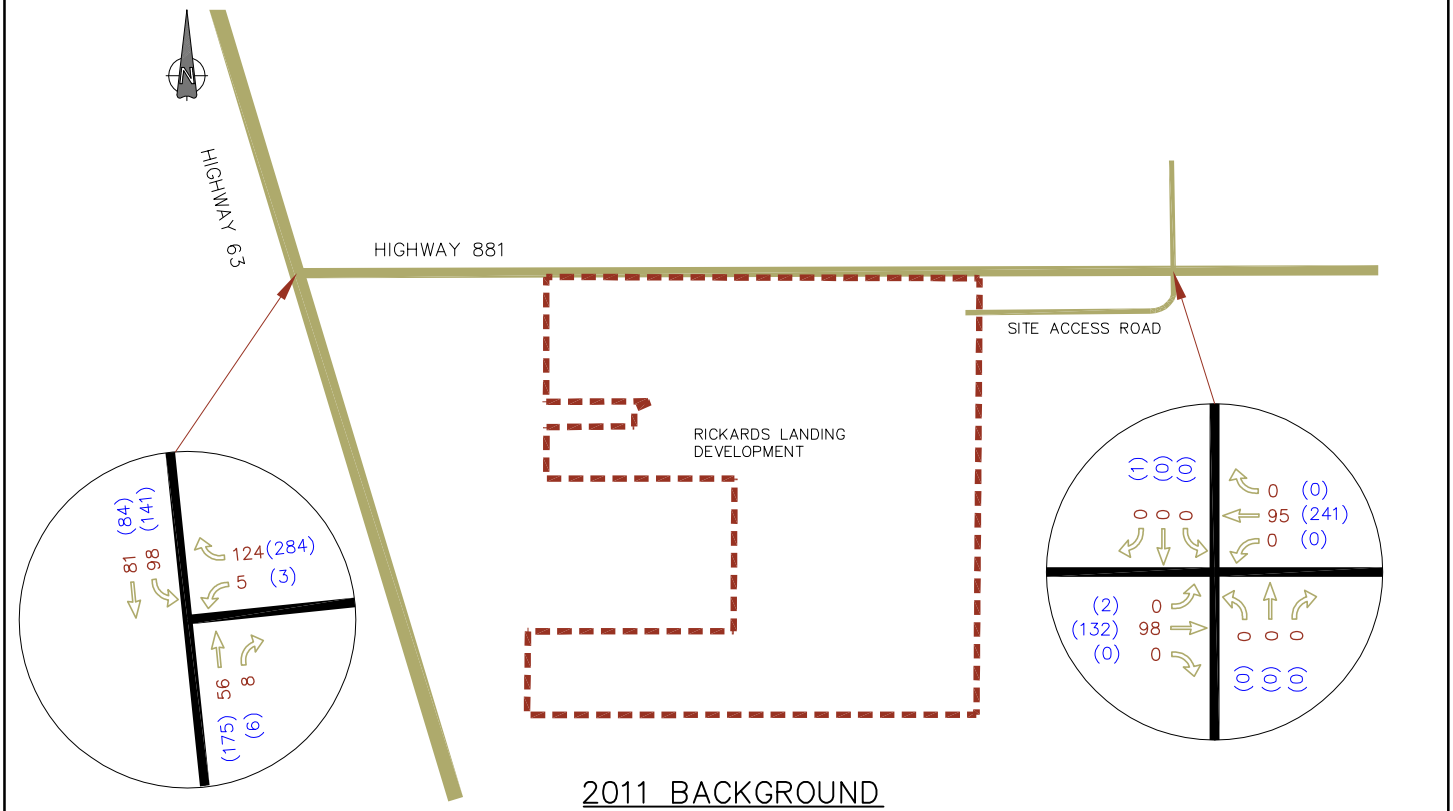
4 = NUMBER OF LANES

ISL Engineering and Land Services

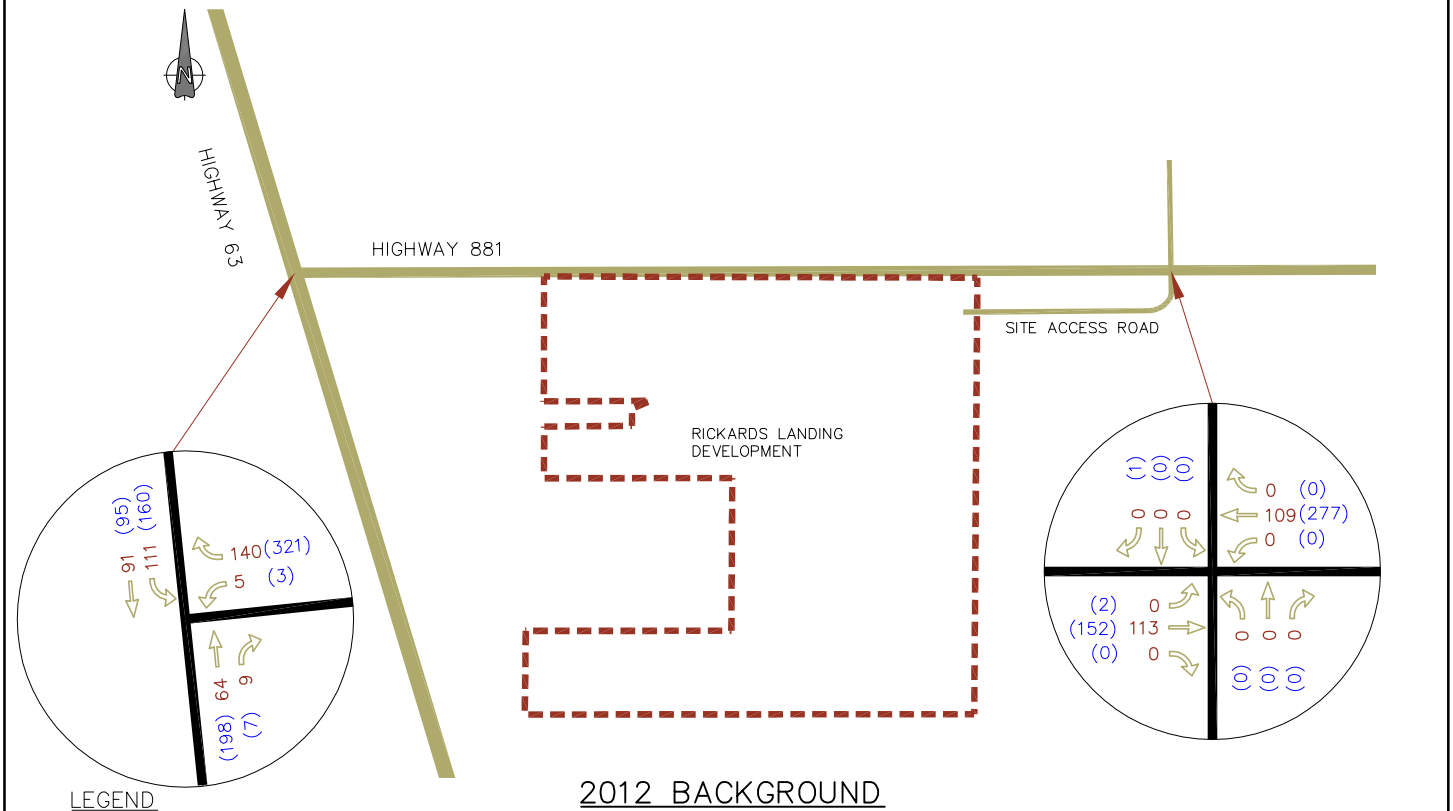
RICKARDS LANDING TIA

EXHIBIT 2.1

EXISTING LANE CONFIGURATIONS
& TRAFFIC CONTROLS



2011 BACKGROUND



2012 BACKGROUND

LEGEND

= SITE BOUNDARY

999 = AM PEAK

(999) = PM PEAK

ISL Engineering and Land Services

RICKARDS LANDING TIA

EXHIBIT 2.2

2011 & 2012 BACKGROUND
PEAK HOUR TRAFFIC VOLUMES

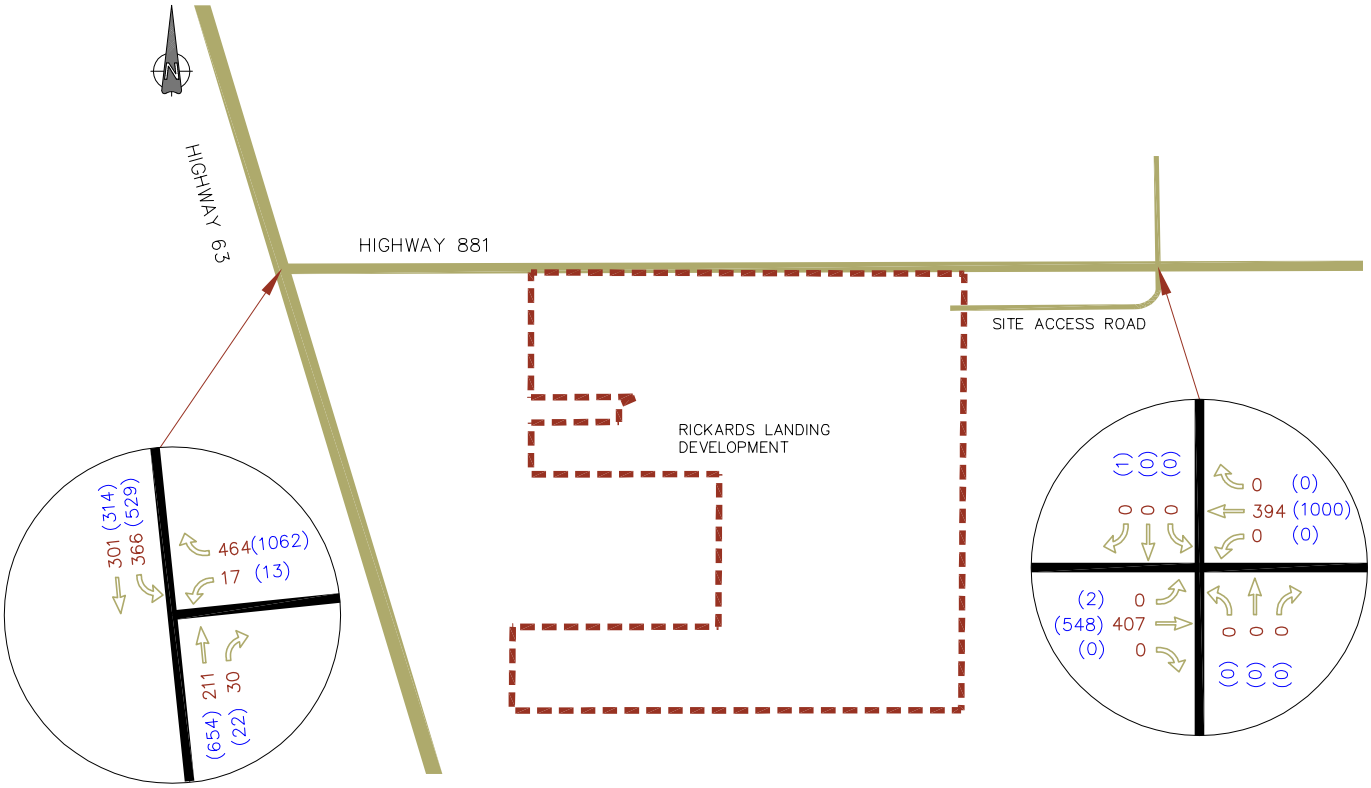
2.3 2032 Road Network

In the Highway 63 / 881 Corridor ASP, an interchange at Highway 881 / Highway 63 and future development in the northeast corner of the interchange were identified. However, the ASP did not identify the amount of additional traffic the growth would generate, the construction timing of the interchange, or access to the growth areas. Due to the lack of information in the ASP, the following assumptions were made:

- Based on the current traffic volumes and the 15% yearly growth rate, the traffic volumes on Highway 881 would exceed the highway twinning threshold of 12,000 vehicles per day (vpd) by 2026 (with or without the subject Rickards development). Therefore, by the 2032 horizon, it was assumed that Highway 881 will have been twinned through this section.
- From AT's Design Guide, Highway 63 is classified as a Multi-Lane highway and Highway 881 is classified as a Major 2 Lane Highway. It was assumed that access to the ASP developments is likely on the lower class roadway, Highway 881. Given the need to maintain suitable spacing from the future interchange ramps, it was assumed that no intermediate access would be approved, and that all access would be via the north leg of the Rickards Landing intersection on Highway 881.
- The ASP indicated that an interchange would be required at Highway 881 / 63 to accommodate the additional traffic from the identified growth areas. However, no interchange construction timing and development timing were provided in the ASP. To avoid making false development assumptions on the ASP growth areas, the growth areas of the ASP were assumed to remain undeveloped in the 2032 horizon of this TIA, and that Highway 881 / Highway 63 would remain an at-grade intersection.
- If the ASP growth areas are to be developed prior to the 2032, a TIA update would be required to be conducted by the developer of the latter development, which remains undefined. Presumably, this major development would trigger the requirement for the interchange, which in turn would provide significant additional network capacity, well in excess of the minor Rickards Landing volumes under consideration here.

2.4 2032 Background Traffic Volumes

Similar to the 2011 and 2012 background traffic volumes, the 2032 background traffic volumes were calculated by applying the 15% per year linear growth rate (see Exhibit 2.3). Given that the growth rate is reflective of "boom" conditions in Fort McMurray in the mid- to late-2000s, this is a highly conservative assumption, and is expected to accommodate theoretical growth well in excess of any growth associated with initial development of the northeast ASP area.



LEGEND

= SITE BOUNDARY

999 = AM PEAK

(999) = PM PEAK

ISL Engineering and Land Services

RICKARDS LANDING TIA

EXHIBIT 2.3

2032 BACKGROUND
PEAK HOUR TRAFFIC VOLUMES

3.0 Trip Generation and Distribution

3.1 Trip Generation Study

The Rickards Landing development is located in a rural area south of Fort McMurray and no water services will be provided to the subject development. Typically, the light industrial rates from the ITE Trip Generation Manual are used to generate traffic; however the ITE rates are for light industrial developments in an urban environment with full utility servicing. Therefore, the ITE rates are not characteristic of the subject development. To forecast traffic of the Rickards Landing development, trip generation studies were carried out on similar rural light industrial developments.

In 2003, ISL conducted a trip generation study on the Brochu light industrial development located at the west end of Grande Prairie, Alberta. The Brochu development consists of storage yards, a truck dealership, and some small office uses. In addition, water services are provided to the full Brochu site. The data of the trip generation study is shown in the scope of work email in Appendix A and the trip generation rates developed from the study are as follow:

- AM: 2.58 trips / acre, 66% In, 34% Out
- PM: 2.79 trips / acre, 39% In, 61% Out

Another light industrial trip generation study was completed by ISL from December 14 to 16, 2010 at the north end of Grande Prairie to check the validity of the Brochu trip rates. The studied area (partial area with water services) is a light industrial area and consists mainly of storage yards located at the southeast corner of Highway 43 / 148 Avenue (refer to Appendix C). The full study results are shown in Appendix C and summarized below:

- AM: 1.40 trips / acre, 64% In, 36% Out
- PM: 1.44 trips / acre, 35% In, 65% Out

Since the Rickards Landing development does not have any water services but the above studied areas do, a third trip generation review was performed at a comparable rural site that has no water services. The trip generation study was completed by ISL from January 11 to 20, 2011 at the south end of Grande Prairie (northeast corner of Highway 668 / Range Road 61). The studied area consists mainly of storage yards and no water services are provided to the area. The full study results are shown in Appendix C and summarized below:

- AM: 0.80 trips / acre, 78% In, 22% Out
- PM: 0.75 trips / acre, 23% In, 77% Out

When the three trip generation rates are compared, the Highway 668 / Range Road 61 rates are the lowest, but also the most representative of the type of low-intensity development anticipated at this location. In comparison, the other studied sites include a mix of uses such as truck dealerships and offices, which could not be supported on the Rickards Landing site due to lack of servicing.

As confirmed with AT in an email dated February 3, 2011 (See Appendix A), the Highway 668 / Range Road 61 rates were agreed to be comparable to the proposed land use in this study, and could be applied directly without averaging the three sites.

3.2 Trip Generation

Using the Highway 668 / Range Road 61 light industrial rates, the trips as generated by the subject Rickards Landing development are summarized in Table 3.1 below.

Table 3.1 Trip Generation

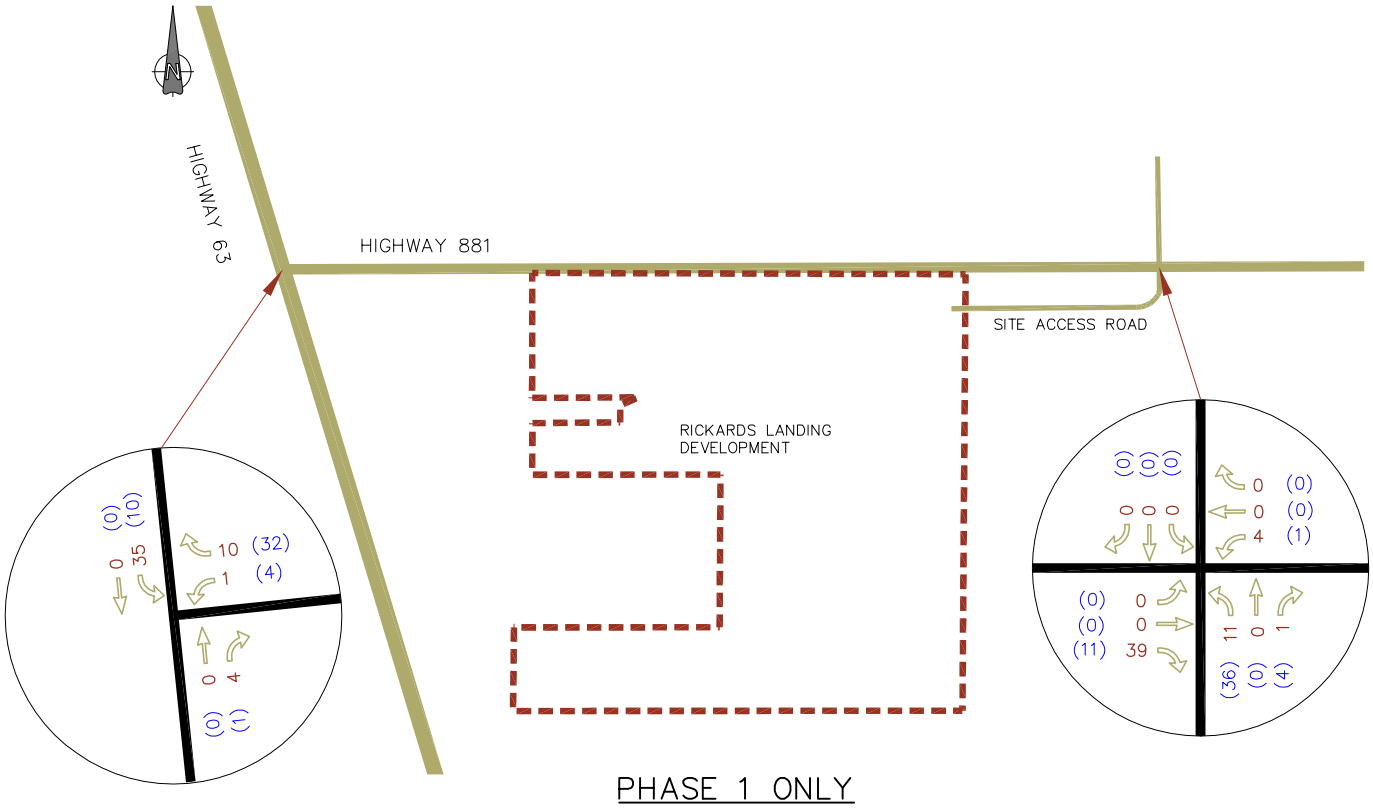
Horizon	Land Use	Size (Acre)	AM Peak			PM Peak		
			Rate Trips/Acre	Total Trips	Trips In/Out	Rate Trips/Acre	Total Trips	Trips In/Out
Phase 1	Light Industrial	70	0.80	56	44/12	0.75	53	12/40
Phase 2	Light Industrial	60	0.80	48	37/11	0.75	45	10/35
Total		**130**		**104**	**81/23**		**98**	**22/75**

3.3 Trip Distribution

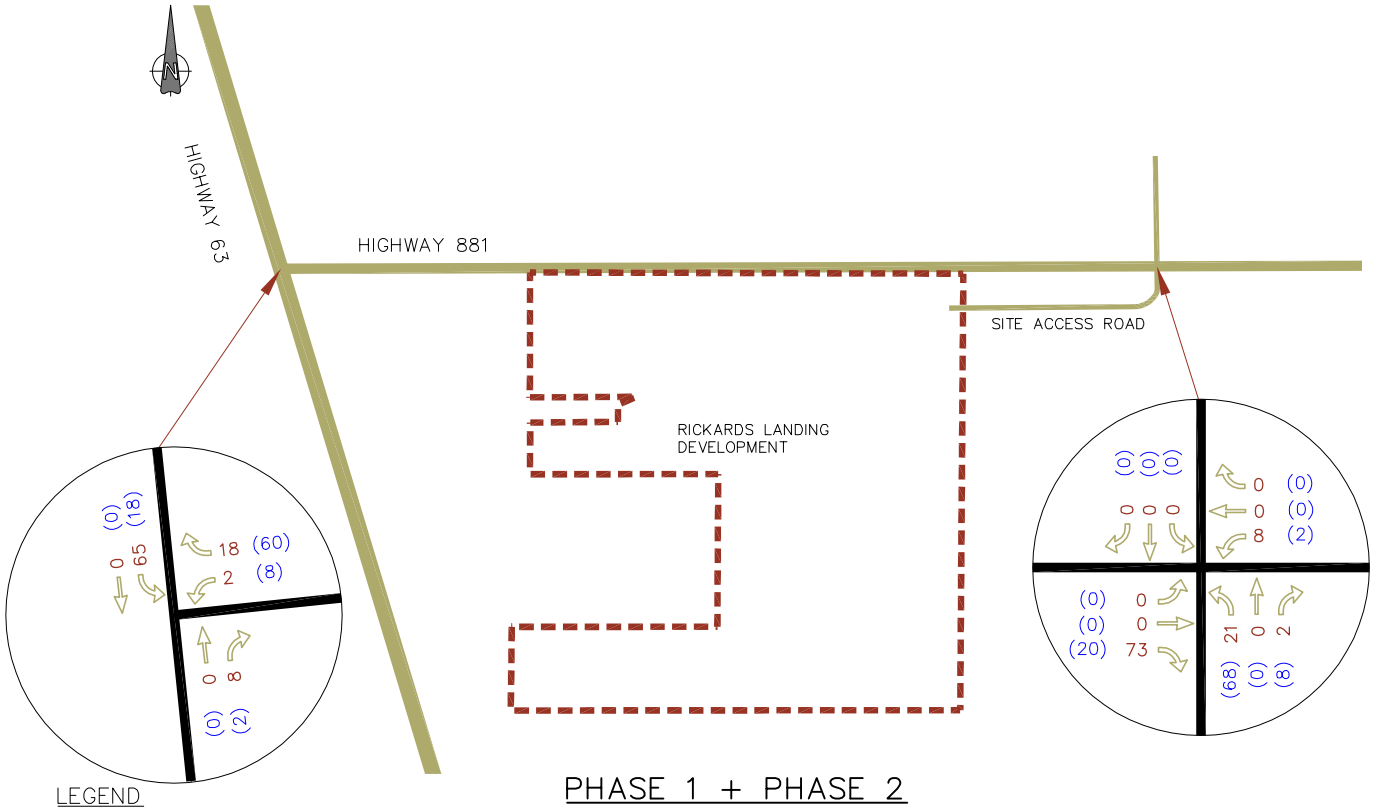
As confirmed with AT, the existing traffic patterns at Highway 881 / Highway 63 were used for distribution or the development generated traffic. In both the AM and PM peaks, 80% of the total trips were distributed to/from Highway 63 north, 10% to/from Highway 63 south, and 10% to/from Highway 881 East. The preceding trip distribution rates were applied to the generated trips in Table 3.1 and the site generated traffic of Rickards Landing for 2011, 2012, and 2032 are shown in Exhibit 3.1.

3.4 Final Trips

To generate the “background + site generated” volumes, the “background” volumes were combined with the “site generated” volumes. The final design volumes for the 2011, 2012 and 2032 horizons are thus shown in Exhibits 3.2 and 3.3.



PHASE 1 ONLY



PHASE 1 + PHASE 2

LEGEND

= SITE BOUNDARY

999 = AM PEAK

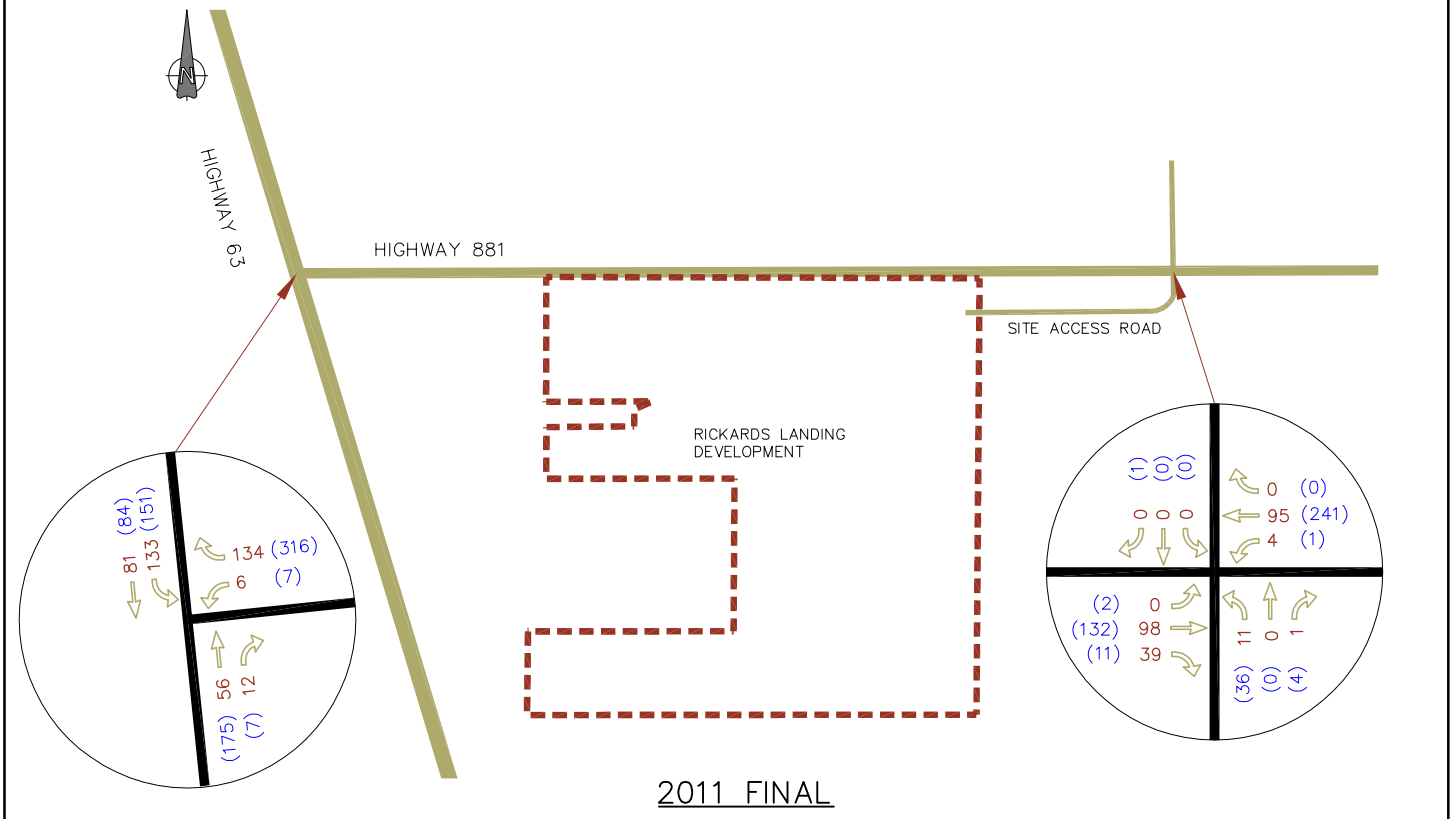
(999) = PM PEAK

ISL Engineering and Land Services

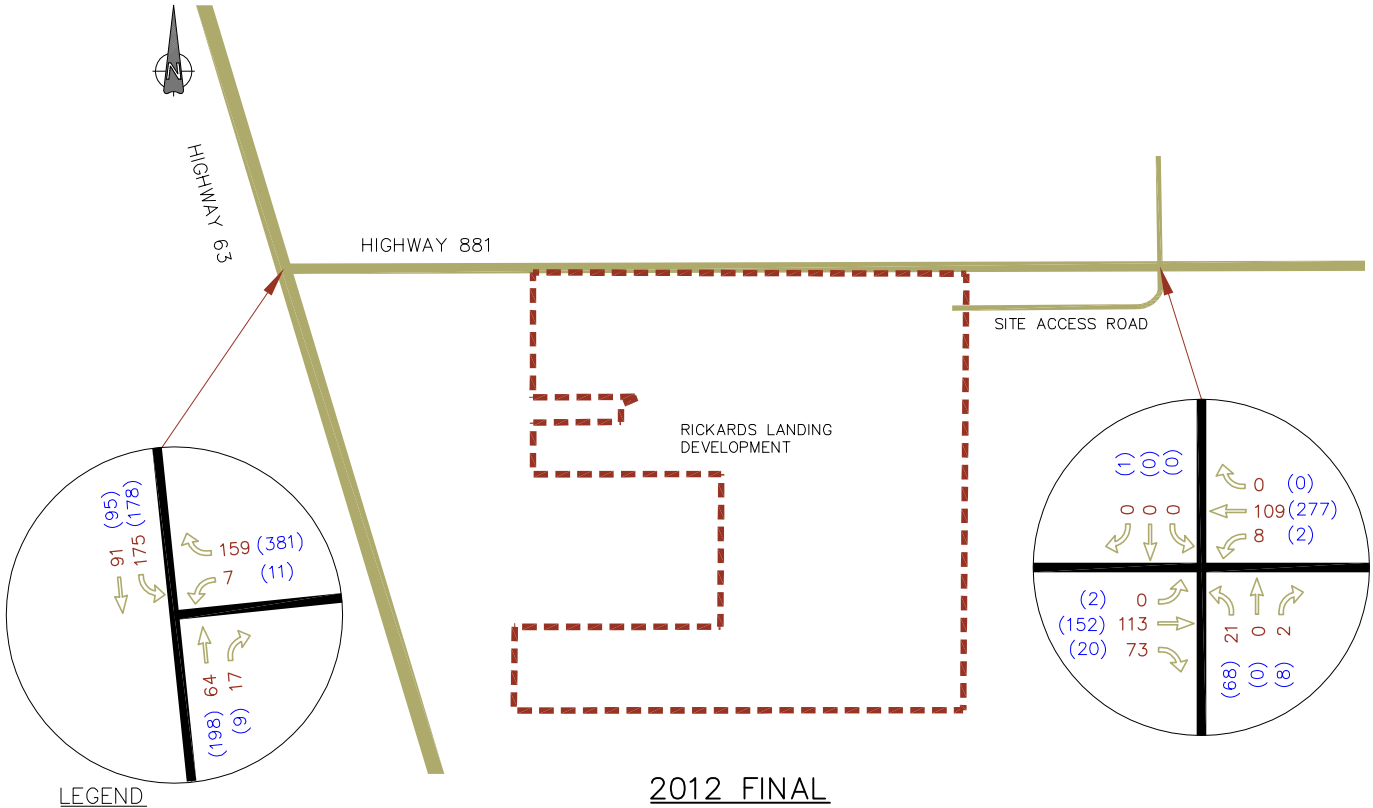
RICKARDS LANDING TIA

EXHIBIT 3.1

PHASE 1 & 2 SITE GENERATED
PEAK HOUR TRAFFIC VOLUMES



2011 FINAL



2012 FINAL

LEGEND

= SITE BOUNDARY

999 = AM PEAK

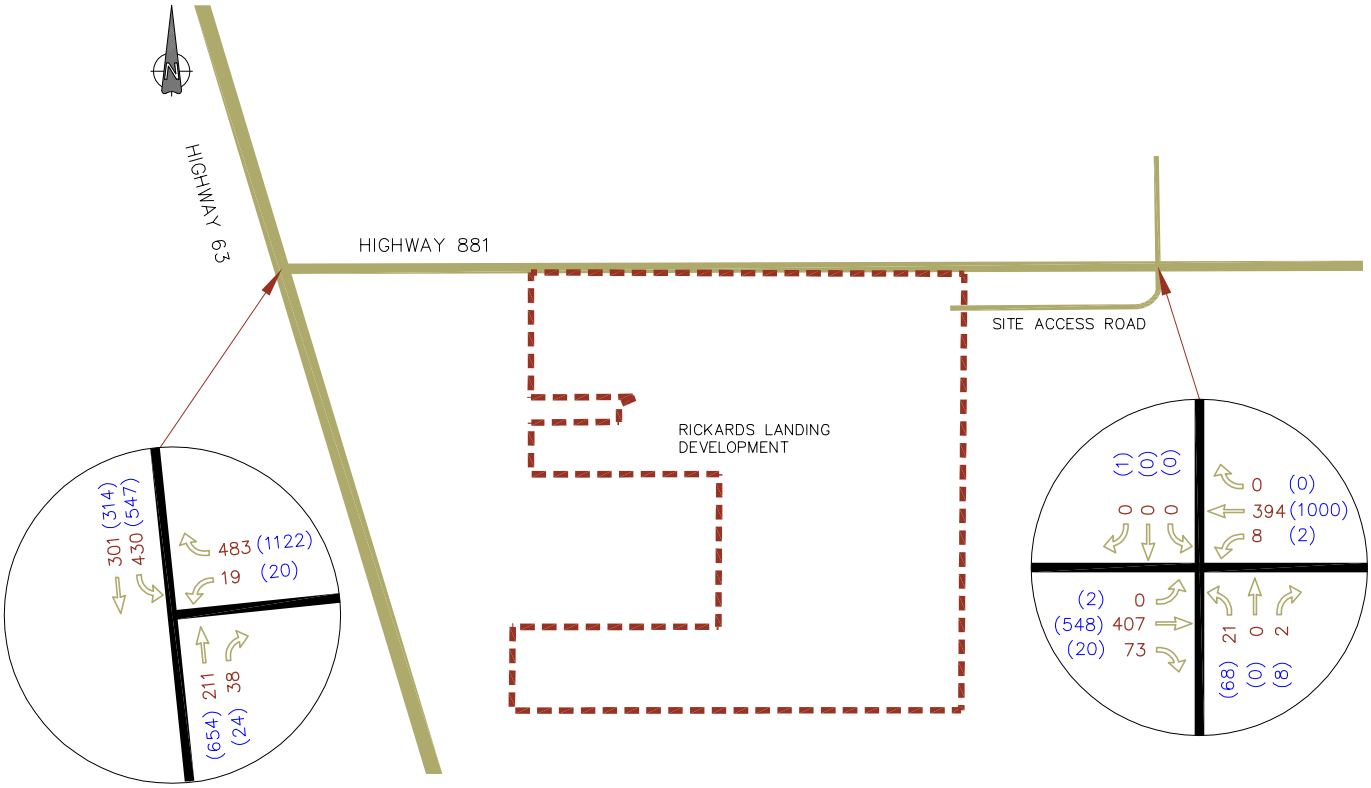
(999) = PM PEAK

ISL Engineering and Land Services

RICKARDS LANDING TIA

EXHIBIT 3.2

2011 & 2012 FINAL
PEAK HOUR TRAFFIC VOLUMES



LEGEND

= SITE BOUNDARY

999 = AM PEAK

(999) = PM PEAK

ISL Engineering and Land Services

RICKARDS LANDING TIA

EXHIBIT 3.3

2032 FINAL
PEAK HOUR TRAFFIC VOLUMES

4.0 Traffic Analysis

4.1 Synchro

The Synchro 7.0 computer analysis package was used to analyze the operational characteristics of the intersections. A Level of Operating Service (LOS) A represents the highest level of service or generally "free flowing conditions" while a LOS F generally represents a "breakdown" or "gridlock" condition in vehicular flow. There are varying degrees of delay and congestion introduced at the intermediate LOS B, C, D, and E levels. LOS D is representative of "normal" peak hour congestion, while LOS E is representative of an intersection nearing its capacity. Typically, LOS D or better is the accepted standard for peak hour operations in rural areas, with LOS E accepted where limited to certain movements. LOS criteria for intersections are based on average delay per vehicle, and are summarized in Table 4.1 below.

Table 4.1 LOS Criteria

LOS	Signalized	Unsignalized
	Average Delay per Vehicle (s/veh)	
A	< 10	< 10
B	10 - 20	10 – 15
C	20 - 35	15 – 25
D	35 - 55	25 – 35
E	55 - 80	35 – 50
F	> 80	> 50

Synchro also calculates each movement's volume to capacity ratio (v/c). A v/c ratio of 1.0 represents an intersection or movement at full capacity with no ability to facilitate extra vehicles. Typically, a v/c ratio of 0.85 or better for all intersection movements is the accepted standard for peak hour operations in rural areas.

Finally, Synchro also calculates the 95th percentile vehicle queue length for each intersection movement, which provides the criteria for left and right turn storage requirements. This queue length is exceeded 5% of the time, which is accepted practice for normal peak hour operation in rural areas.

The following scenarios were analyzed:

- **Scenario 1:** 2011 horizon background
- **Scenario 2:** 2011 horizon background and Phase 1 Rickards Landing
- **Scenario 3:** 2012 horizon background
- **Scenario 4:** 2012 horizon background and Phase 1 & 2 Rickards Landing
- **Scenario 5:** 20 year (2032) horizon background
- **Scenario 6:** 20 year (2032) horizon background and Phase 1 & 2 Rickards Landing

4.2 Scenario 1: 2011 Background

The 2011 Background traffic volumes are analyzed with the current lane configurations as outlined in Section 2.1. The complete Synchro results are shown in Appendix D and summarized in Table 4.2.

Table 4.2 Scenario 1 Synchro Results

INTERSECTION / MOVEMENT			Scenario 1: 2011 Background					
			AM Peak			PM Peak		
			v/c Ratio	LOS	Queue Length 95th (m)	v/c Ratio	LOS	Queue Length 95th (m)
Hwy 63 / Hwy 881 (Unsignalized)	WB	LT	0.12	A	3.2	0.31	B	10.1
		RT	0.12	A	3.2	0.31	B	10.1
	NB	TH	0.02	A	0.0	0.05	A	0.0
		RT	0.00	A	0.0	0.00	A	0.0
	SB	LT	0.07	A	1.6	0.11	A	2.7
		TH	0.02	A	0.0	0.02	A	0.0
Hwy 881 Access (Unsignalized)	EB	LT/TH	0.00	A	0.0	0.00	A	0.0
		RT	-	-	-	-	-	-
	WB	LT	-	-	-	-	-	-
		TH/RT	0.06	A	0.0	0.14	A	0.0
	NB	LT/TH/RT	-	-	-	-	-	-
	SB	LT/TH/RT	-	-	-	0.00	A	0.0

From Table 4.2, the 2011 Background traffic operated well with good LOS and low v/c ratios in the existing lane configurations and unsignalized intersections.

4.3 Scenario 2: 2011 Background and Phase 1

In Scenario 2, the 2011 Background and Phase 1 traffic volumes are analyzed. Since no roadway upgrades are required in Scenario 1, the existing lane configurations and traffic controls were used in the Scenario 2 analysis. The results of the Synchro analysis of Scenario 2 are shown in Appendix D and summarized in Table 4.3 below.

Table 4.3 Scenario 2 Synchro Results

INTERSECTION / MOVEMENT			Scenario 2: 2011 Background & Phase 1					
			AM Peak			PM Peak		
			v/c Ratio	LOS	Queue Length 95th (m)	v/c Ratio	LOS	Queue Length 95th (m)
Hwy 63 / Hwy 881 (Unsignalized)	WB	LT	0.13	A	3.5	0.35	B	11.8
		RT	0.13	A	3.5	0.35	B	11.8
	NB	TH	0.02	A	0.0	0.05	A	0.0
		RT	0.01	A	0.0	0.00	A	0.0
	SB	LT	0.09	A	2.3	0.12	A	3.0
		TH	0.02	A	0.0	0.02	A	0.0
Hwy 881 Access (Unsignalized)	EB	LT/TH	0.00	A	0.0	0.00	A	0.0
		RT	0.02	A	0.0	0.01	A	0.0
	WB	LT	0.00	A	0.1	0.00	A	0.0
		TH/RT	0.06	A	0.0	0.14	A	0.0
	NB	LT/TH/RT	0.02	A	0.4	0.07	B	1.7
	SB	LT/TH/RT	-	-	-	0.00	A	0.0

From Table 4.3, the 2011 Background and Phase 1 traffic operated well with good LOS and low v/c ratios in the existing lane configurations and unsignalized intersections.

4.4 Scenario 3: 2012 Background

In Scenario 3, the 2012 Background traffic volumes are analyzed. Since no roadway upgrades are required in Scenario 2, the existing lane configurations and traffic controls were used in the Scenario 3 analysis. The results of the Synchro analysis of Scenario 3 are shown in Appendix D and summarized in Table 4.4 below.

Table 4.4 Scenario 3 Synchro Results

INTERSECTION / MOVEMENT			Scenario 3: 2012 Background					
			AM Peak			PM Peak		
			v/c Ratio	LOS	Queue Length 95th (m)	v/c Ratio	LOS	Queue Length 95th (m)
Hwy 63 / Hwy 881 (Unsignalized)	WB	LT	0.14	A	3.7	0.36	B	12.4
		RT	0.14	A	3.7	0.36	B	12.4
	NB	TH	0.02	A	0.0	0.06	A	0.0
		RT	0.01	A	0.0	0.00	A	0.0
	SB	LT	0.08	A	1.9	0.12	A	3.2
		TH	0.03	A	0.0	0.03	A	0.0
Hwy 881 Access (Unsignalized)	EB	LT/TH	0.00	A	0.0	0.00	A	0.0
		RT	-	-	-	-	-	-
	WB	LT	-	-	-	-	-	-
		TH/RT	0.06	A	0.0	0.16	A	0.0
	NB	LT/TH/RT	-	-	-	-	-	-
	SB	LT/TH/RT	-	-	-	0.00	A	0.0

From Table 4.4, the 2012 Background traffic operated well with good LOS and low v/c ratios in the existing lane configurations and unsignalized intersections.

4.5 Scenario 4: 2012 Background and Phases 1 & 2

In Scenario 4, the 2012 Background and Phases 1 & 2 traffic volumes are analyzed. Since no roadway upgrades are required in Scenario 3, the existing lane configurations and traffic controls were used in the Scenario 4 analysis. The results of the Synchro analysis of Scenario 4 are shown in Appendix D and summarized in Table 4.5 below.

Table 4.5 Scenario 4 Synchro Results

INTERSECTION / MOVEMENT			Scenario 4: 2012 Background & Phases 1 & 2					
			AM Peak			PM Peak		
			v/c Ratio	LOS	Queue Length 95th (m)	v/c Ratio	LOS	Queue Length 95th (m)
Hwy 63 / Hwy 881 (Unsignalized)	WB	LT	0.16	A	4.3	0.42	B	16.3
		RT	0.16	A	4.3	0.42	B	16.3
	NB	TH	0.02	A	0.0	0.06	A	0.0
		RT	0.01	A	0.0	0.01	A	0.0
	SB	LT	0.12	A	3.1	0.14	A	3.7
		TH	0.03	A	0.0	0.03	A	0.0
Hwy 881 Access (Unsignalized)	EB	LT/TH	0.00	A	0.0	0.00	A	0.0
		RT	0.04	A	0.0	0.01	A	0.0
	WB	LT	0.01	A	0.1	0.00	A	0.1
		TH/RT	0.06	A	0.0	0.16	A	0.0
	NB	LT/TH/RT	0.03	B	0.8	0.14	B	3.8
	SB	LT/TH/RT	-	-	-	0.00	A	0.0

From Table 4.5, the 2012 Background and Phases 1 & 2 traffic operated well with good LOS and low v/c ratios in the existing lane configurations and unsignalized intersections.

4.6 Scenario 5: 2032 Background

The 2032 Background traffic volumes are analyzed with the future lane configurations as outlined in Section 2.3, where Highway 881 was assumed to be twinned based on the daily traffic exceeding the highway twinning threshold of 12,000 vpd by 2026. The intersections were initially analyzed as unsignalized intersections, however Highway 881 / Highway 63 operated at above capacity and interim signalization was implemented. Signalization at Highway 881 / Highway 63 was also confirmed in the signal warrant in Section 5.1. The complete Synchro results are shown in Appendix D and summarized in Table 4.6.

Table 4.6 Scenario 5 Synchro Results

INTERSECTION / MOVEMENT			Scenario 5: 2032 Background					
			AM Peak			PM Peak		
			v/c Ratio	LOS	Queue Length 95th (m)	v/c Ratio	LOS	Queue Length 95th (m)
Hwy 63 / Hwy 881 (Unsignalized)	WB	LT	0.07	C	1.8	0.16	**F**	4.2
		RT	0.52	B	23.6	**1.68**	**F**	**458.6**
	NB	TH	0.06	A	0.0	0.19	A	0.0
		RT	0.02	A	0.0	0.01	A	0.0
	SB	LT	0.29	A	9.2	0.63	C	34.1
		TH	0.09	A	0.0	0.09	A	0.0
Hwy 63 / Hwy 881 (Signalized)	WB	LT	0.10	C	7.2	0.08	C	6.1
		RT	0.33	A	0.0	0.75	A	0.0
	NB	TH	0.13	B	18.0	0.50	B	58.2
		RT	0.02	A	0.0	0.02	A	0.0
	SB	LT	0.78	C	62.4	0.82	C	106.0
		TH	0.10	A	6.2	0.10	A	6.3
Hwy 881 Access (Unsignalized)	EB	LT/TH	0.16	A	0.0	0.21	A	0.1
		RT	-	-	-	-	-	-
	WB	LT/TH/RT	0.12	A	0.0	0.29	A	0.0
	NB	LT/TH/RT	-	-	-	-	-	-
	SB	LT/TH/RT	-	-	-	0.00	B	0.0

From Table 4.6, the 2032 Background traffic operated well with good LOS and low v/c ratios at both intersections, provided that the Highway 63 intersection has been signalized.

Due to the lack of information (development timeline, generated traffic, etc.) in the ASP growth areas, the above 2032 Background analysis assumed no development in the ASP growth areas. With the inclusion of the growth areas, additional improvements (i.e. interchange) are likely required at Highway 881 / Highway 63 and at the Highway 881 access. If the ASP growth areas are to be developed prior to 2032, a TIA update would be required to be completed by the adjacent developer. However, given the highly conservative growth rate (15% annually,) a reasonable level of adjacent develop is nevertheless accommodated.

4.7 Scenario 6: 2032 Background and Phases 1 & 2

In Scenario 6, the 2032 Background and Phases 1 & 2 traffic volumes are analyzed. The roadway configuration as recommended in Scenario 5, where signalization was required at Highway 881 / Highway 63, was used in the analysis. The complete results of the Synchro analysis of Scenario 6 are shown in Appendix D and summarized in Table 4.7 below.

Table 4.7 Scenario 6 Synchro Results

INTERSECTION / MOVEMENT			Scenario 6: 2032 Background & Phases 1+2					
			AM Peak			PM Peak		
			v/c Ratio	LOS	Queue Length 95th (m)	v/c Ratio	LOS	Queue Length 95th (m)
Hwy 63 / Hwy 881 (Signalized)	WB	LT	0.12	C	8.1	0.14	C	9.0
		RT	0.34	A	0.0	0.79	A	0.0
	NB	TH	0.14	B	19.7	0.49	C	66.5
		RT	0.03	A	0.0	0.02	A	0.0
	SB	LT	0.84	C	72.8	0.88	D	107.2
		TH	0.10	A	6.4	0.11	A	6.6
Hwy 881 Access (Unsignalized)	EB	LT/TH	0.16	A	0.0	0.21	A	0.1
		RT	0.04	A	0.0	0.01	A	0.0
	WB	LT/TH/RT	0.12	A	0.2	0.29	A	0.0
	NB	LT/TH/RT	0.06	C	1.5	0.43	**E**	15.0
	SB	LT/TH/RT	-	-	-	0.00	B	0.0

From Table 4.7, all movements at both intersections operated well with good LOS and low v/c ratios in the AM and PM Peaks with exception of the northbound movement at Highway 881 Access in the PM Peak, which operated at LOS E. To rectify the traffic operation at the Highway 881 Access, a traffic signal could be implemented. However, since the background growth rate (15% annually) in this study is highly conservative, and the northbound movement at Highway 881 Access will likely to be operating at LOS E or better in 2032. Per the following section, the signal is also not warranted by the TAC Signal Warrant method, which typically governs on Alberta highways. Therefore, a signal is not proposed at the Highway 881 Access.

At Highway 881 / Highway 63, the southbound left turning queue is longer but could still be accommodated for in the existing 220m turn bay. The turn also enjoys a good LOS.

Similar to Scenario 5, the Scenario 6 analysis assumed no development in the ASP growth areas. If the ASP growth areas are to be developed prior to 2032, a TIA update would be required to be conducted by the adjacent developer.

4.8 Analysis Summary

In Scenarios 1 to 4, the existing unsignalized intersections and lane configurations adequately accommodated the background traffic growth and Rickards Landing in the near term.

In Scenario 5 (2032 Background), signalization was required at Highway 881 / Highway 63 to accommodate the background traffic growth. It is noted that Scenario 5 excludes the Rickards Landing traffic, thus the requirement for signalization at Highway 881 / Highway 63 is due to background growth only, bearing no relationship to the Rickards Landing development.

In Scenario 6 (2032 Background and Phases 1 & 2), the Rickards Landing development

was added to the 2032 Background traffic and signalization might be required at the Highway 881 Access and is subject to further analysis in the future.

In Scenarios 5 and 6, the ASP growth areas were assumed to be undeveloped. The Scenario 5 and 6 analyses show that the two analyzed intersections could remain as at-grade intersections and accommodate the additional traffic from background highway growth and traffic from the subject Rickards Landing development. However, if the ASP growth areas were developed, additional traffic would be added to the two analyzed intersections and improvements (i.e. interchange) are likely required at Highway 881 / Highway 63 and at the north leg of the Highway 881 access. If the ASP growth areas are to be developed prior to 2032, a TIA update would be required from the adjacent developer.

5.0 Warrant Analysis

Illumination, signal, left turn, and right turn warrant analyses were performed at the two intersections and the results are summarized in the following sections.

5.1 Traffic Signal Warrant

The "Canadian Traffic Signal Matrix Procedure 2007" by the Transportation Association of Canada was used to perform the signal warrant analyses for both intersections in all six scenarios. The results of the signal warrant analyses are summarized in Table 5.1 and the traffic signal warrant worksheets are shown in Appendix E.

Table 5.1 Scenarios 1 to 6 Signal Warrant Summary

Intersection	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
	Signal Warranted?					
Highway 63 / Highway 881	No	No	No	No	Yes	Yes
Highway 881 Access	No	No	No	No	No	No

From Table 5.1, no traffic signal is warranted for either intersection in the shorter-term Scenarios 1 to 4. In Scenario 5 and Scenario 6, a traffic signal was warranted at the Highway 63 / Highway 881 intersection but no traffic signal was warranted at the Highway 881 Access. The results from the signal warrant analyses are consistent with the findings from the Synchro analyses.

5.2 Left Turn Warrant

As described in Section 2.1, a 220m southbound left turn bay currently exist at Highway 63 / Highway 881 and a westbound left turn bay (250m) currently exists at the Highway 881 Access. Based on Table D-8.6c (Left Turn Warrant for 4-Lane Highway) in the AT Design Guide, the left turns are built to maximum standards, thus no further left turn warrant analyses were conducted at Highway 63 / Highway 881.

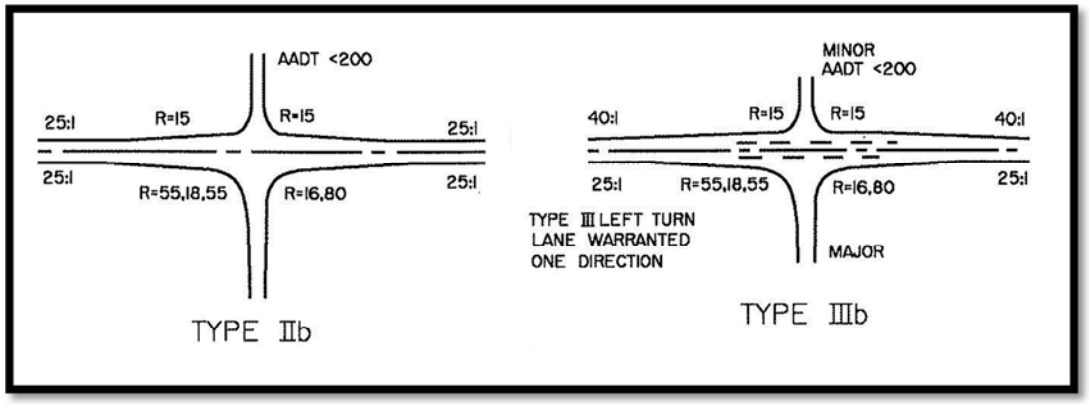
As described in Section 2.1, Highway 881 Access is an unsignalized intersection with Type IIIb treatment in the westbound direction and Type IIb treatment in the eastbound direction (refer to diagram below), which means that the intersection consists of a left turn bay on one of the Highway approaches (westbound left turn bay). Tables from Section D-7.6-7 (Left Turn Warrant for 110 km/h Design Speed on a 2-Lane Highway) in the AT Design Guide were used to complete the left turn warrant for Scenarios 1 to 4. With the assumption that Highway 881 would be twinned in Scenario 5 and Scenario 6 (refer to Section 2.3), Table D-8.6c (Left Turn Warrant for 4-Lane Highway) was used to conduct the left turn warrant. The variables used in the warrants and the results of the warrant analyses are shown in Table 5.2 below. It is noted that the westbound left turn warrant was not conducted for Scenarios 1, 3, and 5, as these are the background only scenarios and do not have any Rickards Landing traffic.

Table 5.2 Scenarios 1 to 6 Left Turn Warrant Summary

Highway 881 Access									
Movement / Scenario	**EBL**	**EBL**	**WBL**	**EBL**	**EBL**	**WBL**	**EBL**	**EBL**	**WBL**
	Sc 1	**Sc 2**		**Sc 3**	**Sc 4**		**Sc 5**	**Sc 6**	
L_T Volume	0 (2)	0 (2)	4 (1)	0 (2)	0 (2)	8 (2)	0 (2)	0 (2)	8 (2)
L_T %	0.0% (1.5%)	0.0% (1.4%)	4.4% (0.5%)	0.0% (1.3%)	0.0% (1.1%)	6.9% (0.8%)	0.0% (0.4%)	0.0% (0.4%)	2.0% (0.2%)
V_A	98 (134)	137 (145)	99 (242)	113 (154)	186 (174)	117 (279)	407 (550)	480 (570)	402 (1002)
V_O	95 (241)	99 (242)	137 (145)	109 (277)	117 (279)	186 (174)	394 (1000)	402 (1002)	480 (570)
Type	II (II)	II (II)	II (III)	II (II)	II (II)	II (III)	-	-	-
Left Turn Bay Warranted?	No (No)	No (No)	No (Yes)	No (No)	No (No)	No (Yes)	No (No)	No (No)	No (No)

99 = AM Peak Parameters
(99) = PM Peak Parameters

From Table 5.2, no eastbound left turn bay is warranted in any of the six scenarios. In addition, no further improvements are required to the existing westbound left turn bay in Scenarios 1 to 4. Once Highway 881 is twinned in Scenarios 5 and 6, no eastbound or westbound left turn bays are warranted. The findings in this analysis are consistent with the findings in the Synchro analysis, and confirm that no further upgrades to the eastbound or westbound left turn movements are warranted in any scenario.



5.3 Right Turn Warrant

As mentioned in Section 2.1, a northbound right turn bay and a westbound right turn bay already exist at Highway 63 / Highway 881. Also, an eastbound right turn bay now exists at the Highway 881 Access. Therefore, the right turn warrant was performed only on the westbound right at the Highway 881 Access.

Section D.7.7 in the AT Design Guide was used for the right turn warrant in Scenarios 1 to 4 (Right Turn Warrant for 2 Lane Highways). From the warrant, all three conditions in Table 5.3 must be met to warrant an exclusive turn bay. For Scenarios 5 and 6, Section D.8.7 in the AT Design Guide (Right Turn Warrant for 4 Lane Highways) was used. In that case, only the third condition must be met for a right turn bay to be warranted.

Table 5.3 Scenarios 1 to 6 Right Turn Warrant Summary

Conditions		Highway 881 Access WBR					
		Sc 1	**Sc 2**	**Sc 3**	**Sc 4**	**Sc 5**	**Sc 6**
1	Main Road AADT > 1800	2840	3119	3265	3782	11755	12272
2	Side Road AADT > 900	5	269	5	495	5	495
3	Right Turn Daily Volume > 360	0	0	0	0	0	0
Warranted?		No	No	No	No	No	No

From Table 5.3, no westbound right turn bay is warranted in any of the five scenarios. This is consistent with the lane configurations from the Synchro analyses.

5.4 Illumination Warrant

Currently, the Highway 63 / Highway 881 intersection is illuminated, so the illumination warrant was only performed at the Highway 881 Access. The "Illumination of Isolated Rural Intersections 2001" by the Transportation Association of Canada was used to perform the illumination warrant at the Highway 881 Access in all six scenarios. The results are summarized in Table 5.4 below and detailed illumination warrant results are shown in Appendix E.

Table 5.4 Scenarios 1 to 6 Illumination Warrant Summary

Intersection	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
	Illumination Warranted?					
Highway 881 Access	No	No	No	No	No	No

From Table 5.4, no illumination is warranted at the Highway 881 Access in any of the six scenarios.

5.5 Warrant Summary

Based on the above signal, left turn, right turn, and illumination warrants, the following table summarizes the upgrades required for each scenario:

Table 5.5 Warrant Summary

Scenario		Hwy 881 / Hwy 63	Hwy 881 Access
1	2011 Background	None	None
2	2011 Background & Stage 1		
3	2012 Background		
4	2012 Background & Stages 1+2		
2026		Hwy 881 assumed twinned due to background highway growth	
5	2032 Background	Signal warranted due to background Highway growth.	None
6	2032 Background & Stages 1+2		

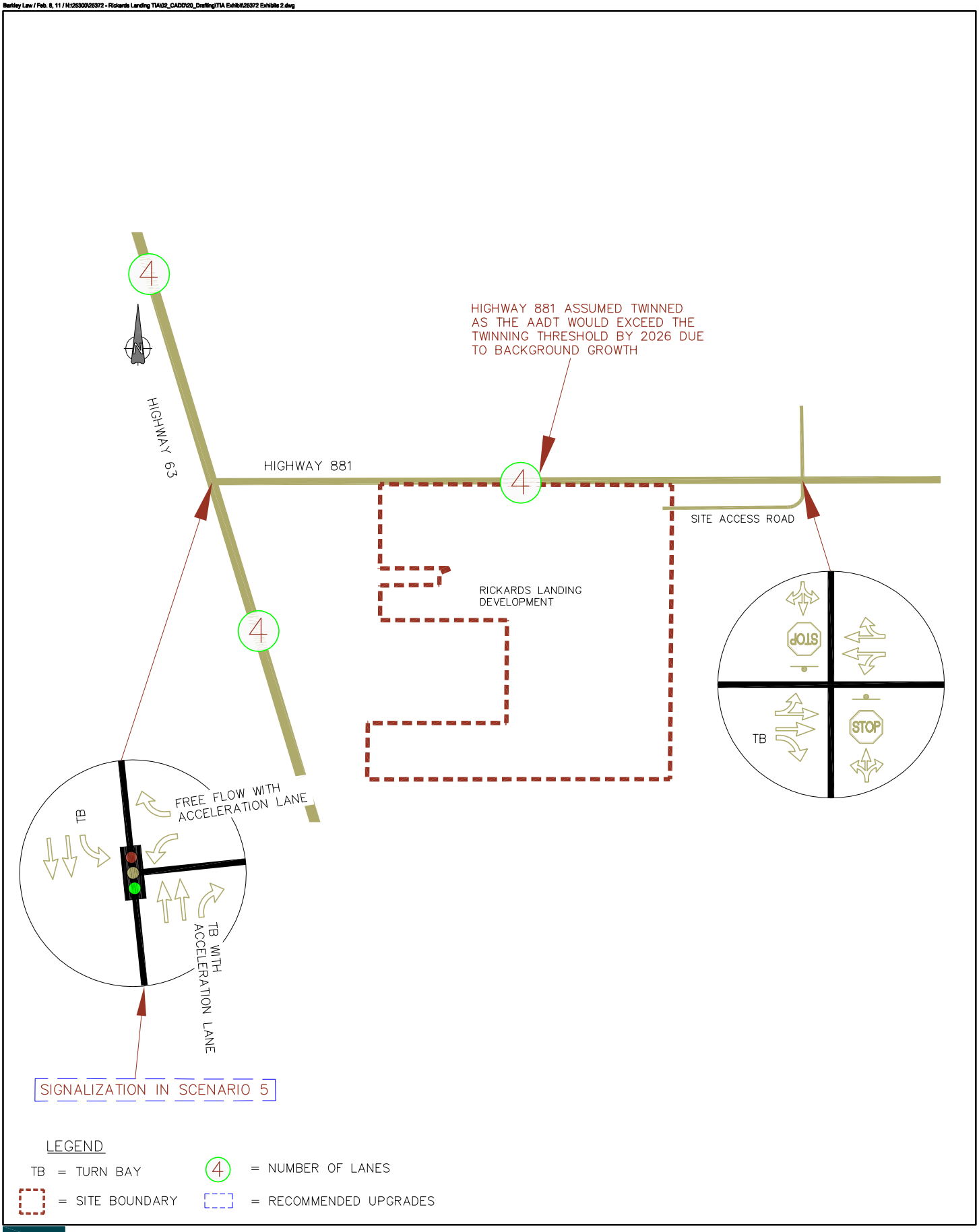
6.0 Conclusions and Recommendations

The proposed Rickards Landing light industrial development on Highway 881 will consist of low-intensity storage uses, with no utility servicing. The total site trip generation is 104 vehicles in the AM Peak period and 98 vehicles in the PM Peak period, respectively. Two development stages are proposed, with one stage built each year over the next two years. Phase 1 will be completed in 2011 and Phase 2 will be competed in 2012. Analyses were completed for 2011, 2012, and the 20-Year horizon in 2032. Based on the Synchro and warrant analyses, the recommended upgrades are summarized in Table 6.1 and shown in Exhibits 6.1.

Table 6.1 Upgrade Summary

<table>
<tr><th colspan="2">Scenario</th><th>Hwy 881 / Hwy 63</th><th>Hwy 881 Access</th></tr>
<tr><td>1</td><td>2011 Background</td><td rowspan="4">None</td><td rowspan="4">None</td></tr>
<tr><td>2</td><td>2011 Background & Stage 1</td></tr>
<tr><td>3</td><td>2012 Background</td></tr>
<tr><td>4</td><td>2012 Background & Stages 1+2</td></tr>
<tr><td colspan="2">2026</td><td colspan="2">Hwy 881 assumed twinned due to background highway growth</td></tr>
<tr><td>5</td><td>2032 Background</td><td rowspan="2">Signal warranted due to background highway growth.</td><td rowspan="2">None</td></tr>
<tr><td>6</td><td>2032 Background & Stages 1+2</td></tr>
</table>

With these recommended improvements, the two analyzed intersections could remain as at-grade intersections and accommodate the additional traffic from robust background growth on both highways and from the subject Rickards Landing development, up to a 20 year horizon. However, if the nearby ASP growth areas are developed, additional traffic would be added to the two analyzed intersections and improvements (i.e. the ultimate interchange) are likely required at Highway 881 / Highway 63 and at the north leg of the Highway 881 access. If the ASP growth areas are to be developed prior to 2032, a TIA update would be required from the adjacent developer, to verify such additional improvements.



ISL Engineering and Land Services

RICKARDS LANDING TIA

EXHIBIT 6.1

SCENARIO 5 & SCENARIO 6 RECOMMENDED
LANE CONFIGURATIONS & TRAFFIC CONTROLS

7.0 Closure

ISL has prepared this document entitled the "Rickards Landing - Transportation Impact Assessment" for Wood Buffalo South Industrial Park Ltd. in support of the proposed light industrial development. The material contained herein reflects ISL's best judgment in light of the information available at the time of the study and the level of detail normally expected at the planning stage. Any use which a third party makes of this report or reliance on this report or decision made based on this report are the sole responsibility of such third parties. ISL accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made, or actions taken, based on this report.

Appendix A

Scope of Work

From: Moges Gebreleoul [moges.gebreleoul@gov.ab.ca]
Sent: Monday, November 29, 2010 4:48 PM
To: Alex Ho
Subject: RE: Rickards Landing TIA

Alex,

The scope of work looks fine, but you might need to double check the peak hours since the Oil Sand workers shift schedule contributes to the peak hour, especially Nexen Long Lake in that area. I checked with our staff about the Brochu Industrial park rates, and their suggestion is to check an existing comparable industrial park to ensure Brochu rates are still appropriate. You can then get an average rate.

Thank you,
Moges

From: ! Alex Ho
Sent: Friday, November 26, 2010 12:03 PM
To: Moges Gebreleoul
Cc: Zobayur Rahman
Subject: Rickards Landing TIA

Hi Moges,

ISL has been hired by CSM Engineering to undertake a TIA on the Rickards Landing TIA.

Rickards Landing is a light industrial development in the Regional Municipality of Wood Buffalo (RMWB) located at the southeast corner of the intersection of Highway 881 / Highway 63 (see attached pdf).
25 lots will be built in 2 phases: Phase 1 (14 lots, completed in 2011) and Phase 2 (11 lots, completed in 2012).
Access to the development is off Highway 881.

We have proposed the following scope of work:

1. Intersection to be analyzed:
    - Highway 63 / Highway 881
    - Highway 881 Access
2. Horizons to be analyzed:
    1. 2011 background
    2. 2011 background + proposed Phase 1 development (14 lots)
    3. 2012 background
    4. 2012 background + proposed Phase 1+2 development (25 lots total)
    5. Future background (20 Years, 2022)
    6. Future background + proposed Phase 1+2 development
3. Manual traffic counts will be conducted in the AM (7-9 AM), noon (11 AM -1 PM), and PM peak (4-6 PM) hours at
    - Highway 63 / Highway 881
    - Highway 881 Access
4. A highway growth rate of 15%/year will be applied to the existing counts to forecast the future traffic volumes. This growth rate was obtained from AT's 10 year traffic volume data of Hwy 63 / 881.
5. Trips generated from the site will be based on the following trip generation study for a similar light industrial park in a rural area:

The ITE rates are most applicable for light industrial developments located in an urban environment, while the proposed Rickards Landing is located in a rural setting. Instead, the trip generation rates from a previous rural light industrial trip (Brochu) generation study as conducted by ISL Engineering and Land Services Ltd. were used. In addition, this trip generation rate had been used in previous TIA studies by ISL for AT, including the "Donnelly Corner TIA" located in Donnelly, AB and the "West Peace Industrial TIA" in Peace River, AB which are more representative of the planned development. The "Brochu Light Industrial Generation Survey", located in the west end of Grande Prairie, is composed of storage yards, truck dealerships, and small offices. The findings of the survey are as follow:

Table 3.1 Brochu Trip Generation Survey

Brochu Industrial Trip Generation Survey	
Date of Survey	September 25, 2003
Characteristic of Area	Storage yards, truck dealership, some office uses
Developed Area	24.82 ha, 61.31 acres
Peak Hour Generation Rate	AM: (1 hour): 53 out, 105 in, 158 total PM: (1 hour): 104 out, 67 in, 171 total
Peak Hour Rate	AM: 2.58 trips / acre, 66% In, 34% Out PM: 2.79 trips / acre, 39% In, 61% Out

.

6. Traffic warrants (left turn, right turn, illumination, and signalization) will also be checked at the two analyzed intersection.
7. Analysis and recommendations for the analyzed intersection.
8. Record findings and recommendations in a draft report.

Please let me know if the scope of work is acceptable.

Thanks,

Alex Ho, P.Eng. | *Transportation Engineer*
ISL Engineering and Land Services Ltd.
#1, 6325 - 12 Street SE
Calgary AB T2H 2K1
T: 403.**254.0544** **F:** 403.**254.9186**
aho@islengineering.com www.islengineering.com

2nd among Canada's 2010 Best Small and Medium Employers.

Barkley Law

From: Moges Gebreleoul <moges.gebreleoul@gov.ab.ca>
Sent: February-03-11 3:42 PM
To: Barkley Law
Cc: Zobayur Rahman; Ron Fraser; Cathy Maniego
Subject: RE: Rickards Landing TIA

Hi Barkley,

We had a meeting with the developers last Tuesday, and they gave us additional information on the developments described in your email. Based on that, I discussed the issue with our Road Side Development Manager in Edmonton and we agreed that you can use the trip generation study information you have for South of Grand Prairie.

Thank you,
Moges

From: ! Barkley Law
Sent: Monday, January 24, 2011 9:48 AM
To: Moges Gebreleoul
Subject: RE: Rickards Landing TIA

Hi Moges,
We have been informed by our client that the proposed Rickards landing development does not have any water services. So the trip rates will be much lower than the Brochu rates. To confirm the rates, I have done a new trip generation study in a light industrial area located just south of Grande Prairie (See attached pictures for the site location). Similar to the Rickards landing, this new study area also does not have water services. The results of the new trip generation study are compared with the Brochu study and the previous trip generation study (North of Grande Prairie) and are summarized below:

Brochu - With water services and consist of storage yards, office, truck dealership
Trip Gen rates: 2.58 trips / acre in AM, 2.79 trips / acre in PM

Previous Trip Gen study (North of Grande Prairie – see attached pictures) – Partial area with water services
Trip Gen rates: 1.4 trips / acre in AM, 1.44 trips / acre in PM

New Trip Gen study (South of Grande Prairie – see attached pictures) – Without water services
Trip Gen rates: 0.80 trips / acre in AM, 0.75 trips / acre in PM

Since the Rickards landing development does not have any water services but Brochu and the north site do, therefore trips from Rickard landing should be much lower than the other two sites. For this reason, we would like to use the new trip generation rates (0.80 trips / acre in AM, 0.75 trips / acre in PM) in the Rickards landing TIA. Please let me know if the new rates are reasonable so that I can proceed with the analysis.

Thanks

Barkley

Barkley Law, P.Eng. | *Transportation Engineer*
ISL Engineering and Land Services Ltd.

Hi Moges,

Similar to the Brochu site in Grande Prairie, ISL had conducted a trip generation study of a comparable light industrial park in the outskirts of Grande Prairie (see attached picture) that consist of mainly storage yards last week.
Storage yards are also likely the main tenant of the proposed Rickards Landing, however this would have to be confirmed at the time of sale of the lots.

In our trip generation study, we concluded to a trip generation rate of 1.4 trips / acre in the AM peak and 1.5 trips / acre in the PM peak.
As compared to the Brochu rates that consist of storage yards, office, truck dealership, the Brochu rates are higher (2.58 / acre in AM, 2.79 / acre in PM) than the recent ISL study.

Since we are unsure of the exact type of light industrial development until the sale of the lots, to be conservative, we propose to use the Brochu rates that consist of a variety of light industrial land use instead of the rate that ISL had just conducted which only consist of storage yards.

Please let us know ASAP if the Brochu rates are OK as we are in the tight timeline.

Also, I forgot to mention that for the trip generation of the proposed development traffic, we will use the existing traffic patterns at Hwy 881/63.
The rates are 80% north, 10% south, 10% east.
Please also let us know if the trip distribution rates are OK.

Thanks,

Alex Ho, P. Eng. | *Transportation Engineer*
ISL Engineering and Land Services Ltd.

From: Moges Gebreleoul [mailto:moges.gebreleoul@gov.ab.ca]
Sent: Monday, November 29, 2010 4:48 PM
To: Alex Ho
Subject: RE: Rickards Landing TIA

Alex,

The scope of work looks fine, but you might need to double check the peak hours since the Oil Sand workers shift schedule contributes to the peak hour, especially Nexen Long Lake in that area. I checked with our staff about the Brochu Industrial park rates, and their suggestion is to check an existing comparable industrial park to ensure Brochu rates are still appropriate. You can then get an average rate.

Thank you,
Moges

From: ! Alex Ho
Sent: Friday, November 26, 2010 12:03 PM
To: Moges Gebreleoul
Cc: Zobayur Rahman
Subject: Rickards Landing TIA

Hi Moges,

ISL has been hired by CSM Engineering to undertake a TIA on the Rickards Landing TIA.

Rickards Landing is a light industrial development in the Regional Municipality of Wood Buffalo (RMWB) located at the southeast corner of the intersection of Highway 881 / Highway 63 (see attached pdf).
25 lots will be built in 2 phases: Phase 1 (14 lots, completed in 2011) and Phase 2 (11 lots, completed in 2012). Access to the development is off Highway 881.

We have proposed the following scope of work:

1. Intersection to be analyzed:
    - Highway 63 / Highway 881
    - Highway 881 Access
2. Horizons to be analyzed:
    1. 2011 background
    2. 2011 background + proposed Phase 1 development (14 lots)
    3. 2012 background
    4. 2012 background + proposed Phase 1+2 development (25 lots total)
    5. Future background (20 Years, 2022)
    6. Future background + proposed Phase 1+2 development
3. Manual traffic counts will be conducted in the AM (7-9 AM), noon (11 AM -1 PM), and PM peak (4-6 PM) hours at
    - Highway 63 / Highway 881
    - Highway 881 Access
4. A highway growth rate of 15%/year will be applied to the existing counts to forecast the future traffic volumes. This growth rate was obtained from AT's 10 year traffic volume data of Hwy 63 / 881.
5. Trips generated from the site will be based on the following trip generation study for a similar light industrial park in a rural area:

The ITE rates are most applicable for light industrial developments located in an urban environment, while the proposed Rickards Landing is located in a rural setting. Instead, the trip generation rates from a previous rural light industrial trip (Brochu) generation study as conducted by ISL Engineering and Land Services Ltd. were used. In addition, this trip generation rate had been used in previous TIA studies by ISL for AT, including the "Donnelly Corner TIA" located in Donnelly, AB and the "West Peace Industrial TIA" in Peace River, AB which are more representative of the planned development. The "Brochu Light Industrial Generation Survey", located in the west end of Grande Prairie, is composed of storage yards, truck dealerships, and small offices. The findings of the survey are as follow:

Table 3.1 Brochu Trip Generation Survey

Brochu Industrial Trip Generation Survey	
Date of Survey	September 25, 2003
Characteristic of Area	Storage yards, truck dealership, some office uses
Developed Area	24.82 ha, 61.31 acres
Peak Hour Generation Rate	AM: (1 hour): 53 out, 105 in, 158 total PM: (1 hour): 104 out, 67 in, 171 total
Peak Hour Rate	AM: 2.58 trips / acre, 66% In, 34% Out

	PM: 2.79 trips / acre, 39% In, 61% Out

.

6. Traffic warrants (left turn, right turn, illumination, and signalization) will also be checked at the two analyzed intersection.
7. Analysis and recommendations for the analyzed intersection.
8. Record findings and recommendations in a draft report.

Please let me know if the scope of work is acceptable.

Thanks,

Alex Ho, P.Eng. | *Transportation Engineer*
ISL Engineering and Land Services Ltd.
#1, 6325 - 12 Street SE
Calgary AB T2H 2K1
T: 403.**254.0544** **F:** 403.**254.9186**
aho@islengineering.com www.islengineering.com

2nd among Canada's 2010 Best Small and Medium Employers.

Appendix B

Previous Studies

Highway 63/881 Corridor
Area Structure Plan
Consolidated Legend

General

- ASP Boundary
- Urban Service Area
- Hamlet
- Indian Reserve
- Provincial Park
- Airport / Airstrip
- Rivers
- Lakes

Transportation and Infrastructure

- Provincial Highway
- Provincial Highway (Unpaved)
- Unpaved Road
- Resource Road
- Bridge
- Potential Road Widening
- Potential By-pass / Road Realignment
- Potential Access Road
- Athabasca Northern Railway
- Future Grade Separated Intersection Upgrade
- Future Intersection Upgrade
- South East Regional Water Supply Line

Man Made Constraints

- Existing Power Line
- Existing Pipeline
- Existing Utility Access
- Cutline

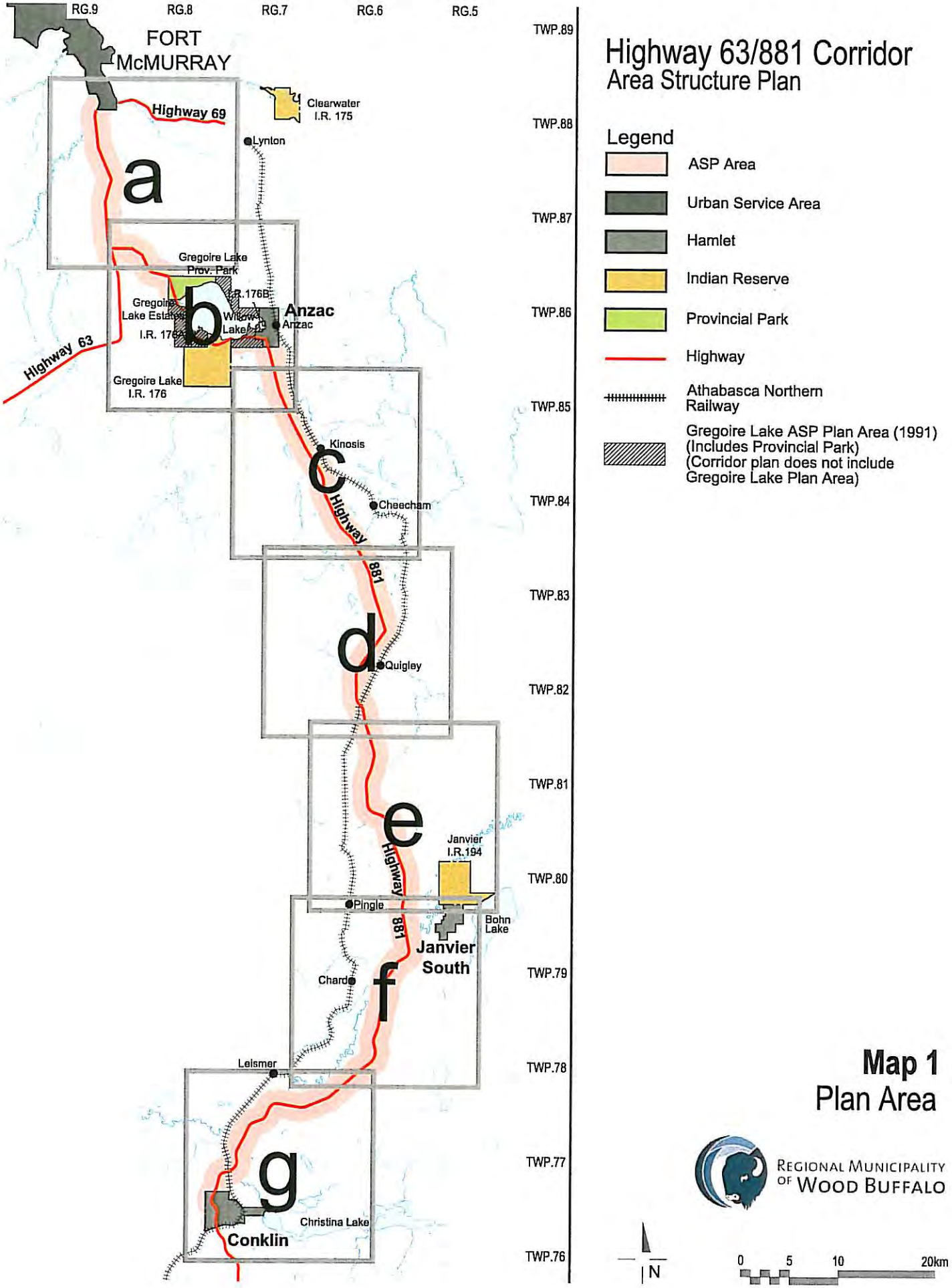
Existing Land Use

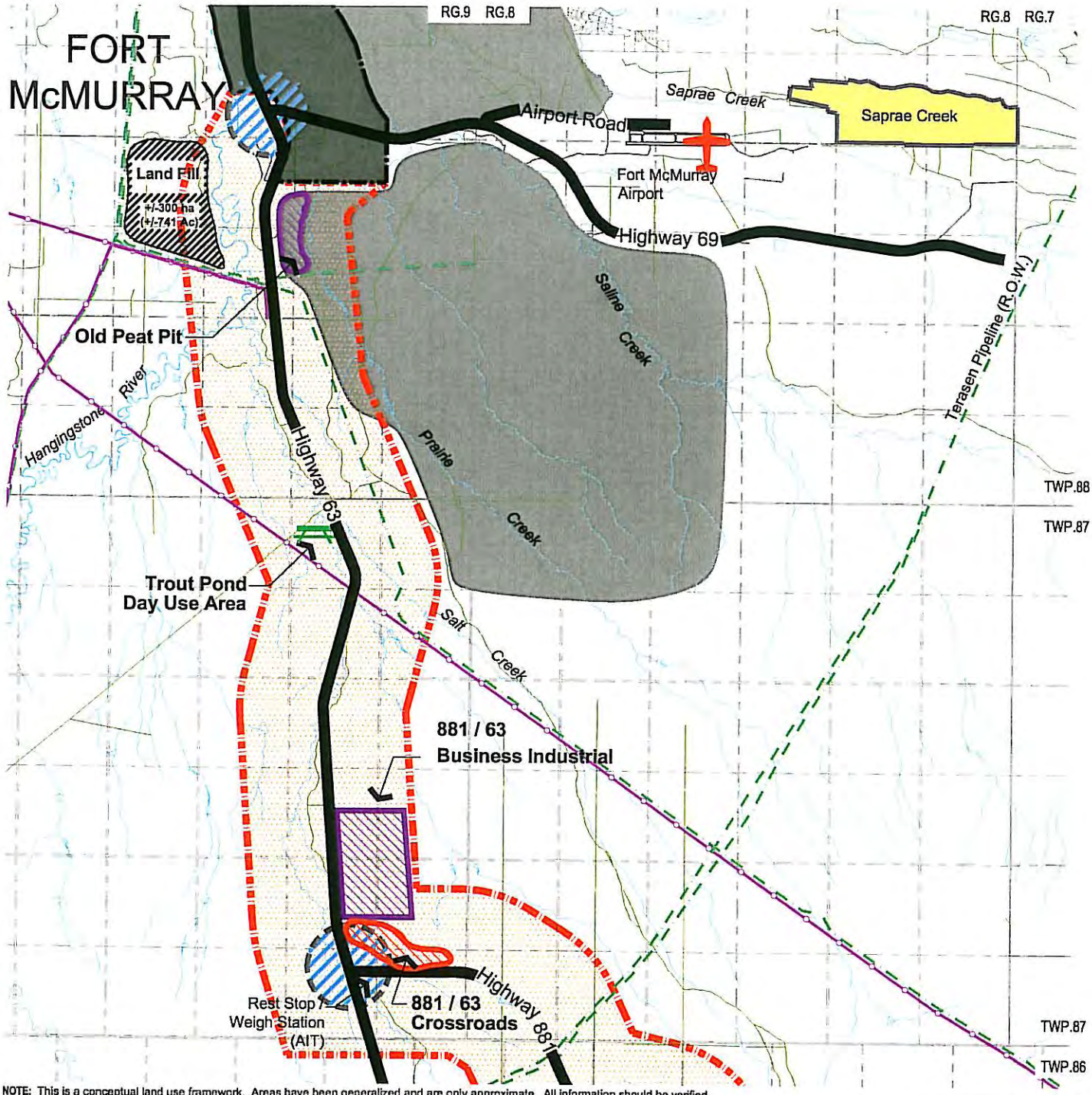
- Country Residential Subdivision
- Historic / Archeological Resource Site
- Camp Sites
- Day Use Area

Future Land Uses

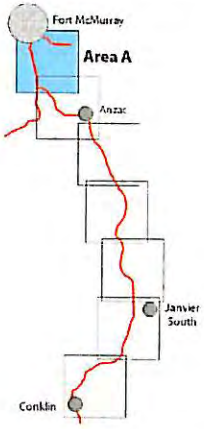
- Commercial
- Business / Industrial
- Tourism / Recreation
- Rural
- Proposed Long Lake South SAGD Project
- Future Pipeline and Powerline R/W
- Lookout Point

Regional Municipality of Wood Buffalo


RG.9
RG.8
RG.7
RG.6
RG.5
TWP.89
TWP.88
TWP.87
TWP.86
TWP.85
TWP.84
TWP.83
TWP.82
TWP.81
TWP.80
TWP.79
TWP.78
TWP.77
TWP.76
FORT McMURRAY
Highway 69
Clearwater I.R. 175
Lynton
a
Gregoire Lake Prov. Park
I.R.176B
Gregoire Lake Estates
Willow Lake
Anzac
Anzac
b
I.R. 176
Highway 63
Gregoire Lake I.R. 176
Kinosis
c
Highway 881
Cheecham
d
Quigley
e
Janvier I.R.194
Highway 881
Pingle
Bohn Lake
Janvier South
Chard
f
Leismer
g
Christina Lake
Conklin
Highway 63/881 Corridor
Area Structure Plan
Legend
ASP Area
Urban Service Area
Hamlet
Indian Reserve
Provincial Park
Highway
Athabasca Northern Railway
Gregoire Lake ASP Plan Area (1991) (Includes Provincial Park) (Corridor plan does not include Gregoire Lake Plan Area)
Map 1
Plan Area
Regional Municipality of Wood Buffalo
N
0
5
10
20km



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.



Legend

- ASP Boundary
- Urban Service Area
- Commercial
- Business / Industrial
- Rural Policy Area
- Proposed Day Use Area
- Provincial Highway
- Future Grade Separated Intersection Upgrade
- Future Urban Expansion

Map 2a
Future Land Use Concept

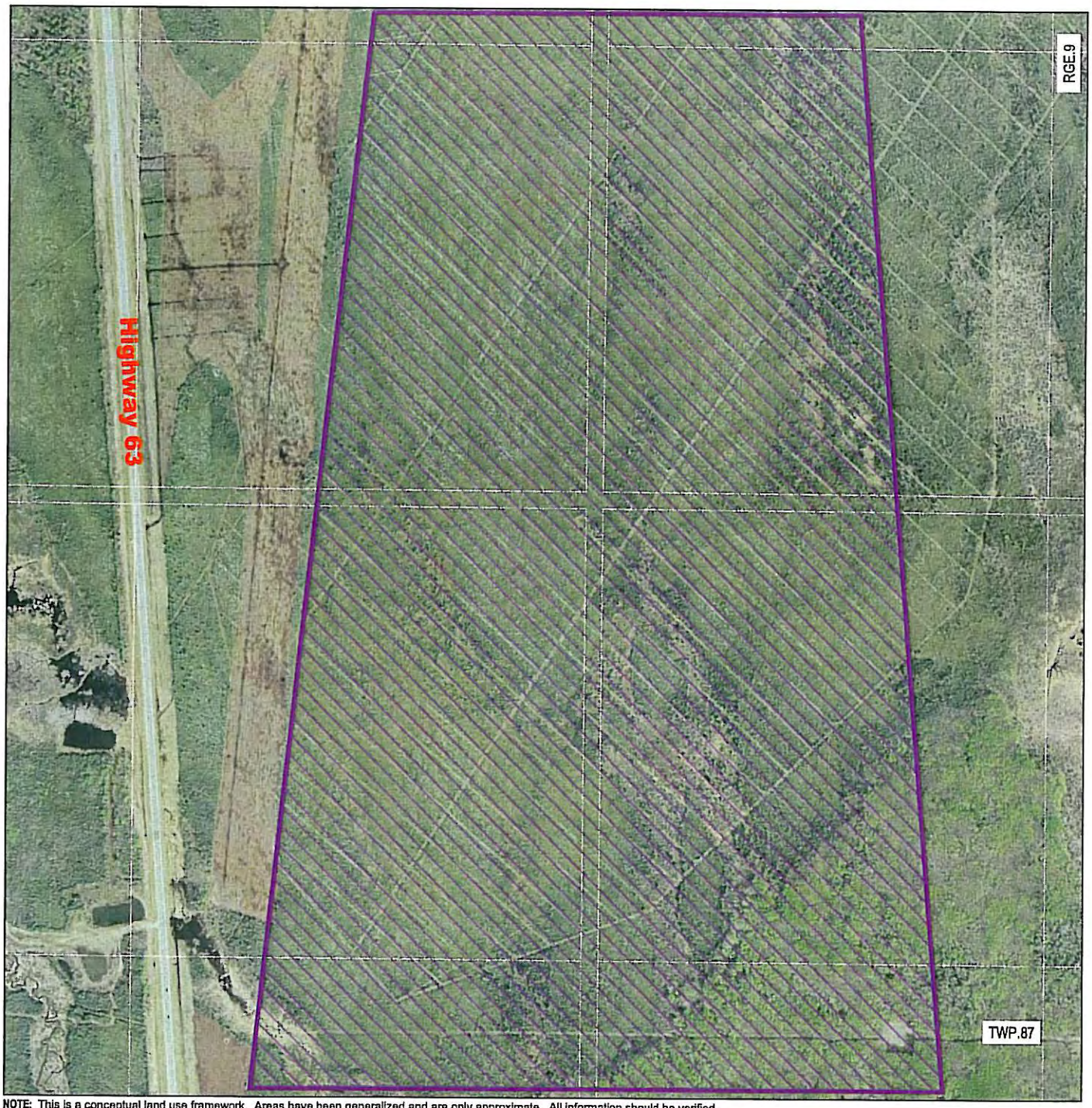
REGIONAL MUNICIPALITY OF WOOD BUFFALO

Highway 63/881 Corridor Area Structure Plan

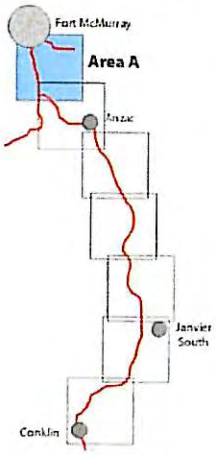
N

0 1000 2000 4000m

NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.



Legend

881 / 63 Business / Industrial

Map 2a-1
Future Land Use Concept

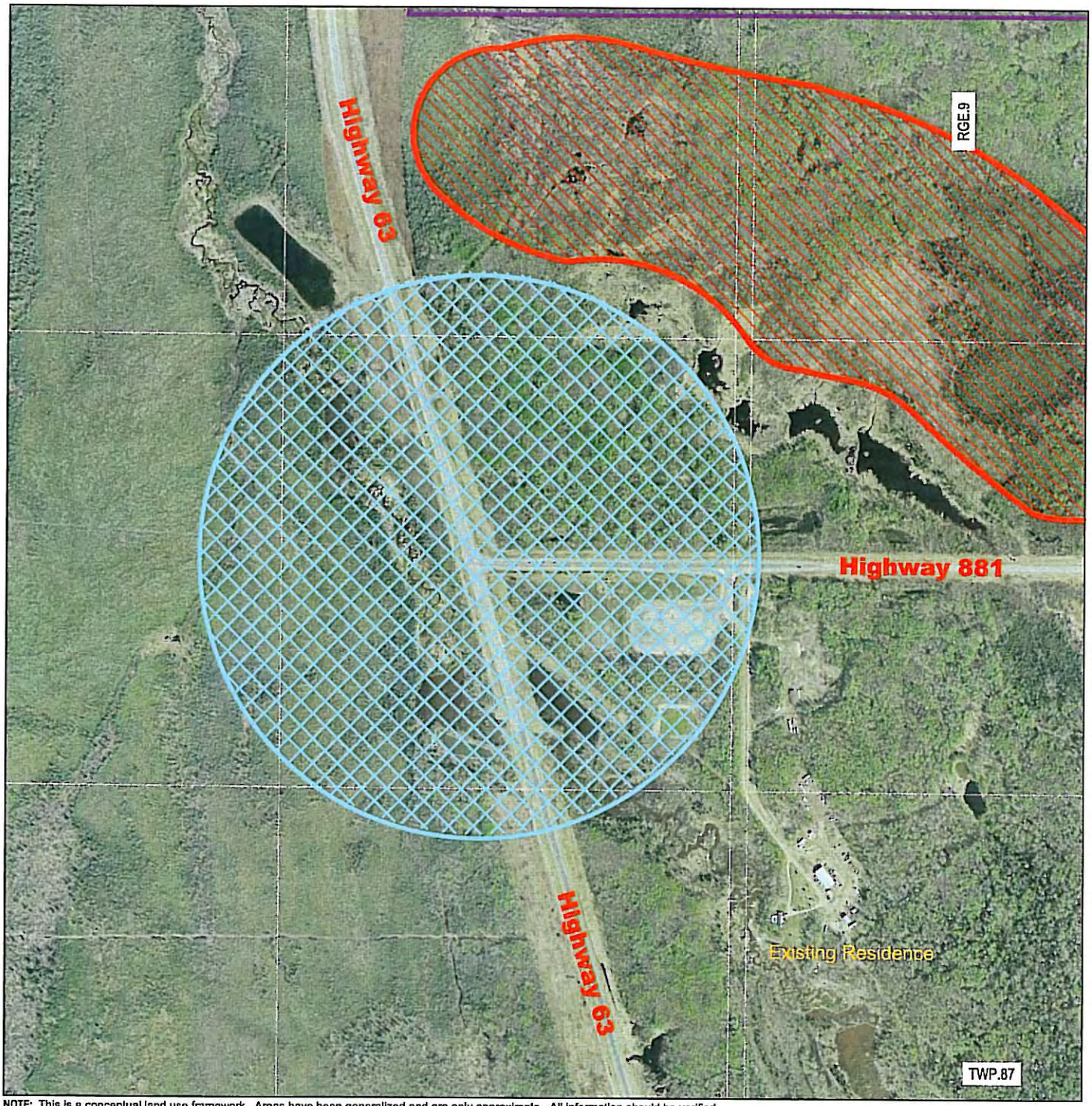
Regional Municipality of Wood Buffalo

Highway 63/881 Corridor Area Structure Plan

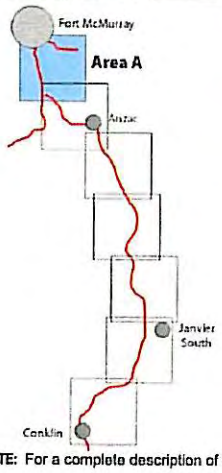
N

Scale: 1:10000
Photography Acquired May 2006

NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.



Legend

881 / 63 Commercial Crossroads

881 / 63 Future Intersection Upgrade

NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.

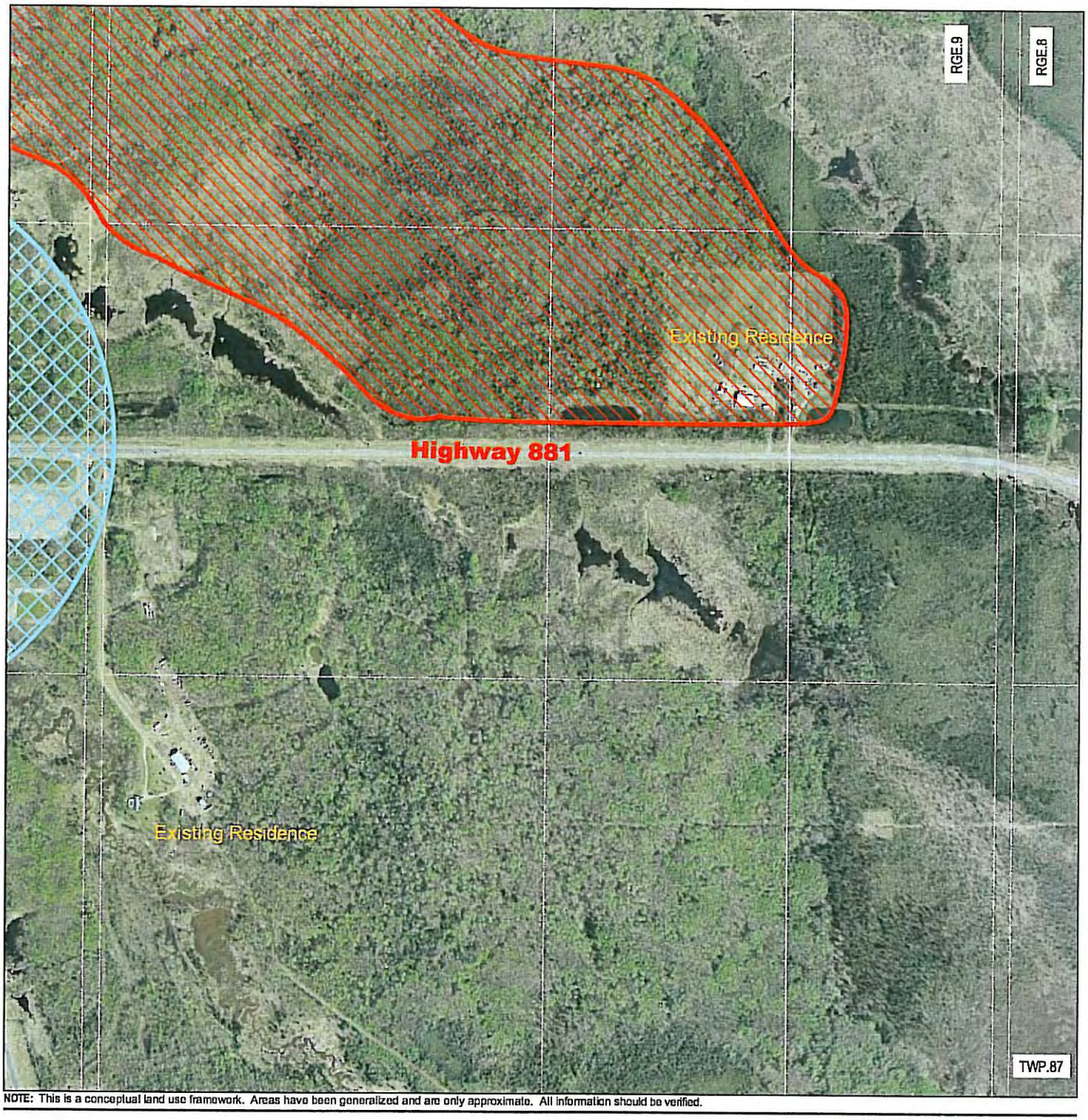
Map 2a-2
Future Land Use Concept

Regional Municipality of Wood Buffalo

Highway 63/881 Corridor Area Structure Plan

N

Scale: 1:10000
Photography Acquired May 2006



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.

Legend

881 / 63 Commercial Crossroads

Future Intersection Upgrade

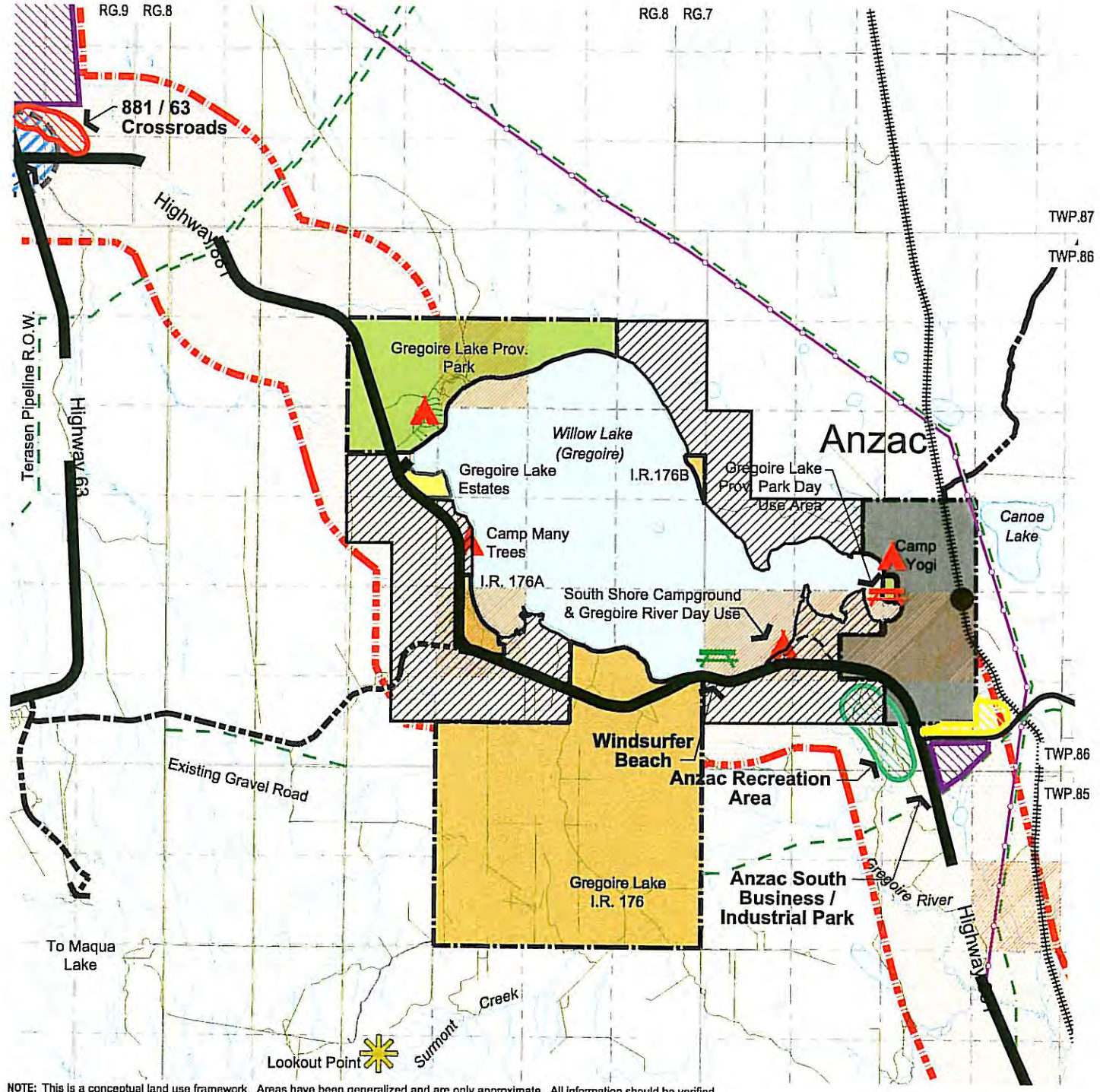
Map 2a-3
Future Land Use Concept

Highway 63/881 Corridor
Area Structure Plan

N

Scale: 1:10000
Photography Acquired May 2006

NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.

Legend

- ASP Boundary
- Hamlet
- Indian Reserve
- Commercial
- Business / Industrial
- Residential (Anzac Area Structure Plan 2002)
- Gregoire Lake ASP Plan Area (1991) (Includes Provincial Park) (Corridor Plan does not include Gregoire Lake Plan Area)
- Tourism / Recreation
- Rural Policy Area
- Historic / Archeological Resource Site
- Provincial Highway
- Future Intersection Upgrade
- Proposed Day Use Area

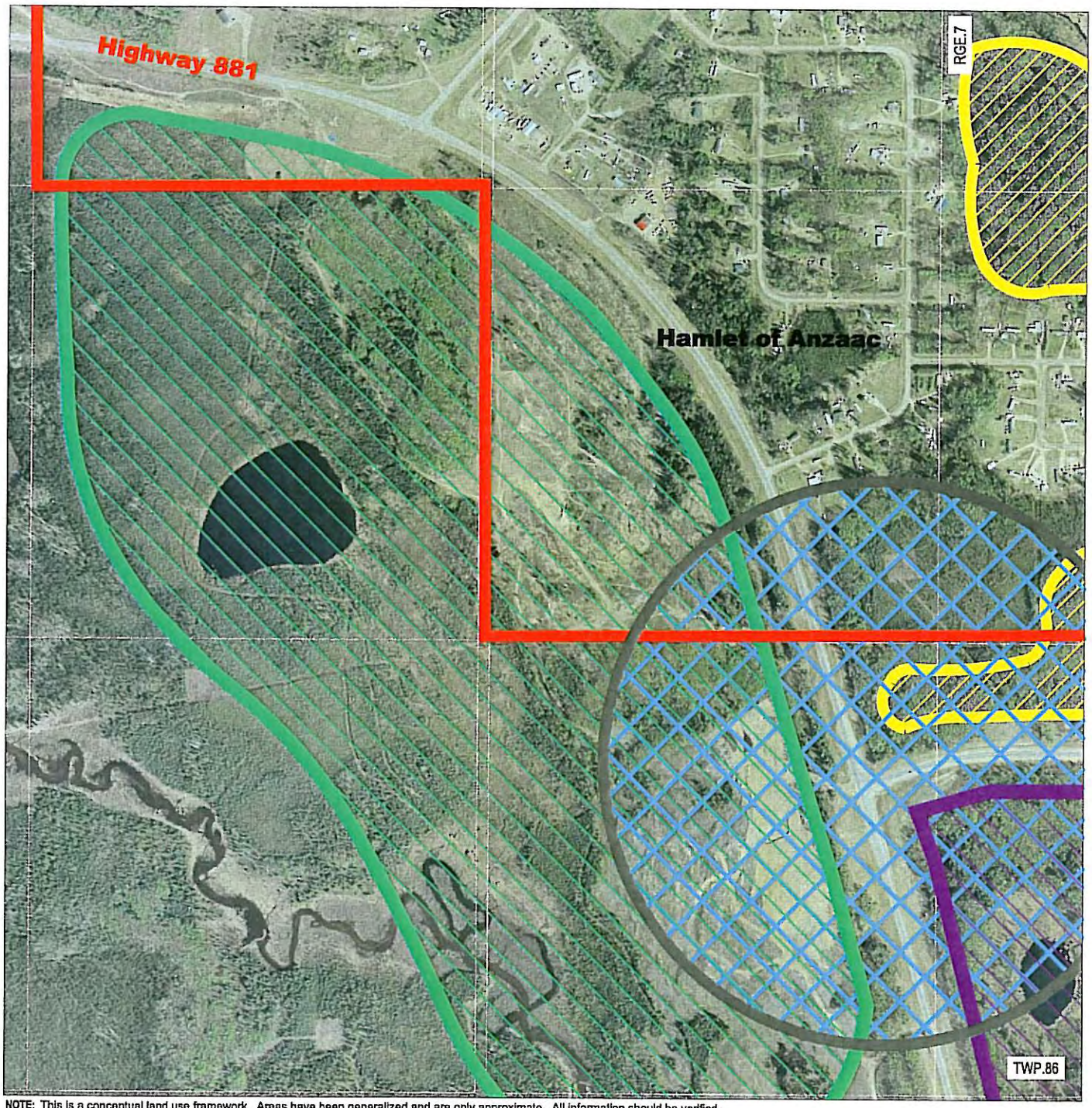
NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.

Map 2b
Future Land Use Concept

Highway 63/881 Corridor Area Structure Plan

N

0 1000 2000 4000m



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.

Legend

- Future Residential (Anzac Area Structure Plan 2002)
- Anzac South Business / Industrial Park
- Anzac Community Recreation Area (NE 5-86-7-4 Falls Under The Gregoire Lake Area Structure Plan Boundary. Amendments To Gregoire Lake ASP Must Be Made If Development is to Occur.)
- 881 Future Intersection Upgrade

Map 2b-1
Future Land Use Concept

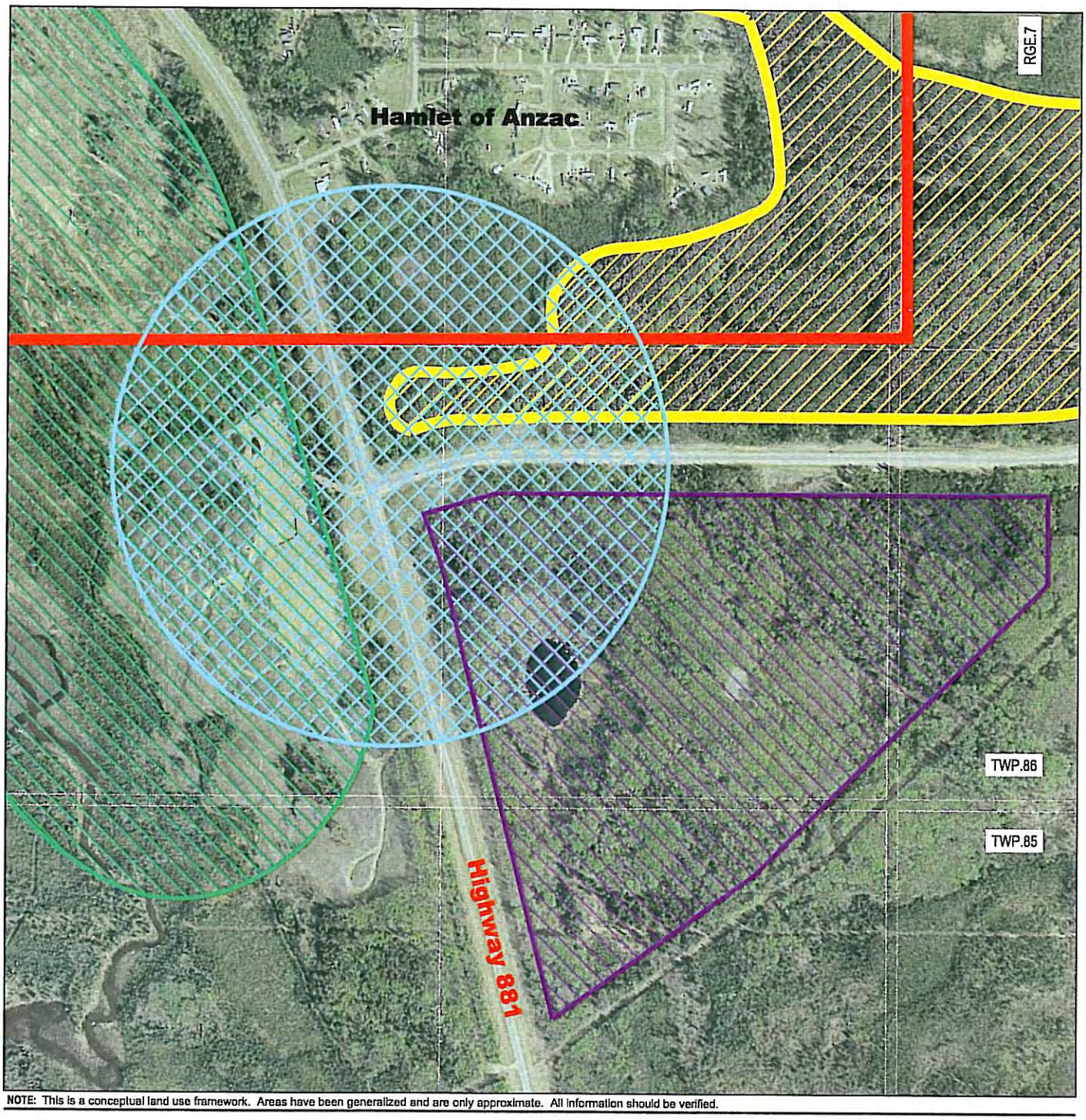
Regional Municipality of Wood Buffalo

Highway 63/881 Corridor Area Structure Plan

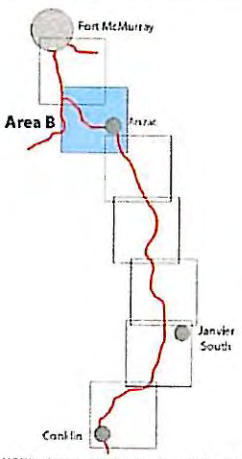
N

Scale: 1:10000
Photography Acquired May 2006

NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.



NOTE: This is a conceptual land use framework. Areas have been generalized and are only approximate. All information should be verified.



Legend

- Future Residential (Anzac Area Structure Plan 2002)
- Anzac South Business / Industrial Park - (+/- 62.3 ha) (Requires amendment to Hamlet of Anzac ASP)
- Anzac Community Recreation Area
- 881 Future Intersection Upgrade

Map 2b-2
Future Land Use Concept

REGIONAL MUNICIPALITY OF WOOD BUFFALO

Highway 63/881 Corridor Area Structure Plan

N

Scale: 1:10000
Photography Acquired May 2006

NOTE: For a complete description of the symbols identified on this map refer to the Consolidated Legend page provided.

Appendix C

Highway 43 / 148 Avenue and Highway 688 / Range Road 61 Trip Generation Studies

February, 2011

Appendix C
Highway 43 /148 Avenue and Highway 688 / Range Road 61 Trip Generation Studies

Highway 43 / 148 Avenue Trip Generation Study

AM PEAK	
Total Inbound	Total Outbound
256	144
64%	36%

Study area = 286.64 acres

AM Peak Trip Rates = **1.40** Trips per acre

PM PEAK	
Total Inbound	Total Outbound
144	268
35%	65%

PM Peak Trip Rates = **1.44** Trips per acre

Highway 668 / Range Road 61 Trip Generation Study

AM PEAK	
Total Inbound	Total Outbound
195	54
78%	22%

Study area = 311.35 acres

AM Peak Trip Rates = **0.80** Trips per acre

PM PEAK	
Total Inbound	Total Outbound
53	180
23%	77%

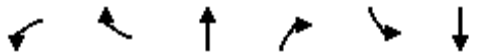
PM Peak Trip Rates = **0.75** Trips per acre


43
100 St
146 Ave
148 Ave
150 Ave
91 St
94 St
95 St
97 St
93 St
144 Ave
141 Ave
Range Road 69
69 St
Count Location
Trip Generation Study boundary
Highway 43 / 148 Avenue Trip Generation Study - Site location
©2010 Google
Imagery Date: Sep 4, 2005
55°12'42.47" N 118°46'40.55" W elev 686 m
Eye alt 2.69 km


Highway 668 / Range Road 61 Trip Generation Study - Site location
47 Ave
46 Ave
Range Road 60A
42 Ave
99 St
97 St
39 Ave
38 Ave
Range Road 61
Count Location
Trip Generation Styudy Boundary
© 2010 Google
Image © 2011 DigitalGlobe
©2010 Google
Imagery Date: Sep 4, 2005
55°06'57.90" N 118°46'54.46" W elev 649 m
Eye alt 2.90 km

Appendix D

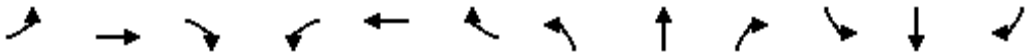
Synchro Results



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	5	124	56	8	98	81
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	124	56	8	98	81
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	292	28			56	
vC1, stage 1 conf vol	56					
vC2, stage 2 conf vol	236					
vCu, unblocked vol	292	28			56	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	88			93	
cM capacity (veh/h)	671	1000			1457	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	129	28	28	8	98	40	40
Volume Left	5	0	0	0	98	0	0
Volume Right	124	0	0	8	0	0	0
cSH	1040	1700	1700	1700	1457	1700	1700
Volume to Capacity	0.12	0.02	0.02	0.00	0.07	0.02	0.02
Queue Length 95th (m)	3.2	0.0	0.0	0.0	1.6	0.0	0.0
Control Delay (s)	9.2	0.0	0.0	0.0	7.6	0.0	0.0
Lane LOS	A				A		
Approach Delay (s)	9.2	0.0			4.2		
Approach LOS	A						

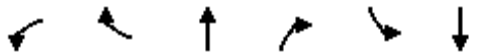
Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	22.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	98	0	0	95	0	0	0	0	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	98	0	0	95	0	0	0	0	0	0	0
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	95			98			193	193	98	193	193	95
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	95			98			193	193	98	193	193	95
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1421			1417			739	680	924	739	680	927

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	98	0	0	95	0	0
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0
cSH	1421	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.00	0.00	0.06	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS					A	A
Approach Delay (s)	0.0		0.0		0.0	0.0
Approach LOS					A	A

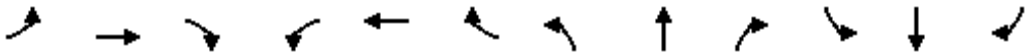
Intersection Summary				
Average Delay	0.0			
Intersection Capacity Utilization	8.5%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	3	284	175	6	141	84
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	284	175	6	141	84
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	499	88			175	
vC1, stage 1 conf vol	175					
vC2, stage 2 conf vol	324					
vCu, unblocked vol	499	88			175	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	69			89	
cM capacity (veh/h)	560	913			1309	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	287	88	88	6	141	42	42
Volume Left	3	0	0	0	141	0	0
Volume Right	284	0	0	6	0	0	0
cSH	923	1700	1700	1700	1309	1700	1700
Volume to Capacity	0.31	0.05	0.05	0.00	0.11	0.02	0.02
Queue Length 95th (m)	10.1	0.0	0.0	0.0	2.7	0.0	0.0
Control Delay (s)	10.7	0.0	0.0	0.0	8.1	0.0	0.0
Lane LOS	B				A		
Approach Delay (s)	10.7	0.0			5.1		
Approach LOS	B						

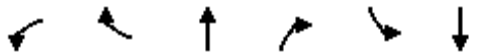
Intersection Summary			
Average Delay	6.1		
Intersection Capacity Utilization	29.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	132	0	0	241	0	0	0	0	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	2	132	0	0	241	0	0	0	0	0	0	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)												
pX, platoon unblocked												
vC, conflicting volume	241			132			378	377	132	377	377	241
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	241			132			378	377	132	377	377	241
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1253			1377			555	534	884	557	534	767

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	134	0	0	241	0	1
Volume Left	2	0	0	0	0	0
Volume Right	0	0	0	0	0	1
cSH	1253	1700	1700	1700	1700	767
Volume to Capacity	0.00	0.00	0.00	0.14	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.1	0.0	0.0	0.0	0.0	9.7
Lane LOS	A				A	A
Approach Delay (s)	0.1		0.0		0.0	9.7
Approach LOS					A	A

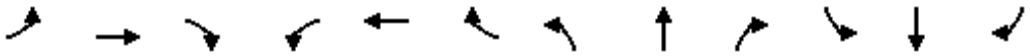
Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	22.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	6	134	56	12	133	81
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	6	134	56	12	133	81
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	362	28			56	
vC1, stage 1 conf vol	56					
vC2, stage 2 conf vol	306					
vCu, unblocked vol	362	28			56	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	87			91	
cM capacity (veh/h)	601	1000			1457	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	140	28	28	12	133	40	40
Volume Left	6	0	0	0	133	0	0
Volume Right	134	0	0	12	0	0	0
cSH	1045	1700	1700	1700	1457	1700	1700
Volume to Capacity	0.13	0.02	0.02	0.01	0.09	0.02	0.02
Queue Length 95th (m)	3.5	0.0	0.0	0.0	2.3	0.0	0.0
Control Delay (s)	9.2	0.0	0.0	0.0	7.7	0.0	0.0
Lane LOS	A				A		
Approach Delay (s)	9.2	0.0			4.8		
Approach LOS	A						

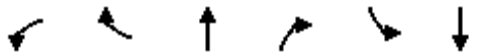
Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	24.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	98	39	4	95	0	11	0	1	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	98	39	4	95	0	11	0	1	0	0	0
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	95			137			201	201	98	202	240	95
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	95			137			201	201	98	202	240	95
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			98	100	100	100	100	100
cM capacity (veh/h)	1421			1371			728	671	924	726	638	927

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	98	39	4	95	12	0
Volume Left	0	0	4	0	11	0
Volume Right	0	39	0	0	1	0
cSH	1421	1700	1371	1700	741	1700
Volume to Capacity	0.00	0.02	0.00	0.06	0.02	0.00
Queue Length 95th (m)	0.0	0.0	0.1	0.0	0.4	0.0
Control Delay (s)	0.0	0.0	7.6	0.0	9.9	0.0
Lane LOS			A		A	A
Approach Delay (s)	0.0		0.3		9.9	0.0
Approach LOS					A	A

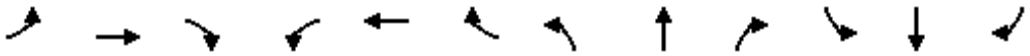
Intersection Summary				
Average Delay	0.6			
Intersection Capacity Utilization	15.2%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	7	316	175	7	151	84
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	7	316	175	7	151	84
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	519	88			175	
vC1, stage 1 conf vol	175					
vC2, stage 2 conf vol	344					
vCu, unblocked vol	519	88			175	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	65			88	
cM capacity (veh/h)	543	913			1309	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	323	88	88	7	151	42	42
Volume Left	7	0	0	0	151	0	0
Volume Right	316	0	0	7	0	0	0
cSH	933	1700	1700	1700	1309	1700	1700
Volume to Capacity	0.35	0.05	0.05	0.00	0.12	0.02	0.02
Queue Length 95th (m)	11.8	0.0	0.0	0.0	3.0	0.0	0.0
Control Delay (s)	11.0	0.0	0.0	0.0	8.1	0.0	0.0
Lane LOS	B				A		
Approach Delay (s)	11.0	0.0			5.2		
Approach LOS	B						

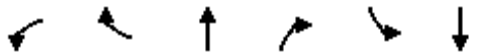
Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	31.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	132	11	1	241	0	36	0	4	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	2	132	11	1	241	0	36	0	4	0	0	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)												
pX, platoon unblocked												
vC, conflicting volume	241			143			380	379	132	383	390	241
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	241			143			380	379	132	383	390	241
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			93	100	100	100	100	100
cM capacity (veh/h)	1253			1364			553	532	884	549	524	767

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	134	11	1	241	40	1
Volume Left	2	0	1	0	36	0
Volume Right	0	11	0	0	4	1
cSH	1253	1700	1364	1700	575	767
Volume to Capacity	0.00	0.01	0.00	0.14	0.07	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	1.7	0.0
Control Delay (s)	0.1	0.0	7.6	0.0	11.7	9.7
Lane LOS	A		A		B	A
Approach Delay (s)	0.1		0.0		11.7	9.7
Approach LOS					B	A

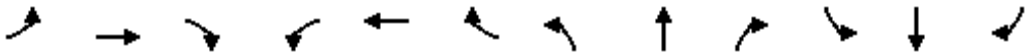
Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	29.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	5	140	64	9	111	91
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	140	64	9	111	91
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	332	32			64	
vC1, stage 1 conf vol	64					
vC2, stage 2 conf vol	268					
vCu, unblocked vol	332	32			64	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	86			92	
cM capacity (veh/h)	639	994			1446	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	145	32	32	9	111	46	46
Volume Left	5	0	0	0	111	0	0
Volume Right	140	0	0	9	0	0	0
cSH	1029	1700	1700	1700	1446	1700	1700
Volume to Capacity	0.14	0.02	0.02	0.01	0.08	0.03	0.03
Queue Length 95th (m)	3.7	0.0	0.0	0.0	1.9	0.0	0.0
Control Delay (s)	9.3	0.0	0.0	0.0	7.7	0.0	0.0
Lane LOS	A				A		
Approach Delay (s)	9.3	0.0			4.2		
Approach LOS	A						

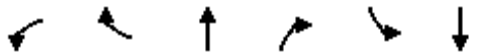
Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	22.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	113	0	0	109	0	0	0	0	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	113	0	0	109	0	0	0	0	0	0	0
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	109			113			222	222	113	222	222	109
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	109			113			222	222	113	222	222	109
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1404			1399			707	655	906	707	655	910

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	113	0	0	109	0	0
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0
cSH	1404	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.00	0.00	0.06	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS					A	A
Approach Delay (s)	0.0		0.0		0.0	0.0
Approach LOS					A	A

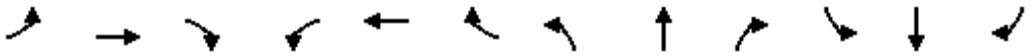
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	9.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	4	321	198	7	160	95
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	4	321	198	7	160	95
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	566	99			198	
vC1, stage 1 conf vol	198					
vC2, stage 2 conf vol	368					
vCu, unblocked vol	566	99			198	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	64			88	
cM capacity (veh/h)	520	897			1282	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	325	99	99	7	160	48	48
Volume Left	4	0	0	0	160	0	0
Volume Right	321	0	0	7	0	0	0
cSH	908	1700	1700	1700	1282	1700	1700
Volume to Capacity	0.36	0.06	0.06	0.00	0.12	0.03	0.03
Queue Length 95th (m)	12.4	0.0	0.0	0.0	3.2	0.0	0.0
Control Delay (s)	11.2	0.0	0.0	0.0	8.2	0.0	0.0
Lane LOS	B				A		
Approach Delay (s)	11.2	0.0			5.2		
Approach LOS	B						

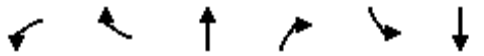
Intersection Summary			
Average Delay	6.3		
Intersection Capacity Utilization	32.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	152	0	0	277	0	0	0	0	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	2	152	0	0	277	0	0	0	0	0	0	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)												
pX, platoon unblocked												
vC, conflicting volume	277			152			434	433	152	433	433	277
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	277			152			434	433	152	433	433	277
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1215			1353			509	496	861	511	496	732

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	154	0	0	277	0	1
Volume Left	2	0	0	0	0	0
Volume Right	0	0	0	0	0	1
cSH	1215	1700	1700	1700	1700	732
Volume to Capacity	0.00	0.00	0.00	0.16	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.1	0.0	0.0	0.0	0.0	9.9
Lane LOS	A				A	A
Approach Delay (s)	0.1		0.0		0.0	9.9
Approach LOS					A	A

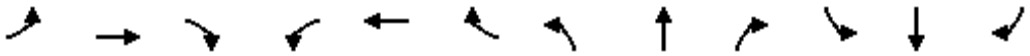
Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	24.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	7	159	64	17	175	91
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	7	159	64	17	175	91
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	460	32			64	
vC1, stage 1 conf vol	64					
vC2, stage 2 conf vol	396					
vCu, unblocked vol	460	32			64	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	99	84			88	
cM capacity (veh/h)	522	994			1446	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	166	32	32	17	175	46	46
Volume Left	7	0	0	0	175	0	0
Volume Right	159	0	0	17	0	0	0
cSH	1038	1700	1700	1700	1446	1700	1700
Volume to Capacity	0.16	0.02	0.02	0.01	0.12	0.03	0.03
Queue Length 95th (m)	4.3	0.0	0.0	0.0	3.1	0.0	0.0
Control Delay (s)	9.4	0.0	0.0	0.0	7.8	0.0	0.0
Lane LOS	A				A		
Approach Delay (s)	9.4	0.0			5.2		
Approach LOS	A						

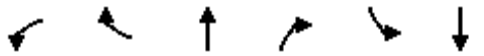
Intersection Summary			
Average Delay	5.7		
Intersection Capacity Utilization	26.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	113	73	8	109	0	21	0	2	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	113	73	8	109	0	21	0	2	0	0	0
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	109			186			238	238	113	240	311	109
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	109			186			238	238	113	240	311	109
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			99			97	100	100	100	100	100
cM capacity (veh/h)	1404			1314			687	637	906	683	579	910

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	113	73	8	109	23	0
Volume Left	0	0	8	0	21	0
Volume Right	0	73	0	0	2	0
cSH	1404	1700	1314	1700	701	1700
Volume to Capacity	0.00	0.04	0.01	0.06	0.03	0.00
Queue Length 95th (m)	0.0	0.0	0.1	0.0	0.8	0.0
Control Delay (s)	0.0	0.0	7.8	0.0	10.3	0.0
Lane LOS			A		B	A
Approach Delay (s)	0.0		0.5		10.3	0.0
Approach LOS					B	A

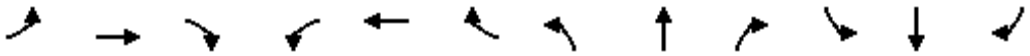
Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	16.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	11	381	198	9	178	95
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	11	381	198	9	178	95
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		33				
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	602	99			198	
vC1, stage 1 conf vol	198					
vC2, stage 2 conf vol	404					
vCu, unblocked vol	602	99			198	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	98	58			86	
cM capacity (veh/h)	492	897			1282	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	392	99	99	9	178	48	48
Volume Left	11	0	0	0	178	0	0
Volume Right	381	0	0	9	0	0	0
cSH	923	1700	1700	1700	1282	1700	1700
Volume to Capacity	0.42	0.06	0.06	0.01	0.14	0.03	0.03
Queue Length 95th (m)	16.3	0.0	0.0	0.0	3.7	0.0	0.0
Control Delay (s)	12.0	0.0	0.0	0.0	8.3	0.0	0.0
Lane LOS	B				A		
Approach Delay (s)	12.0	0.0			5.4		
Approach LOS	B						

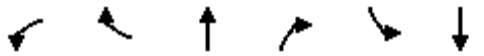
Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	35.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	152	20	2	277	0	68	0	8	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	2	152	20	2	277	0	68	0	8	0	0	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)												
pX, platoon unblocked												
vC, conflicting volume	277			172			438	437	152	445	457	277
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	277			172			438	437	152	445	457	277
tC, single (s)	4.2			4.2			7.2	6.7	6.4	7.2	6.7	6.4
tC, 2 stage (s)												
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			100			87	100	99	100	100	100
cM capacity (veh/h)	1215			1330			505	492	861	496	480	732

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total	154	20	2	277	76	1
Volume Left	2	0	2	0	68	0
Volume Right	0	20	0	0	8	1
cSH	1215	1700	1330	1700	528	732
Volume to Capacity	0.00	0.01	0.00	0.16	0.14	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	3.8	0.0
Control Delay (s)	0.1	0.0	7.7	0.0	13.0	9.9
Lane LOS	A		A		B	A
Approach Delay (s)	0.1		0.1		13.0	9.9
Approach LOS					B	A

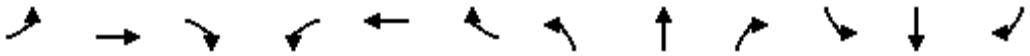
Intersection Summary				
Average Delay	1.9			
Intersection Capacity Utilization	32.2%	ICU Level of Service		A
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	17	464	211	30	366	301
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	17	464	211	30	366	301
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1094	106			211	
vC1, stage 1 conf vol	211					
vC2, stage 2 conf vol	882					
vCu, unblocked vol	1094	106			211	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	93	48			71	
cM capacity (veh/h)	230	888			1267	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	17	464	106	106	30	366	150	150
Volume Left	17	0	0	0	0	366	0	0
Volume Right	0	464	0	0	30	0	0	0
cSH	230	888	1700	1700	1700	1267	1700	1700
Volume to Capacity	0.07	0.52	0.06	0.06	0.02	0.29	0.09	0.09
Queue Length 95th (m)	1.8	23.6	0.0	0.0	0.0	9.2	0.0	0.0
Control Delay (s)	21.9	13.4	0.0	0.0	0.0	9.0	0.0	0.0
Lane LOS	C	B				A		
Approach Delay (s)	13.7		0.0			4.9		
Approach LOS	B							

Intersection Summary			
Average Delay	7.1		
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	407	0	0	394	0	0	0	0	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	407	0	0	394	0	0	0	0	0	0	0
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	394			407			604	801	204	598	801	197
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	394			407			604	801	204	598	801	197
tC, single (s)	4.4			4.4			7.8	6.8	7.2	7.8	6.8	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.4			3.6	4.2	3.4	3.6	4.2	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1073			1061			356	293	765	360	293	772

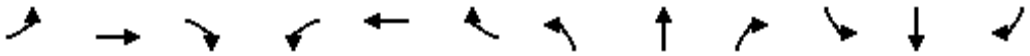
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	136	271	0	197	197	0	0
Volume Left	0	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0	0
cSH	1073	1700	1700	1061	1700	1700	1700
Volume to Capacity	0.00	0.16	0.00	0.00	0.12	0.00	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS						A	A
Approach Delay (s)	0.0			0.0		0.0	0.0
Approach LOS						A	A

Intersection Summary				
Average Delay	0.0			
Intersection Capacity Utilization	14.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	13	1062	654	22	529	314
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	13	1062	654	22	529	314
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			Raised			Raised
Median storage veh)			2			2
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1869	327			654	
vC1, stage 1 conf vol	654					
vC2, stage 2 conf vol	1215					
vCu, unblocked vol	1869	327			654	
tC, single (s)	7.1	7.2			4.4	
tC, 2 stage (s)	6.1					
tF (s)	3.6	3.4			2.4	
p0 queue free %	84	0			37	
cM capacity (veh/h)	79	632			846	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	13	1062	327	327	22	529	157	157
Volume Left	13	0	0	0	0	529	0	0
Volume Right	0	1062	0	0	22	0	0	0
cSH	79	632	1700	1700	1700	846	1700	1700
Volume to Capacity	0.16	1.68	0.19	0.19	0.01	0.63	0.09	0.09
Queue Length 95th (m)	4.2	458.6	0.0	0.0	0.0	34.1	0.0	0.0
Control Delay (s)	59.3	330.3	0.0	0.0	0.0	16.1	0.0	0.0
Lane LOS	F	F				C		
Approach Delay (s)	327.0		0.0			10.1		
Approach LOS	F							

Intersection Summary			
Average Delay	138.8		
Intersection Capacity Utilization	90.5%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	548	0	0	1000	0	0	0	0	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	2	548	0	0	1000	0	0	0	0	0	0	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)												
pX, platoon unblocked												
vC, conflicting volume	1000			548			1053	1552	274	1278	1552	500
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1000			548			1053	1552	274	1278	1552	500
tC, single (s)	4.4			4.4			7.8	6.8	7.2	7.8	6.8	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.4			3.6	4.2	3.4	3.6	4.2	3.4
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	614			933			163	99	686	110	99	483

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	185	365	0	500	500	0	1
Volume Left	2	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0	1
cSH	614	1700	1700	933	1700	1700	483
Volume to Capacity	0.00	0.21	0.00	0.00	0.29	0.00	0.00
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	0.2	0.0	0.0	0.0	0.0	0.0	12.5
Lane LOS	A					A	B
Approach Delay (s)	0.1			0.0		0.0	12.5
Approach LOS						A	B

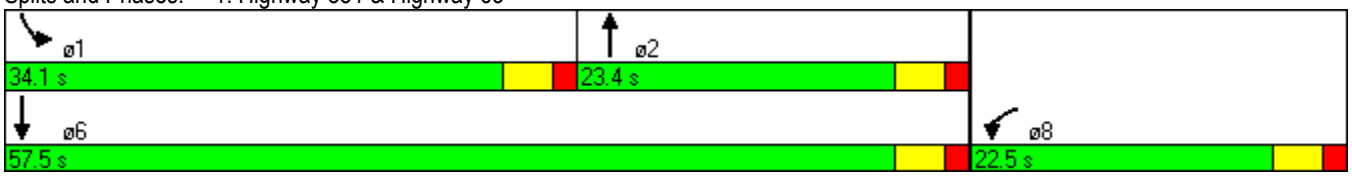
Intersection Summary				
Average Delay	0.0			
Intersection Capacity Utilization	37.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	17	464	211	30	366	301
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)	0%		0%			0%
Storage Length (m)	0.0	0.0		260.0	220.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	25.0	25.0		25.0	25.0	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Ped Bike Factor						
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1587	1420	3174	1420	1587	3174
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1587	1420	3174	1420	1587	3174
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		464		30		
Link Speed (k/h)	100		110			110
Link Distance (m)	308.5		771.6			259.5
Travel Time (s)	11.1		25.3			8.5
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%		0%			0%
Adj. Flow (vph)	17	464	211	30	366	301
Shared Lane Traffic (%)						
Lane Group Flow (vph)	17	464	211	30	366	301
Turn Type		Free		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		Free		
Detector Phase	8		2		1	6
Switch Phase						
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	22.5		22.5		8.5	22.5
Total Split (s)	22.5	0.0	23.4	0.0	34.1	57.5
Total Split (%)	28.1%	0.0%	29.3%	0.0%	42.6%	71.9%
Yellow Time (s)	3.0		3.0		3.0	3.0
All-Red Time (s)	1.5		1.5		1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0	4.5	4.0	4.5	4.5
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		Max		None	Max
Act Effct Green (s)	6.2	60.0	31.1	60.0	17.8	57.1
Actuated g/C Ratio	0.10	1.00	0.52	1.00	0.30	0.95

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
v/c Ratio	0.10	0.33	0.13	0.02	0.78	0.10
Control Delay	27.2	0.6	10.5	0.0	31.1	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.2	0.6	10.5	0.0	31.1	0.8
LOS	C	A	B	A	C	A
Approach Delay	1.6		9.2			17.4
Approach LOS	A		A			B
Queue Length 50th (m)	1.7	0.0	5.0	0.0	34.6	0.0
Queue Length 95th (m)	7.2	0.0	18.0	0.0	62.4	6.2
Internal Link Dist (m)	284.5		747.6			235.5
Turn Bay Length (m)				260.0	220.0	
Base Capacity (vph)	479	1420	1644	1420	787	3023
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.33	0.13	0.02	0.47	0.10

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 60			
Natural Cycle: 70			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.78			
Intersection Signal Delay: 10.5		Intersection LOS: B	
Intersection Capacity Utilization 40.7%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 1: Highway 881 & Highway 63



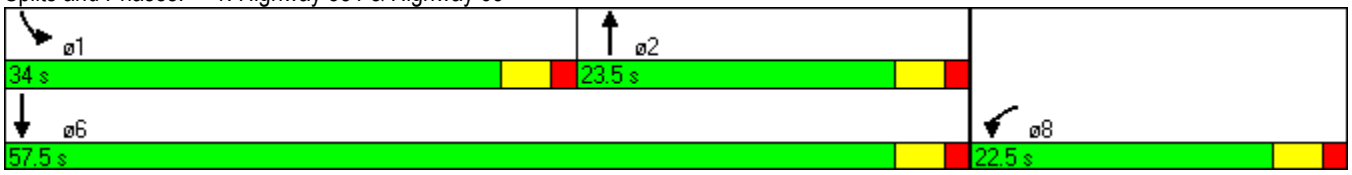
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	13	1062	654	22	529	314
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)	0%		0%			0%
Storage Length (m)	0.0	0.0		260.0	220.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	25.0	25.0		25.0	25.0	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Ped Bike Factor						
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1587	1420	3174	1420	1587	3174
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1587	1420	3174	1420	1587	3174
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		787		22		
Link Speed (k/h)	100		110			110
Link Distance (m)	308.5		771.6			259.5
Travel Time (s)	11.1		25.3			8.5
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%		0%			0%
Adj. Flow (vph)	13	1062	654	22	529	314
Shared Lane Traffic (%)						
Lane Group Flow (vph)	13	1062	654	22	529	314
Turn Type		Free		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		Free		
Detector Phase	8		2		1	6
Switch Phase						
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	22.5		22.5		8.5	22.5
Total Split (s)	22.5	0.0	23.5	0.0	34.0	57.5
Total Split (%)	28.1%	0.0%	29.4%	0.0%	42.5%	71.9%
Yellow Time (s)	3.0		3.0		3.0	3.0
All-Red Time (s)	1.5		1.5		1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0	4.5	4.0	4.5	4.5
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		Max		None	Max
Act Effct Green (s)	6.1	59.9	24.5	59.9	24.4	57.1
Actuated g/C Ratio	0.10	1.00	0.41	1.00	0.41	0.95

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
v/c Ratio	0.08	0.75	0.50	0.02	0.82	0.10
Control Delay	27.0	3.6	17.1	0.0	28.1	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.0	3.6	17.1	0.0	28.1	0.8
LOS	C	A	B	A	C	A
Approach Delay	3.9		16.6			17.9
Approach LOS	A		B			B
Queue Length 50th (m)	1.3	0.0	25.5	0.0	44.6	0.0
Queue Length 95th (m)	6.1	0.0	58.2	0.0	#106.0	6.3
Internal Link Dist (m)	284.5		747.6			235.5
Turn Bay Length (m)				260.0	220.0	
Base Capacity (vph)	480	1420	1296	1420	786	3025
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.75	0.50	0.02	0.67	0.10

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 59.9
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 11.8 Intersection LOS: B
Intersection Capacity Utilization 62.0% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Highway 881 & Highway 63

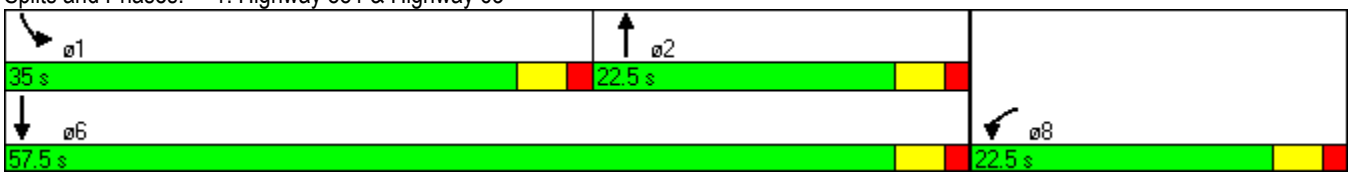


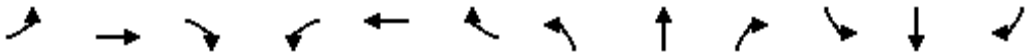
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	20	487	211	40	445	301
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)	0%		0%			0%
Storage Length (m)	0.0	0.0		260.0	220.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	25.0	25.0		25.0	25.0	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Ped Bike Factor						
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1587	1420	3174	1420	1587	3174
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1587	1420	3174	1420	1587	3174
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		487		40		
Link Speed (k/h)	100		110			110
Link Distance (m)	308.5		771.6			259.5
Travel Time (s)	11.1		25.3			8.5
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%		0%			0%
Adj. Flow (vph)	20	487	211	40	445	301
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	487	211	40	445	301
Turn Type		Free		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		Free		
Detector Phase	8		2		1	6
Switch Phase						
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	22.5		22.5		14.5	22.5
Total Split (s)	22.5	0.0	22.5	0.0	35.0	57.5
Total Split (%)	28.1%	0.0%	28.1%	0.0%	43.8%	71.9%
Yellow Time (s)	3.0		3.0		3.0	3.0
All-Red Time (s)	1.5		1.5		1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0	4.5	4.0	4.5	4.5
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		Max		None	Max
Act Effct Green (s)	6.3	60.0	28.7	60.0	20.1	57.1
Actuated g/C Ratio	0.10	1.00	0.48	1.00	0.34	0.95

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
v/c Ratio	0.12	0.34	0.14	0.03	0.84	0.10
Control Delay	27.3	0.7	12.2	0.0	32.8	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.3	0.7	12.2	0.0	32.8	0.8
LOS	C	A	B	A	C	A
Approach Delay	1.7		10.2			19.9
Approach LOS	A		B			B
Queue Length 50th (m)	1.9	0.0	5.5	0.0	42.5	0.0
Queue Length 95th (m)	8.1	0.0	19.7	0.0	72.8	6.4
Internal Link Dist (m)	284.5		747.6			235.5
Turn Bay Length (m)				260.0	220.0	
Base Capacity (vph)	479	1420	1519	1420	812	3021
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.34	0.14	0.03	0.55	0.10

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 60			
Natural Cycle: 75			
Control Type: Semi Act-Uncoord			
Maximum v/c Ratio: 0.84			
Intersection Signal Delay: 12.2		Intersection LOS: B	
Intersection Capacity Utilization 45.1%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 1: Highway 881 & Highway 63





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	407	73	8	394	0	21	0	2	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	407	73	8	394	0	21	0	2	0	0	0
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	394			480			620	817	204	616	890	197
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	394			480			620	817	204	616	890	197
tC, single (s)	4.4			4.4			7.8	6.8	7.2	7.8	6.8	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.4			3.6	4.2	3.4	3.6	4.2	3.4
p0 queue free %	100			99			94	100	100	100	100	100
cM capacity (veh/h)	1073			992			345	284	765	346	256	772

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	136	271	73	205	197	23	0
Volume Left	0	0	0	8	0	21	0
Volume Right	0	0	73	0	0	2	0
cSH	1073	1700	1700	992	1700	362	1700
Volume to Capacity	0.00	0.16	0.04	0.01	0.12	0.06	0.00
Queue Length 95th (m)	0.0	0.0	0.0	0.2	0.0	1.5	0.0
Control Delay (s)	0.0	0.0	0.0	0.4	0.0	15.6	0.0
Lane LOS				A		C	A
Approach Delay (s)	0.0			0.2		15.6	0.0
Approach LOS						C	A

Intersection Summary				
Average Delay	0.5			
Intersection Capacity Utilization	26.6%	ICU Level of Service	A	
Analysis Period (min)	15			

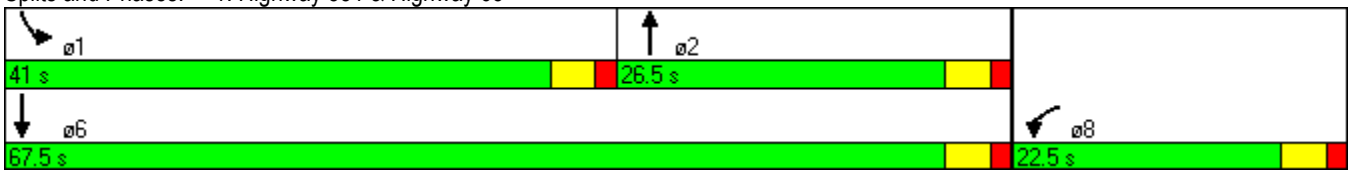
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	20	1122	654	24	547	314
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (m)	3.7	3.7	3.7	3.7	3.7	3.7
Grade (%)	0%		0%			0%
Storage Length (m)	0.0	0.0		260.0	220.0	
Storage Lanes	1	1		1	1	
Taper Length (m)	25.0	25.0		25.0	25.0	
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Ped Bike Factor						
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1587	1420	3174	1420	1587	3174
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1587	1420	3174	1420	1587	3174
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		786		24		
Link Speed (k/h)	100		110			110
Link Distance (m)	308.5		771.6			259.5
Travel Time (s)	11.1		25.3			8.5
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%		0%			0%
Adj. Flow (vph)	20	1122	654	24	547	314
Shared Lane Traffic (%)						
Lane Group Flow (vph)	20	1122	654	24	547	314
Turn Type		Free		Free	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		Free		
Detector Phase	8		2		1	6
Switch Phase						
Minimum Initial (s)	4.0		4.0		4.0	4.0
Minimum Split (s)	22.5		22.5		14.5	22.5
Total Split (s)	22.5	0.0	26.5	0.0	41.0	67.5
Total Split (%)	25.0%	0.0%	29.4%	0.0%	45.6%	75.0%
Yellow Time (s)	3.0		3.0		3.0	3.0
All-Red Time (s)	1.5		1.5		1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0	4.5	4.0	4.5	4.5
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		Max		None	Max
Act Effct Green (s)	6.5	72.4	30.7	72.4	28.2	66.3
Actuated g/C Ratio	0.09	1.00	0.42	1.00	0.39	0.92

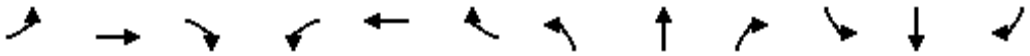
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
v/c Ratio	0.14	0.79	0.49	0.02	0.88	0.11
Control Delay	34.5	4.6	20.1	0.0	37.4	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.5	4.6	20.1	0.0	37.4	1.2
LOS	C	A	C	A	D	A
Approach Delay	5.1		19.4			24.2
Approach LOS	A		B			C
Queue Length 50th (m)	2.4	0.0	25.8	0.0	64.0	0.0
Queue Length 95th (m)	9.0	0.0	66.5	0.0	#107.2	6.6
Internal Link Dist (m)	284.5		747.6			235.5
Turn Bay Length (m)				260.0	220.0	
Base Capacity (vph)	397	1420	1345	1420	806	2909
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.79	0.49	0.02	0.68	0.11

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 72.4
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 14.8 Intersection LOS: B
Intersection Capacity Utilization 63.0% ICU Level of Service B
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Highway 881 & Highway 63





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	548	20	2	1000	0	68	0	8	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	2	548	20	2	1000	0	68	0	8	0	0	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)												
pX, platoon unblocked												
vC, conflicting volume	1000			568			1057	1556	274	1290	1576	500
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1000			568			1057	1556	274	1290	1576	500
tC, single (s)	4.4			4.4			7.8	6.8	7.2	7.8	6.8	7.2
tC, 2 stage (s)												
tF (s)	2.4			2.4			3.6	4.2	3.4	3.6	4.2	3.4
p0 queue free %	100			100			58	100	99	100	100	100
cM capacity (veh/h)	614			916			162	98	686	106	95	483

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	185	365	20	502	500	76	1
Volume Left	2	0	0	2	0	68	0
Volume Right	0	0	20	0	0	8	1
cSH	614	1700	1700	916	1700	176	483
Volume to Capacity	0.00	0.21	0.01	0.00	0.29	0.43	0.00
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.0	15.0	0.0
Control Delay (s)	0.2	0.0	0.0	0.1	0.0	40.2	12.5
Lane LOS	A			A		E	B
Approach Delay (s)	0.1			0.0		40.2	12.5
Approach LOS						E	B

Intersection Summary				
Average Delay	1.9			
Intersection Capacity Utilization	46.6%	ICU Level of Service		A
Analysis Period (min)	15			

Appendix E

Warrant Analyses

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 63	Direction (EW or NS)	NS	Road Authority:	Wood Buffalo
Side Street (name)	Highway 881	Direction (EW or NS)	EW	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2011 Background Only	Analysis Date:	2010 Dec 20, Mon
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2010 Nov 29, Mon
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 63	NB			2			1	10,000	2
Highway 63	SB	1		2				10,000	2
Highway 881	WB	1					1		
Highway 881	EB								
							y		

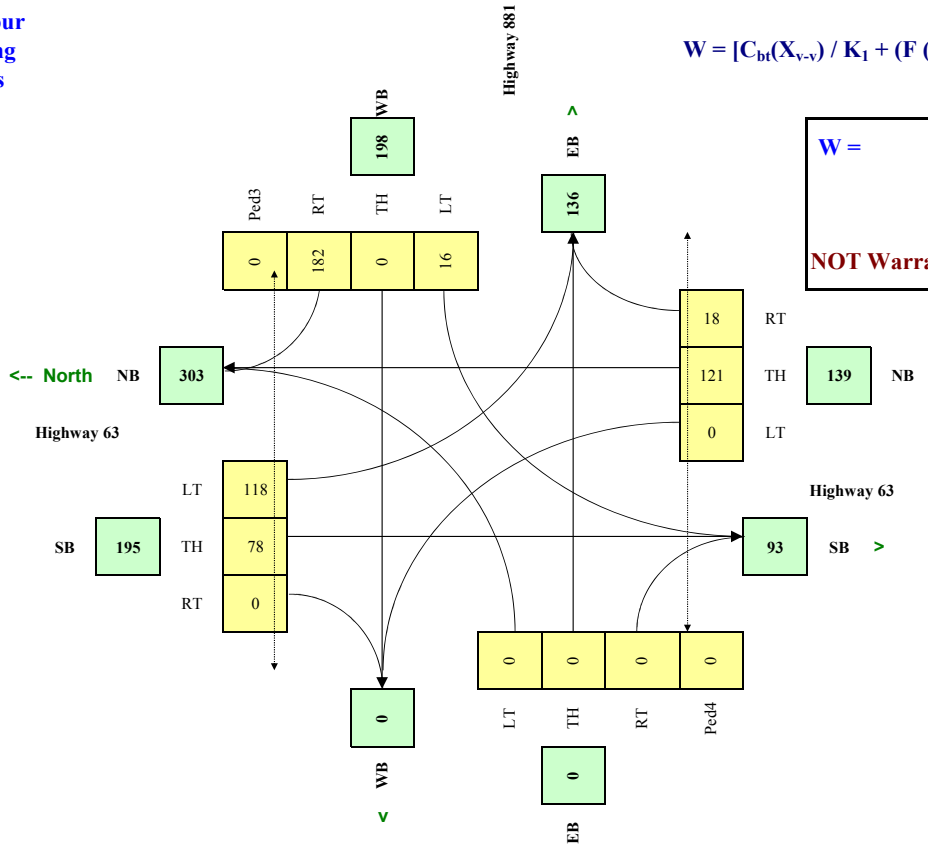
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 63	NS	110	15.0%	n	0.0
Highway 881	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	56	8	98	81	0	5	0	124	0	0	0				
	0	56	8	98	81	0	5	0	124	0	0	0				
	0	131	40	114	68	0	39	0	138	0	0	0				
	0	131	40	114	68	0	39	0	138	0	0	0				
	0	175	6	141	84	0	3	0	284	0	0	0				
	0	175	6	141	84	0	3	0	284	0	0	0				
Total (6-hour peak)	0	724	108	706	466	0	94	0	1,092	0	0	0	0	0	0	0
Average (6-hour peak)	0	121	18	118	78	0	16	0	182	0	0	0	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	30	30	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 881	Direction (EW or NS)	EW	Road Authority:	Wood Buffalo
Side Street (name)	Site Access	Direction (EW or NS)	NS	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2011 Background Only	Analysis Date:	2011 Jan 19, Wed
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2011 Jan 11, Tue
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 881	WB	1				1		10,000	1
Highway 881	EB		1				1	1,700	1
Site Access	NB				1				
Site Access	SB				1				
Are the Site Access NB right turns significantly impeded by through movements? (y/n)							n		
Are the Site Access SB right turns significantly impeded by through movements? (y/n)							n		

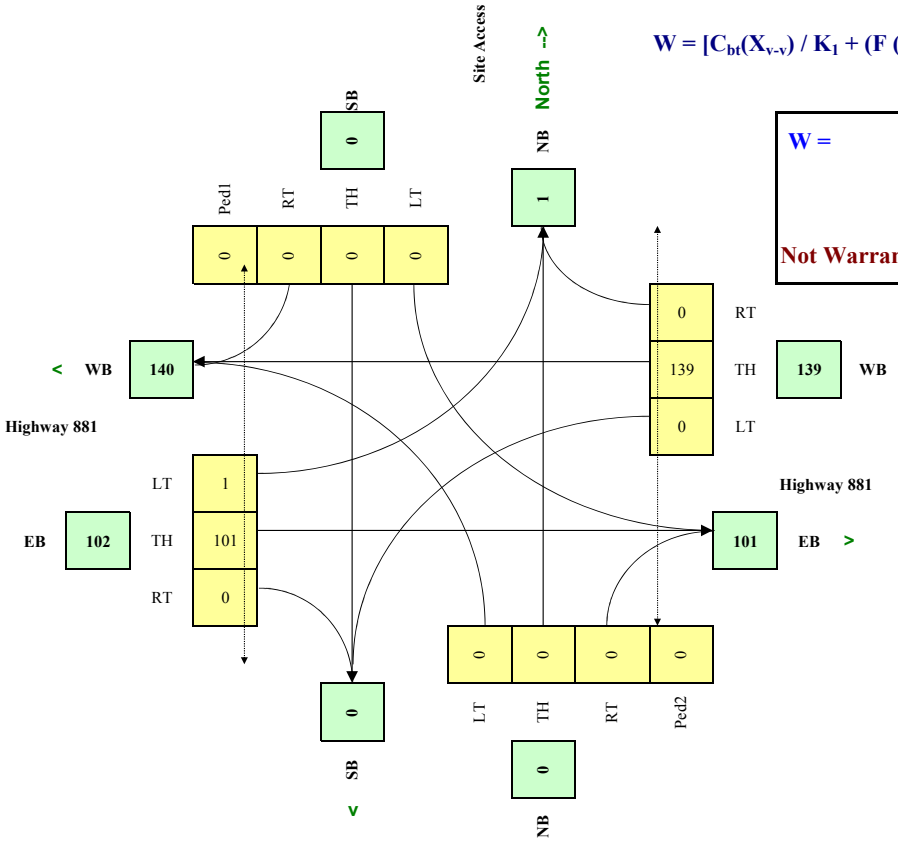
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 881	EW	100	15.0%	n	0.0
Site Access	NS		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	0	0	0	0	0	0	95	0	0	98	0				
	0	0	0	0	0	0	0	95	0	0	98	0				
	0	0	0	0	0	0	0	82	0	0	73	0				
	0	0	0	0	0	0	0	82	0	0	73	0				
	0	0	0	0	0	1	0	241	0	2	132	0				
	0	0	0	0	0	1	0	241	0	2	132	0				
Total (6-hour peak)	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**836**	**0**	**4**	**606**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**139**	**0**	**1**	**101**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W = 0 0 0

Veh *Ped*

Not Warranted - Vs<75

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 63	Direction (EW or NS)	NS
Side Street (name)	Highway 881	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2012 Background Only

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	Wood Buffalo	
City:	Near Fort McMurray, AB	
Analysis Date:	2010 Dec 20, Mon	
Count Date:	2010 Nov 29, Mon	
Date Entry Format:	(yyyy-mm-dd)	

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 63	NB			2			1	10,000	2
Highway 63	SB	1		2				10,000	2
Highway 881	WB	1					1		
Highway 881	EB								
							y		

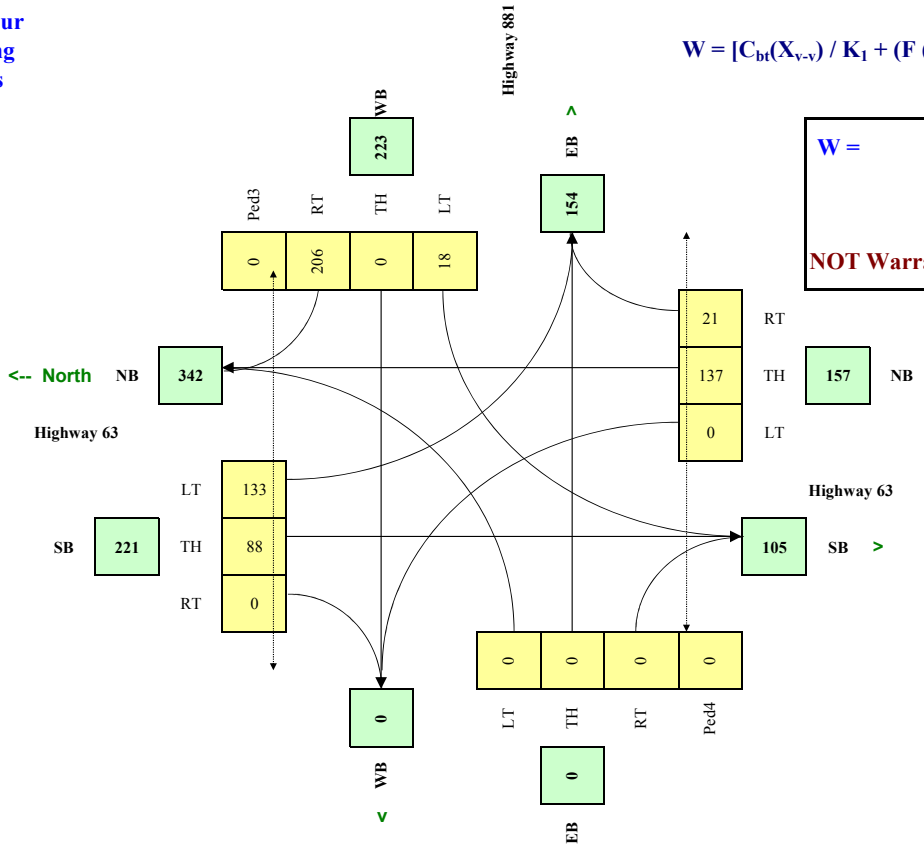
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 63	NS	110	15.0%	n	0.0
Highway 881	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	64	9	111	91	0	5	0	140	0	0	0				
	0	64	9	111	91	0	5	0	140	0	0	0				
	0	148	46	129	77	0	44	0	156	0	0	0				
	0	148	46	129	77	0	44	0	156	0	0	0				
	0	198	7	160	95	0	4	0	321	0	0	0				
	0	198	7	160	95	0	4	0	321	0	0	0				
Total (6-hour peak)	0	820	124	800	526	0	106	0	1,234	0	0	0	0	0	0	0
Average (6-hour peak)	0	137	21	133	88	0	18	0	206	0	0	0	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	38	38	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 881	Direction (EW or NS)	EW	Road Authority:	Wood Buffalo
Side Street (name)	Site Access	Direction (EW or NS)	NS	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2012 Background Only	Analysis Date:	2011 Jan 19, Wed
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2011 Jan 11, Tue
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 881	WB	1				1		10,000	1
Highway 881	EB		1				1	1,700	1
Site Access	NB				1				
Site Access	SB				1				
Are the Site Access NB right turns significantly impeded by through movements? (y/n)							n		
Are the Site Access SB right turns significantly impeded by through movements? (y/n)							n		

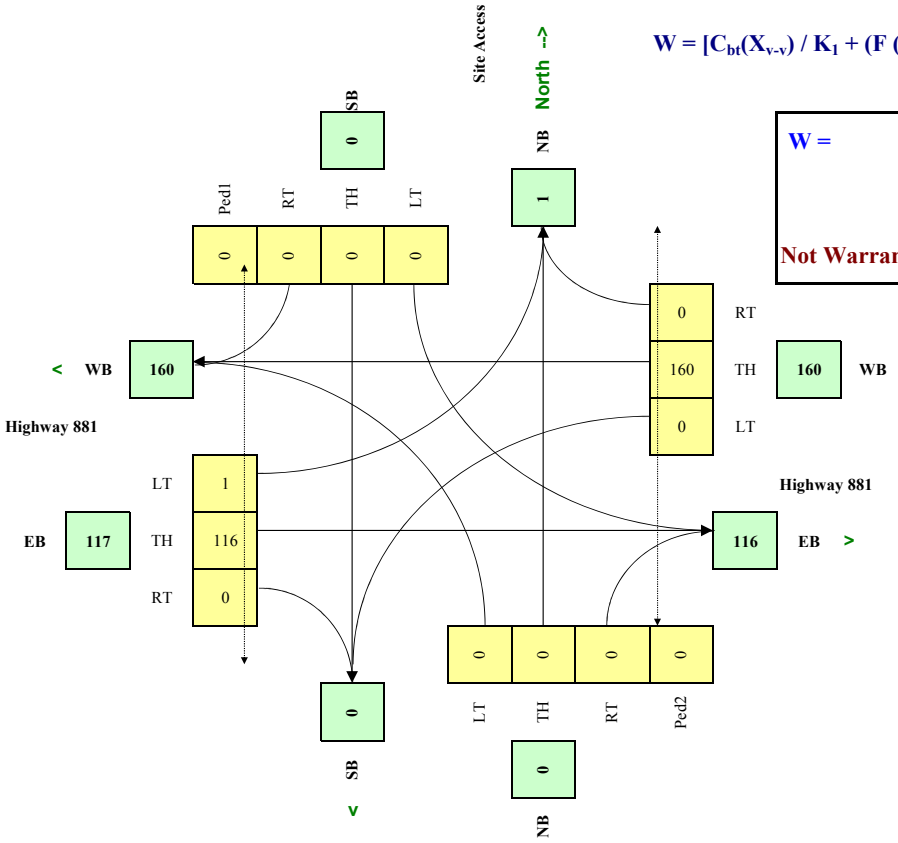
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 881	EW	100	15.0%	n	0.0
Site Access	NS		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	0	0	0	0	0	0	109	0	0	113	0				
	0	0	0	0	0	0	0	109	0	0	113	0				
	0	0	0	0	0	0	0	94	0	0	84	0				
	0	0	0	0	0	0	0	94	0	0	84	0				
	0	0	0	0	0	1	0	277	0	2	152	0				
	0	0	0	0	0	1	0	277	0	2	152	0				
Total (6-hour peak)	0	0	0	0	0	2	0	960	0	4	698	0	0	0	0	0
Average (6-hour peak)	0	0	0	0	0	0	0	160	0	1	116	0	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	0	0	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 63	Direction (EW or NS)	NS
Side Street (name)	Highway 881	Direction (EW or NS)	EW
Quadrant / Int #		Comments	2032 Background Only

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	Wood Buffalo
City:	Near Fort McMurray, AB
Analysis Date:	2010 Dec 20, Mon
Count Date:	2010 Nov 29, Mon
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 63	NB			2			1	10,000	2
Highway 63	SB	1		2				10,000	2
Highway 881	WB	1					1		
Highway 881	EB								
							y		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

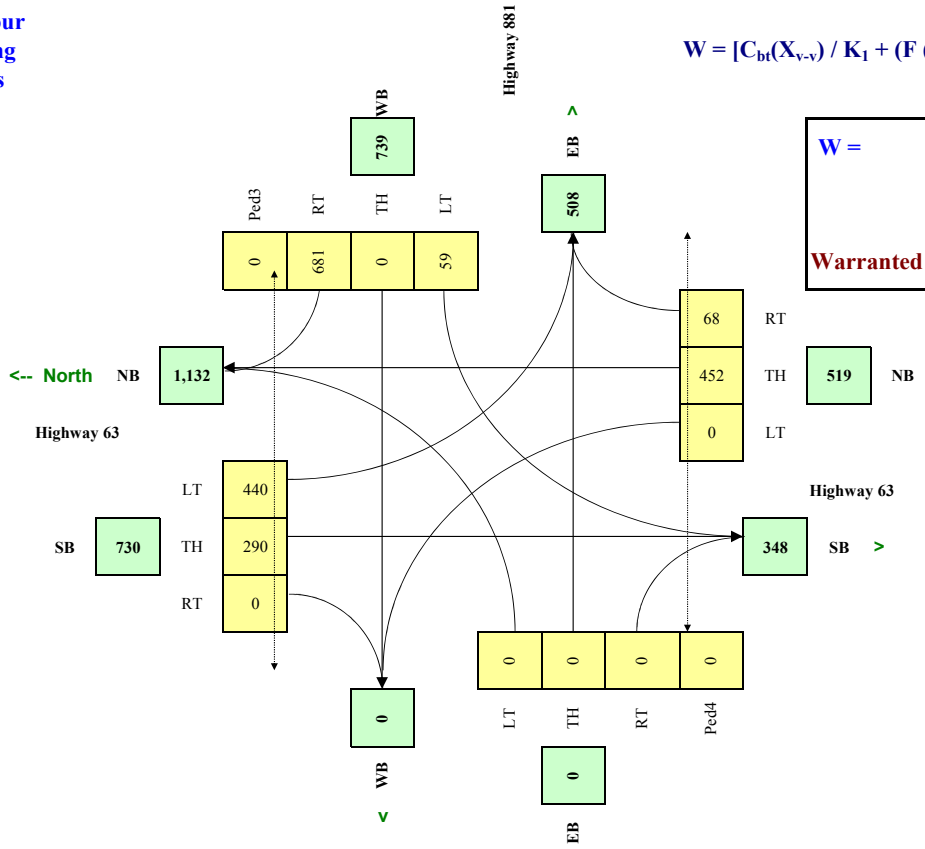
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 63	NS	110	15.0%	n	0.0
Highway 881	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	211	30	366	301	0	17	0	464	0	0	0				
	0	211	30	366	301	0	17	0	464	0	0	0				
	0	490	151	426	254	0	146	0	516	0	0	0				
	0	490	151	426	254	0	146	0	516	0	0	0				
	0	654	22	529	314	0	13	0	1062	0	0	0				
	0	654	22	529	314	0	13	0	1062	0	0	0				
Total (6-hour peak)	0	2,710	406	2,642	1,738	0	352	0	4,084	0	0	0	0	0	0	0
Average (6-hour peak)	0	452	68	440	290	0	59	0	681	0	0	0	0	0	0	0

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	413	413	0
		Veh	*Ped*

Warranted

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 881	Direction (EW or NS)	EW	Road Authority:	Wood Buffalo
Side Street (name)	Site Access	Direction (EW or NS)	NS	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2032 Background Only	Analysis Date:	2011 Jan 19, Wed
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2011 Jan 11, Tue
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 881	WB	1		1		1		10,000	2
Highway 881	EB		1	1			1	1,700	2
Site Access	NB				1				
Site Access	SB				1				
Are the Site Access NB right turns significantly impeded by through movements? (y/n)							n		
Are the Site Access SB right turns significantly impeded by through movements? (y/n)							n		

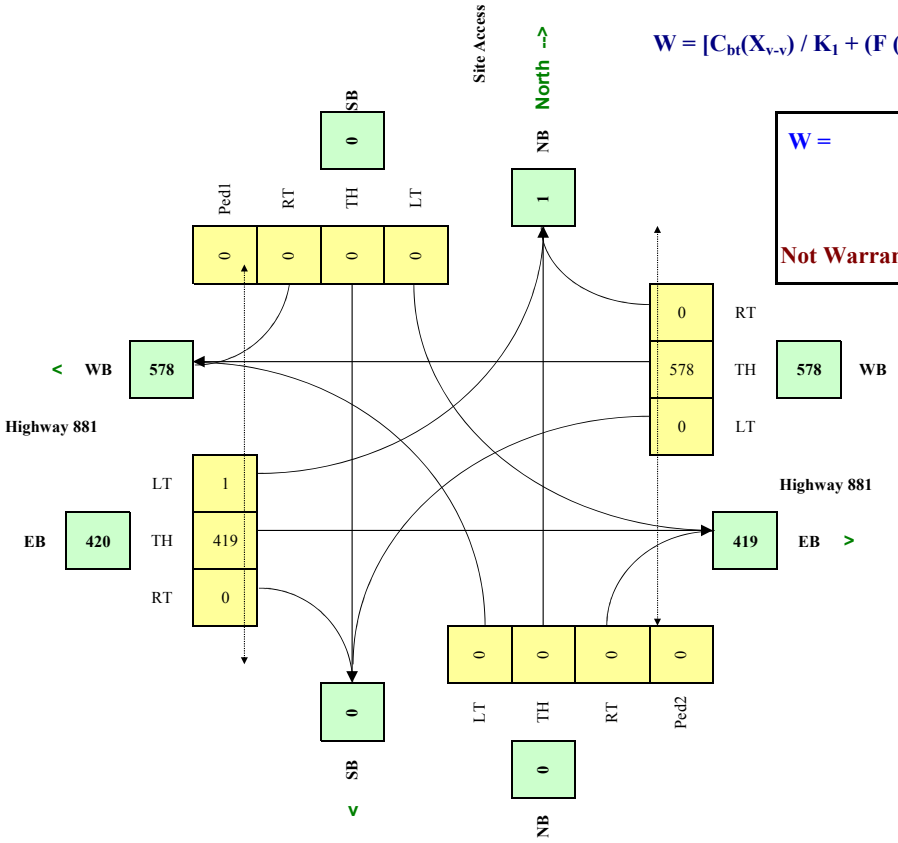
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 881	EW	100	15.0%	n	0.0
Site Access	NS		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	0	0	0	0	0	0	394	0	0	407	0				
	0	0	0	0	0	0	0	394	0	0	407	0				
	0	0	0	0	0	0	0	340	0	0	303	0				
	0	0	0	0	0	0	0	340	0	0	303	0				
	0	0	0	0	0	1	0	1000	0	2	548	0				
	0	0	0	0	0	1	0	1000	0	2	548	0				
Total (6-hour peak)	0	0	0	0	0	2	0	3,468	0	4	2,516	0	0	0	0	0
Average (6-hour peak)	0	0	0	0	0	0	0	578	0	1	419	0	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W = 0 0 0

Veh *Ped*

Not Warranted - Vs<75

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 63	Direction (EW or NS)	NS	Road Authority:	Wood Buffalo
Side Street (name)	Highway 881	Direction (EW or NS)	EW	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2011 Final	Analysis Date:	2011 Jan 20, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2010 Nov 29, Mon
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 63	NB			2			1	10,000	2
Highway 63	SB	1		2				10,000	2
Highway 881	WB	1					1		
Highway 881	EB								
							y		

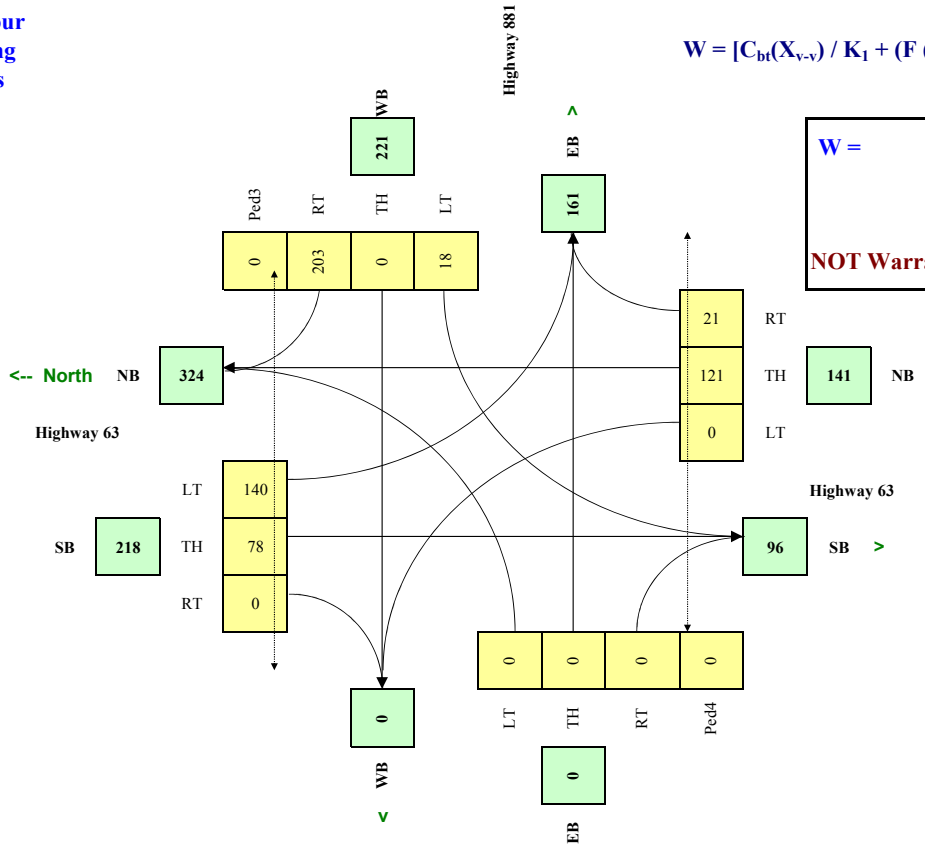
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 63	NS	110	15.0%	n	0.0
Highway 881	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	56	12	133	81	0	6	0	134	0	0	0				
	0	56	12	133	81	0	6	0	134	0	0	0				
	0	131	43	136	68	0	42	0	159	0	0	0				
	0	131	43	136	68	0	42	0	159	0	0	0				
	0	175	7	151	84	0	7	0	316	0	0	0				
	0	175	7	151	84	0	7	0	316	0	0	0				
Total (6-hour peak)	**0**	**724**	**124**	**840**	**466**	**0**	**110**	**0**	**1,218**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**121**	**21**	**140**	**78**	**0**	**18**	**0**	**203**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	34	34	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 881	Direction (EW or NS)	EW	Road Authority:	Wood Buffalo
Side Street (name)	Site Access	Direction (EW or NS)	NS	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2011 Final	Analysis Date:	2011 Jan 20, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2011 Jan 11, Tue
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 881	WB	1				1		10,000	1
Highway 881	EB		1				1	1,700	1
Site Access	NB				1				
Site Access	SB				1				
Are the Site Access NB right turns significantly impeded by through movements? (y/n)							n		
Are the Site Access SB right turns significantly impeded by through movements? (y/n)							n		

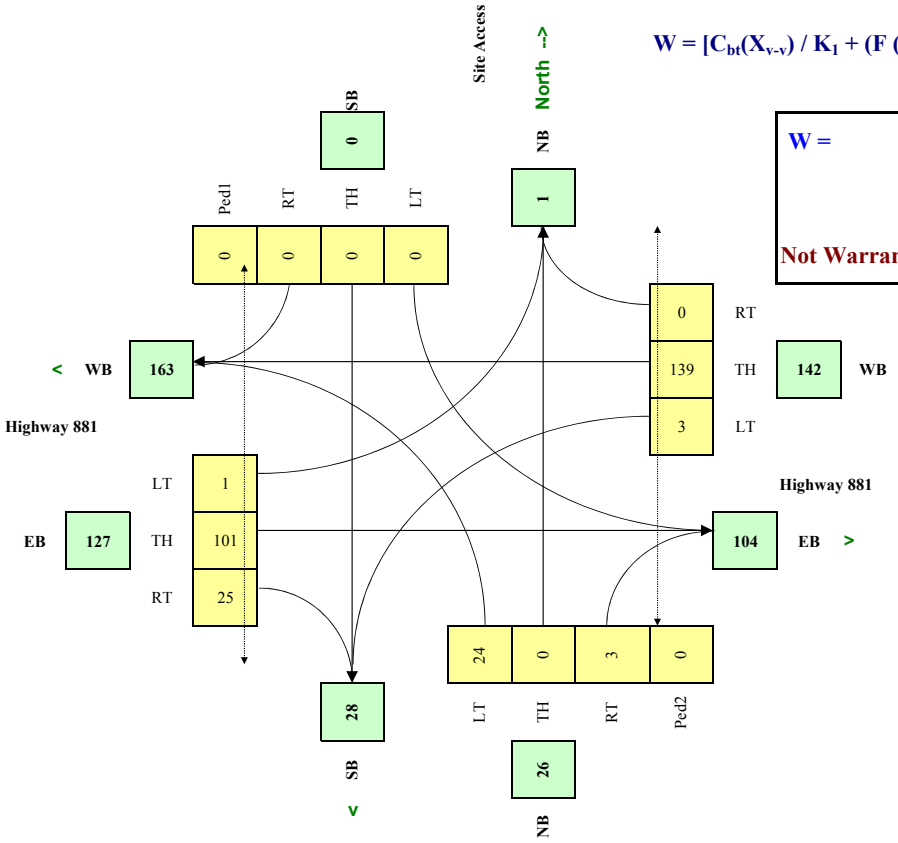
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 881	EW	100	15.0%	n	0.0
Site Access	NS		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	11	0	1	0	0	0	4	95	0	0	98	39				
	11	0	1	0	0	0	4	95	0	0	98	39				
	24	0	3	0	0	0	3	82	0	0	73	25				
	24	0	3	0	0	0	3	82	0	0	73	25				
	36	0	4	0	0	1	1	241	0	2	132	11				
	36	0	4	0	0	1	1	241	0	2	132	11				
Total (6-hour peak)	142	0	16	0	0	2	16	836	0	4	606	150	0	0	0	0
Average (6-hour peak)	24	0	3	0	0	0	3	139	0	1	101	25	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	5	5	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 63	Direction (EW or NS)	NS	Road Authority:	Wood Buffalo
Side Street (name)	Highway 881	Direction (EW or NS)	EW	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2012 Final	Analysis Date:	2011 Jan 20, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2010 Nov 29, Mon
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 63	NB			2			1	10,000	2
Highway 63	SB	1		2				10,000	2
Highway 881	WB	1					1		
Highway 881	EB								
							y		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

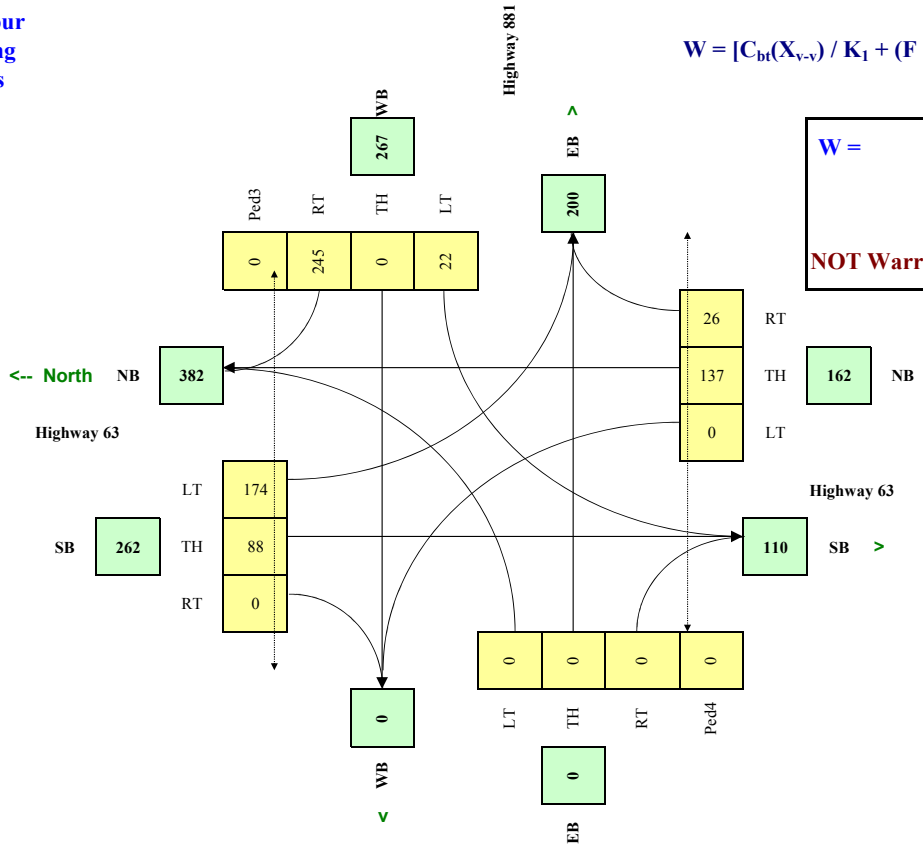
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 63	NS	110	15.0%	n	0.0
Highway 881	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	64	17	175	91	0	7	0	159	0	0	0				
	0	64	17	175	91	0	7	0	159	0	0	0				
	0	148	51	170	77	0	49	0	195	0	0	0				
	0	148	51	170	77	0	49	0	195	0	0	0				
	0	198	9	178	95	0	11	0	381	0	0	0				
	0	198	9	178	95	0	11	0	381	0	0	0				
Total (6-hour peak)	0	820	154	1,046	526	0	134	0	1,470	0	0	0	0	0	0	0
Average (6-hour peak)	0	137	26	174	88	0	22	0	245	0	0	0	0	0	0	0

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$



W =	48	48	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 881	Direction (EW or NS)	EW	Road Authority:	Wood Buffalo
Side Street (name)	Site Access	Direction (EW or NS)	NS	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2012 Final	Analysis Date:	2011 Jan 20, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2011 Jan 11, Tue
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 881	WB	1				1		10,000	1
Highway 881	EB		1				1	1,700	1
Site Access	NB				1				
Site Access	SB				1				
Are the Site Access NB right turns significantly impeded by through movements? (y/n)							n		
Are the Site Access SB right turns significantly impeded by through movements? (y/n)							n		

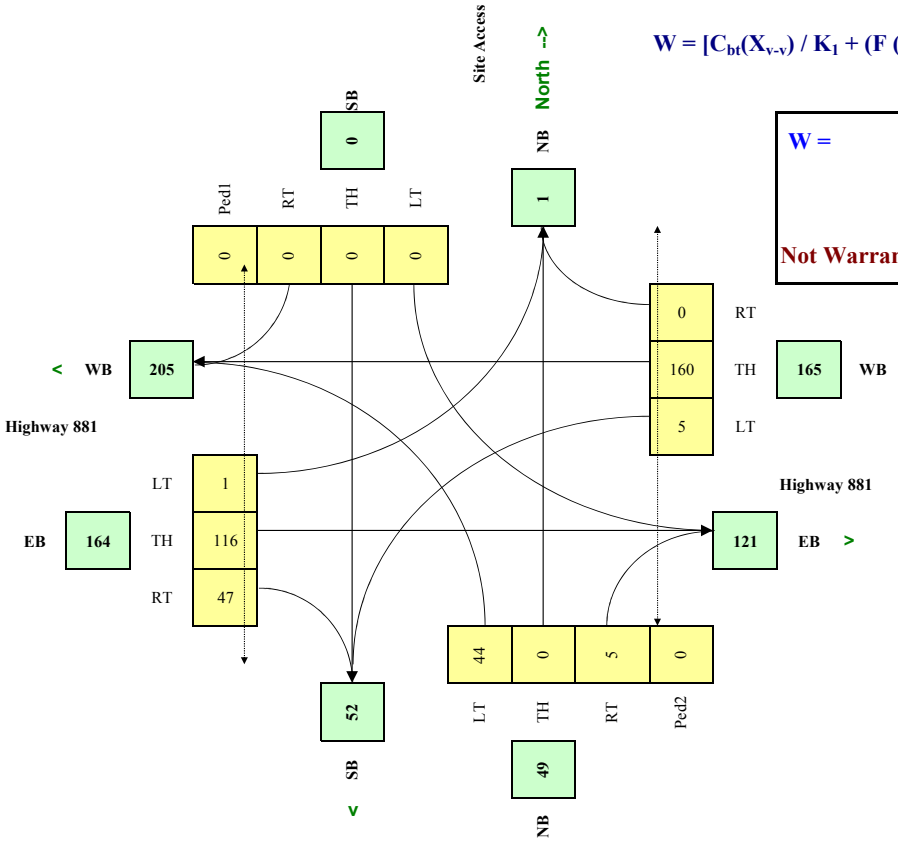
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 881	EW	100	15.0%	n	0.0
Site Access	NS		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	21	0	2	0	0	0	8	109	0	0	113	73				
	21	0	2	0	0	0	8	109	0	0	113	73				
	44	0	5	0	0	0	5	94	0	0	84	47				
	44	0	5	0	0	0	5	94	0	0	84	47				
	68	0	8	0	0	1	2	277	0	2	152	20				
	68	0	8	0	0	1	2	277	0	2	152	20				
Total (6-hour peak)	266	0	30	0	0	2	30	960	0	4	698	280	0	0	0	0
Average (6-hour peak)	44	0	5	0	0	0	5	160	0	1	116	47	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	10	10	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 63	Direction (EW or NS)	NS	Road Authority:	Wood Buffalo
Side Street (name)	Highway 881	Direction (EW or NS)	EW	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2032 Final	Analysis Date:	2011 Jan 20, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2010 Nov 29, Mon
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 63	NB			2			1	10,000	2
Highway 63	SB	1		2				10,000	2
Highway 881	WB	1					1		
Highway 881	EB								
							y		

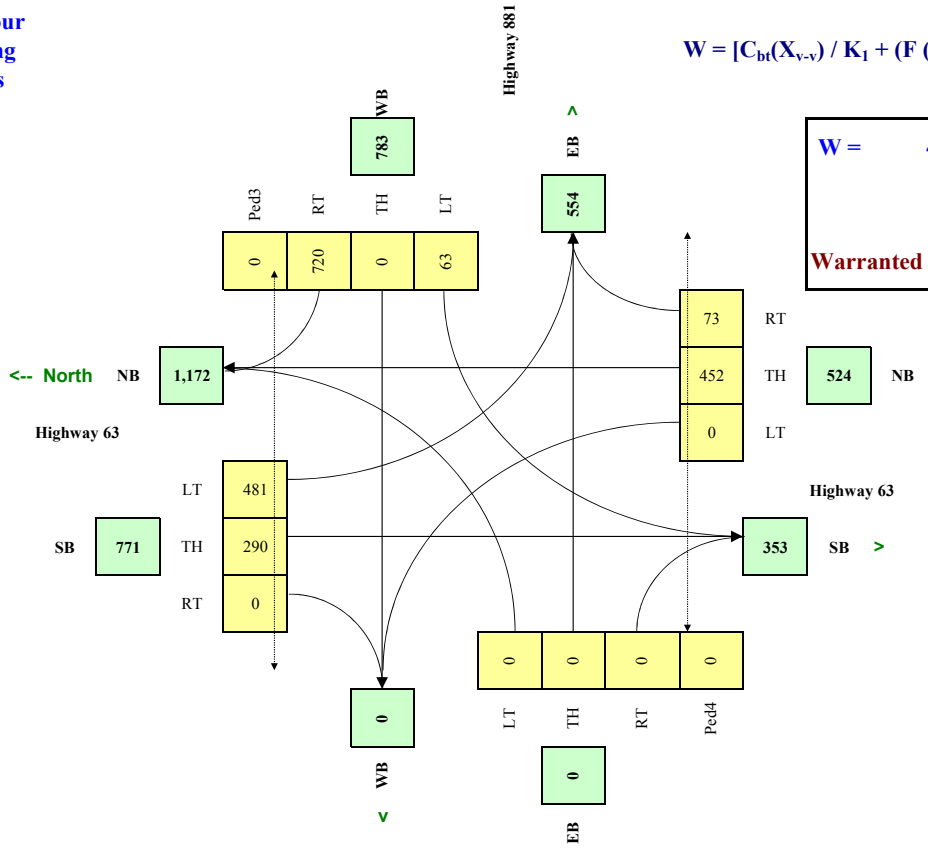
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 63	NS	110	15.0%	n	0.0
Highway 881	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	0	211	38	430	301	0	19	0	483	0	0	0				
	0	211	38	430	301	0	19	0	483	0	0	0				
	0	490	156	467	254	0	151	0	555	0	0	0				
	0	490	156	467	254	0	151	0	555	0	0	0				
	0	654	24	547	314	0	20	0	1122	0	0	0				
	0	654	24	547	314	0	20	0	1122	0	0	0				
Total (6-hour peak)	0	2,710	436	2,888	1,738	0	380	0	4,320	0	0	0	0	0	0	0
Average (6-hour peak)	0	452	73	481	290	0	63	0	720	0	0	0	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	447	447	0
		Veh	*Ped*

Warranted

RESET SHEET

Wood Buffalo - Traffic Signal Warrant Analysis

Main Street (name)	Highway 881	Direction (EW or NS)	EW	Road Authority:	Wood Buffalo
Side Street (name)	Site Access	Direction (EW or NS)	NS	City:	Near Fort McMurray, AB
Quadrant / Int #		Comments	2032 Final	Analysis Date:	2011 Jan 20, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	2011 Jan 11, Tue
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Highway 881	WB		1			1		10,000	2
Highway 881	EB		1	1			1	1,700	2
Site Access	NB				1				
Site Access	SB								
Are the Site Access NB right turns significantly impeded by through movements? (y/n)							n		
							n		

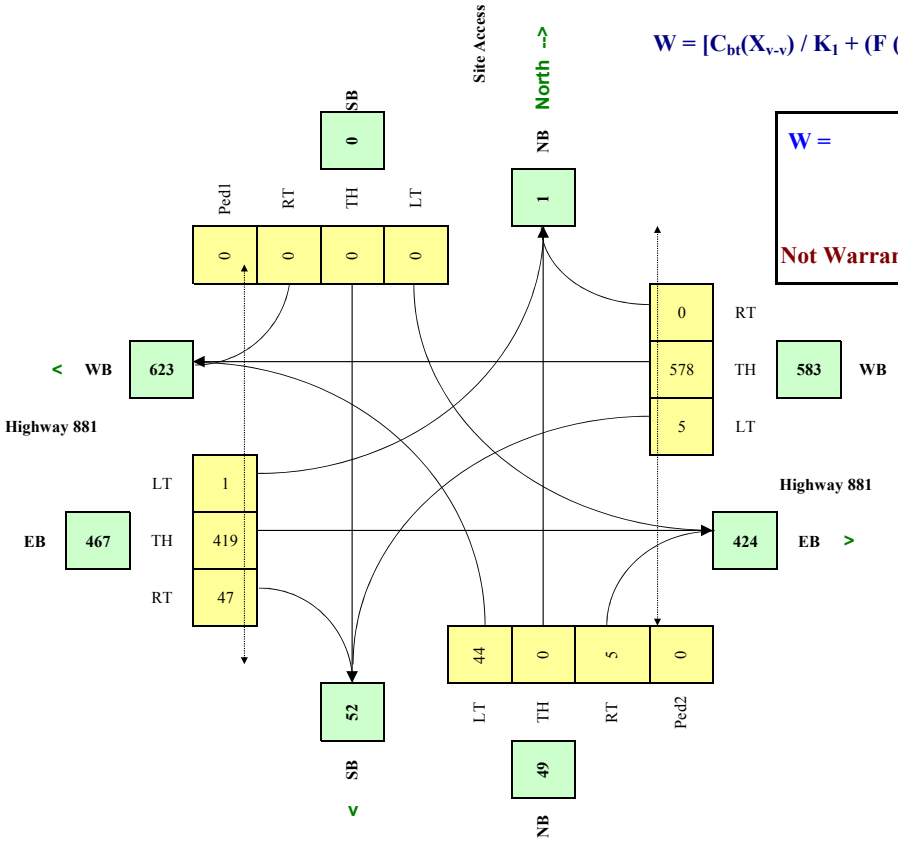
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	65,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Highway 881	EW	100	15.0%	n	0.0
Site Access	NS		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	21	0	2	0	0	0	8	394	0	0	407	73				
	21	0	2	0	0	0	8	394	0	0	407	73				
	44	0	5	0	0	0	5	340	0	0	303	47				
	44	0	5	0	0	0	5	340	0	0	303	47				
	68	0	8	0	0	1	2	1000	0	2	548	20				
	68	0	8	0	0	1	2	1000	0	2	548	20				
Total (6-hour peak)	266	0	30	0	0	2	30	3,468	0	4	2,516	280	0	0	0	0
Average (6-hour peak)	44	0	5	0	0	0	5	578	0	1	419	47	0	0	0	0

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\,(X_{v\text{-}p})\,L) / K_2] \times C_i$$

W =	34	34	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 881	Main Road
Site Access	Minor Road
Wood Buffalo	City/Town

Date January 19, 2011
Other Scenario 1: 2011 Background Only

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**6**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	2840	2	10	Either Use the two AADT inputs **OR** the Descriptive Signalization	OK	20
AADT on Minor Road (2-way)	5	0	20	Warrant (Unused values should be set to Zero) Refer to Table	OK	0
Signalization Warrant	Descriptive	0	30	1(B) for description and rating values for signalization warrant.	OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	**45**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY

Geometric Factors Subtotal	6
Operational Factor Subtotal	45
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**51**

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 881	Main Road	**Date**	January 20, 2010
Site Access	Minor Road	**Other**	Scenario 2: 2011 Background + Development
Wood Buffalo	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**6**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	3119	3	10	Either Use the two AADT inputs **OR** the Descriptive Signalization	OK	30
AADT on Minor Road (2-way)	269	0	20	Warrant (Unused values should be set to Zero) Refer to Table	OK	0
Signalization Warrant	Descriptive	0	30	1(B) for description and rating values for signalization warrant.	OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	**55**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	55
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**61**

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 881	Main Road	**Date**	January 19, 2011
Site Access	Minor Road	**Other**	Scenario 3: 2012 Background Only
Wood Buffalo	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**6**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	3265	3	10	Either Use the two AADT inputs **OR** the Descriptive Signalization	OK	30
AADT on Minor Road (2-way)	5	0	20	Warrant (Unused values should be set to Zero) Refer to Table	OK	0
Signalization Warrant	Descriptive	0	30	1(B) for description and rating values for signalization warrant.	OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	**55**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	55
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**61**

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 881	Main Road	**Date**	January 20, 2010
Site Access	Minor Road	**Other**	Scenario 4: 2012 Background + Development
Wood Buffalo	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**6**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	3782	3	10	Either Use the two AADT inputs **OR** the Descriptive Signalization	OK	30
AADT on Minor Road (2-way)	495	0	20	Warrant (Unused values should be set to Zero) Refer to Table	OK	0
Signalization Warrant	Descriptive	0	30	1(B) for description and rating values for signalization warrant.	OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	**55**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	55
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**61**

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 881	Main Road	**Date**	January 19, 2011
Site Access	Minor Road	**Other**	Scenario 5: 2032 Background Only
Wood Buffalo	City/Town		

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**6**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	11755	4	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	40
AADT on Minor Road (2-way)	5	0	20		OK	0
Signalization Warrant	Descriptive	0	30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	**65**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY

Geometric Factors Subtotal	6
Operational Factor Subtotal	65
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**71**

Illumination of Isolated Rural Intersections
LIGHTING WARRANT SPREADSHEET

This spreadsheet is to be used in conjunction with *Illumination of Isolated Rural Intersections*, Transportation Association of Canada, February 2001.

Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Highway 881	Main Road
Site Access	Minor Road
Wood Buffalo	City/Town

Date January 20, 2011

Other Scenario 6: 2032 Background + Development

GEOMETRIC FACTORS

	Value	Rating	Weight	Comments	Check	Score
Channelization Rating	Descriptive	0		Refer to Table 1(A) to determine rating value	OK	
Presence of raised channelization? (Y / N)	n				OK	
Highest operating speed on raised, channelized approach (km/h)	100		5		OK	
Channelization Factor					OK	0
Approach Sight Distance on most constrained approach (%)	100	0	10	Relative to the recommended minimum sight distance	OK	0
Posted Speed limit (in 10's of km/h)	100				OK	
Radius of Horizontal Curve (m)	T			Enter "T" for tangent (no horizontal curve at the intersection)	OK	
Posted Speed Category =		0				
Posted Speed Category =	B	0				
Posted Speed Category =		0				
Posted Speed Category =		0				
Horizontal Curvature Factor		0	5		OK	0
Angle of Intersection (10's of Degrees)	90	0	5		OK	0
Downhill Approach Grade (x.x%)	2.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	4	2	3	Number of legs = 3 or more	OK	6
					Geometric Factors Subtotal	**6**

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)	12272	4	10	Either Use the two AADT inputs **OR** the Descriptive Signalization Warrant (Unused values should be set to Zero) Refer to Table 1(B) for description and rating values for signalization warrant.	OK	40
AADT on Minor Road (2-way)	495	0	20		OK	0
Signalization Warrant	Descriptive	0	30		OK	0
					OK	
Night-Time Hourly Pedestrian Volume	0	0	10	Refer to Table 1(B), note #2, to account for children and seniors	OK	0
Intersecting Roadway Classification	Descriptive	1	5	Refer to Table 1(B) for ratings.	OK	5
Operating Speed or Posted Speed on Major Road (km/h)	100	4	5	Refer to Table 1(B), note #3	OK	20
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	**65**

ENVIRONMENTAL FACTOR

Lighted Developments within 150 m radius of intersection	0	0	5	Maximum of 4 quadrants	OK	0
					Environmental Factor Subtotal	**0**

COLLISION HISTORY

Average Annual night-time collision frequency due to inadequate lighting (collisions/yr, rounded to nearest whole #)	0.0	0	0	Enter **either** the annual frequency (See Table 1(C), note #4)	OK	0
OR				**OR** the number of collisions / MEV		
Collision Rate over last 3 years, due to inadequate lighting (/MEV)	0	0	0	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)	n	0			OK	
					OK	
					Collision History Subtotal	**0**

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	65
Environmental Factor Subtotal	0
Collision History Subtotal	0
TOTAL POINTS	**71**

Ducks Unlimited Canada
Conserving Canada's Wetlands

Active by nature.

July 19, 2010

Wood Buffalo South Industrial Park Ltd.
133 Ash Way
Ft. McMurray, AB
T9K 0E8

Attention: Mike Walsh

Re: Wetland Loss Compensation – Rickard's Landing

Ducks Unlimited Canada (DUC) supports the protection of wetlands as the foundation to fulfilling the goals of the North American Waterfowl Management Plan (NAWMP), specifically the Alberta component. In cases where avoidance or minimization of the wetland impacts cannot be achieved, DUC through its proactive wetland restoration efforts supports the mitigation process by providing restoration of drained wetlands as a compensation option resulting in no net loss of wetlands.

DUC is currently engaged in implementing restoration activities for wetland loss compensation options based upon program area implementation. The wetlands to be restored will fall into the Boreal Transition Zone (BTZ) initiative and will replace the wetland loss from the proposed development with similar wetland classes within the same major watershed basin. This landscape has been identified as an important wetland restoration area, which will support the recovery of waterfowl, wildlife and biodiversity within the north eastern region of Alberta.

Following restoration of these drained wetlands, each individual project will be managed consistent with the Alberta NAWMP objectives. These projects and the wetlands associated with them vary in size and class. The restoration of wetlands in this initiative will provide adequate compensation for the wetland loss created by the proposed development.

The proposed development according to the wetland impact assessment supplied by EBA Engineering Consultants Ltd. states that there would be a direct loss of 5.8 hectares of wetland habitat. With the replacement ratio of 3:1, 17.4 hectares of restored wetland habitat will be required. The cost of restoring these wetlands in the Boreal Transition Zone (BTZ) initiative being $8,500/ha, this equates to $147,900.00 as total compensation.

DUC requires written acceptance from Wood Buffalo South Industrial Park Ltd. in the space provided below. Please return a signed copy of the proposal to the address outlined below. Once approved by Alberta Environment (AENV), please remit payment to DUC by a certified cheque or Bank draft to the address as indicated on the invoice.

Upon receipt, DUC will provide a confirmation notice for Wood Buffalo South Industrial Park Ltd. and AENV's files. This proposal and the fees charged will be available for acceptance for 90 days from the date of issue. Payment must be received within 30 days after approval has been issued from AENV. If these terms are not met, DUC will not be obligated to complete the agreement.

3520 - 114 Avenue SE, Calgary, Alberta, T2Z 3V6, Phone: (403) 201-5577, Fax: (403) 201-5580
Toll Free: 1-800-665-DUCK (3825), E-mail: webfoot@ducks.ca, Website: ducks.ca

Please feel free to call Craig Bishop at (403) 668-0974 if you have any questions or concerns regarding this proposal.

Yours Truly,

Pat Kehoe

Provincial Manager - Alberta

Ducks Unlimited Canada

Cc: Gale, Bryan – EBA Engineering Consultants Ltd.

Enclosures

I, Mike Walsh, on behalf of Wood Buffalo South Industrial Park Ltd., do acknowledge and agree to accept the Wetland Loss Compensation proposal and its terms as prepared by Ducks Unlimited Canada.

Signature of Mike Walsh for Wood Buffalo South Industrial Park Ltd.

THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

HIGHWAY 881 INDUSTRIAL/COMMERCIAL AREA NEAR FORT McMURRAY, ALBERTA PRELIMINARY GEOTECHNICAL INVESTIGATION

Report

to

Rickard Landing

PROFESSIONAL ENGINEER ALBERTA JOHN RYBAK

John Rybak, P. Eng.
Project Engineer

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature Don Proudfoot
Date November 28, 08
PERMIT NUMBER: P 5186
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PROFESSIONAL ENGINEER ALBERTA Don W. Proudfoot

Don Proudfoot, P.Eng.
Review Principal

Date: November 28, 2008
File: 19-5325-0

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)...

1. INTRODUCTION

This report presents the results of a preliminary geotechnical investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed industrial/commercial area along Highway 881, about 13 km south of Fort McMurray, Alberta. The property is located in W1-87-9-W4M.

The scope of the geotechnical investigation was summarized in Thurber's proposal to Ms. Liz Wilson, E.I.T. of CSM Engineering Ltd. (CSM) dated March 20, 2008. Authorization to proceed with the investigation was received verbally from Ms. Wilson on or about April 3, 2008.

This scope of work did not include an assessment of soil or groundwater for environmental contamination.

Use of this report is subject to the Statement of General Conditions that is included at the end of the text of this report. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of this report.

2. PROPOSED DEVELOPMENT

It is understood that the proposed development will likely consist of industrial and commercial businesses and involve road construction, building structures, and underground utilities. However, the layout of the proposed development was not known at the time of writing this report.

3. METHOD OF INVESTIGATION

3.1 Field Program

A total of eight (8) test holes were drilled on April 7 and 8, 2008 using a truck-mounted auger drill rig operated by Mobile Augers & Research Ltd. of Edmonton, Alberta. The test holes were advanced to depths of about 10.4 m below existing ground surface. Test hole layout, access preparation, and tree clearing was coordinated by CSM prior to drilling. The test holes were limited to

the cleared areas of the site and the approximate locations are shown on Drawing 19-5325-0-1, in Appendix A.

Disturbed soil samples were obtained from the solid stem auger flights during drilling and Standard Penetration Tests (SPT's) were carried out at selected depths in the test holes. The undrained shear strength (Cpen value) of cohesive samples was estimated using a pocket penetrometer.

Slough and water levels were noted during and after completion of the drilling and standpipe piezometers were installed in all eight (8) of the test holes. Water levels in the standpipes were measured on November 19, 2008.

3.2 Laboratory Testing

Laboratory testing included a visual classification and the determination of the natural water content of all soil samples.

The results of the drilling and laboratory program are summarized on the test hole logs in Appendix B. An explanation of the symbols and terms used to describe observations in the test hole logs and the Modified Unified Soil Classification are also provided in Appendix B.

4. SITE DESCRIPTION

4.1 Surface Conditions

The site is covered with trees with the exception of in the southwest quadrant of the site where a light industrial complex is located. The area surrounding the site was wooded. Halfway Creek crosses the southwest corner of the property. Another stream and beaver dam are located near the northwest corner northeast corner of the property. The site is bordered by Highway 881 to the north and by Highway 63 is located about 0.5 km to the west of the site.

4.2 Subsurface Conditions

In general, the subsurface conditions encountered at the test hole locations consisted of:

- Topsoil;
- Clay Till;
- Clay; and
- Sand.

Further descriptions of the main soil layers are provided in the following sections. A detailed description of subsurface conditions observed at each test hole location is presented on the test hole logs in Appendix B.

4.2.1 Topsoil

Topsoil was noted in each of the test holes except for test holes TH08-7 and TH08-8 and varied in thickness from 150 mm to 200 mm.

It should be noted that the topsoil thickness may vary between test hole locations and may be thicker in other areas of the site. The lack of topsoil at the above noted test holes is likely a result of the tree clearing and access preparation.

If volume quantities of topsoil for stripping or other purposes are required, additional test holes at a higher density should be excavated. It is not recommended to use the topsoil thicknesses of the test hole logs for volume estimates.

4.2.2 Clay Till

Clay till was encountered in all of the test holes underlying the topsoil or at ground surface and extended to depths of about 3.0 m to 10.4 m below existing ground surface. The clay till was typically brown becoming grey with depth, silty, and sandy, with traces of oxides and gravel. SPT 'N' values ranged from 7 to 39 blows

per 300 mm indicating that the clay till was firm to hard in consistency. Natural moisture contents in the clay till ranged from 11% to 36%.

It should be noted that sand layers and pockets and cobbles or boulders are frequently encountered within clay till.

4.2.3 Clay

Clay was encountered in most of the test holes underlying the clay till and extended to depths of about 7.7 m to 10.4 m (end of test hole) below existing ground surface. The clay was typically grey, silty, and sandy. SPT 'N' values ranged from 18 to greater than 100 blows per 300 mm indicating that the clay was very stiff to very hard in consistency. Natural moisture contents in the clay ranged from 14% to 26%.

4.2.4 Sand

Sand was encountered in test holes TH08-4 and TH08-7 underlying the clay till or clay and extended to the bottom of the test holes at 10.4 m. A 0.7 m thick layer of sand was also present at 6.9 m depth below ground surface within the clay in TH08-1. The sand was typically grey, silty, fine to medium grained, with a trace to some clay. SPT 'N' values typically ranged from 56 to 89 blows per 300 mm penetration indicating that the sand was very dense. Natural moisture contents in the sand ranged from 16% to 25%.

4.3 Groundwater, Seepage and Slough Levels

Water and slough levels measured in the open test holes after drilling are noted on the test hole logs in Appendix B. Water levels in the piezometers installed by Thurber are summarized in Table 4.1 below.

TABLE 4.1
SUMMARY OF SLOUGHING/SEEPAGE AND GROUNDWATER LEVELS

TEST HOLE	TEST HOLE DEPTH B.G.S. (m)	SEEPAGE OBSERVED B.G.S (m)	SLOUGH LEVEL ON COMPLETION B.G.S. (m)	FREE WATER ON COMPLETION ABOVE SLOUGH B.G.S. (m)	WATER LEVELS NOVEMBER 19, 2008 B.G.S. (m)
TH08-1	10.4	None	None	10.2	2.2
TH08-2	10.4	7.5	10.1	10.1	0.1
TH08-3	10.4	None	10.1	10.1	0.2
TH08-4	10.4	None	10.1	9.8	1.2
TH08-5	10.4	9.3	9.8	9.4	1.1
TH08-6	10.4	None	9.8	None	0.5
TH08-7	10.4	None	10.1	9.8	4.4
TH08-8	10.4	None	9.9	9.8	0.4

It should be noted that groundwater levels may fluctuate seasonally and may rise in times of high precipitation. Hence, the actual groundwater levels at the time of construction may differ from those reported herein.

4.4 Frost Effects

The near surface native clay till is considered to be moderately frost susceptible. Hence good drainage must be maintained at this site to avoid saturation of these surface materials in order to minimize the loss of strength due to repeated freeze thaw cycles and the risk of frost heaving.

The estimated frost penetration depth for an average freezing index of 2200 degree-days Celsius (4000 degree-days Fahrenheit) is 2.1 m, and for a 50-year return period freezing index of 2900 degree-days Celsius (5250 degree days Fahrenheit) is 2.8 m.

The frost penetration is for a uniform soil type with no insulative cover. If the area is covered with turf or significant snow cover, the depth of frost penetration will be less.

The 50-year return estimated frost depth is generally used for design, while the mean annual value could be used for construction with some risk.

5. GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

5.1 General

Based on the information collected during the field investigation, the site is considered to be suitable for the proposed development. Underground utilities will likely be installed in either clay or clay till, and some sand pockets or layers may be encountered in areas of the site during underground utility installation.

The groundwater levels at the site vary from 0.1 m to 4.4 m below ground surface. The higher water tables were encountered primarily at the north and east side of the site. It will there fore be important to establish good drainage early on in development. The high water tables in these areas could require dewatering during. Weeping tiles will be required around building foundations and under floor slabs to prevent water from softening the subgrade.

Feasible foundation types for structures at the site include spread footings, cast-in-place friction or end bearing piles, and driven steel piles. Slab-on-grade construction is also considered feasible at this site.

General site development guidelines are provided in the sections following, however they may need to be revised pending further site investigations.

5.2 Site Preparation, Grading and General Fill Placement

Site preparation will include the removal of all topsoil/organics and all unsuitable materials under roadways and development areas.

Permanent site drainage should be developed at early stages of construction in order to control surface water and reduce future frost effects in the subgrade. The final site grade should be sloped to shed water away from the buildings. Deep drainage ditches should be considered in development areas to lower the long term groundwater table.

All fill should be placed and compacted to the following specifications:

a) Fill required to raise the site under roads and parking areas should consist of low to medium plastic, inorganic clay till or clay and should be placed in 150 mm maximum lifts compacted thickness and compacted to at least 95% of Standard Proctor Maximum Dry Density within 2% of Optimum Moisture Content. The upper 150 mm under roadways should compacted to 100% of Standard Proctor Maximum Dry Density within 2% of Optimum Moisture Content.

b) Fill placed under slab-on-grades should be placed in 150 mm maximum lifts compacted to at least 98% of Standard Proctor Maximum Dry Density within 2% of Optimum Moisture Content. Prior to placing the fill, the subgrade should be proof rolled to detect soft areas which should be sub-excavated and replaced with better quality fill.

c) General site grading fills outside the building footprints should also be placed in 150 mm lifts compacted thickness and compacted to at least 95% of Standard Proctor Maximum Dry Density within 2% of Optimum Moisture Content.

d) Where possible, site grading should be designed to avoid placement of fill within the building footprints since even well compacted fill will be subject to some long term settlement. At select locations where small depths of fill (less than 2 m) cannot be avoided it may be possible to construct footings over "engineered fill" compacted to at least 98 % of SPMDD. "Engineered fill" means that the fill has to be placed under full time inspection by geotechnical personnel and include compaction testing. However, the details of such locations should be reviewed by Thurber prior to finalizing the design.

e) Fill used for landscaping purposes requires only moderate compaction (i.e.: 92% of Standard Proctor Maximum Dry Density) to ensure future settlements do not adversely affect design drainage provisions.

Uniformity of compaction is essential to reduce the potential for differential settlement. It is recommended that fill placement be inspected and tested by qualified geotechnical personnel to ensure adequate compaction.

5.3 Concrete Floor Slabs

Recommended procedures for site preparation for a slab-on-grade were provided in Section 5.2. If a slab-on-grade is used the following additional recommendations apply:

a) The natural clay at the site has a moderate swelling potential in its current condition, particularly if it has free access to moisture. Swelling of the clay under the ground floor slab may cause heaving of the slab if the moisture content is allowed to vary. Care should be taken to prevent over-drying of the clay subgrade during floor slab construction. Material which has become desiccated or exceedingly wet should be removed prior to construction of the slab. Free water should not be allowed access to the subgrade beneath the slab-on-grade. Also, utilities should be designed with water tight corrections to avoid leakage into the subgrade soils and any hot water or heating pipes located below the floor slabs should be insulated to prevent excessive drying of the subgrade clay soils.

b) Floor slabs should be structurally separate from the building to allow for movement to occur. Non-load bearing partition walls resting on the floor slab should have a minimum clearance of 25 mm between the top plate and the ceiling to accommodate possible future heaving of the floor slab.

c) A minimum of 150 mm of clean, well-graded sand or gravel is recommended beneath floor slabs and along the outside of grade beams for leveling and drainage purposes. Coarse material greater than 50 mm in diameter should be avoided directly beneath the floor slab to prevent stress

concentrations within the slab. The granular leveling course should be compacted to a uniform dry density of about 98% of Standard Proctor Maximum dry density. A recommended typical gradation for free draining granular material, for use under the floor slabs (and also on the outside of the perimeter basement walls, if required) is provided below:

SIEVE	% PASSING
1 ½ (38,000 um)	100
3/8 (10,000 um)	65 - 100
No. 4 (5,000 um)	50 - 90
No. 10 (2,000 um)	35 - 75
No. 40 (400 um)	10 - 45
No. 100 (150 um)	0 - 20
No. 200 (75 um)	0 - 5

Other appropriate materials, which fall outside the above recommended gradation limits may be suitable. Alternate materials should however, be evaluated by a geotechnical engineer prior to use.

5.4 Underground Utilities

5.4.1 Trench Drainage

It is expected that the depth of sewer installation will be in the order of 3.0 m to 4.0 m below existing ground. Based on the test holes drilled, it is expected that the excavations will be mainly in the clay till and/or clay; however sand pockets or layers may also be encountered within the clay till.

The water levels measured varied from 0.1 m to 4.4 m below ground surface in the standpipe piezometers. Based on this information groundwater seepage will likely be encountered during trench excavations at the site.

Seepage rates into trenches from the clay and clay till are expected to be relatively slow. Faster seepage may occur from sand layers or pockets within the clay till however, the seepage rates should be of a magnitude that can be handled by normal trench grading practices and sumps and pumps where necessary.

Utility lines affected by freezing should be located below the expected frost depths provided in Section 4.4.

5.4.2 Open Excavation

Based on the test hole information, the trench excavations will be mainly through firm to very stiff clay till, and hard clay. Open sloped excavations are considered feasible throughout the site. Braced excavations may be considered where space restrictions dictate.

The temporary excavation slope requirements will be largely governed by the type of material encountered in the trenches. For trenches excavated in the clay till or clay the lower 1.5 m of the excavation may be cut vertical and the section above this depth should be sloped back at a maximum trench angle of 1H to 1V.

If areas of wet sand, loose and/or softer clay are encountered, flatter slopes cut back from the base of the excavation at 1H to 1V or flatter may be required, assuming that the sand is adequately dewatered in advance of excavation.

It should be noted that the presence of water bearing sand layers and sand pockets within the clay till, if encountered, may lead to potential excavation wall instability. Care should be taken to protect workers and equipment during excavation.

It is recommended that the trenching be carried out in relatively short lengths and all trenches should be backfilled at the end of each day.

Excavated spoil material should be kept back from the top of the trench by a distance of at least the depth of the trench. Personnel should not be allowed in the open trench during installations without proper safety precautions being taken. In

all cases, excavations should be consistent with Occupational Health and Safety regulations.

5.4.3 Pipe Bedding

All soft, loosened and disturbed material should be removed from the trench base before placement of bedding. The pipe should be bedded and installed according to the manufacturer's specifications. Care should be taken such that the pipe is not in contact with rigid objects such as cobbles or rocks as this will cause a stress concentration in the pipe and may result in breakage.

Where a granular bedding is specified it is recommended that a minimum thickness of 150 mm of granular bedding be placed below the pipe. The bedding material should also be placed around the pipe and should extend at least 150 mm above the crown of the pipe.

The material should be placed around the pipe in 200 mm lifts and compacted uniformly to at least 95% of the Standard Proctor Maximum Dry Density. The granular bedding should consist of well graded sand and gravel with less than 10% passing the 80 micron sieve (No. 200 sieve) and should be free from angular rocks (particularly near the pipe) and organics.

If the trench base is situated in soft clays or saturated sands below the water table where the pipe support conditions may be poor, special bedding procedures may be required to improve pipe support conditions and reduce future settlement of the pipes. Such special bedding requirements may consist of subexcavation and placement of a washed gravel pad of about 300 mm minimum thickness wrapped in a non-woven geotextile fabric in the base of the trench for support of the pipe bedding. This technique has been found to provide a better working surface in the trench base and also facilitates trench drainage during pipe installation.

5.4.4 Backfilling

The remainder of the trench above the bedding zone may be backfilled with the excavated on-site materials that are free of debris or organics and compacted to standards noted in Section 5.2.

Backfill of trenches under roadways should be compacted to at least 95% Standard Proctor Maximum Dry Density in 150 mm lifts.

The native clay till and clay material may require some moisture conditioning to achieve the required compaction. The above recommendations may be affected by weather conditions before and during construction.

It should be recognized that even when compacted to the above standards, settlement of the trench backfill should be expected in the first one to two years and this should be considered in the design. Maintenance may therefore be required for trenches under roadways, including future patching or overlaying of the pavement.

The on site native material should not be placed frozen, nor placed at temperatures below freezing. Heavy compaction equipment should not be allowed to operate above the placed pipe until 1 m of backfill has been placed and compacted above the pipe.

5.5 Manholes

Manholes may be founded directly on the native undisturbed inorganic soils. If areas of soft base conditions are encountered, consideration should be given to the use of a washed gravel pad wrapped in non-woven geotextile or alternatively a lean concrete base, below the base of the excavation. It is recommended that the native clay or clay till backfill be placed uniformly around the manhole in 200 mm lifts and compacted to about 95% of Standard Proctor Maximum Dry Density (SPMDD) to provide uniform and adequate support to the manholes.

Buoyancy of the manholes due to hydrostatic uplift pressures on the base should be checked against the highest water levels noted in Table 4.1. If required, one method of providing the necessary uplift resistance is to widen the base of the manholes beyond the manhole vertical walls.

5.6 Foundations

Feasible foundation types for structures at the site include spread footings and cast-in-place concrete friction piles for light to moderately loaded structures.

Cast-in-place concrete end bearing piles founded in the hard to very hard clay or steel piles driven into the very hard clay or very dense sand could be considered for moderately to heavily loaded structures at the site.

Additional geotechnical investigations should be undertaken once the building locations have been finalized to determine appropriate site specific foundation design parameters.

6. FURTHER WORK

As noted above, geotechnical investigation was limited to the cleared areas of the site.

Further geotechnical investigation should be carried out once the details of the proposed development layout, including roadways, underground utilities, and building locations are available.

7. LIMITATION AND USE OF REPORT

There is a possibility that this report may form part of the design and construction documents for information purposes. This report was issued before any final design or construction details have been prepared or issued. Therefore differences may exist between the report recommendations and the final design, in the contract documents, or during construction. In such instances, Thurber Engineering Ltd. should be contacted immediately to address these differences.

Designers and contractors undertaking or bidding the work should examine the factual results of the investigation, satisfy themselves on to the adequacy of the information for design and construction, and make their own interpretation of the data as it may affect their proposed scope of work, cost, schedules, and safety and equipment capabilities.

THURBER ENGINEERING LTD.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over . . . .)

INTERPRETATION OF THE REPORT *(continued . . . .)*

c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We should be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause an accidental release of those substances. In consideration of the provision of the services by us, which are for the Client's benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the "Company") from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of conducting work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

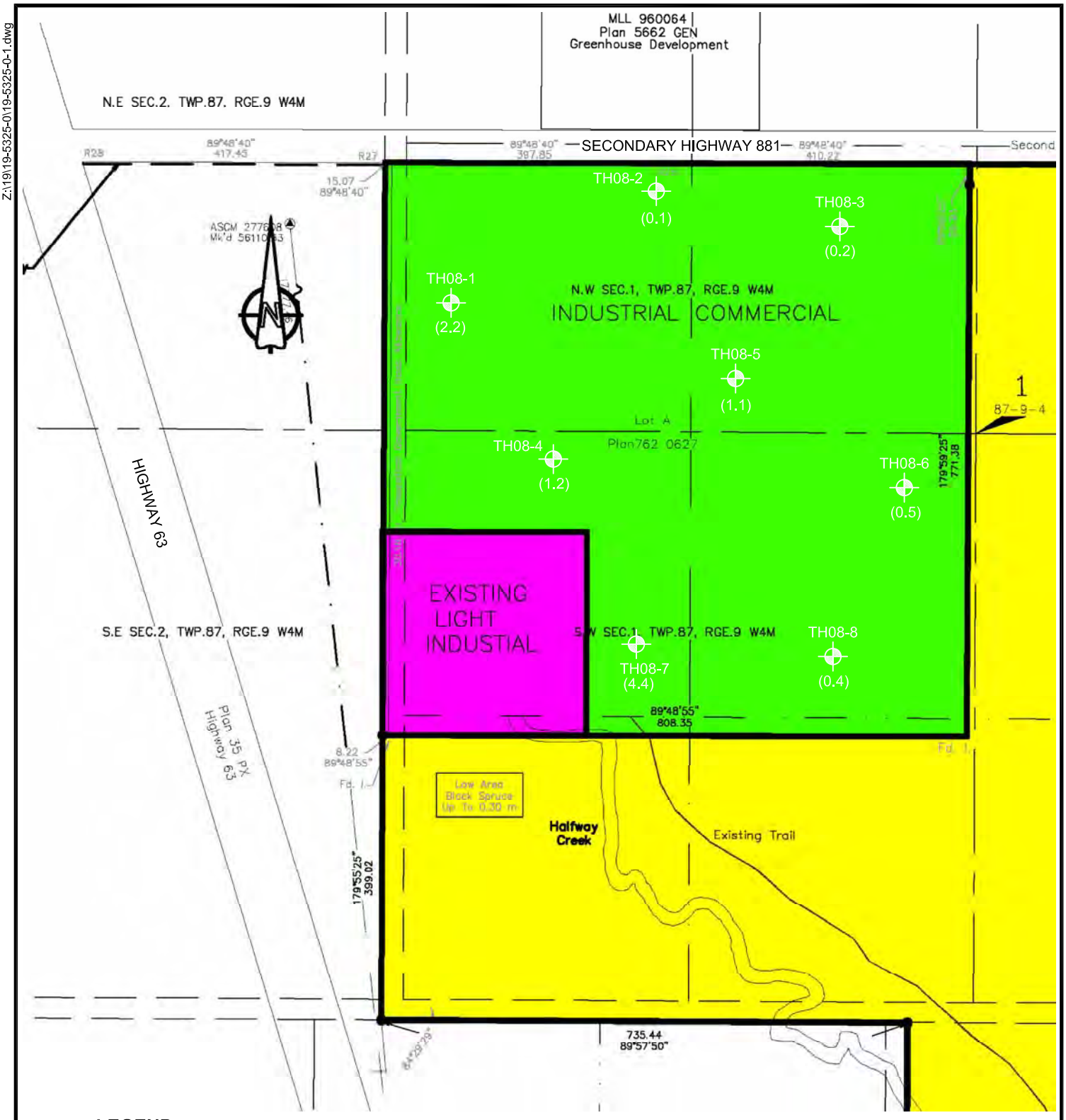
9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

APPENDIX A

Drawing 19-5325-0-1 - Site Plan Showing Test Hole Locations

Z:\19\19-5325-0\19-5325-0-1.dwg



LEGEND

APPROXIMATE TEST HOLE LOCATIONS (1.0) DEPTH BELOW GROUND SURFACE TO WATER TABLE IN METRES (NOV. 19, 2008)

RICKARD LANDING

SITE PLAN SHOWING APPROXIMATE TEST HOLE LOCATIONS

HWY 881 INDUSTRIAL COMMERCIAL SITE
PRELIMINARY GEOTECHNICAL INVESTIGATION

SOUTH OF FT. MCMURRAY, AB

THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

ENGINEER :	DRAWN :	APPROVED :
JTR	CMH	FTM
DATE :	SCALE :	DRAWING No.
NOV. 2008	APPROX. 1:7500	19-5325-0-1

THURBER ENGINEERING LTD.

APPENDIX B

Symbols and Terms Used on Test Hole Logs
Unified Soils Classification
Test Hole Logs

SYMBOLS AND TERMS USED ON TEST HOLE LOGS

1. VISUAL TEXTURAL CLASSIFICATION OF MINERAL SOILS

CLASSIFICATION	APPARENT PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200 mm	Greater than 200 mm
Cobbles	75 mm to 200 mm	75 mm to 200 mm
Gravel	4.75 mm to 75 mm	5 mm to 75 mm
Sand	0.075 mm to 4.75 mm	Visible particles to 5 mm
Silt	0.002 mm to 0.075 mm	Non-Plastic particles, not visible to the naked eye
Clay	Less than 0.002 mm	Plastic particles, not visible to the naked eye

2. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	APPROXIMATE UNDRAINED SHEAR STRENGTH		APPROXIMATE SPT * 'N' VALUE
Very Soft	Less than 10 kPa		Less than 2
Soft	10 - 25 kPa		2 to 4
Firm	25 - 50 kPa		4 to 8
Stiff	50 - 100 kPa		8 to 15
Very Stiff	100 - 200 kPa	Modified from	15 to 30
Hard	200 - 300 kPa	National Building	Greater than 30
Very Hard	Greater than 300 kPa	Code	

* SPT 'N' Value Standard Penetration Test 'N' Value - refers to the number of blows from a 63.5 kg hammer free falling a height of 0.76m to advance a standard 50mm outside diameter split spoon sampler for 0.3m depth into the undrilled portion of the test hole.

3. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	STANDARD PENETRATION TEST (SPT) (Number of Blows per 300 mm)	
Very Loose	0 - 4	
Loose	4 - 10	
Compact	10 - 30	Modified from
Dense	30 - 50	National Building
Very Dense	Over 50	Code

4. LEGEND FOR TEST HOLE LOGS

SYMBOL FOR SAMPLE TYPE

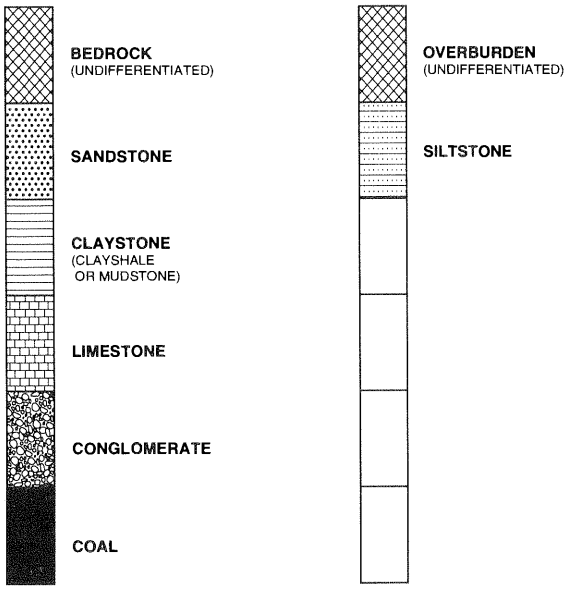
SYMBOLS USED FOR TEST HOLE LOGS

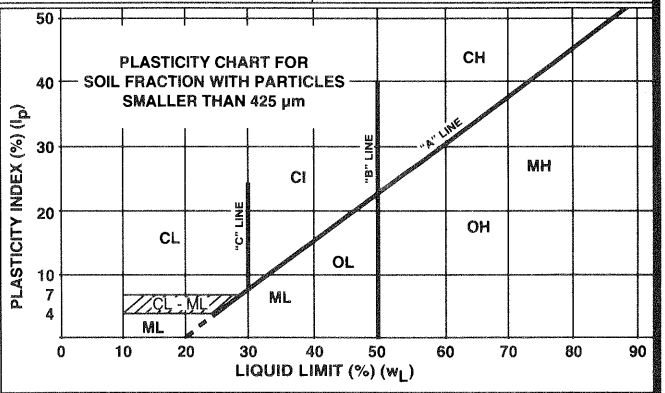
●	MC - Moisture Content (% by weight) of soil sample
▼	Water Level
■ SPT	Standard Penetration Test 'N' Value (Blows/300mm)
▲ CPen	Shear Strength determined by pocket penetrometer
CVane	Shear Strength determined by pocket vane
Cu	Undrained Shear Strength determined by unconfined compression test
SO_4%	Percent (%) of water soluble sulphate ions

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS
(MODIFIED BY PFRA, 1985)

MAJOR DIVISION			GROUP SYMBOL	THURBER LOG SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	Determine percentages of gravel and sand from grain size curve. Depending on percentages of fines (fraction smaller than 75µm) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols. $C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR GW
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE I_p LESS THAN 4; ATTERBERG LIMITS ABOVE "A" LINE I_p MORE THAN 7; Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	
	SANDS MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE I_p LESS THAN 4; ATTERBERG LIMITS ABOVE "A" LINE I_p MORE THAN 7; Above "A" line with I_p between 4 and 7 are borderline cases requiring use of dual symbols
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES	
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$w_L < 50\%$	ML		INORGANIC SILTS AND 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 NEGLIGIBLE ORGANIC CONTENT	$w_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	
		$30\% < w_L < 50\%$	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

SPECIAL SYMBOLS





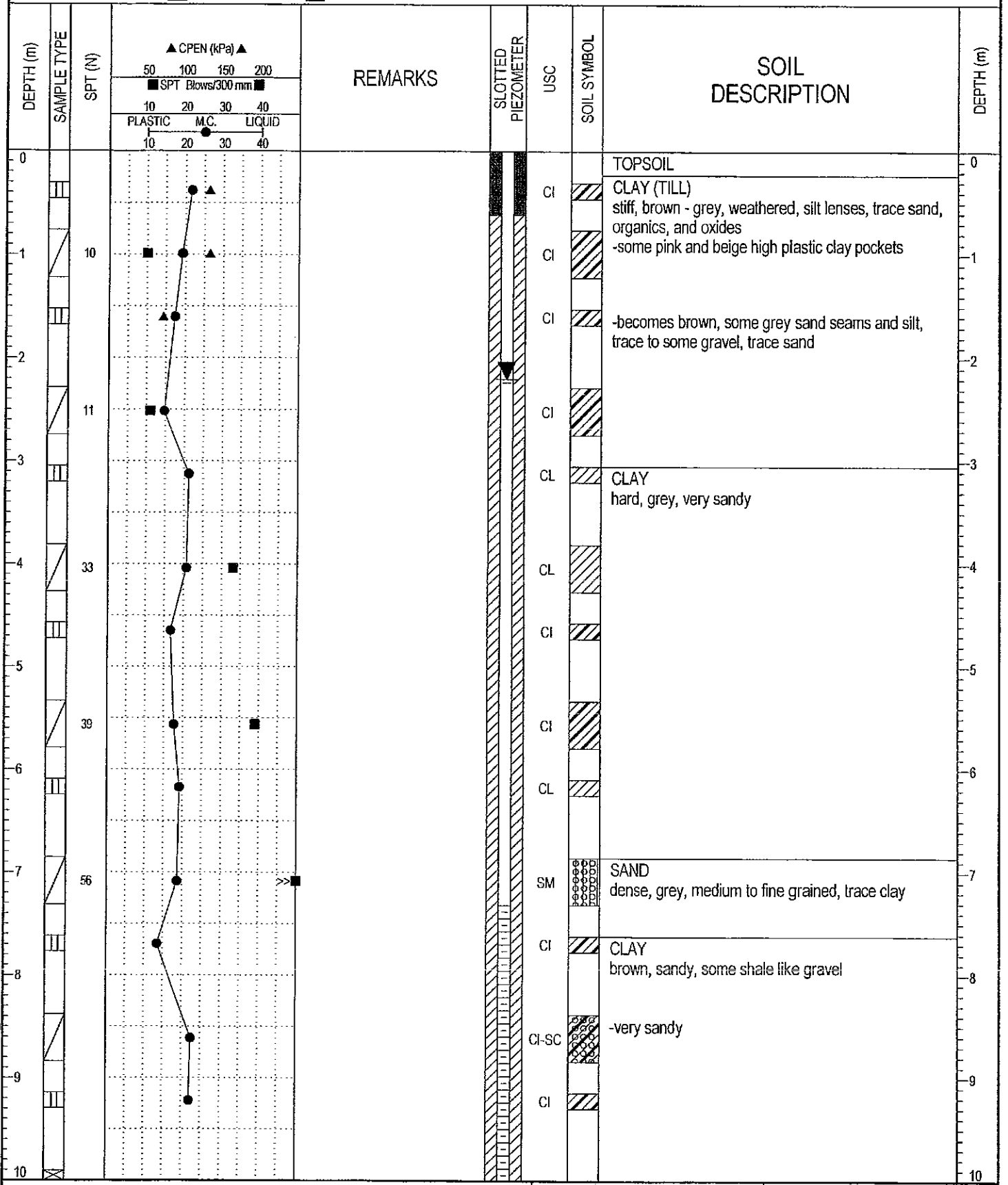
THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS
(MODIFIED BY PFRA, 1985)

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-1**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS



TOPSOIL

CLAY (TILL)
stiff, brown - grey, weathered, silt lenses, trace sand, organics, and oxides
-some pink and beige high plastic clay pockets

-becomes brown, some grey sand seams and silt, trace to some gravel, trace sand

CLAY
hard, grey, very sandy

SAND
dense, grey, medium to fine grained, trace clay

CLAY
brown, sandy, some shale like gravel

-very sandy

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 1 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-1**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		50/0	>>■					CLAY - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -No slough -Water at 10.2m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 2.2m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

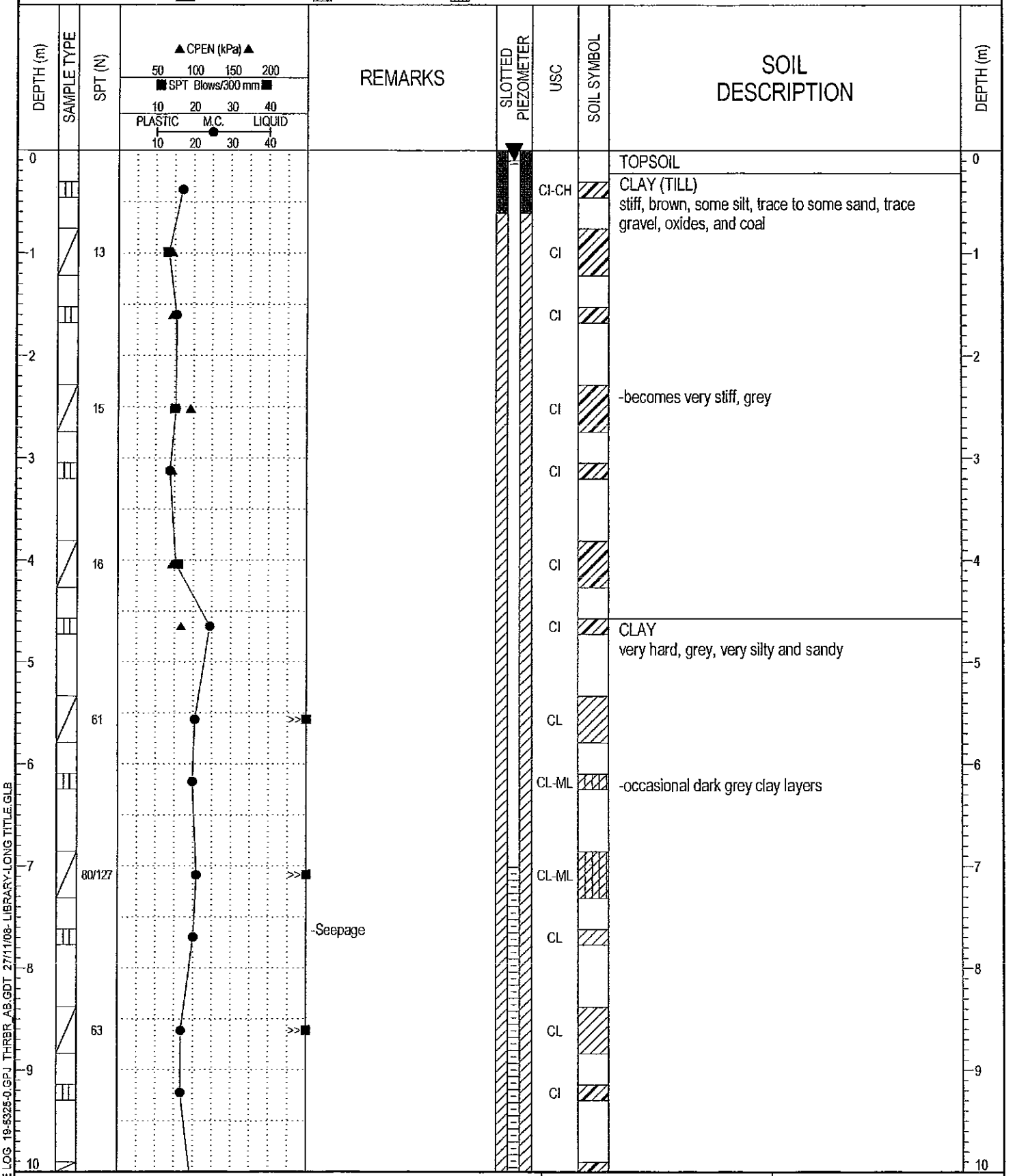
THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-2**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH



BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 1 of 2

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-2**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		80	>>			CI		CLAY - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 10.1m -Water at 10.1m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 0.1m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

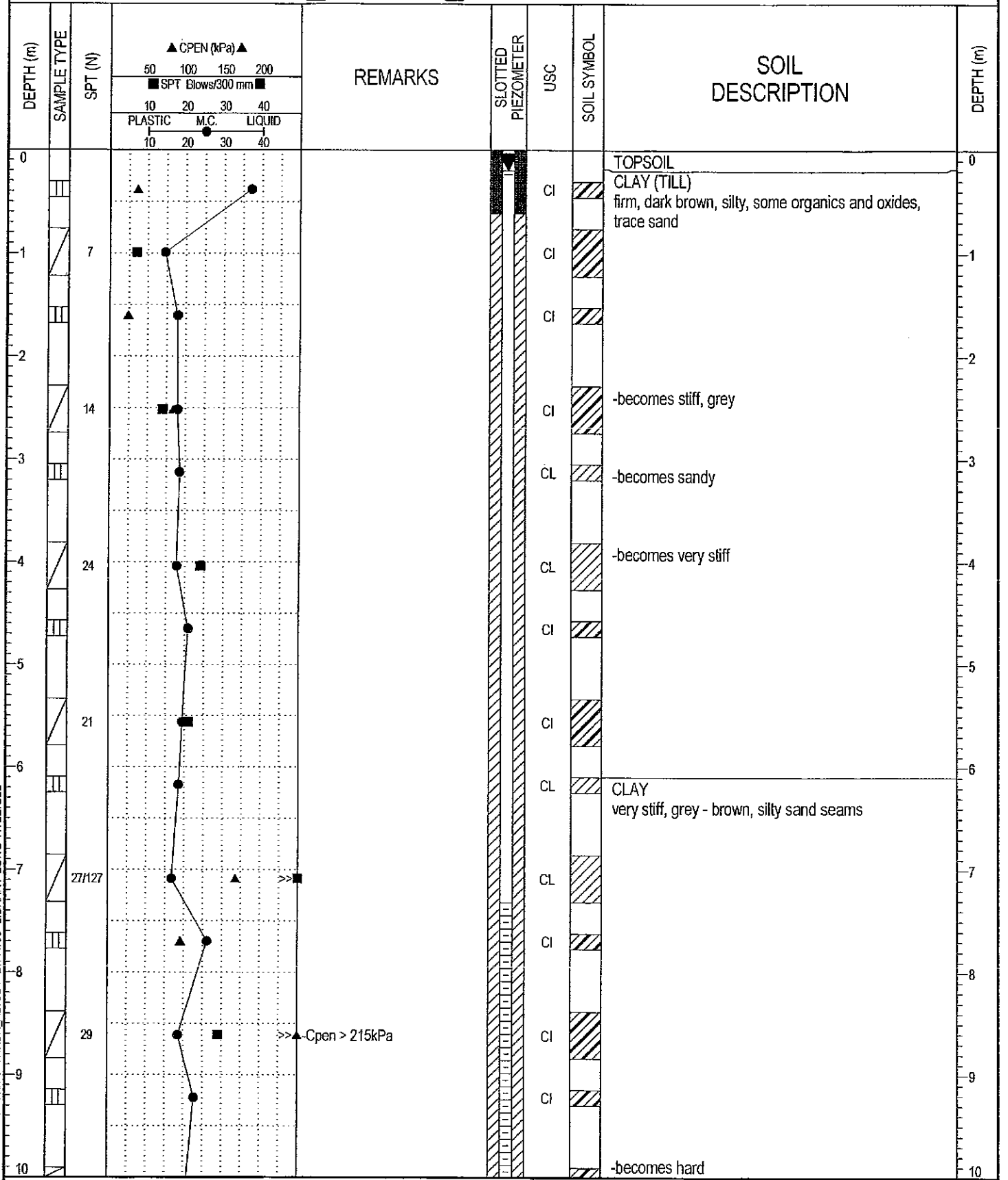
FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 2 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-3**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH



FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 1 of 2

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-3**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		42				CI		CLAY - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 10.1m -Water at 10.1m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 0.2m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

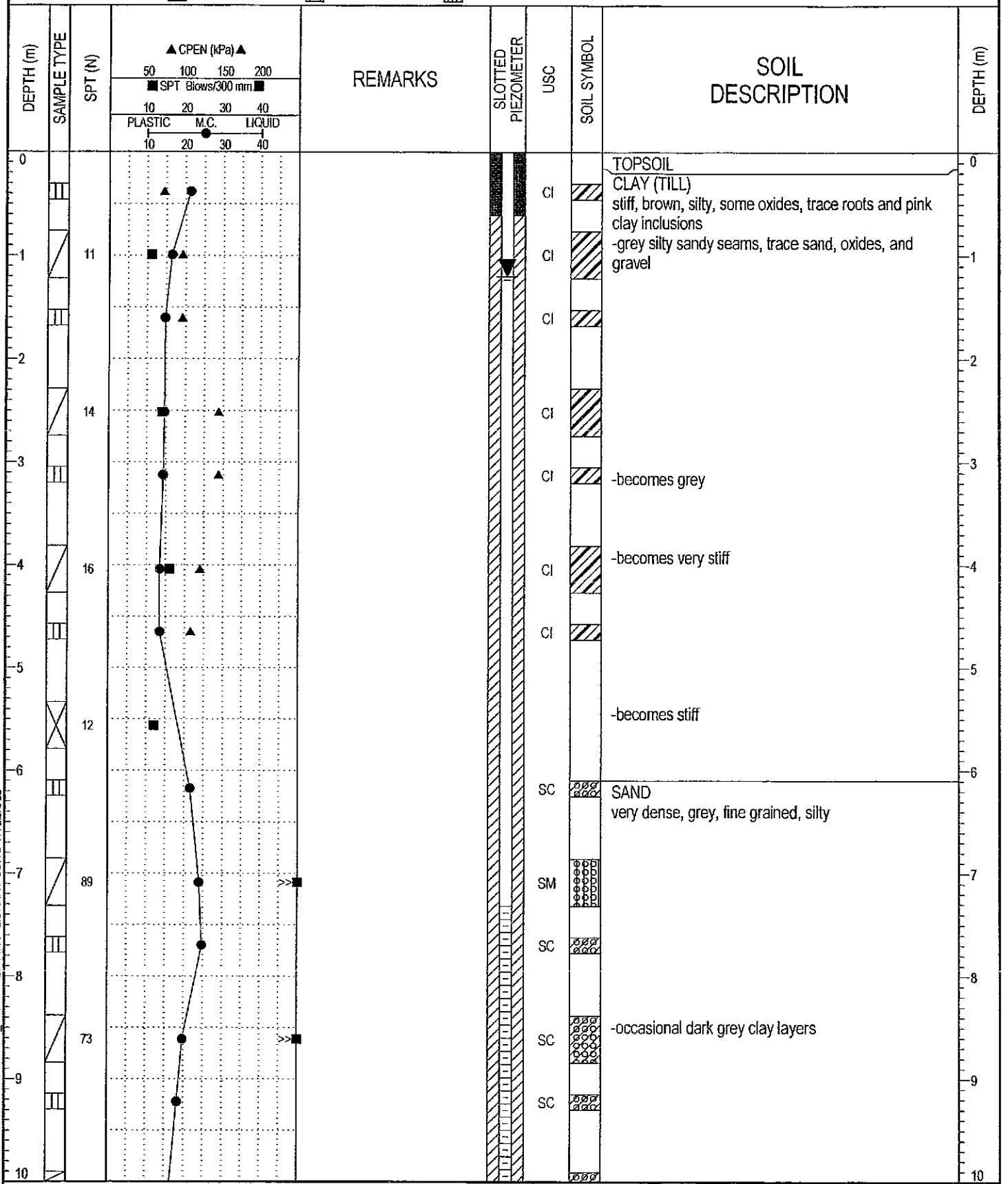
FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 2 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-4**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS | SLOUGH



THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 1 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: TH08-4
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS | SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		76	>>■			SC		SAND - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 10.1m -Water at 9.8m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 1.2m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

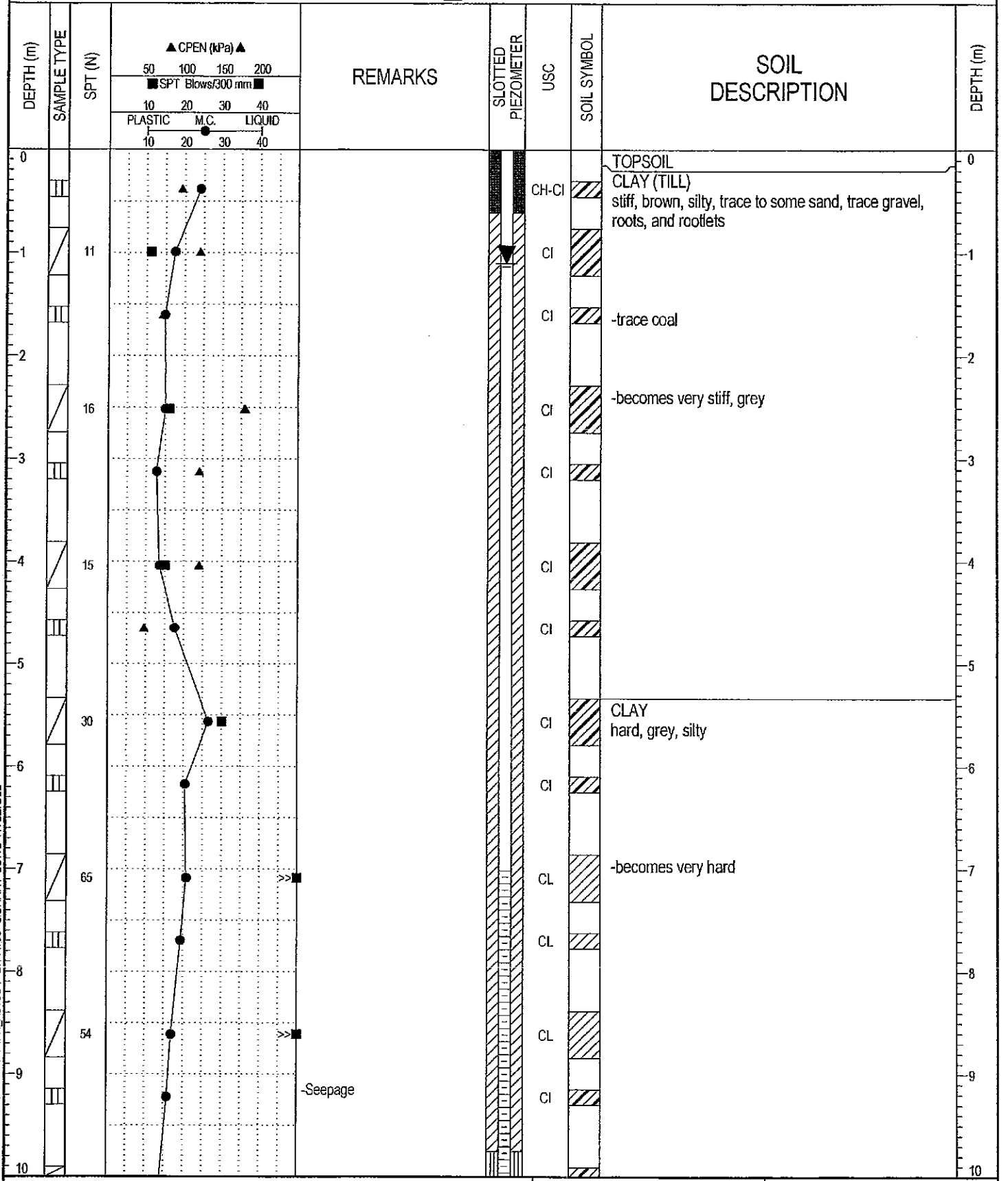
FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 2 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-5**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH



BOREHOLE LOG 19-5326-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 1 of 2

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-5**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 8, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		74	>■			CI		CLAY - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 9.8m -Water at 9.4m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 1.1m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

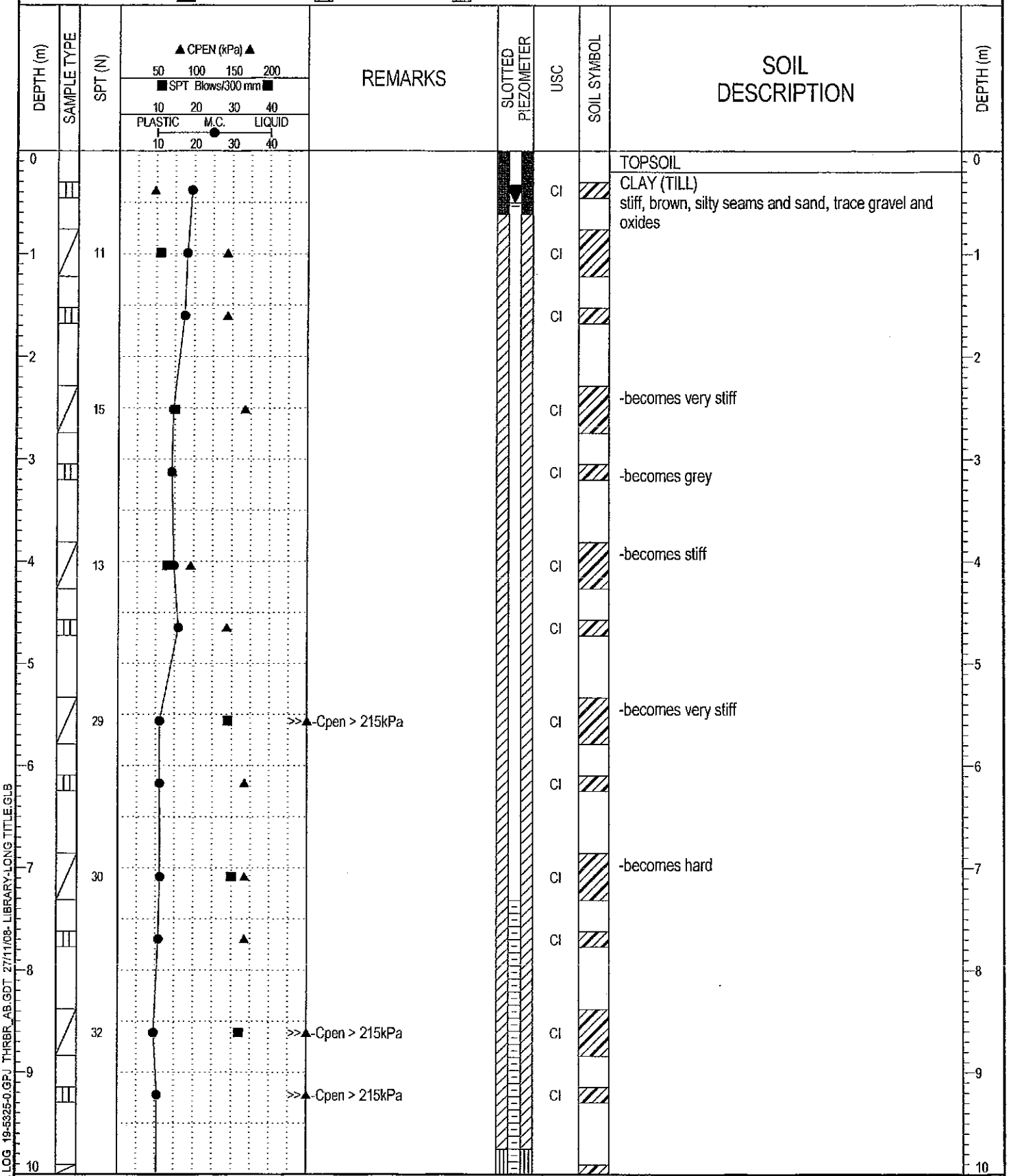
FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 8/4/08
REVIEWED BY: DWP	Page 2 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-6**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 7, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH



BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 7/4/08
REVIEWED BY: DWP	Page 1 of 2

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: TH08-6
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 7, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		39	>>▲	-Cpen > 215kPa		CI		CLAY (TILL) - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 9.8m -No water Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 0.5m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

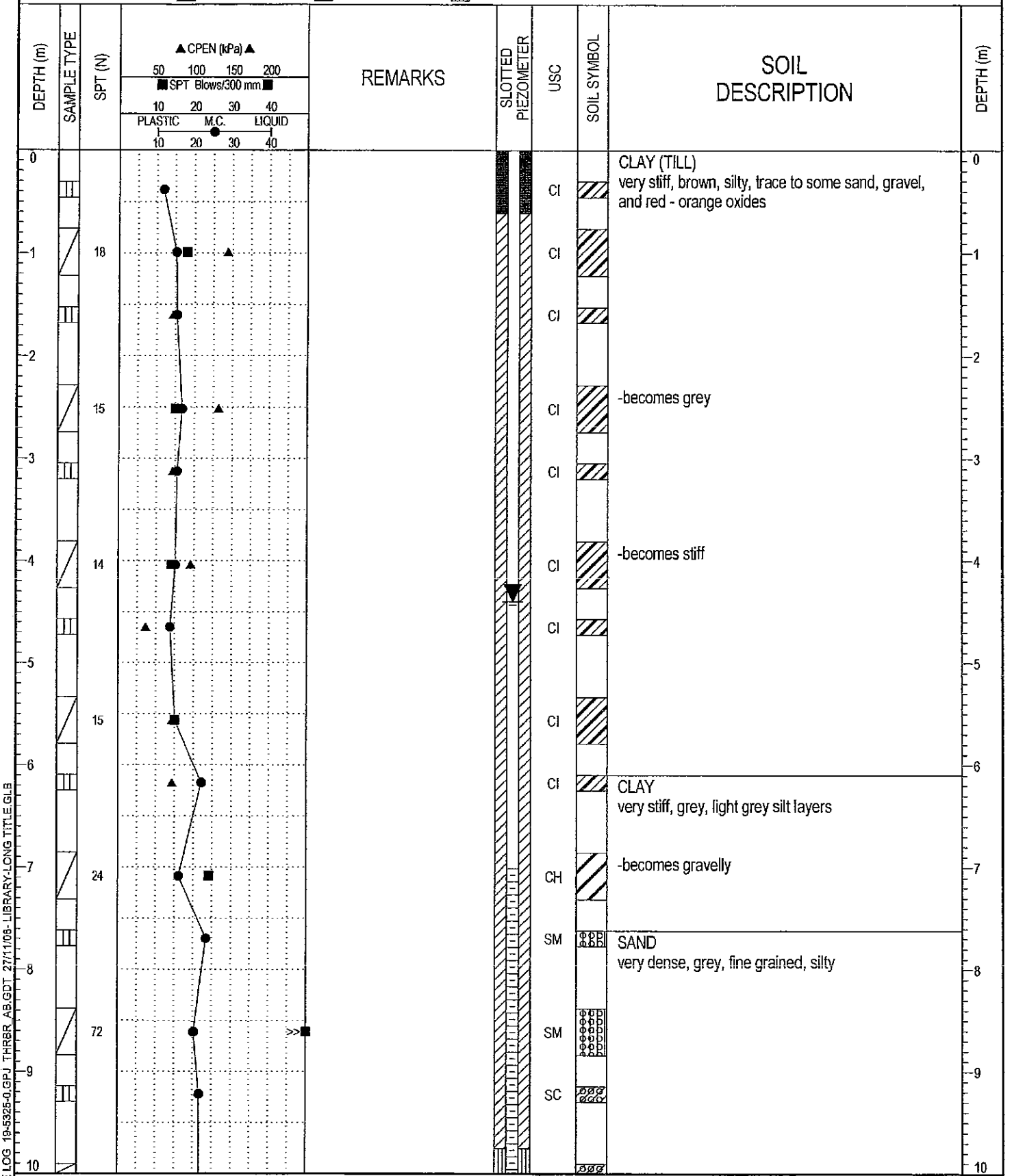
THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 7/4/08
REVIEWED BY: DWP	Page 2 of 2

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-7**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 7, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH



THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 7/4/08
REVIEWED BY: DWP	Page 1 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/06- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: **TH08-7**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 7, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE; SPT

BACKFILL TYPE: BENTONITE; DRILL CUTTINGS; SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		80	>>			SC		SAND - CONTINUED -some silt and clay END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 10.1m -Water at 9.8m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 4.4m	10
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

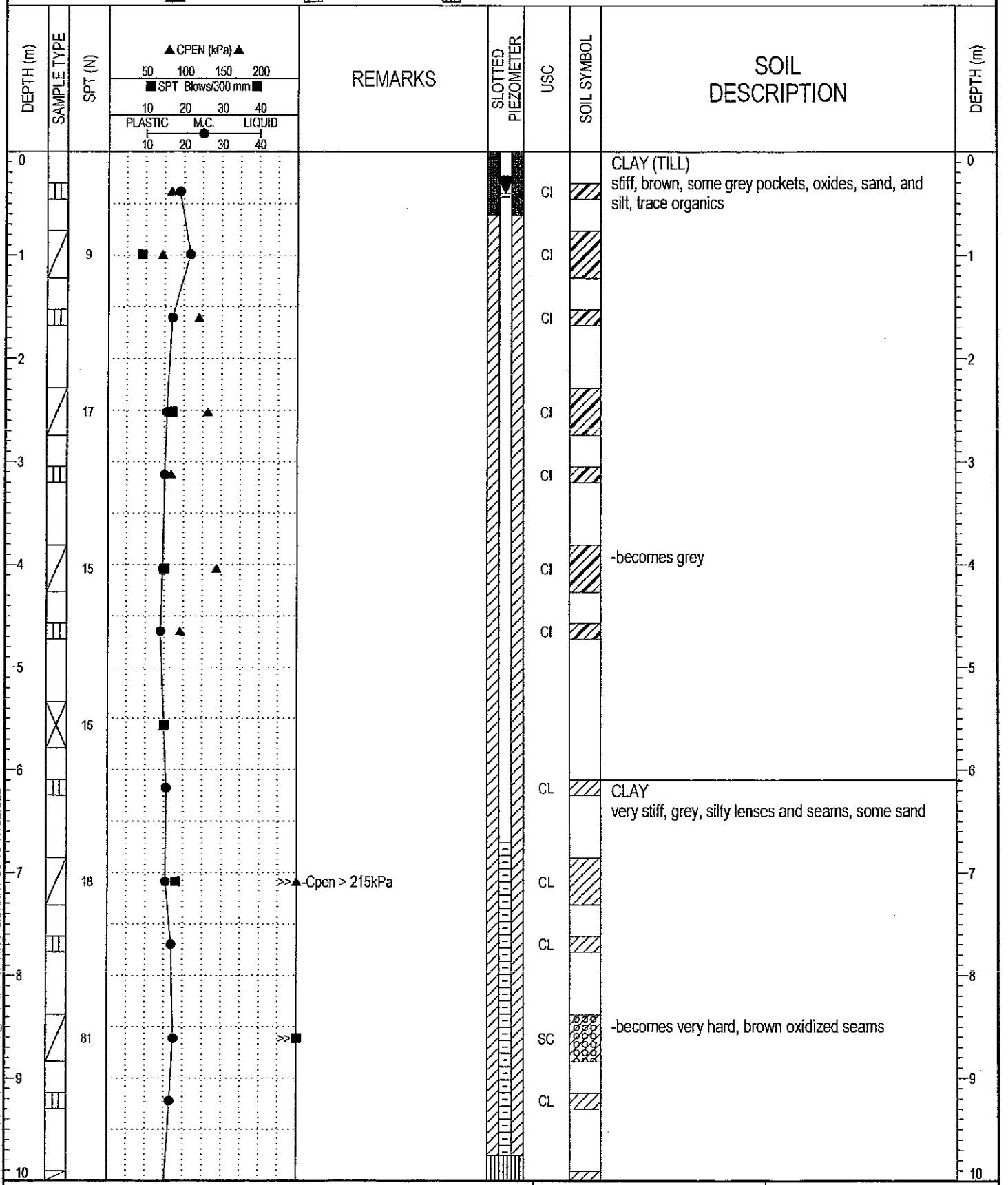
FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 7/4/08
REVIEWED BY: DWP	Page 2 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: TH08-8
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 7, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS | SLOUGH



BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 7/4/08
REVIEWED BY: DWP	Page 1 of 2

CLIENT: RICKARD LANDING	PROJECT: HWY 881 INDUSTRIAL COMMERCIAL SITE PRELIM	BOREHOLE NO: TH08-8
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: April 7, 2008	PROJECT NO: 19-5325-0
DRILL/METHOD: M5 / Solid Stem Augers	LOCATION: See Drawing #19-5325-0-1	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | SPT | NO RECOVERY

BACKFILL TYPE: BENTONITE | DRILL CUTTINGS | SLOUGH

DEPTH (m)	SAMPLE TYPE	SPT (N)	▲CPEN (kPa)▲ 50 100 150 200 / ■SPT Blows/300 mm■ 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	REMARKS	SLOTTED PIEZOMETER	USC	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)
10		70	>>■			CL		CLAY - CONTINUED	10
								END OF TEST HOLE AT 10.4m UPON COMPLETION: (Below ground surface) -Slough at 9.9m -Water at 9.8m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -November 19, 2008 = 0.4m	
11									11
12									12
13									13
14									14
15									15
16									16
17									17
18									18
19									19
20									20

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

FIELD LOGGED BY: CM	COMPLETION DEPTH: 10.4 m
PREPARED BY: JTR	COMPLETION DATE: 7/4/08
REVIEWED BY: DWP	Page 2 of 2

BOREHOLE LOG 19-5325-0.GPJ THRBR_AB.GDT 27/11/08- LIBRARY-LONG TITLE.GLB

Government of Alberta ■

Environment

Fax Cover Sheet

Environmental Management - Northern Region
111 Twin Atria Building
4999 – 98 Avenue, Edmonton, AB T6B 2X3
Phone: 780-427-7617 Fax: 780-427-7824

DATE: Oct 12/10

TO: Shawn Martin

COMPANY: EBA Engineering

FAX: 403.203.3381

FROM: Dale Adams

SECTION: Water Mgmt.

RE: Attached Approval

Number of pages including cover sheet: 6

Message/Comments

☑ Hard Copy to Follow in the Mail: Yes ☒ No ☐

If you have not received all the pages or have any problems with this fax transmission please contact (780) 427-7617

cc. Cory McLaughlin AENV Compliance.

780. 790. 3936

CONFIDENTIAL

R:\ADMINSEC\Miscellaneous\NR Fax Cover Sheet.doc

Government of Alberta ■
Environment

APPROVAL
PROVINCE OF ALBERTA
WATER ACT, R.S.A. 2000, c. W-3, as amended

APPROVAL NO.: 00268043-00-00

FILE NO.: 00268043

WATERBODY: Unnamed Wetland, Surface Runoff

ACTIVITY LOCATION: South of Fort McMurray, Alberta

EFFECTIVE DATE: October 08, 2010

EXPIRY DATE: October 07, 2011

APPROVAL HOLDER: Donald Rickard & Mike Walsh – Wood Buffalo South Industrial Park Ltd.

Pursuant to the Water Act, R.S.A. 2000, c. W-3, as amended, an Approval is issued to the Approval Holder for the following activity:

placing, constructing, operating, maintaining, removing, disturbing works, in or on any land, water or water body;

removing or disturbing ground, vegetation or other material in or on any land, water or water body;

for the purpose of removing a wetland and carrying out associated drainage works;

subject to the attached terms and conditions.

Designated Director under the Act: Amit Banerjee
A/Dir Patrick Marriott, P.Eng.

Date Signed: October 8, 2010

DEFINITIONS

1.0 All definitions from the Act and the Regulations apply except where expressly defined in this Approval.

1.1 In all parts of this Approval:

(a) "Act" means the Water Act, RSA 2000, c. W-3, as amended;

(b) "Director" means an employee of the Government of Alberta designated as a Director under the Act;

(c) "Maintenance" means the routine repair, upkeep and preservation of the activity authorized under this approval; and

(d) "Regulations" means the regulations, as amended, enacted under the authority of the Act.

GENERAL

2.0 The Approval Holder shall immediately report to the Director by telephone, any contravention of the terms and conditions of this Approval at (780) 422-4505.

2.1 The terms and conditions of this Approval are severable. If any term or condition of this Approval is held invalid, the application of such term or condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2.2 The Approval Holder shall retain a copy of:

(a) this Approval; and

(b) the plan(s)/report(s) referred to in Section 3.2

at the site of the activity at all times while conducting the activity.

PARTICULARS

3.0 This Approval is appurtenant to the undertaking as described as in-filling, drainage and surface water management located on the NE ¼ 01-087-09-W4.

3.1 The Approval Holder shall undertake the activity in accordance with the following plan(s)/report(s):

TITLE	AENV NUMBER
Wetland Compensation for the Rickard Development Located Within the NE ¼ Section 01, Township 087, Range 09, W4M EBA Engineering – June 2010	00268043-R001
Remedial Action Plan for NE 01-087-09-W4 – Including CSM Engineering Overall Storm Water Remedial Plan EBA Engineering – October 2010	00268043-R002

3.2 The Approval Holder shall not undertake the activity in any manner or use any material that causes or may cause an adverse effect on the aquatic environment, human health or public safety.

3.3 The Approval Holder shall not release water affected by the activity to any water body located off site, unless the quality of water is equal to or better than the quality of water in the receiving water body.

3.4 The Approval Holder shall not conduct activities in the water body between April 15 and July 30. This is a requirement to protect nesting and brood rearing migratory birds.

3.5 The Approval Holder shall not cause an adverse effect to drainage patterns on adjacent properties.

3.6 The Approval Holder shall be responsible for operation and maintenance of all constructed works and for any damages resulting there from.

SILTATION AND EROSION CONTROL

4.0 The Approval Holder shall minimize:

(a) siltation; and

(b) erosion

of downstream water bodies as a result of the activity.

4.1 The Approval Holder shall:

(a) develop a written Siltation and Erosion Control Plan prior to commencing the activity;

(b) implement the Siltation and Erosion Control Plan; and

(c) retain a copy of the Siltation and Erosion Control Plan at the site of the activity at all times while conducting the activity.

4.2 The Siltation and Erosion Control Plan shall specify measures to minimize and avoid siltation and erosion of the water body and shall include, at a minimum, the following information:

(a) measures to ensure no removal or disturbance of bank vegetation outside the site of the activity;

(b) site preparation practices to be used on erodible soils;

(c) measures for the management of surface and subsurface water flow to minimize siltation and erosion of any water body;

(d) measures for the stabilization of all disturbed areas until vegetation or other long-term erosion control methods are fully established and functioning; and

(e) measures for the management of excavated material.

WETLAND COMPENSATION

5.0 The Approval Holder shall provide compensation for the loss of wetland habitat as stipulated in the agreement dated July 19, 2010 between *Ducks Unlimited Canada* and *Wood Buffalo South Industrial Park Ltd.* such that the Approval Holder shall pay financial compensation in the amount of $147,900.00 CDN to *Ducks Unlimited Canada*.

5.1 On or before the expiry of this Approval, the Approval Holder shall provide to the Director written confirmation from *Ducks Unlimited Canada*, that the compensation has been received.

CERTIFICATE OF COMPLETION

6.0 Within 60 days following completion of the activity, the Approval Holder shall submit to the Director, a Certificate of Completion.

6.1 The Certificate of Completion shall include:

(a) a statement that the activity has been completed in accordance with the Approval; and

(b) any other information requested in writing by the Director.

Date Signed: October 8, 2010

Amit Banerjee

Designated Director under the Act
Patrick Marriott, P.Eng.