THE COUNTY OF VERMILION RIVER IN THE PROVINCE OF ALBERTA

BYLAW 12-12

A bylaw of the County of Vermilion River in the Province of Alberta to adopt the Industrial Area Structure Plan at NW-10-50-1-W4 1-2-0740651

WHEREAS the Council of the County of Vermilion River deems it to be in the public interest to adopt the Industrial Area Structure Plan for the NW-10-50-1-W4 Lot 1 Block 2 Plan 0740651,

NOW THEREFORE be it resolved that the Council of the County of Vermilion River, duly assembled, hereby enacts as follows:

1. That the Industrial Area Structure Plan for the NW-10-50-1-W4 Lot 1 Block 2 Plan 0740651, being Schedule "A" attached to and forming part of this By-Law, be adopted.

SHOULD any provision of this Bylaw be determined to be invalid, then such provisions shall be severed and the remaining bylaw shall be maintained.

THIS Bylaw shall come into force and effect upon receiving third and final reading and having been signed by the Reeve and Chief Administrative Officer.

Read a first time this 22nd day of May, 2012

Advertised the 1st day of June, 2012 AND the 6th day of June, 2012 in the Lloydminster Meridian Booster.

PUBLIC HEARING held the 12th day of June, 2012 at 1 p.m.

READ A SECOND TIME THIS 12th DAY OF June, 2012.

READ A THIRD TIME AND FINALLY PASSED THIS 12th DAY OF June, 2012.

SIGNED by the Reeve and Chief Administrative Officer this 12 day of June, 2012.

REEVE

CHIEF ADMINISTRATIVE OFFICER

Bylaw 12-12 - Schedule 'A'

Area Structure Plan

NW-10-50-1-W4M

Lot 1 Block 2 Plan 0740651

Industrial / Commercial Development

Date: April 27, 2012

Table of Contents

1. Development Concept

This Area Structural Plan outlines the proposed lot layout of 40 acres of land located at NW ¼ sec 10-50-1 W4. The area has been zoned identified for Industrial & Commercial Business uses. Specific zoning information is included in Section 6 of this package.

Please refer to: "Surface Water Assessment for Sand Control Systems Ltd. Industrial Development" Document "Submitted by: AMEC Environment & Infrastructure" in Attachment A: Bar Engineering: Page Appendix A-1, A-2 and A-3 for the Conceptual Diagram shows the entire section and current detail plans elements.

2. Transportation Considerations

a. External Roads

Sand Control Systems Ltd. Road infrastructure via Range road 13 & TWP road 502. Please refer to Attachment B: Traffic Impact Assessment

b. Internal Roads

The internal road design consists of the development of access roads that will run from range road 13. The internal road design will be built to county specifications, graveled and is to become part of the County of Vermilion River grid road system. Water will be managed as run off from the road ditches to the water retention pond.

3. Utilities and Servicing

a. Power

The location will be serviced by ATCO Electric via both underground and overhead service. Area has been staked. Three phase power was brought to site when the original site was developed. Sand Control Systems is currently sub-dividing the remaining property into five parcels with power available on all sites.

b. Natural Gas

The location will be serviced by ATCO Gas. Natural Gas is currently located on the property with a main line located on easement on the North and West side of the property. This line is available for tying into and has been in discussion with the gas utility regarding upsizing.

c. Telephone

Telephone servicing is available by Telus via underground on the West side of the property to be extended to all subdivided properties.

d. Water

All locations will be serviced by private wells or if required, water will be hauled from Lloydminster. Water expected volume of 200 gal/day. Installation of water / sewage / holding tanks; County of Vermilion Plumbing permit will be secured.

e. Sewage

The sewage system for the location will be in the form of private holding tanks Installation of water / sewage / holding tanks; County of Vermilion Plumbing permit will be secured.

f. Garbage

Garbage will be hauled to Lloydminster via QuikPick or some other disposal company.

g. Drainage

The County has been provided with the relevant information for Alberta Environment Approvals. The approvals will allow for the construction, operation and maintenance of the drainage channels currently servicing the area. There will be a drain pond that will store 97% of the site run off that will discharge at a controlled rate by a pump system. It will be graded as to not adversely affect the drainage system. Please refer to Attachment B: Bar Engineering report

4. Background and Staging

The Area Structure Plan for NW ¼ Sec 10-50-1W4 is being submitted to Council for the approval of the application to acknowledge the finalized layout of this site. The site has been previously subdivided to allow for Industrial and Business developments to occur across from the Lloydminster Airport. This application to further sub-divide is shown on the map attached. Please refer to Figure 1: Plan of Proposed Subdivision. The intension of this Area Structural Plan is to show the finalized layout of this site.

a. History

The site NW ¼ Sec 10-50-1 W4 was subdivided and re-zoned from farm land about 5 years ago. Three phase power was brought to the site when the original site was

developed by Sand Control Systems Ltd. Sand Control Systems is currently sub-dividing the remaining property into five parcels.

b. Staging

- **Phase 1** consists of beginning of construction of roads, ditches, storm water pond, berm and drainage.
- **Phase 2** consists of the completion of construction of roads, ditches, build-up of lower lying land, storm water pond, well, berm, drainage and holding tanks.

5. Site Information

a. Existing Sand Control Systems property information. Please refer to Attachment C: Sand Control Systems Ltd. Maps and Building Plans
b. Additional Existing features. The road down the middle, berm between property, fence on berm and berm against Airport road.
c. Adjacent Land Uses:
   - North – Airport Road; Airport Facility
   - East – Residential area; trailer park/ acreage
   - South - Farmland
   - West – Industrial site, farm land and trucking yard

6. Zoning

The section is zoned as "M" Industrial. The finalized intent of this section is for Industrial and Business. The zoning information is also included. Please refer to Figure 2: Industrial Development (M) District and Figure 3: **NW-10-50-1W4 Zoned (M)**

7. Fire Protection

FIRE DISTRICT: Blackfoot

Firefighting services of the area in-and-around the development are under the jurisdiction of the volunteer Fire Department located in Blackfoot. There are two large water storage ponds proposed on site.

8. Attachments (Maps and Diagrams)

- Figure 1: Plan of Proposed Subdivision

- Figure 2: Industrial Development (M) District
- Figure 3: NW-10-50-1W4 Zoned (M)
- Attachment A: Bar Engineering
- Attachment B: Traffic Impact Assessment
- Attachment C: Sand Control Systems Ltd. Site and Building Plans

PLAN OF PROPOSED SUBDIVISION

OF ALL OF

LOT 1, BLOCK 2, REG'D PLAN 074-0651

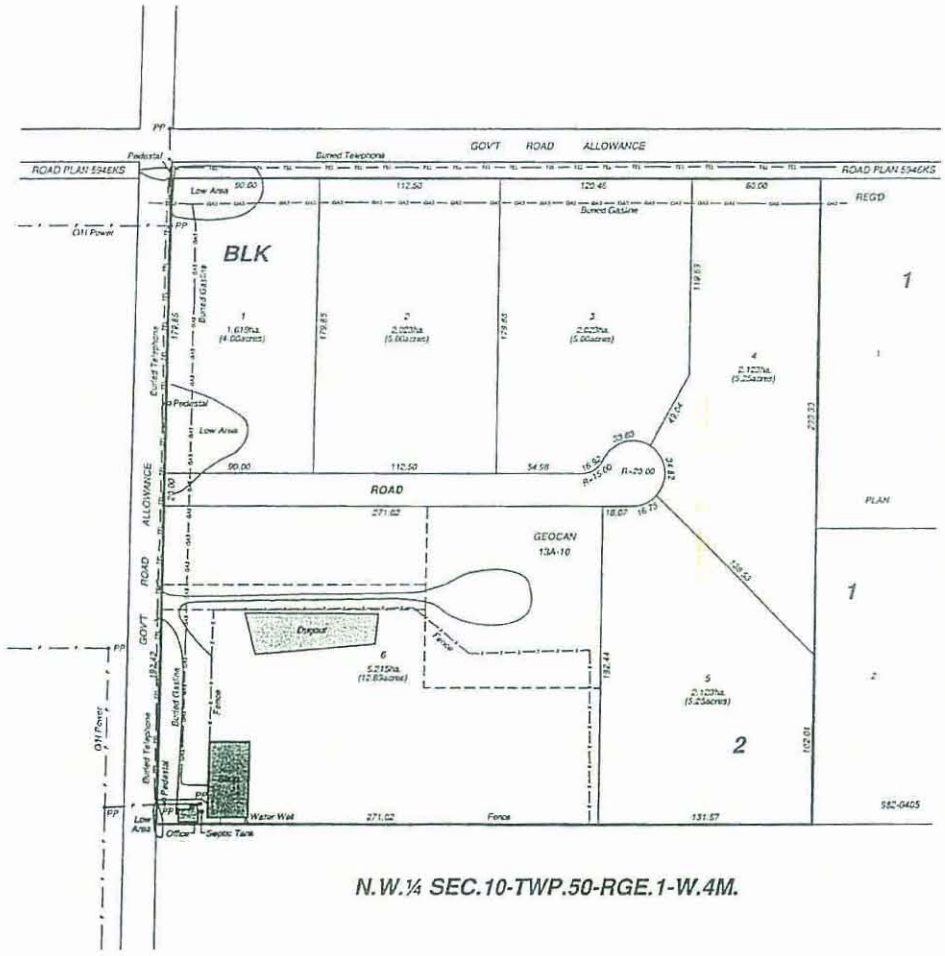
WITHIN

N.W.¼ SEC.10-TWP.50-RGE.1-W.4M.
COUNTY OF VERMILION RIVER

2011

SCALE 1:2000

AREA REQ'D WITHIN LOT 1, BLOCK 2, REG'D PLAN 074-0551 = 15.800ha.(39.04acres)

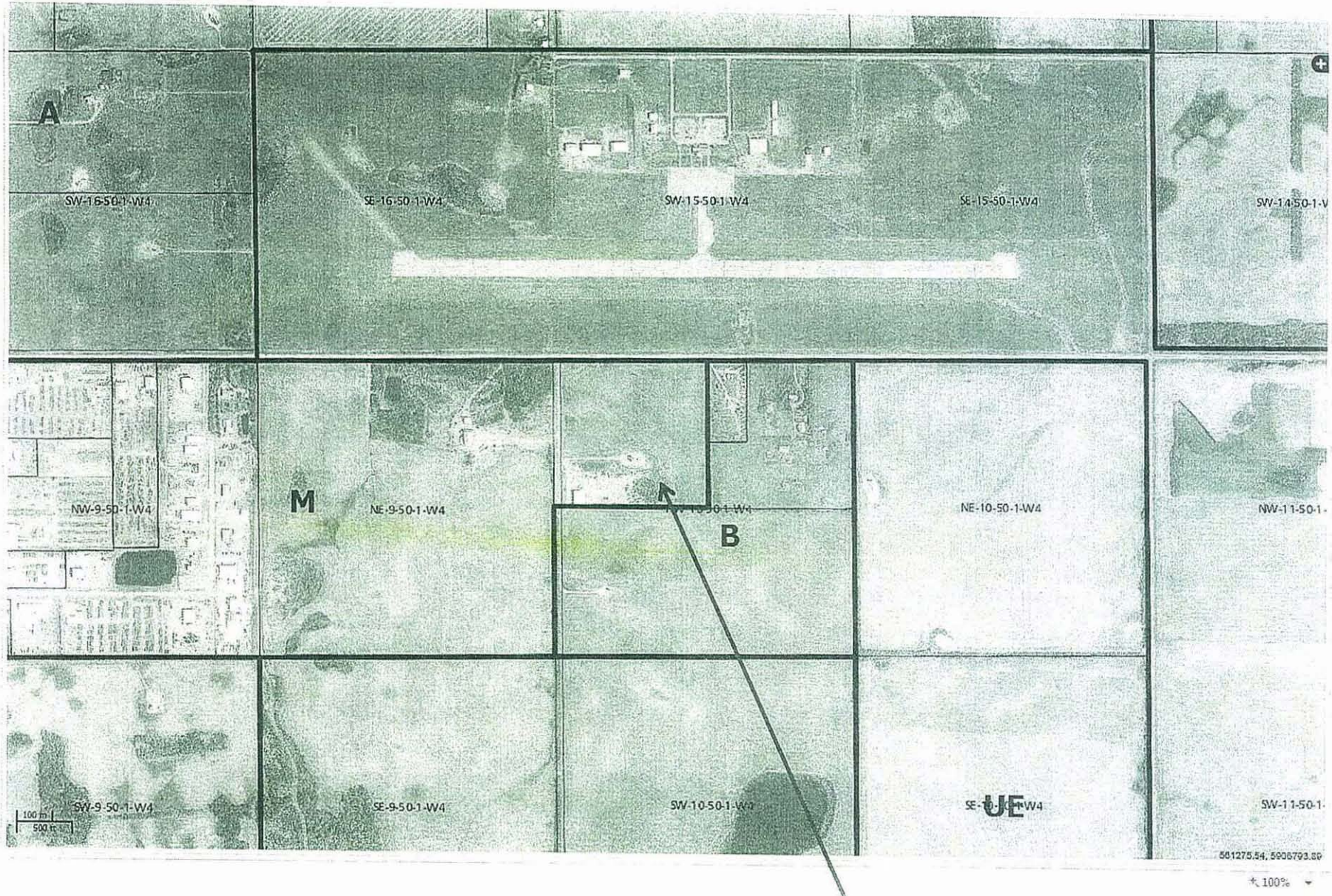


N.W.¼ SEC.10-TWP.50-RGE.1-W.4M.

September 27, 2011
June 30, 2011
FILE No. 11700LA

BOX 10216, LLOYDMINSTER, ALBERTA, T9V 3A4
Bus:(780)875-1440 Fax:(780)875-4313

Meridian Surveys (Alta.) Ltd.


A
SW-16-50-1-W4
SE-16-50-1-W4
SW-15-50-1-W4
SE-15-50-1-W4
SW-14-50-1-W
M
NW-9-50-1-W4
NE-9-50-1-W4
B
NE-10-50-1-W4
NW-11-50-1-
SW-9-50-1-W4
SE-9-50-1-W4
SW-10-50-1-W4
UE
SW-11-50-1-
100 m
500 ft
561275.54, 5906793.89
100%
This is Lot 1- Block 2- Plan 0740651
Of
NW-10-50-1-4
Zoned as Industrial (M)

6.3.7 Industrial Development (M) District

The Purpose of this District is to allow the development of industries which require large tracts of land and which may not be appropriate to develop within an urban municipality.

1. DISTRICT BOUNDARIES

This District comprises all the land in the County of Vermilion River as indicated on the Land Use District Map - Schedule C.

2. PERMITTED USES

Amended By Bylaw No. 09-31

Amended By Bylaw No. 09-31

a. Farming
b. Light industry
c. Manufacturing
ca. Medium industry
d. Storage
e. Warehousing
f. Buildings and uses accessory to permitted uses

3. DISCRETIONARY USES

Amended By Bylaw No. 09-31

a. Auto wreckers
b. Heavy Industry
c. Offices
d. Primary manufacture of:
   i. gravel, including its crushing
   ii. metals
   iii. wood
   iv. natural gas and its derivatives
e. Public utilities
f. Sewage treatment facilities and sewage disposal plants
g. The following uses provided that they are unlikely to have restrictive effects upon the development of the industrial area and are compatible with the industrial uses:
   i. commercial uses
   ii. municipal uses
   iii. offices
   iv. recreational uses
h. Other uses which, in the opinion of the Development Authority, are similar to the above mentioned permitted and discretionary uses
i. Buildings and uses accessory to discretionary uses

4. REGULATIONS

1. All site regulations and requirements shall be based upon the type of industrial development proposed, and shall be at the discretion of the Development Authority.

2. Some developments may produce, directly or indirectly, noise, odour, fumes, dust, smoke unsightly appearance, or other effects that may be detrimental to other land uses in or outside this District. These uses may be restricted by the Development Authority to particular areas of the District, or may be subject to special regulations or conditions of approval.

BAR Engineering

t: 780.875.1683 | 6004 - 50th Avenue
f: 780.875.2728 | Lloydminster, AB
www.bareng.ca | T9V 2T9

12 April 2012

BAR Project No.: 11-2024

Alberta Environment – Regulatory Approvals Centre
Main Floor Oxbridge Place
9820 – 106 Street
Edmonton, Alberta
T5K 2G6

To whom it may concern:

Re: Alberta Environment (AENV) Application under the Water Act for Approval
Surface Water Management Plan
Sand Control Systems Ltd. - Industrial Subdivision
NW 1/4, Sec. 10, Twp. 50, Rge. 1, W4M – County of Vermilion River

On behalf of Sand Control Systems Ltd., BAR Engineering Co. Ltd. (BAR) is pleased to submit the attached Application under the Water Act for Approval. Supporting the application are the following documents:

- BAR Issued for Approval (IFA) drawing set, Drawing No.: 11-2024 REV1.dwg, Cover Page and 7 Sheets; and
- AMEC Environment & Infrastructure (AMEC) Report, "Surface Water Assessment for Sand Control Systems Ltd.; Industrial Development; NW 10-50-1-W4M; County of Vermilion River; April 2012; EW1035".

The applicant is Sand Control Systems Ltd. as outlined in the attached form.

Yours truly,
BAR Engineering Co. Ltd.

— Severed

Rick Collins, P. Eng.
Municipal Engineering Manager

Attachment: AENV Application under the Water Act for Approval
AMEC April 2012 Report
BAR Drawing No.: 11-2024 REV1.dwg (Cover Page and 7 Sheets)

cc Sand Control Systems Ltd. – Wayne King
County of Vermilion River – Roger Garnett

SURFACE WATER ASSESSMENT FOR SAND CONTROL SYSTEMS LTD. INDUSTRIAL DEVELOPMENT NW 10-50-1-W4M County of Vermilion River

Submitted to:

BAR Engineering
Lloydminster, Alberta

Submitted by:

AMEC Environment & Infrastructure
Edmonton, Alberta

April 2012

EW1035

L:\PROJECT\EW1035 SWMP NW10-50-1W4\Reporting\EW1035 Final Report.doc

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1.0 INTRODUCTION

1.1 Project Objectives and Scope

AMEC Earth and Environmental (AMEC) conducted a surface water runoff analysis to support the development and design of a Surface Water Management System for Sand Control Systems Ltd., NW 10-50-1W4M located in the County of Vermilion River (County). Figure 1 (Appendix A) shows the location of the study site, and the proposed development area.

This report summarizes the results of AMEC's analysis defined by the following work scope components:

- Obtain and analyze local precipitation data (rainfall and snowpack) for the purpose of developing suitable design runoff events.
- Create a hydrologic model representative of the development area and determine peak rainfall runoff rates and volumes for the development area under pre- and post-development conditions.
- Provide estimates of total runoff volumes from an extreme snowmelt event.
- Provide routing through major drainage conveyance (e.g. ditches and culverts) and a single storm pond.
- Provide a brief report presenting the data and results of the hydrologic analysis.

1.2 Stormwater Release Rate Criteria

The design of the surface water management pond is controlled by criteria restricting the maximum release rate from the development area. The following three basic criteria relating to surface water releases are applicable to the proposed development area.

1. Under the County's Stormwater Management Policy (PD 009) any stormwater management plan is to be designed to accommodate 100 year rainfall flood (storm) events.
2. Under the Alberta Environment Stormwater Management Guidelines, peak runoff rates resulting from 100 year storm events (under post-development) should not exceed those under pre-development conditions.
3. Under the County's Master Stormwater Management Plan, discharge from County land into the City of Lloydminster storm channel is limited to a maximum of 2.5 L/s/ha. The County has also indicated that this release rate would be applicable to the proposed development area.[1]

To meet the maximum release rate criterion, stormwater discharges from the development will be regulated by a surface water management (SWM) pond. All runoff will be directed to the pond which will then be subsequently released at a controlled rate by a pump system. The pump discharge rates can be set to conform to the applicable standard release criteria.

[1] Personal communication, Rick Collins, BAR Engineering February 2012.
[2] County of Vermilion River Master Stormwater Management Plan – Technical Report. Clifton and

2.0 PRECIPITATION ANALYSIS

2.1 Rainfall

It is recommended that a 100-year, 24 hour rainfall event be adopted for the evaluation of surface water management systems that provide retention and storage. This recommendation is in agreement with both the Alberta Environment Stormwater Management Guidelines and the County's Master Storm Water Management Plan. The County's Stormwater Master Plan Technical Report[2] includes the most recent update to the rainstorm intensity, duration, frequency (IDF) information. The report estimates a 100-year, 24 hour rainfall depth for runoff to be 86.2 mm. This value was adopted for analysis of this report.

2.2 Snowmelt

Estimates on snow available for melt are based on direct measurements on snow water equivalents (SWE). Alberta Environment (AENV) has maintained records of snowcourse data in the province since 1973. Data was obtained from the snowcourse measurement stations most proximate to the study site (listed in Table 2.1). The snowcourse measurements are typically taken in March and April. The results of the frequency analysis presented in Table 2.2 are based on the maximum reported SWE for each year. Since there is no guidance provided in the County's current Master Stormwater Management Plan on development of, or estimates for an appropriate design snowmelt event, AMEC proposes assessment of a snowmelt resulting from the 100-year SWE (**142.8 mm**) for the evaluation of the surface water management system.

TABLE 2.1
Proximate AENV Snowcourse Measurement Stations

Station ID	Station Name	East (m)	North (m)	Distance from Study Site* (km)
05ED801	Clandonald	508830	5935319	60
05FE801	Mannville	500000	5890811	64
05FD802	Wainwright	525894	5840822	75

* Study site location: 561600 E, 5906630 N (NAD83, UTM 12N)

TABLE 2.2
Maximum Spring Snow Water Equivalent (mm)

Return Period (years)	Clandonald	Manville	Wainwright	Study Site*
2	58.5	49.1	41.3	50.2
5	84.5	71.5	65.4	74.5
25	126	99.2	107	111.2
50	144	109	127	127.0
100	162	119	147	142.8

*Based on weighted average of all stations. Station weighting factor = inverse of distance to study site.

[2] County of Vermilion River Master Stormwater Management Plan – Technical Report. Clifton and Associates Ltd. 07 December 2010.

3.0 RUNOFF ESTIMATES

3.1 Runoff Model

The Horton Method was used to simulate the response of the contributing catchments to the design storm events. The use of this method is consistent with the County's Stormwater Master Plan Technical Report. The four primary parameters that describe watershed response to rainfall by the Horton Method are the maximum infiltration rate, minimum infiltration rate, infiltration rate decay constant which describes how fast the rate decreases over time, and the time it takes a fully saturated soil to completely dry. These parameters depend on the soil's characteristics. Table 3.1 presents the recommended values for each of these factors as published in the County's Stormwater Master Plan Technical Report. In addition, parameters describing depression storage were incorporated into the model. The values used for these parameters are also displayed in Table 3.1, with the value of depression storage for pervious sub-area obtained from the County's Stormwater Master Plan Technical Report. The U.S. Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) was used to simulate rainfall runoff processes using the Horton Method.

TABLE 3.1
Hydrologic Catchment Properties for Pre-Development Condition

Infiltration Parameter	Value
Maximum Infiltration Rate (Horton)	50.8 mm/hr
Minimum Infiltration Rate (Horton)	1.3 mm/hr
Decay Rate of Infiltration (Horton)	4.14 $hour^{-1}$
Depression Storage for Impervious Sub-Area	1.5 mm
Depression Storage for Pervious Sub-Area	14 mm
Percent of Impervious Area with No Depression Storage	25%

3.2 Design Rainfall Storm

A 100-year, 24-hour duration storm was modelled based on the updated IDF data presented in County's Stormwater Master Plan Technical Report. A total rainfall depth of 86.2 mm was selected for the study site. A long-duration storm was adopted following recommendations found in the AENV Stormwater Management Guidelines (1999) suggesting that such storms provide a better representation of runoff for rural areas and also for the sizing of stormwater detention facilities. The design storm used for analysis distributes the total rainfall depth over a 24-hour period according to the Atmospheric Environment Service (AES) 70 percentile distribution. This distribution is based on observed prairie storms and is considered appropriate for the area under investigation.

3.3 Model Scenarios

The following two modelling scenarios were developed to provide comparisons between pre- and post-development conditions and to assess performance of the conceptual drainage system and storm water pond.

Pre-Development Condition

Figure 2 illustrates the catchment areas and surface drainage corresponding to the pre-development condition. The pre-development condition represents the existing drainage system within the proposed development and adjacent upstream areas (including drainage alongside and/or through the proposed development). A small storage pond exists in the southern-most central catchment. As a conservative measure, this pond was assumed to be full in all model scenarios (pre- and post-development). Runoff from the site drains through ditches located along the west (Range Road 13 Ditch) and north (Township Road 502 Ditch) perimeter of the development and exits the site through the outlet located at the northeast corner.

Post-Development Condition

Figure 3 illustrates catchment areas and surface drainage for the post-development option. A storm water pond that will collect drainage from nearly the entire site is proposed to detain runoff and release flows at a controlled rate. The proposed development area utilizes existing drainage channels as well as new drainage ditches within the development. Routing of flows into the pond was achieved through a ditch block along the Township Road 502 Ditch and by using a new set of ditches to be developed near the centre of the site. The proposed stormwater storage pond collects flows from 97% of the development area; the remaining area on the outer north east edges of the pond drains directly to the Township Road 502 Ditch.

All model runs assumed that no pumping would be carried out during the storm event. Pond storage will be pumped out after the storm event into the Township Road 502 Ditch before exiting the site through the outlet located at the northeast corner. Outflows from the stormwater detention pond will be controlled so that the peak outflows exiting the development area are less than or equal to 2.5 L/s/ha. The reader is referred to the design prepared by BAR Engineering for the proposed alignment of new and existing drainage elements.

Auxiliary Overflow: The new pond will be equipped with an auxiliary overflow that will allow flows to safely discharge from the pond in a controlled manner, should the design capacity be exceeded. The auxiliary overflow consists of a 300 mm diameter culvert with an inlet set at elevation 666.15 m (15 cm above the design high water level). Model simulations confirmed that these pipe sizes would maintain pond levels below the pond crest elevation (prevent overtopping) in the event the pond is at full capacity and then receives either the 100-year rain or extreme snowmelt events.

3.4 Catchment Hydrology

The modelled catchment boundaries for pre- and post-development conditions are provided in Figures 2 and 3. Catchment areas were delineated based on inspection of available topographic mapping and aerial photography as well as a site visit. Approximate surface drainage paths are also indicated. The total modelled drainage area is 16.8 ha.

3.4.1 Rainfall Runoff

For pre-development conditions, the percentage of impervious area at the study site was estimated to be 3% for undisturbed land and 40% for areas with light industrial development. The lower value is considered most appropriate for the undisturbed areas of the study site which are characterized by continuous grass and vegetative cover overlaying soils with slow infiltration rates. A higher percentage of impervious area, 55%, was selected for post-development conditions to account for the anticipated increase in development.

Tables 3.2 and 3.3 present a summary of the computed peak discharge and total volume resulting from the 100-year rainfall event for the pre- and post-development conditions, respectively.

TABLE 3.2
Pre-Development Peak 100-year Rainfall Runoff Rates and Volumes by Catchment

Model Catchment ID	Area (ha)	Percent Impervious (%)	Total Runoff Volume (m^3)	Runoff Ratio[1]	Peak Runoff Rate (m^3/s)	Unit Runoff Rate (L/s/ha)
PRE_01	0.7	40	370	0.61	0.01	14.3
PRE_02	3.4	40	1770	0.60	0.04	11.7
PRE_03	2.9	3	780	0.31	0.02	6.9
PRE_04	7.0	3	1910	0.32	0.05	7.2
PRE_05	2.8	3	760	0.31	0.02	7.1
Total	16.8	12	5590	0.39		

1. Volumetric Runoff Ratio= Direct Runoff Depth/Total Rainfall Depth

TABLE 3.3
Post-Development Peak 100-year Rainfall Runoff Rates and Volumes by Catchment

Model Catchment ID	Area (ha)	Percent Impervious (%)	Total Runoff Volume (m^3)	Runoff Ratio[1]	Peak Runoff Rate (m^3/s)	Unit Runoff Rate (L/s/ha)
POST_01	1.7	55	1020	0.71	0.02	11.9
POST_02	1.7	55	1020	0.71	0.02	11.9
POST_03	1.4	55	880	0.71	0.02	13.8
POST_04	0.6	90	450	0.93	0.01	17.6
POST_05	1.3	55	770	0.71	0.02	15.9
POST_06	2.1	55	1290	0.71	0.03	14.1
POST_08	0.3	55	190	0.71	0.00	0.0
POST_09	3.0	40	1580	0.60	0.04	13.1
POST_10	0.2	55	130	0.71	0.00	0.0
POST_11	1.4	55	840	0.70	0.02	14.3
POST_12	0.4	55	250	0.71	0.01	24.7
POST_13	0.8	40	400	0.61	0.01	13.3
POST_14	0.4	55	220	0.71	0.01	28.5
POST_15	0.6	55	390	0.71	0.01	15.7
POST_16	0.5	55	310	0.71	0.01	19.8
POST_17	0.4	55	270	0.71	0.01	23.1
Total	16.8	53	10010	0.69		

1. Volumetric Runoff Ratio = Direct Runoff Depth/Total Rainfall Depth

3.4.2 Snowmelt Runoff

For this study, AMEC assessed snowmelt resulting from the 100-year SWE (142.8 mm) for the evaluation of the surface water management system. A simplified analysis for melting the adopted 100-year snowpack was used to develop a snowmelt-generated hydrograph for each catchment. Melting of the snowpack will occur over several days, depending on the available snow and meteorological conditions during the melt period. To provide estimates of snowmelt runoff for each catchment a "snowmelt hyetograph" was created using the average daily melt rate of 15 mm/day and total SWE of 142.8 mm. As an approximation, it was assumed that approximately 70% of the total SWE (water) available for melt "runs off", while the remaining 30% is lost through abstractions during the melt period. These abstractions depend on a variety of factors including the soil conditions, vegetative cover (land use), degree of freezing in the soil, and local topography. The percentages of impervious areas were adjusted to approximate these runoff ratios for the pre-development conditions, while the same values were used for the post-development conditions.

Tables 3.4 and 3.5 present a summary of the computed peak discharge and total runoff due to snowmelt for each individual catchment for the pre- and post-development conditions, respectively.

TABLE 3.4
Pre-Development Peak Snowmelt Runoff Rates and Volumes by Catchment

Model Catchment ID	Area (ha)	Percent Impervious (%)	Total Runoff Volume (m^3)	Runoff Ratio[1]	Peak Runoff Rate (m^3/s)	Unit Runoff Rate (L/s/ha)
PRE_01	0.7	40	400	0.40	0.000	0.7
PRE_02	3.4	40	1940	0.40	0.002	0.7
PRE_03	2.9	55	2270	0.55	0.003	1.0
PRE_04	7.0	55	5430	0.55	0.007	1.0
PRE_05	2.8	55	2200	0.55	0.003	1.0
Total	16.8	51	12240	0.51		

1. Volumetric Runoff Ratio = Direct Runoff Depth/Total Rainfall Depth

TABLE 3.5
Post-Development Peak Snowmelt Runoff Rates and Volumes by Catchment

Model Catchment ID	Area (ha)	Percent Impervious (%)	Total Runoff Volume (m^3)	Runoff Ratio[1]	Peak Runoff Rate (m^3/s)	Unit Runoff Rate (L/s/ha)
POST_01	1.7	55	1310	0.55	0.002	1.0
POST_02	1.7	55	1310	0.55	0.002	1.0
POST_03	1.4	55	1130	0.55	0.001	1.0
POST_04	0.6	90	720	0.89	0.001	1.6
POST_05	1.3	55	980	0.55	0.001	1.0
POST_06	2.1	55	1660	0.55	0.002	1.0
POST_08	0.3	55	240	0.55	0.0003	1.0
POST_09	3.0	40	1730	0.40	0.002	0.7
POST_10	0.2	55	170	0.55	0.000	0.9
POST_11	1.4	55	1090	0.55	0.001	1.0
POST_12	0.4	55	320	0.55	0.000	1.0
POST_13	0.8	40	430	0.40	0.001	0.7
POST_14	0.4	55	270	0.55	0.000	0.9
POST_15	0.6	55	500	0.55	0.001	1.0
POST_16	0.5	55	390	0.55	0.000	1.0
POST_17	0.4	55	340	0.55	0.000	0.9
Total	16.8	53	12590	0.52		

1. Volumetric Runoff Ratio = Direct Runoff Depth/Total Rainfall Depth

4.0 RUNOFF ROUTING

Under pre-development conditions, almost all of the runoff drains off the site. This is achieved through ditches located along the perimeter of the development. All the runoff exits the site through one outlet along the Township Road 502 Ditch located at the northeast corner of the study area.

A storm storage pond is provided to capture the full volume of the 100-year rainfall event. Flows are then discharged from the pond by a pumping system at a controlled rate that does not exceed the release rate criteria of 2.5 L/s/ha (third and most restrictive criterion listed in Section 1). Details on the pumping system are provided in the design report prepared by BAR Engineering. The location of the detention pond and associated catchment areas are indicated on Figure 3.

4.1 Rainfall Runoff Routing

The AENV Stormwater Management Guidelines recommend maintaining the pre-development peak runoff rates for the 100-year rainfall event. This event formed the basis for design of the outflow controls for the pond. The SWMM rainfall runoff model was used to hydraulically route runoff through the series of proposed ditches and into the stormwater pond (provided by BAR Engineering). Figure 4 provides a comparison between the pre- and post-development runoff hydrographs reporting to the outlet and pond. Figure 5 presents the computed pond hydrograph for post-development conditions. A summary of the hydraulic routing analysis for the 100-year rainfall is provided in Tables 4.1 and 4.2.

TABLE 4.1
Pre versus Post Development Rainfall Runoff

Development Scenario	Runoff Destination	Peak Runoff Rate (m^3/s)	Unit Peak Runoff Rate (L/s/ha)	Total Runoff (m^3)
Pre-Development	Outlet_01	0.144	8.6	5590
Post-Development	Outlet_01	0.042*	2.5*	10010

* peak rate controlled by pumping out of pond to specified design rate

TABLE 4.2
Pond Rainfall Runoff Summary

Development Scenario	Runoff Destination	Peak Pond Inflow Rate (m^3/s)	Total Pond Inflow (m^3)	Maximum Pond Depth (m)	Maximum Pond Level (m)
Post-Development	Pond	0.227	9700	3.91	665.91

4.2 Snowmelt Routing

The total runoff volumes for the 100-year snowmelt event are larger than for the rainfall runoff event. The 100-year snowmelt event was also routed through the system of ditches and ponds to illustrate the impact on pond capacity for an extreme (100-year) snowmelt event. Figure 6 provides a comparison between the pre- and post-development snowmelt hydrographs and Figure 7 presents the computed pond hydrograph for post-development conditions. While total runoff volumes are larger for the snowmelt event, the peak rates are much smaller. The results of the snowmelt routing analysis indicate that pond capacities designed to accommodate the 100-year rainfall event will also accommodate extreme snowmelt events (provided that the outlet is not restricted or blocked by snow and ice). A summary of the hydraulic routing analysis for the 100-year snowmelt is provided in Table 4.2.

TABLE 4.2
Snowmelt Routing Summary

Development Scenario	Runoff Destination	Peak Runoff/Inflow Rate (m^3/s)	Total Runoff/Inflow Volume (m^3)	Maximum Pond Depth (m)	Maximum Pond Level (m)
Pre-Development	Outlet_01	0.015	14490	-	-
Post-Development	Outlet_01	0.015	12590	-	-
Post-Development	Pond	0.015	12157	4.25	666.25

5.0 SUMMARY

The following summarizes the key findings of the surface water assessment:

- The 2.5 L/s/ha discharge criterion, can be met by storing 97% of the site runoff in a stormwater pond and then discharging at a controlled rate by a pumping system.
- The hydrologic modelling assessment confirmed the following regarding conveyance:
  - ditches (0.5 m wide bottom widths and 3:1 side slopes) will not overtop during the 100-year rainfall event.
  - new culverts are able to pass the 100-year flows without surcharging.
  - Under pre-development conditions the existing 300 mm pipe, northeast of the proposed pond, will surcharge to a depth of approximately 0.75 m. This pipe will no longer surcharge following the construction of the proposed pond.
- Water from the pond will be pumped to the Township Road 502 Ditch, just north of the proposed pond.
- The proposed detention pond design volume of 9900 m^3 (refer to BAR Engineering design report) is of sufficient volume for capture of the 100-year rainfall runoff event and will accommodate an extreme snowmelt event.
- The allowable pumping rate for the development area of 16.8 ha, that meet the 2.5 L/s/ha criteria, is 42 L/s. Therefore, the full pond capacity of 9900 m^3 can be pumped down over a period of 65 hours.
- The proposed auxiliary overflow is adequately sized to prevent overtopping of the pond berm in the event the pond is full prior to arrival of the 100-year rainfall or an extreme snowmelt.

6.0 CLOSURE

This report has been prepared for the exclusive use of BAR Engineering. This report is based on, and limited by, the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. It has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.

Yours truly,

AMEC Environment & Infrastructure

Severed

Agata Hall, M.Sc., E.I.T.
Water Resources Engineer
AH/DH
Permit to Practice No. P-4546

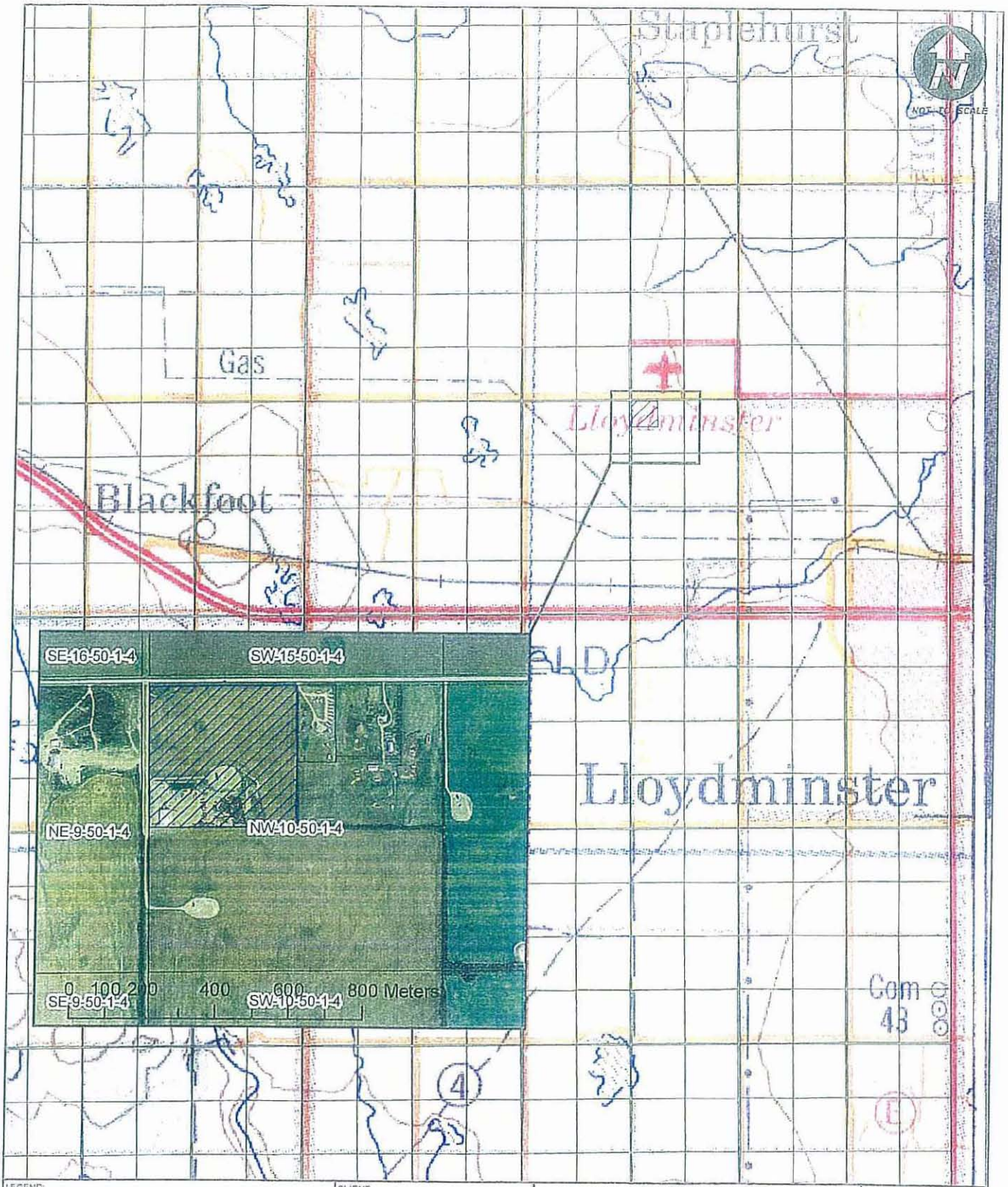
Reviewed by:

Severed

Dan Healy, Ph.D., P.Eng.
Senior Water Resources Engineer

Appendix A

Figures



LEGEND: Development_Area	CLIENT: BAR Engineering	SAND CONTROL SYSTEMS LTD. INDUSTRIAL DEVELOPMENT NW-10-50-1-W4	April 2012
	AMEC Project No.: EW1035		FIGURE 1
	DWN BY: DJH CHK'D BY: DJH	Study Location	amec

Map Path: L:\PROJECTS\EW\1035 SWAP (NW10-50-1W4)\GIS\Report Figures

LEGEND:
- Surface Drainage
- Subcatchment
- Model Node
- Model Link

CLIENT: BAR Engineering	SAND CONTROL SYSTEMS LTD. INDUSTRIAL DEVELOPMENT NW-10-50-1-W4	April 2012	
		FIGURE 2	
AMEC Project No.: EW1035	Pre-Development Surface Drainage	amec	
DWN BY: AH / CHKD BY: DJH			

Map Path: L:\PROJECT\EW1035\SWMP NW10-50-1W4\GIS\Report Figures

LEGEND:
- Surface Drainage
- Subcatchment
- Model Node
- Model Link

CLIENT: BAR Engineering	SAND CONTROL SYSTEMS LTD. INDUSTRIAL DEVELOPMENT NW-10-50-1-W4	April 2012	
		FIGURE 3	
AMEC Project No.: EW1035	Post-Development Surface Drainage	amec	
DWN BY: AH / CHKD BY: DJH			

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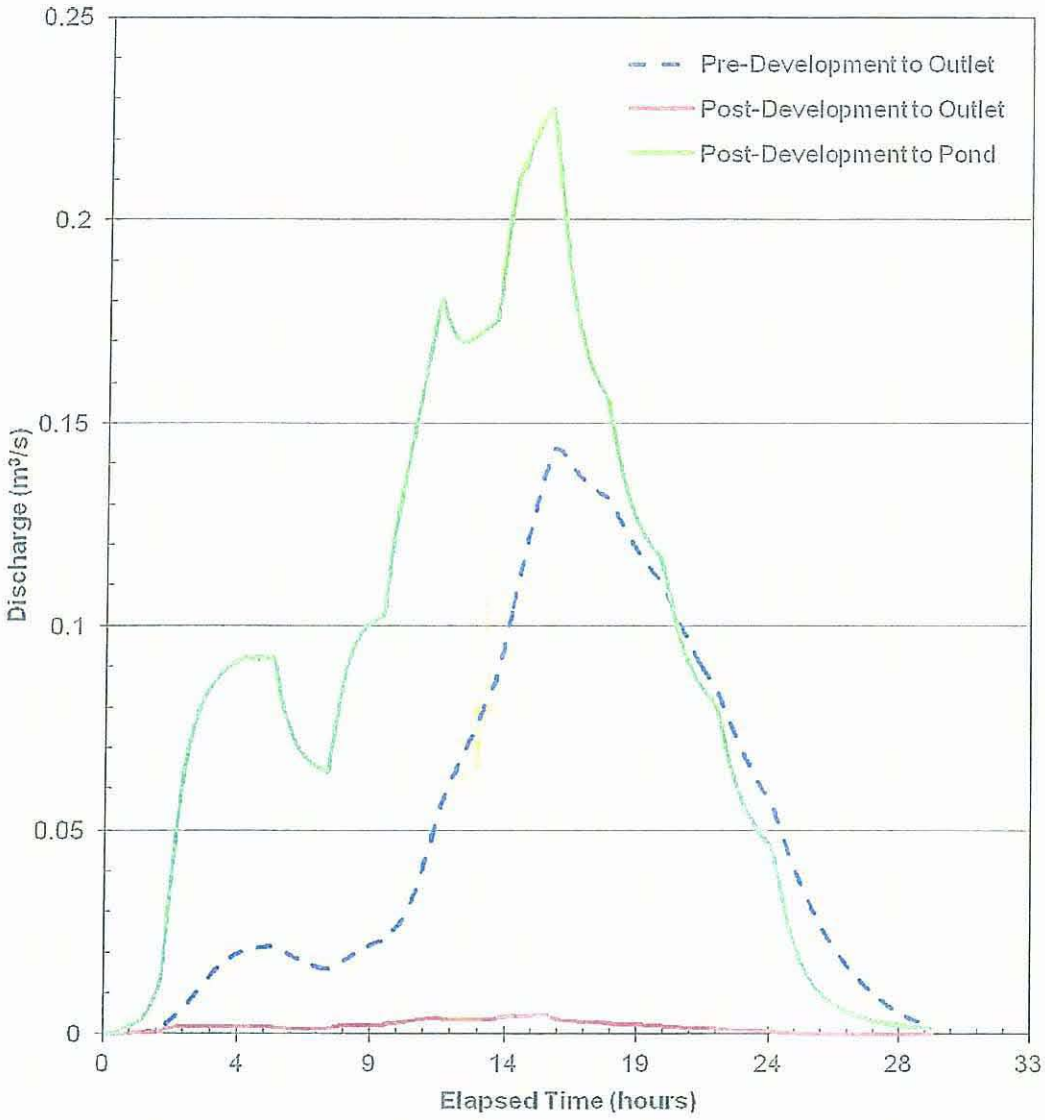

Figure 4. Pre- and Post-Development Routed Rainfall Runoff Hydrographs (100-year 24-hour Event).

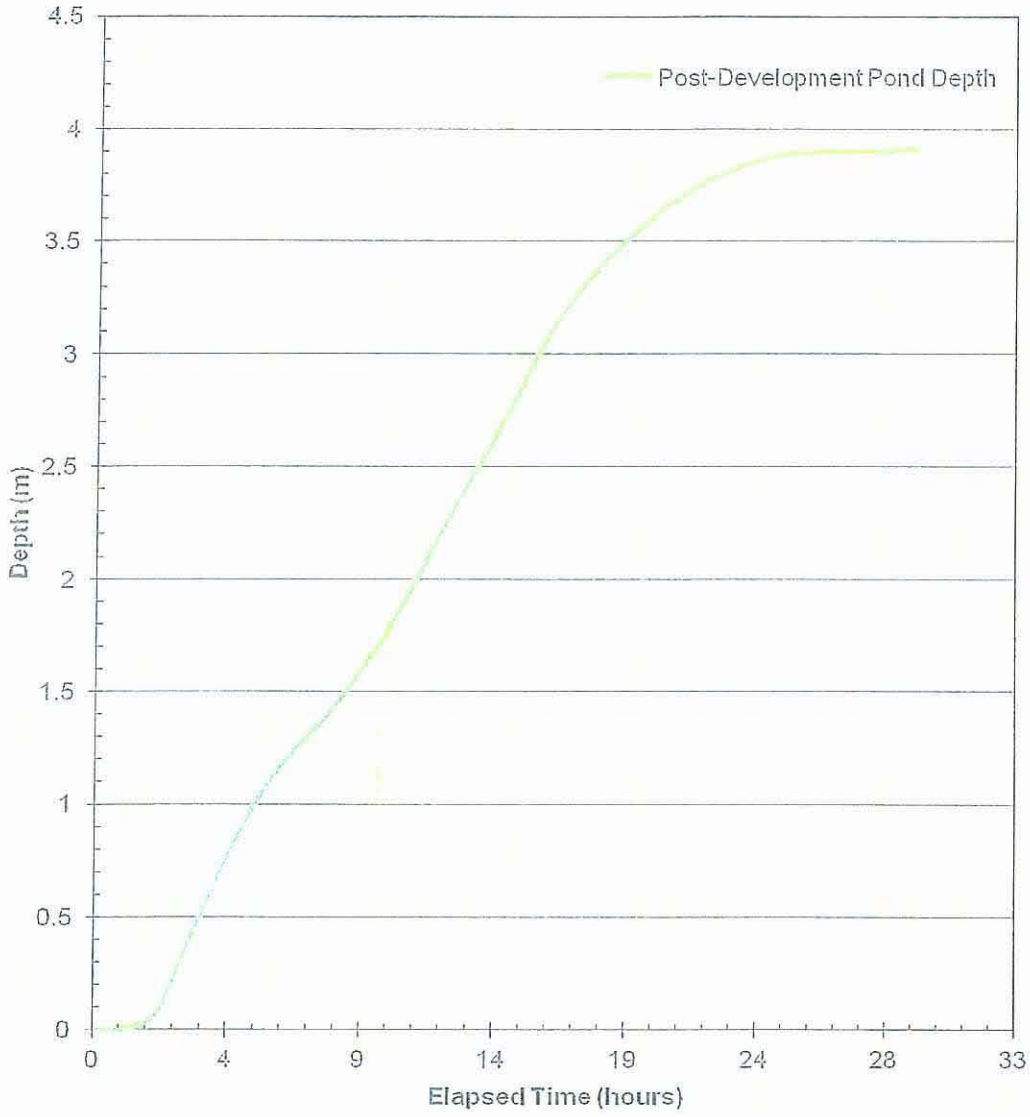

Figure 5: Post-Development Rainfall Runoff Pond Depth Hydrograph (100-year 24-hour Event).

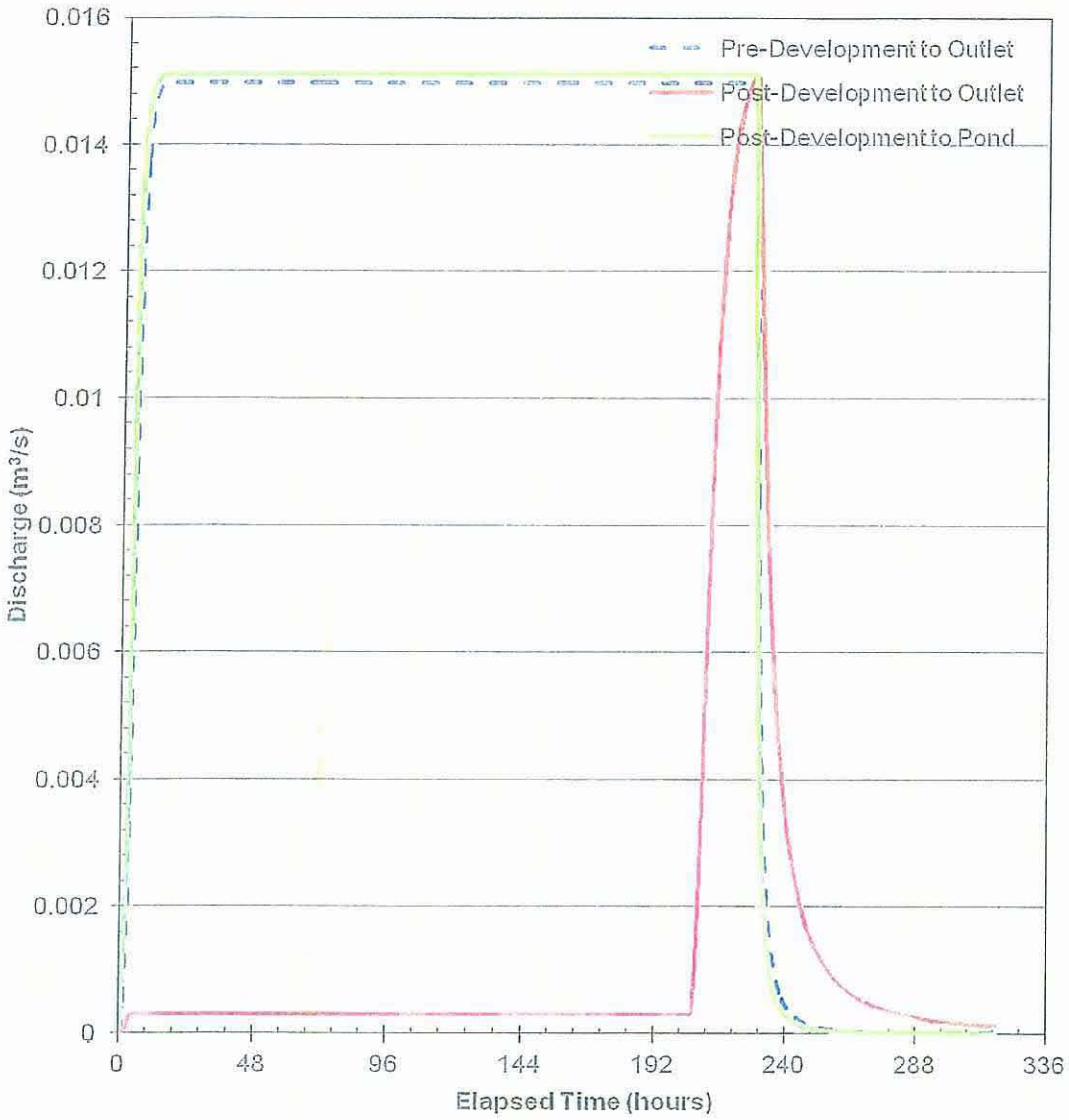

Figure 6: Pre- and Post-Development Routed Snowmelt Hydrographs (100-year Snowfall Event).

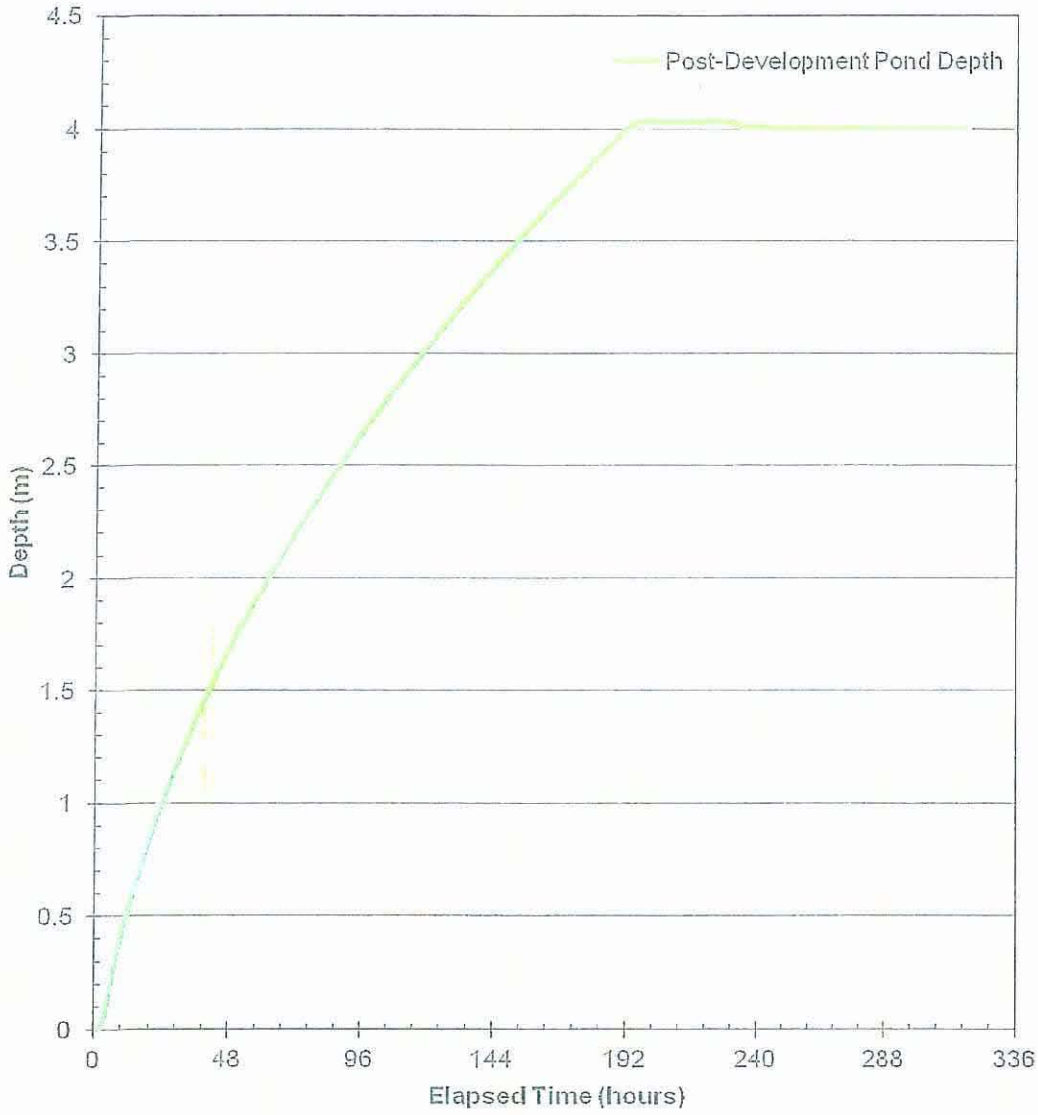

Figure 7: -Development Snowmelt Runoff Pond Depth Hydrograph (100-year Snowfall Event).

TRANSPORTATION PLANNERS AND ENGINEERS

bunt & associates

Sand Control Systems Ltd. Industrial Subdivision
Traffic Impact Assessment

FINAL REPORT

Prepared for

Sand Control Systems Ltd.

Date

May 1, 2012

Prepared by

Bunt & Associates

Project No.

3383.01

CORPORATE AUTHORIZATION

This document entitled "Sand Control Systems Ltd. Industrial Subdivision, Traffic Impact Assessment" was prepared by Bunt & Associates for the benefit of the Client to whom it is addressed. The information and data in the report reflects Bunt & Associates best professional judgment in light of the knowledge and information available to Bunt & Associates at the time of preparation. Except as required by law, this report and the information and data contained are to be treated as confidential and may be used and relied upon only by the client, its officers and employees. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Bunt & Associates accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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BUNT & ASSOCIATES (N. ALBERTA) LTD.
Signature: Serched
Date: MAY 1, 2012
PERMIT NUMBER: P 7801
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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May 1, 2012

Corporate Permit

Engineer's Stamp

TABLE OF CONTENTS

EXHIBITS

TABLES

1. INTRODUCTION

1.1 Background

Sand Control Systems Ltd. is currently in the process of advancing a development permit for the construction and operation of a new 6 lot industrial subdivision in the County of Vermilion River, south of Township Road 502 and east of Range Road 13. As part of the application process, Sand Control Systems Ltd. retained Bunt & Associates to complete a Traffic Impact Assessment (TIA) to identify any potential roadway geometry or traffic control improvements that may be required to accommodate the traffic anticipated to be generated by the industrial subdivision.

1.2 Study Objectives

Careful consideration must be given to the incremental increase in traffic generation on the adjacent county roadway network to ensure that the function and the integrity of the transportation system are maintained. The primary objectives of the assignment were to:

- Assess anticipated trip generating characteristics of the proposed development;
- Assess the traffic impacts of the proposed development on the adjacent roadway network;
- Evaluate the total projected traffic activity along Township Road 502, Range Rd. 12 (75 Avenue), Range Rd. 13, and 62 Avenue/67 Street, including operations at key intersections and access points; and,
- Identify roadway and intersection improvements required, if any, to accommodate projected site generated and background traffic volumes.

1.3 Study Methodology

The Traffic Impact Assessment was completed using the following methodology:

- An examination of existing land use, roadway, and traffic conditions adjacent to the development area;
- An examination of the proposed future roadway network adjacent to the development area and forecast traffic conditions;
- An estimate of future trips anticipated to be generated by the proposed development;

- Distribution and assignment of site generated trips to the adjacent roadway network based on the proposed access strategy and a review of existing traffic volumes and patterns; and,
- An overall analysis and assessment of the roadway volumes within the study area to identify lane requirements, capacity restrictions, and traffic impacts of the development.

2. SITE CONTEXT – EXISTING AND FUTURE AREA CONDITIONS

2.1 Site Location and Adjacent Land Uses

The Sand Control Systems industrial subdivision is proposed to be located on Lot 1 of Block 2 on NW ¼ Section 10-50-1 W4 within the County of Vermilion River. The site is located on the south side of Twp. Rd. 502 and to the east of Range Rd. 13. Exhibit 2-1 illustrates the site location in relation to key provincial and county roadways. One parcel, Lot 6, is currently developed and is occupied by a small oil field trucking company.

Adjacent land uses include a small existing industrial development in the southwest quadrant of the Twp. Rd. 502/Range Rd. 13 intersection, the City of Lloydminster airport to the north of Twp. Rd. 502. Farmland is located immediately to the south and east of the development site.

2.2 Existing Transportation System

2.2.1 Existing Roadway Network

The existing roadway network in the vicinity of the proposed development site includes the following roadways:

- *Twp Rd. 502* is an east/west two-lane, paved rural roadway. East of the west boundary of the airport lands, Twp. Rd. 502 forms the boundary road between the City of Lloydminster and the County of Vermilion River. It is designated by the County as a county main road between Range Rd. 20 and the west boundary of the airport lands and is considered an arterial roadway by the City of Lloydminster east of this point, and therefore adjacent to the proposed development site. The posted speed limit in the vicinity of the proposed development is 80 km/hr. Twp. Rd. 502 extends east of the proposed development site and forms the north boundary of the City of Lloydminster. The roadway bends to the south midway between Range Rd. 12 and Highway 17 (49th Avenue) to intersect with 62 Avenue/67 Street as a T-intersection. Twp. Rd. 502 is included in the City's truck haul route between Range Rd. 12 (75 Avenue) and 40 Avenue.

- *Range Rd. 13* is a two-lane, cold mix rural roadway adjacent to the development site. It intersects with Twp. Rd. 502 from the south and extends south approximately 600m where it terminates as a dead end. There is no posted speed limit along the section of Range Rd. 13; however, it is assumed to be 50 km/hr.

- *Range Rd. 12 (75 Avenue)* is the northwest boundary road between the County of Vermilion River (on the west side) and the City of Lloydminster (on the east side). It is a two-lane paved, north/south rural roadway. It intersects with Twp. Rd. 502 east of the proposed development

area. It extends south across Highway 16 and is classified as an arterial roadway by the City of Lloydminster. The posted speed limit in the vicinity of the Twp. Rd. 502 intersection is 80 km/hr.

- *62 Avenue* is a two-lane paved, north/south rural arterial roadway located in the City of Lloydminster. As it approaches Twp. Rd. 502 from the south, it bends 90 degrees to the east to become *67 Street*, continuing east to intersect Highway 17. Illumination is provided along the roadway adjacent to developed areas within the City of Lloydminster. The posted speed limit on 62 Avenue in this area is 80 km/hr.

The existing key study area intersections include the following:

- The intersection of Twp. Rd. 502 and Range Rd. 13 is a three-legged unsignalized intersection with yield control on the south approach. No illumination is provided at the intersection.

- The intersection of *Twp. Rd. 502 and Range Rd. 12* is an unsignalized four-legged intersection with stop control on the north and south approaches. One lane accommodating left, through, and right turn movements is provided on each intersection approach. Illumination is not currently provided at the intersection.

- The intersection of *Twp. Rd. 502 and 62 Avenue* is an unsignalized three-legged intersection. Twp. Rd. 502 intersects with 62 Avenue/67 Street along the 90 degree horizontal curve. For the purpose of the assessment, the Twp. Rd. 502 approach will be considered the north leg, the 62 Avenue approach will be considered the west leg, and the 67 Street approach will be considered the east leg of the intersection. Stop control is located on the Twp. Rd. 502 approach which is flared to separate right turn movements from left turn movements at the intersection. The 62 Avenue approach includes one through lane and one left turn bay, and the 67 Street approach includes one lane accommodating through and right turn movements. Full illumination is currently provided at the intersection.

P:\3383.01 - Lloydminster Industrial Park\CAD\Exhibit 2-1.dwg

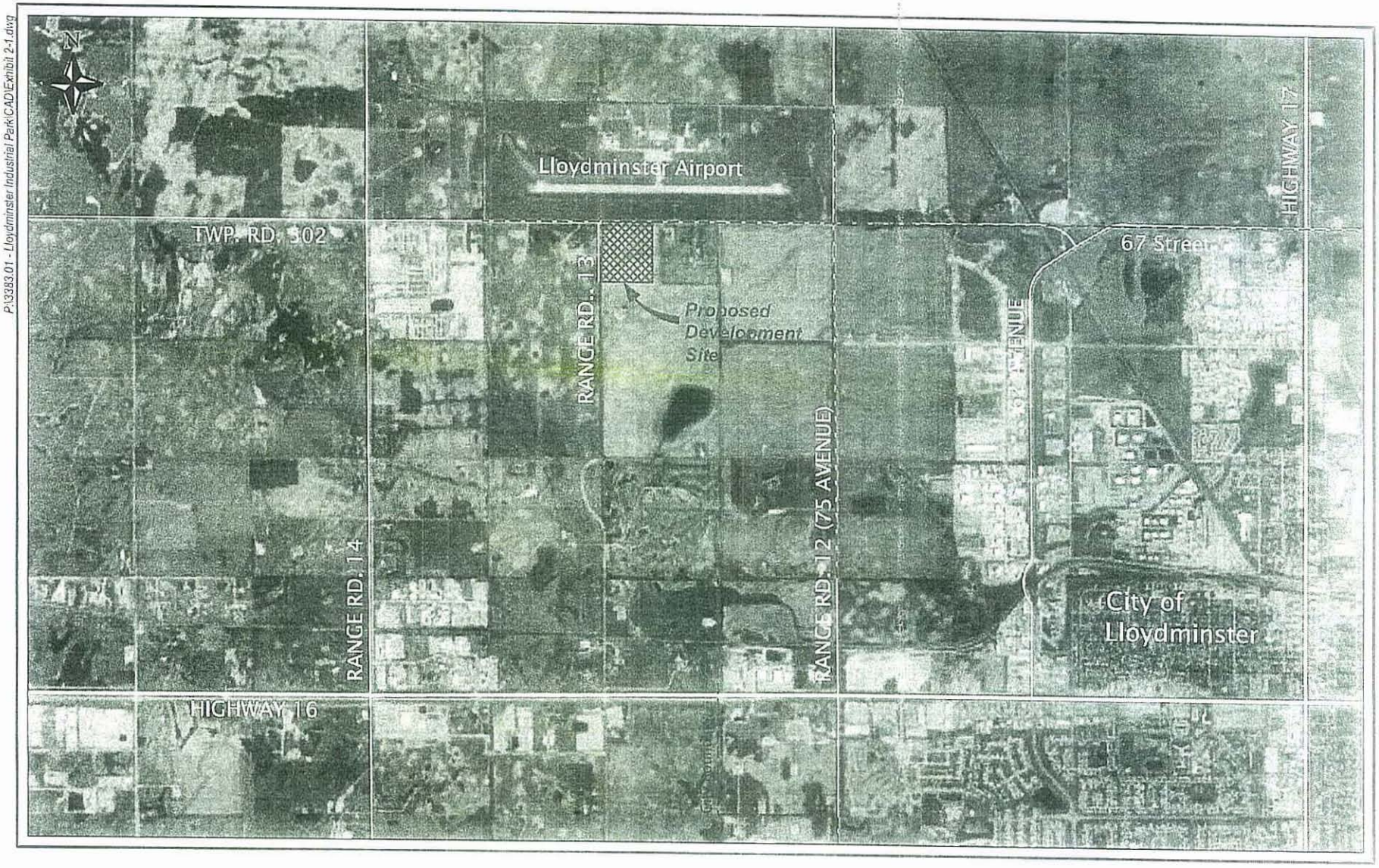

Exhibit 2-1

Scale NTS

Location Plan

Blunt & Associates

2.2.2 Existing Traffic Characteristics

AM (7:00 AM to 9:00 AM), noon (11:30 AM to 1:30 PM), and PM (4:00 PM to 6:00 PM) intersection turning movement counts were completed by Bunt & Associates in March 2012 at the intersection of Twp. Rd. 502 and 62 Avenue. The AM peak hour occurred between 7:15 AM and 8:15 AM, the noon peak hour occurred between 12:00 PM and 1:00 PM, and the PM peak hour occurred between 4:30 PM and 5:30 PM.

The City of Lloydminster provided 2009 noon and PM peak hour turning movement count information for the Twp. Rd. 502/Range Rd. 12 (75 Avenue) intersection. The noon peak hour occurred between 11:30 AM and 12:30 PM while the PM peak hour occurred between 4:00 PM and 5:00 PM. In the absence of AM peak hour count data, for assessment purposes AM peak hour traffic at the Twp. Rd. 502/Range Rd. 12 (75 Avenue) intersection was assumed to be equal to the reverse of the PM peak hour, less ten percent. As the percentage of heavy vehicles during the AM peak was also unknown, they were assumed to be equal to the reverse of the percentage of heavy vehicles in the PM peak.

In order estimate 2012 conditions at the Twp. Rd. 502/Range Rd. 12 (75 Avenue) intersection, the 2009 traffic volumes were increased to balance with the 2012 volumes counted on the Twp. Rd. 502 leg of the Twp. Rd. 502/62 Avenue intersection. In addition to this increase in volume, movements not contributing to the traffic volume on Twp Rd. 502 east of Range Rd. 12 were increased at a rate of 3.5% per year. The rate of 3.5% per year was chosen based on a review of historical six hour volumes at the Twp. Rd. 502/Range Rd. 12 (75 Avenue) intersection in 2007 and 2008, published in the 2008 City of Lloydminster Traffic Report.

Exhibit 2-2 presents the 2012 AM and PM peak hour background traffic assumed for the key study intersections for assessment purposes. Available raw count data for the Twp. Rd. 502/Range Rd. 12 (2009) and Twp. Rd. 502/62 Avenue (2012) is presented in addition to the balanced network assumed for assessment purposes. Given that there are no intersections and few private accesses located between Range Rd. 12 and Range Rd. 13, through traffic volumes at the Twp. Rd. 502/Range Rd. 12 intersection were balanced with the Twp. Rd. 502/Range Rd. 13 intersection. As very little development currently takes access to Range Rd. 13, no turning movements were assumed to occur during the peak hours.

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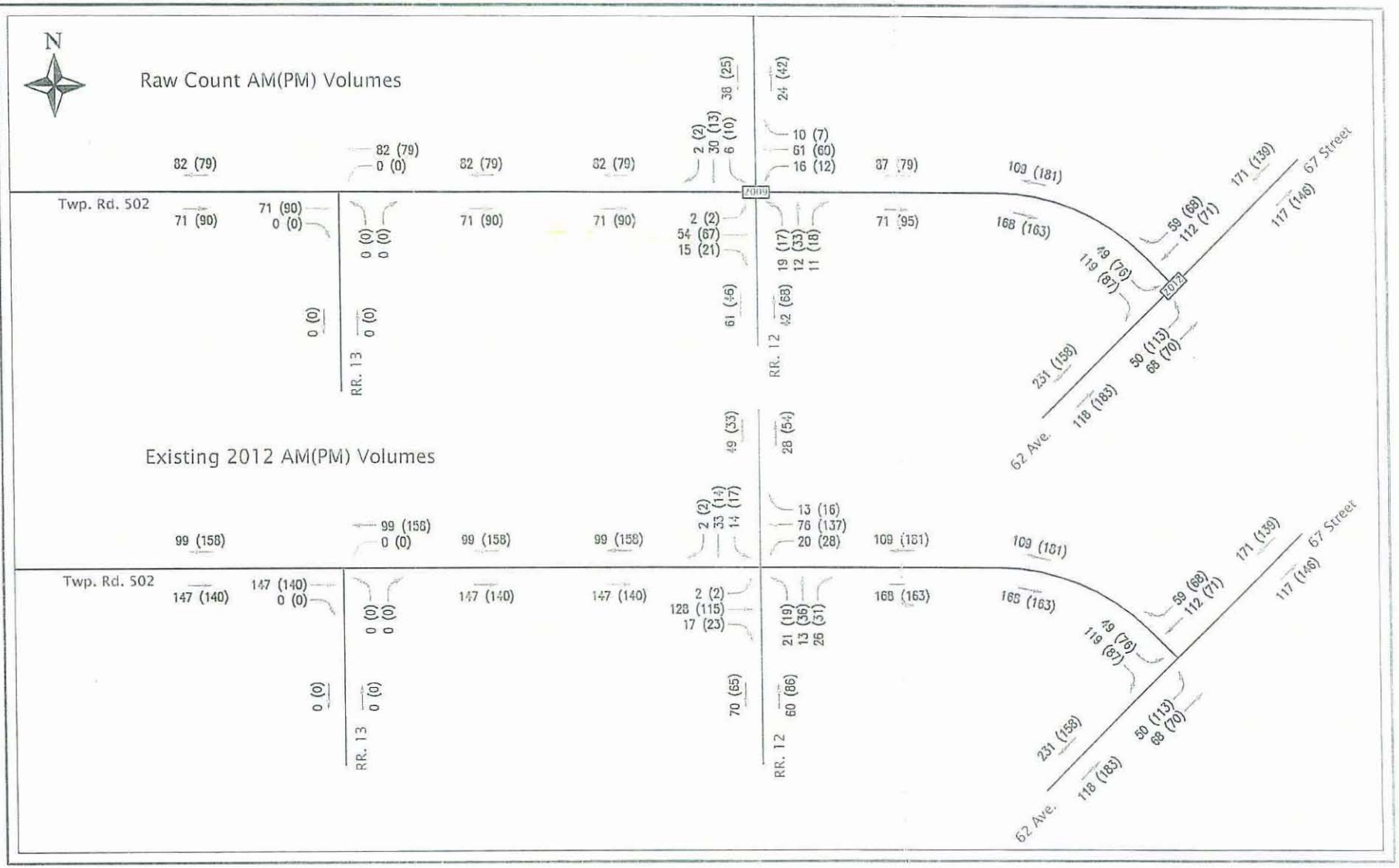

Exhibit 2-2

Scale NTS

Existing AM(PM) Peak Hour Volumes

2.3 Horizon Years

The Sand Control Systems industrial development is anticipated to build out by the year 2014; therefore, the short term horizon year selected for review is 2014. In addition to the build-out year of 2014, a long-term horizon has been reviewed to ensure that any improvements identified are appropriate for 20 years, or the expected life of the improvements. A long term 2034 horizon has been selected for assessment purposes.

2.4 Future Transportation System

2.4.1 Future Roadway Network

County of Vermilion River Transportation Master Plan

AMEC Earth and Environmental completed a Transportation Master Plan for the County of Vermilion River in May 2009 (2009 TMP). The recommended long term transportation strategy included in the 2009 TMP identified the following improvements to Twp. Rd. 502 by the year 2028 to accommodate the anticipated population growth.

- *Twp. Rd. 502 between Range Rd. 12 and Range Rd. 14* upgraded to a rural arterial divided roadway with a 10.4 m top roadway width (four 3.7 m paved travel lanes with 1.0 m inside and 2.0 m outside paved shoulders)..
- *Twp. Rd. 502 between Range Rd. 14 and Range Rd. 20* upgraded to a rural collector undivided roadway with a 9.0 m top roadway width (two 3.5 m paved travel lanes with two 1.0 m paved shoulders).

Although the forecasted timing (based on the Master Plan) of the above improvements falls within the 2034 long term horizon reviewed in this TIA, the improvements will be implemented in direct response to the amount, location, and form of population and employment growth in the county, and therefore the exact timing is uncertain. For the purposes of this assessment, existing geometry has been assumed for the base case scenario.

2.4.2 Background Traffic Volumes

To estimate the background traffic volumes associated with the short term horizon (2014), available historical intersection turning movement counts in the study area were reviewed. Based on historical six hour count data at the Twp. Rd. 502/Range Rd. 12 (75 Avenue) intersection in 2007 and 2008, a 3.5% per year growth rate was experienced. To estimate the background traffic volumes associated with the short term build out horizon of 2014, a linear growth rate of 3.5% was applied to all turning movements at the study area intersections.

With respect to long term (2034) traffic growth, the County of Vermilion River Transportation Master Plan and the City of Lloydminster Transportation Master Plan were reviewed. The reports assume an

approximate population growth of 2% per year. A corresponding 2.0% per year long term linear growth rate was applied to all traffic movements at the study intersections to project long term background traffic volumes.

Exhibit 2-4 illustrates the 2014 AM and PM peak hour background traffic volume estimates, while Exhibit 2-5 illustrates the 2034 AM and PM peak hour background traffic volume estimates at the key study intersections.

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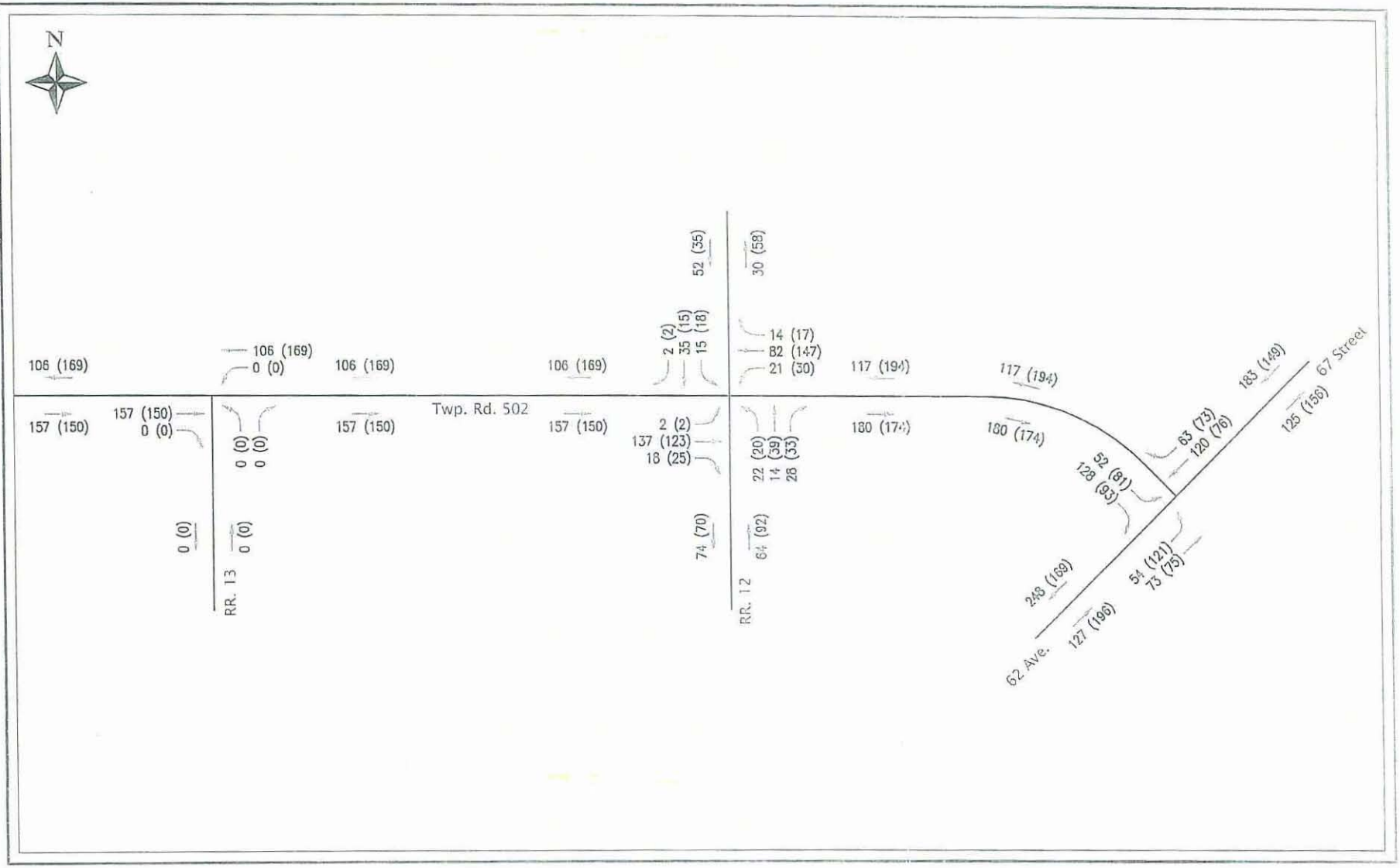

Exhibit 2-3

Scale NTS

Background 2014 AM(PM) Peak Hour Volumes

bunt & associates

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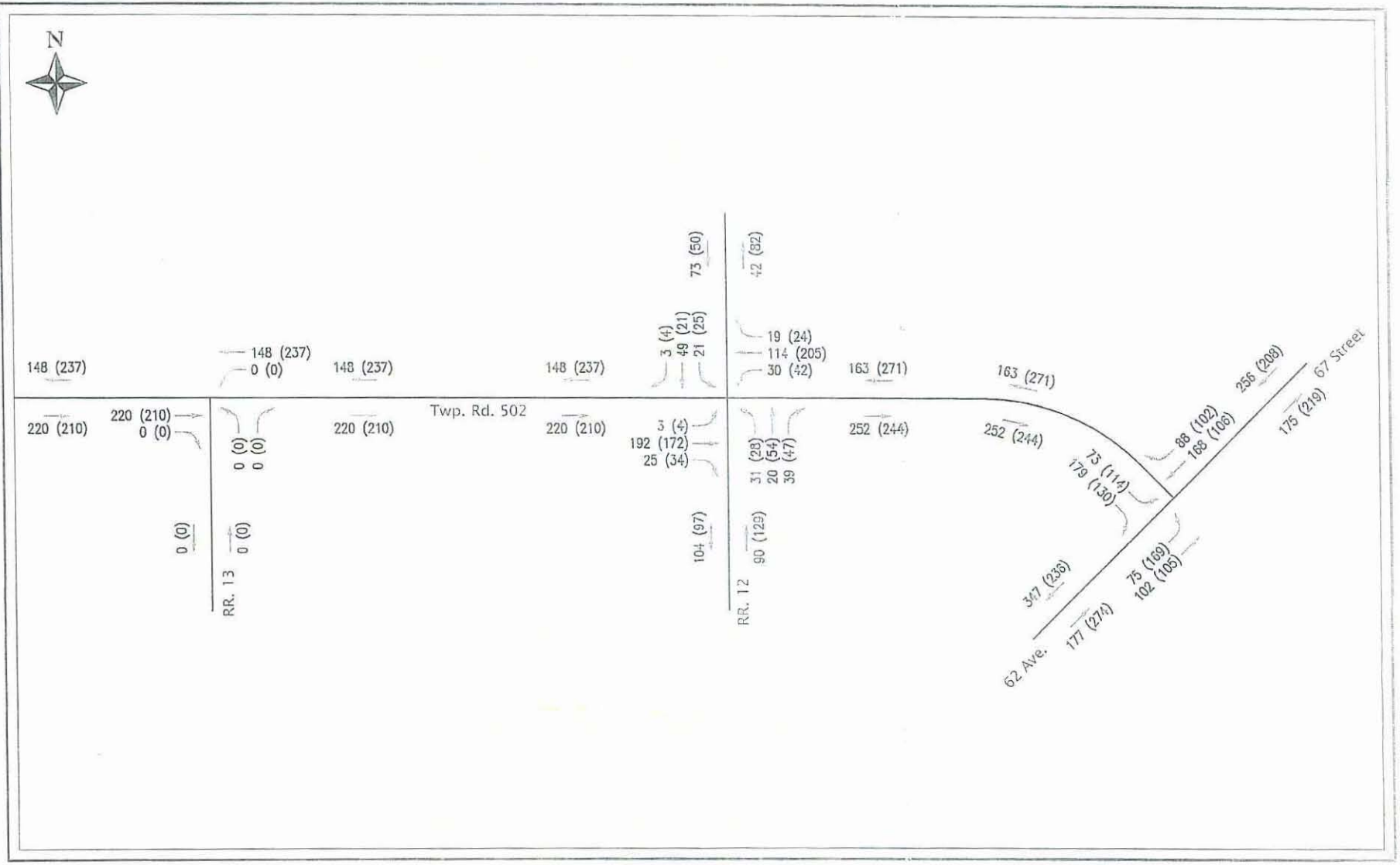

Exhibit 2-4

Scale NTS

Background 2034 AM(PM) Peak Hour Volumes

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3. PROPOSED DEVELOPMENT CHARACTERISTICS

3.1 Proposed Development

Sand Control Systems Ltd. Is an industrial equipment research and development company which specializes in petroleum waste stream management. The proposed subdivision is anticipated to include developments of a similar heavy industrial nature.

The proposed subdivision development, as illustrated in Exhibit 3-1, features a six parcel subdivision including approximately 36.5 acres (15.0 ha) of developed area. Table 3-1 summarizes the lot area breakdown and the corresponding anticipated land uses.

Table 3-1: Proposed Development Area Breakdown

Lot Number - Anticipated Use	Area (acres)	Area (hectares)
Lot 1 - Small oil field trucking company	4.0	1.6
Lot 2 - undetermined	5.0	2.0
Lot 3 – office/propane distribution site for an oil filed trucking company	5.0	2.0
Lot 4 –Grit Industries admin office & field service facilities	5.25	2.1
Lot 5 - Grit Industries admin office & field service facilities	5.25	2.1
Lot 6 – Sand Control Systems admin office & field Service facilities	12.0	5.2
TOTAL	36.5	15.0

Of the proposed development, the only parcel currently occupied is Lot 6. It is occupied by a small oil field company with a service shop.

3.2 Proposed Site Access

One site access is currently proposed to Range Rd. 13. The site access is anticipated to be located approximately 180 meters south of the Twp. Rd. 502/Range Road 13 intersection. This site access is planned to extend east into the development area, providing access to the six proposed parcels, and terminating as a cul-de-sac.

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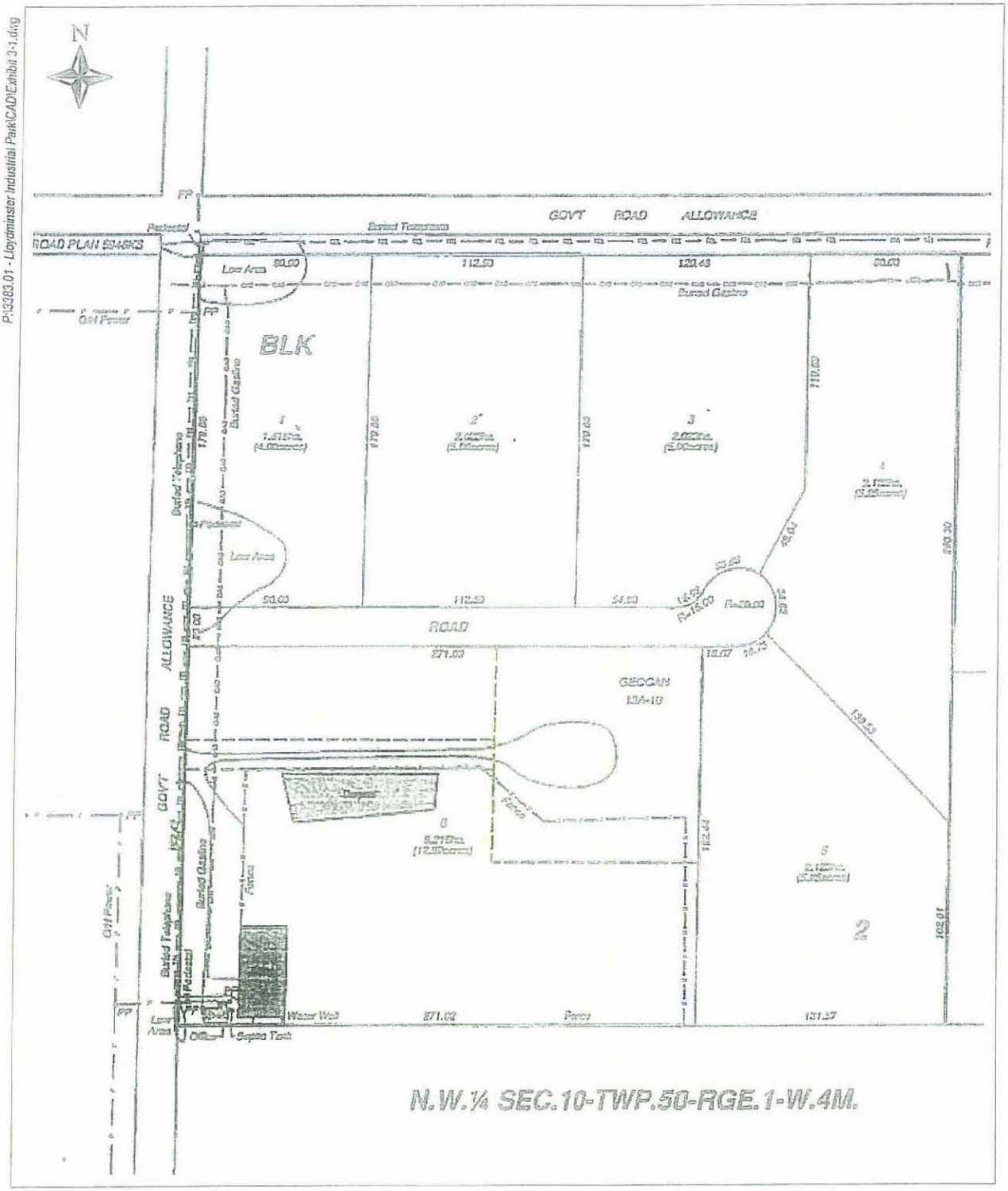

Exhibit 3-1

Scale NTS

Proposed Site Plan

4. SITE TRAFFIC CHARACTERISTICS

4.1 Trip Generation

Trip generation rates were selected based on a review of ITE Trip Generation, 8th Edition as well as information provided by the Client.

ITE classifies a number of different types of industrial land uses. For the purpose of determining an appropriate trip generation rate for the subdivision, General Light Industrial Land Use 110, General Heavy Industrial Land Use 120, and Industrial Park Land Use 130 rates were considered. Table 4-1 illustrates the corresponding average daily rates and provides the ranges of trip rate data collected. As presented, a wide range of trip rates have been measured and are largely dependent on density of development and number of employees.

Table 4-1: Summary of Trip Generation Rates

Land Use	Average Daily trips/acre	Range of surveyed ITE Daily rates (trips/acre)
110 - General Light Industrial	51.8	5.21 - 159.38
120 - General Heavy Industrial	6.75	1.66 - 25.01
130 - Industrial Park	63.11	13.87 - 1272.63
Client's Estimation	9.0	N/A

In order to compare these rates to the proposed subdivision, an approximate daily trip rate was generated for the proposed development. Based on discussions with the client, the estimated rate considers both employee and truck traffic on an individual lot basis. The daily trip making activity projections for each use were summed and averaged over the total anticipated development area. A daily rate of 9 trips per acre has been projected based on first principles. Of these daily trips, it has been estimated that 63% would be heavy vehicle traffic and 37% would be passenger vehicle trips.

Based on the anticipated development characteristics of the proposed subdivision, it has been determined that the proposed land uses are best classified as General Heavy Industrial. Although the ITE General Heavy Industrial average daily trip rate is 6.75 trips per acre, a more conservative daily trip rate of 10.0 trips per acre has been assumed in light of the trip generation characteristics anticipated to be exhibited by this particular development.

To estimate peak hour trip rates, the ITE General Heavy Industrial land use ratio of the AM peak hour trips to daily trips (30%) and the ratio of PM peak hour trips to daily trips (32%) were applied.

Peak hour inbound and outbound splits for the peak hours were not available from ITE. Therefore peak hour splits for ITE General Light Industrial and Industrial Park were considered. A directional split of 83% inbound and 17% outbound trips was applied to the AM peak hour site generated traffic, and a directional split of 20% inbound and 80% outbound trips was applied to the PM peak hour site generated traffic.

Table 4-2 summarizes the projected site generated traffic associated with the proposed development.

Table 4-2: Summary of Site Generated Traffic

Land Use	Units (acres)	AM Peak Hour			PM Peak Hour			Daily	
		Rate	In (83%)	Out (17%)	Rate	In (20%)	Out (80%)	Rate	Total
Industrial Subdivision	36.5	3.0	91	19	3.2	23	93	10.0	366
Total Trips			110			116			366

As presented in Table 4-2, the fully developed country Industrial subdivision is expected to generate in the order of 110 two-way trips during a typical weekday AM peak hour, 116 two-way trips during a typical weekday PM peak hour, and about 366 two-way trips during a typical weekday.

4.2 Trip Distribution & Assignment

The distribution of site generated traffic is based on a review of existing industrial traffic patterns as well as consultation with the Client regarding the anticipated surrounding areas that will be serviced by development within the proposed subdivision. Traffic anticipated to be generated by the proposed subdivision has been distributed to the adjacent roadways as follows:

- 5% to/from Range Rd. 14 south of Twp. Rd. 502;
- 10% to/from Range Rd. 12 (75 Avenue) south of Twp. Rd. 502;
- 45% to/from 62 Avenue south of Twp. Rd. 502, and;
- 40% to/from 67 Street east of the Twp. Rd. 502/62 Avenue intersection.

Exhibit 4-1 illustrates the assignment of the AM and PM peak hour site generated traffic volumes for the proposed Sand Control Systems industrial subdivision.

4.3 Total Traffic

The site generated traffic volumes were superimposed on the 2014 and 2034 background traffic volumes to determine the 2014 and 2034 total traffic volumes for use in the assessment. Exhibits 4-2 and 4-3

summarize the 2014 AM and PM peak hour and the 2034 AM and PM peak hour traffic volumes, respectively.

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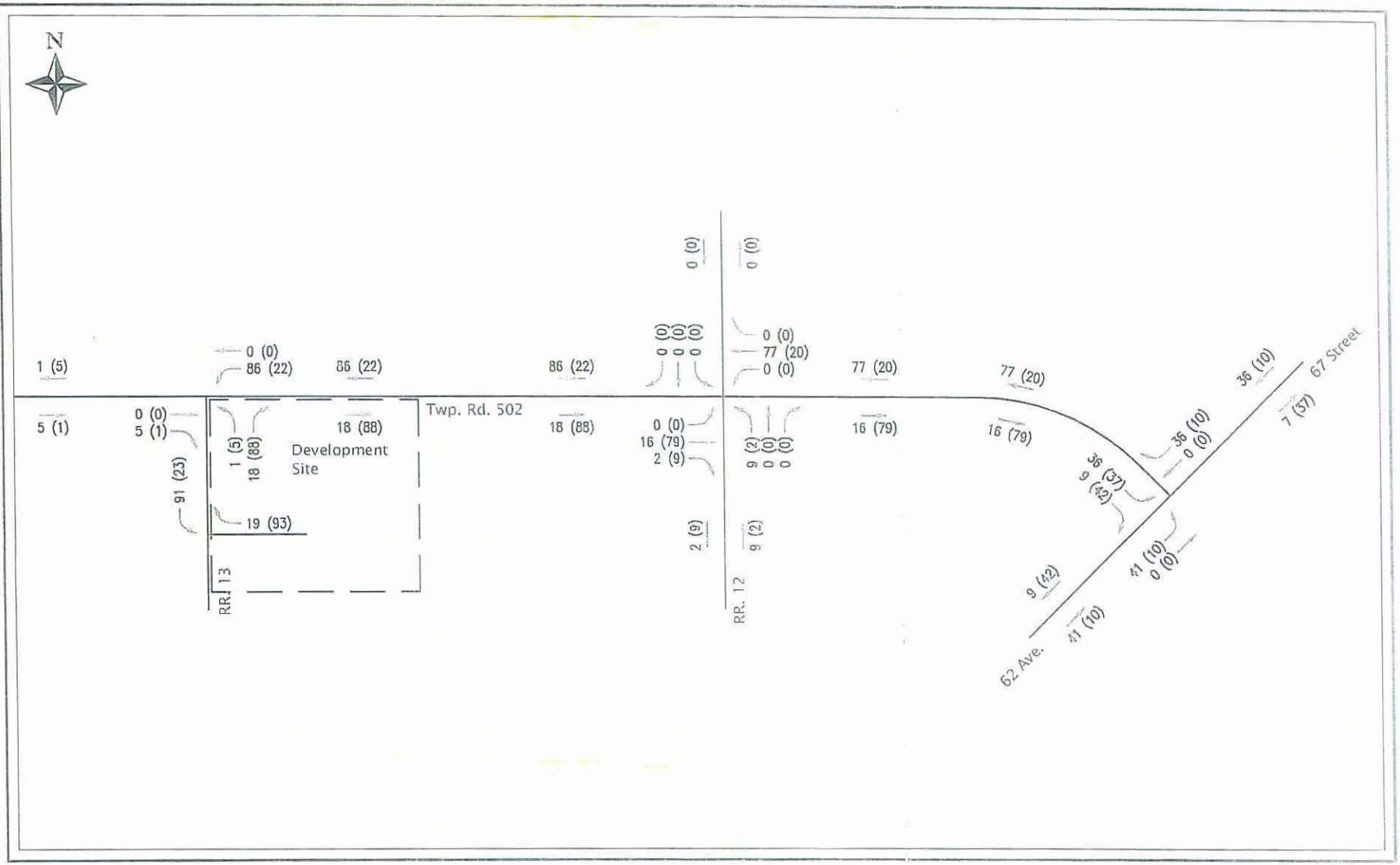

Exhibit 4-1

Scale NTS

Site Generated AM(PM) Peak Hour Volumes

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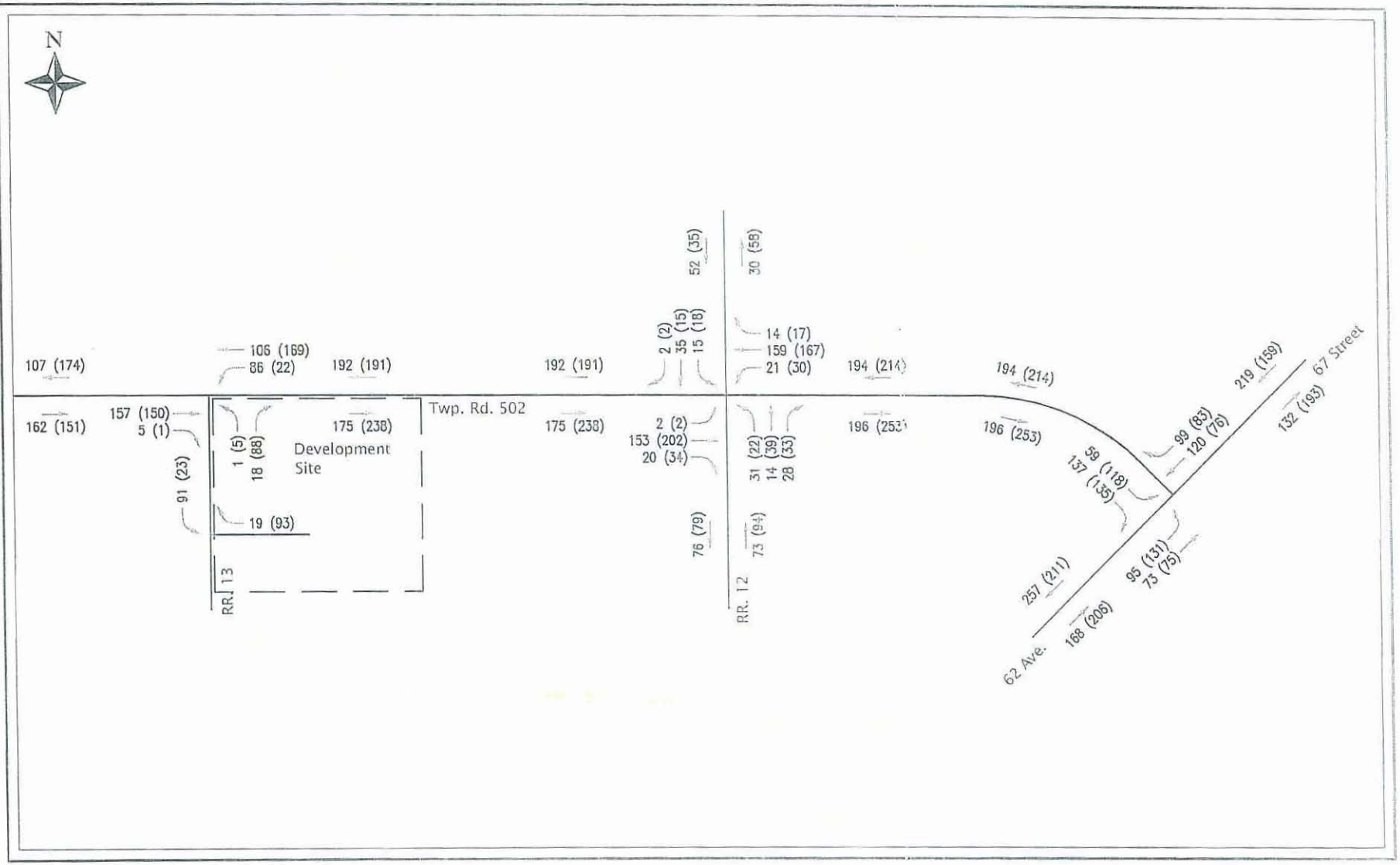


Exhibit 4-2

Scale NTS

Total 2014 AM(PM) Peak Hour Volumes

P:\3383.01 - Lloydminster Industrial Park\CAD\Exhibit 4-3.dwg

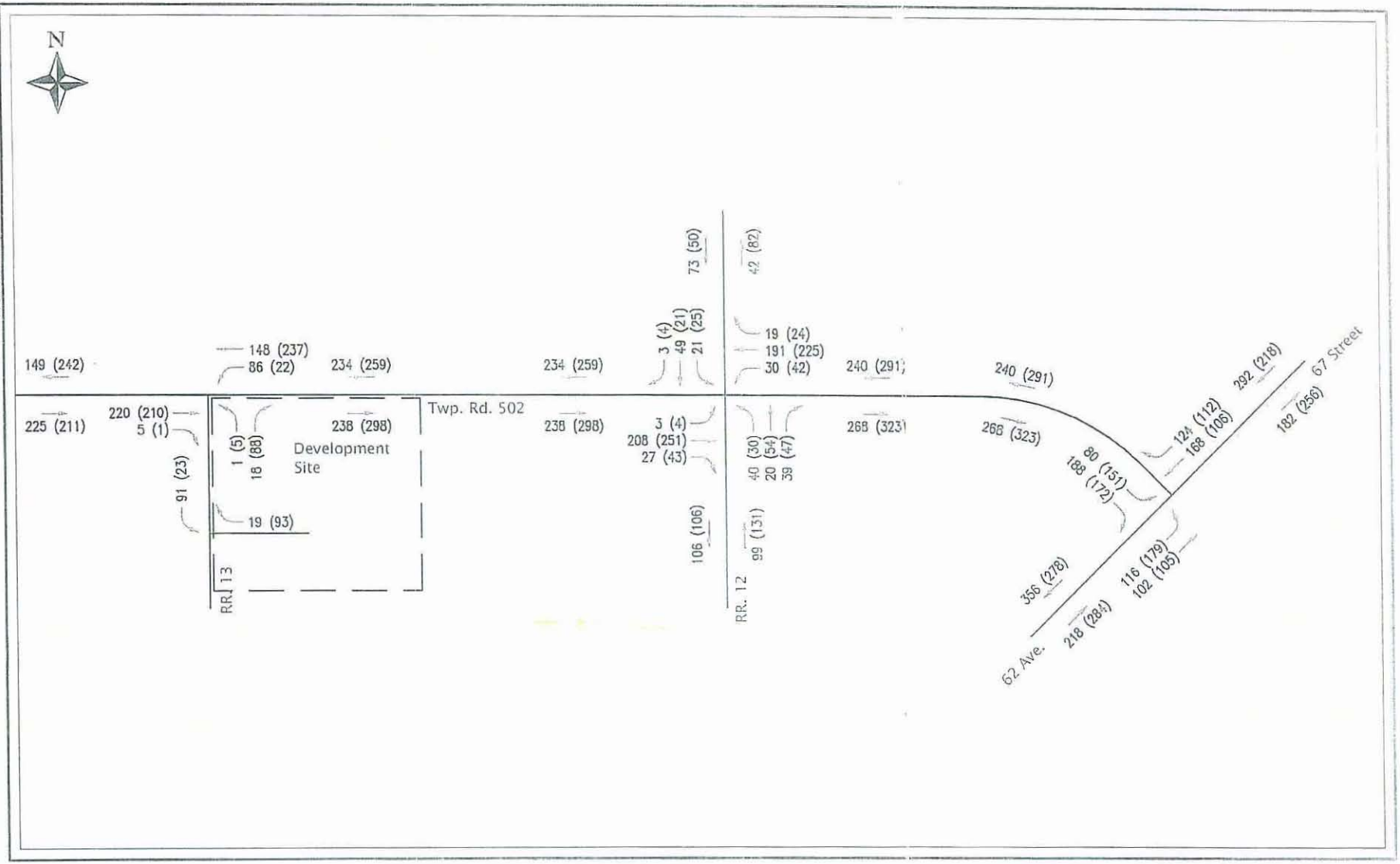


Exhibit 4-3

Scale NTS

Total 2034 AM(PM) Peak Hour Volumes

5. TRANSPORTATION ASSESSMENT

5.1 Analysis Methodology

The transportation assessment includes the following four components:

Traffic Signal Warrants

Signal warrant analyses were conducted for the Twp. Rd. 502/Range Road 12 (75 Avenue), and Twp. Rd. 502/62 Avenue intersections for all horizon years and also for the Twp. Rd. 502/Range Road 13 intersection under total traffic conditions. The methodology followed is outlined in the Transportation Association of Canada's (TAC) "Canadian Traffic Signal Warrant Matrix Procedure 2005" and the spreadsheets associated with the "Traffic Signal Warrant Handbook 2007" were used for calculations. The analyses identify whether traffic signals are anticipated to be required at the intersections in the future.

Capacity Analysis

To evaluate the traffic operating conditions during the peak periods of traffic activity, capacity assessments were completed based on the methods outlined in the Highway Capacity Manual 2000, using Synchro 7.0 analysis software. AM and PM peak hour intersection assessments were completed at the Twp. Rd. 502/ Range Rd. 12 (75 Avenue) and Twp. Rd. 502/62 Avenue intersections for background and total traffic conditions as well as at the Twp. Rd. 502/Range Rd. 13 intersection under total traffic conditions.

Lighting Analysis

Assessments were completed using the TAC Guide for the Design of Roadway Lighting, 2006, to determine if illumination is required at the study area intersections.

5.2 Signal Warrant Analysis

Signal warrant analyses were conducted for the study area intersections using TAC's "Canadian Traffic Signal Warrant Matrix Procedure 2005" and spreadsheets from the "Traffic Signal Warrant Handbook 2007". Appendix A contains a summary of the warrant calculation sheets for reference.

The TAC warrant matrix procedure uses 6 hours of traffic volume data: AM, midday, and PM, to determine the requirements for signalization. For future traffic scenarios, the ratios of the existing AM and PM peak hour data to the full two hour counts were used to adjust the projected AM and PM peak hour volumes to two hour volumes. The midday two-hour traffic volumes were estimated based on the ratio of the sum of the existing AM and PM peak hour volumes to the existing midday two-hour volumes.

At the Twp. Rd. 502/Range Road 12 (75 Avenue) intersection where AM data was unavailable, the ratio of total existing PM two hour volume to the total PM peak hour volume was applied to AM projections and the ratio of midday two hour volumes to the existing PM peak hour volumes was applied to generate

projected two hour volumes. At the Twp. Rd. 502/Range Rd. 13 intersection, the factors applied to the west leg of the Twp. Rd. 502/Range Rd. 12 (75 Avenue) were used to project two hour volumes.

The results of the signal warrant analysis for the study area intersections are summarized in Table 5-1. When an analysis score is higher than 100, traffic signalization is warranted at the intersection.

Table 5-1: Summary of Signal Warrant Analysis

Scenario	Twp. Rd. 502 & Range Road 13		Twp. Rd. 502 & Range Road 12		Twp. Rd. 502 & 62 Avenue	
	Warrant Score	Warranted?	Warrant Score	Warranted?	Warrant Score	Warranted?
2012 Existing	-	-	25	No	15	No
2014 Background	-	-	29	No	17	No
2014 Total	10	No	40	No	25	No
2034 Background	-	-	57	No	34	No
2034 Total	15	No	73	No	45	No

As shown in Table 5-1, traffic signal control is not anticipated to be warranted at any of the study area intersections under the traffic conditions assumed.

5.3 Capacity Assessment

The capacity analysis is based on the methods outlined in the Highway Capacity Manual 2000, using SYNCHRO 7.0 analysis software. Detailed Synchro printouts are included in Appendix B.

Intersection operations are typically rated by two measures. The volume-to-capacity (V/C) ratio describes the extent to which the traffic volumes can be accommodated by the physical capacity of the road configuration and signal control. A value (measured during the peak hour) less than 0.90 indicates that generally, there is sufficient capacity and projected traffic volumes can be accommodated at the intersection. A value between 0.90 and 1.0 suggests unstable operations may occur and volumes are nearing capacity conditions. A calculated value over 1.0 indicates that traffic volumes are theoretically exceeding capacity. The second measure of performance, Level of Service (LOS), is based on the estimated average delay per vehicle among all traffic passing through the intersection. A low average delay merits a LOS A rating. Average delays greater than 80 seconds per vehicle generally produce a LOS F rating for signalized intersections, while average delays greater than 50 seconds per vehicle generally produce a LOS F rating for unsignalized intersections.

The methodology includes a number of assumptions that relate to the operating conditions present at the intersections. The following assumptions were used in the analysis.

- Peak Hour Factor – As per existing counts, or 0.92 where unavailable
- Background % Heavy Vehicles – existing % heavy vehicles or, when unknown, % heavy vehicles balanced back from nearest intersection
- Total % Heavy Vehicles – calculated from existing % heavy vehicles and site generated heavy vehicles

Twp. Rd. 502 and Range Rd. 13

The Twp. Rd. 502/Range Rd. 13 intersection is anticipated to remain an unsignalized intersection in the long term horizon with one lane provided on each approach to accommodate all movements.

Table 5-2 presents the results of the assessments completed for the Twp. Rd. 502/Range Rd. 13 intersection. As shown in Table 5-2, the intersection is anticipated to operate very well as an unsignalized intersection with the addition of site generated traffic in both the 2014 and 2034 horizons. No geometry or traffic control modifications have been identified as a result of the capacity analyses.

Table 5-2: Twp. Rd. 502 and Range Rd. 13 – AM and PM Peak Hour 2034 Analysis

	Eastbound		Westbound		Northbound	
Movement	T	R	L	T	R	L
Geometry	TR		LT		LR	
AM Peak Hour – 2014 Total – Unsignalized (NB Stop Control)						
Volume (vph)	157	5	86	106	1	18
v/c	0.10		0.08		0.03	
Delay (s)	0.0		4.3		10.3	
LOS	A		A		B	
95th Queue (m)	0		2		1	
AM Peak Hour – 2034 Total – Unsignalized (NB Stop Control)						
Volume (vph)	220	5	86	148	1	18
v/c	0.14		0.09		0.03	
Delay (s)	0.0		3.8		10.8	
LOS	A		A		B	
95th Queue (m)	0		2		1	
PM Peak Hour – 2014 Total – Unsignalized (NB Stop Control)						
Volume (vph)	150	1	22	169	5	88
v/c	0.10		0.02		0.14	
Delay (s)	0.0		1.1		10.8	
LOS	A		A		B	
95th Queue (m)	0		1		4	
PM Peak Hour – 2034 Total – Unsignalized (NB Stop Control)						
Volume (vph)	210	1	22	237	5	88
v/c	0.13		0.02		0.15	
Delay (s)	0.0		0.9		11.5	
LOS	A		A		B	
95th Queue (m)	0		1		4	

Twp. Rd. 502 and Range Rd. 12

As noted previously, the Twp. Rd. 502/Range Rd. 12 (75 Avenue) intersection currently includes one lane on each approach to accommodate all movements with stop control on the north and south approaches.

Tables 5-3 through 5-5 present the results of the assessments completed for the Highway 16/Range Road 14 intersection for the AM and PM peak hours.

Table 5-3: Twp. Rd. 502 and Range Rd. 12 – AM Peak Hour 2012 and 2014 Analyses

	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Geometry	LTR			LTR			LTR			LTR		
2012 Existing – Unsignalized (N/S Stop Control)												
Volume (vph)	2	128	17	20	76	13	21	13	26	14	33	2
v/c	0.00			0.02			0.10			0.09		
Delay (s)	0.1			1.5			10.9			11.6		
LOS	A			A			B			B		
95th Queue (m)	0			0			2			2		
2014 Background – Unsignalized (N/S Stop Control)												
Volume (vph)	2	137	18	21	82	14	22	14	28	15	35	2
v/c	0.00			0.02			0.11			0.10		
Delay (s)	0.1			1.5			11.1			11.9		
LOS	A			A			B			B		
95th Queue (m)	0			0			3			2		
2014 Total – Unsignalized (N/S Stop Control)												
Volume (vph)	2	153	20	21	159	14	31	14	28	15	35	2
v/c	0.00			0.02			0.14			0.11		
Delay (s)	0.1			1.0			12.4			13.0		
LOS	A			A			B			B		
95th Queue (m)	0			0			4			3		

Table 5-4: Twp. Rd. 502 and Range Rd. 12 – PM Peak Hour 2012 and 2014 Analyses

	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Geometry	LTR			LTR			LTR			LTR		
2012 Existing – Unsignalized (N/S Stop Control)												
Volume (vph)	2	115	23	28	137	16	19	36	31	17	14	2
v/c	0.00			0.04			0.25			0.16		
Delay (s)	0.2			1.7			14.1			15.5		
LOS	A			A			B			C		
95th Queue (m)	0			1			7			4		
2014 Background – Unsignalized (N/S Stop Control)												
Volume (vph)	2	123	25	30	147	17	20	39	33	18	15	2
v/c	0.00			0.04			0.28			0.18		
Delay (s)	0.2			1.7			14.9			16.5		
LOS	A			A			B			C		
95th Queue (m)	0			1			9			5		
2014 Total – Unsignalized (N/S Stop Control)												
Volume (vph)	2	202	34	30	167	17	22	39	33	18	15	2
v/c	0.00			0.05			0.35			0.22		
Delay (s)	0.1			1.7			18.4			20.0		
LOS	A			A			C			C		
95th Queue (m)	0			1			12			6		

As presented in Tables 5-3 and 5-4, the Twp. Rd. 502/Range Rd. 12 intersection is anticipated to operate at acceptable levels of service under short term traffic conditions.

Table 5-5: Twp. Rd. 502 and Range Rd. 12 – AM and PM Peak Hour 2034 Analysis

	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Geometry	LTR			LTR			LTR			LTR		
AM Peak Hour – 2034 Background – Unsignalized (N/S Stop Control)												
Volume (vph)	3	192	25	30	114	19	31	20	39	21	49	3
v/c	0.00			0.03			0.18			0.17		
Delay (s)	0.1			1.6			12.9			14.0		
LOS	A			A			B			B		
95th Queue (m)	0			1			5			5		
AM Peak Hour – 2034 Total – Unsignalized (N/S Stop Control)												
Volume (vph)	3	208	27	30	191	19	40	20	39	21	49	3
v/c	0.00			0.03			0.23			0.19		
Delay (s)	0.1			1.2			14.9			15.8		
LOS	A			A			B			C		
95th Queue (m)	0			1			7			5		
PM Peak Hour – 2034 Background – Unsignalized (N/S Stop Control)												
Volume (vph)	4	172	34	42	205	24	28	54	47	25	21	4
v/c	0.01			0.06			0.53			0.38		
Delay (s)	0.3			2.0			25.2			27.9		
LOS	A			A			D			D		
95th Queue (m)	0			2			23			13.1		
PM Peak Hour – 2034 Total – Unsignalized (N/S Stop Control)												
Volume (vph)	4	251	43	42	225	24	30	54	47	25	21	4
v/c	0.01			0.07			0.67			0.49		
Delay (s)	0.2			2.1			38.9			39.1		
LOS	A			A			E			E		
95th Queue (m)	0			2			34			18.2		

As shown in Table 5-5, the Twp. Rd. 502/Range Rd. 12 intersection is anticipated to operate at acceptable levels of service as an unsignalized intersection in the 2034 horizon, under both background and total traffic conditions.

The level of service (LOS) on the north and south stop controlled approaches during the PM peak is anticipated to operate at LOS D under background conditions and at LOS E under total 2034 traffic conditions as a result of delay due to increased traffic volumes. The v/c ratios for both the north and south approaches remain below 0.7 and 0.5 respectively, indicating that capacity is anticipated to continue to exist at the intersection. It is also of note that conservative peak hour factors have been continued to be assumed in the long term horizon. No geometry or traffic control modifications have been identified as a result of the capacity analyses completed.

Twp. Rd. 502 and 62 Avenue

The Twp. Rd. 502/62 Avenue intersection is anticipated to remain an unsignalized intersection in the long term horizon. The following existing geometry has been assumed in the intersection analyses:

- *West Approach (62 Avenue)* - one left lane turn bay, one through lane;
- *East Approach (67 Street)* - one shared right/through lane; and,
- *North Approach (Twp. Rd. 502)* - one left turn lane, one right lane.

Tables 5-6 through 5-8 present the results of the assessments completed for the Twp. Rd. 502 and 62 Avenue intersection.

Table 5-6: Twp. Rd. 502 and 62 Avenue - AM Peak Hour 2012 and 2014 Analyses

	Eastbound		Westbound		Southbound	
Movement	L	T	T	R	L	R
Geometry	L/T		TR		L/R	
2012 Background - Unsignalized (SB Stop Control)						
Volume (vph)	50	68	112	59	49	119
v/c	0.06		0.11		0.19	
Delay (s)	8.1		0.0		10.9	
LOS	A		A		B	
95th Queue (m)	2		0		5	
2014 Background - Unsignalized (SB Stop Control)						
Volume (vph)	54	73	120	63	52	128
v/c	0.07		0.12		0.21	
Delay (s)	8.1		0.0		11.2	
LOS	A		A		B	
95th Queue (m)	2		0		6	
2014 Total - Unsignalized (SB Stop Control)						
Volume (vph)	95	73	120	99	59	137
v/c	0.13		0.14		0.23	
Delay (s)	8.7		0.0		12.6	
LOS	A		A		B	
95th Queue (m)	3		0		7	

Table 5-7: Twp. Rd. 502 and 62 Avenue – PM Peak Hour 2012 and 2014 Analyses

	Eastbound		Westbound		Southbound	
Movement	L	T	T	R	L	R
Geometry	L/T		TR		L/R	
2012 Existing – Unsignalized (SB Stop Control)						
Volume (vph)	113	70	71	68	76	87
v/c	0.12		0.09		0.18	
Delay (s)	7.9		0.0		11.6	
LOS	A		A		B	
95th Queue (m)	3		0		5	
2014 Background – Unsignalized (SB Stop Control)						
Volume (vph)	121	75	76	73	81	93
v/c	0.12		0.10		0.20	
Delay (s)	8.0		0.0		12.0	
LOS	A		A		B	
95th Queue (m)	3		0		6	
2014 Total – Unsignalized (SB Stop Control)						
Volume (vph)	131	75	76	83	118	135
v/c	0.14		0.10		0.33	
Delay (s)	8.1		0.0		13.8	
LOS	A		A		B	
95th Queue (m)	4		0		11	

Table 5-8: Twp. Rd. 502 and 62 Avenue - AM and PM Peak Hour 2034 Analysis

	Eastbound		Westbound		Southbound	
Movement	L	T	T	R	L	R
Geometry	L/T		TR		L/R	
AM Peak Hour - 2034 Background - Unsignalized (SB Stop Control)						
Volume (vph)	75	102	168	88	73	179
v/c	0.10		0.16		0.32	
Delay (s)	8.5		2.2		13.3	
LOS	A		A		B	
95th Queue (m)	3		0		11	
AM Peak Hour - 2034 Total - Unsignalized (SB Stop Control)						
Volume (vph)	95	73	120	99	59	137
v/c	0.13		0.14		0.23	
Delay (s)	8.7		0.0		12.6	
LOS	A		A		B	
95th Queue (m)	4		0		7	
PM Peak Hour - 2034 Background - Unsignalized (SB Stop Control)						
Volume (vph)	169	105	106	102	114	130
v/c	0.18		0.14		0.40	
Delay (s)	8.4		0.0		16.3	
LOS	A		A		C	
95th Queue (m)	5		0		15	
PM Peak Hour - 2034 Total - Unsignalized (SB Stop Control)						
Volume (vph)	179	105	106	112	151	172
v/c	0.20		0.14		0.61	
Delay (s)	8.6		0.0		22.0	
LOS	A		A		C	
95th Queue (m)	6		0		31	

As shown in the above tables, the Twp. Rd. 502/62 Avenue intersection is anticipated to operate at acceptable levels of service with the addition of site generated traffic in both the 2014 and 2034 horizons.

No geometry or traffic control modifications have been identified as a result of the capacity analyses.

5.4 Lighting Assessment

The lighting assessment is based on TAC's Guide for the Design of Roadway Lighting (2006) using available geometric, operational, and environmental factors. Calculation spreadsheets for the street lighting assessment are included in Appendix C. Illumination warrants were completed for the Twp. Rd. 502/Range Rd. 12 intersection under background and total traffic conditions as well as at the Twp. Rd. 502/Range Rd. 13 intersection under total traffic conditions. The Twp. Rd. 502/62 Avenue is currently fully illuminated.

Table 5-9 presents the warrant scores for the illumination assessment completed. A warrant score of 120 identifies that intersection illumination is warranted.

Table 5-9: Summary of Lighting Assessment

Intersection	2012 Existing	2014 Background	2014 Total	2034 Background	2034 Total	Illumination Warranted?
Twp. Rd. 502 and Range Rd. 12	66	66	66	96	126	Yes
Twp. Rd. 502 and Range Rd. 13	N/A	N/A	18	N/A	18	No

As shown in Table 5-9, illumination is not anticipated to be warranted at the Twp. Rd. 502 and Range Rd. 13 intersection under the traffic conditions assessed. At the Twp. Rd. 502 and Range Rd. 12 intersection delineation lighting is anticipated to be warranted under the 2034 total traffic conditions assessed in order to illuminate cross street traffic. Because the warrant score of 126 just exceeds the threshold for lighting and is based on long term projections, it is recommended that this intersection be evaluated as development occurs in the area to confirm projected growth and conditions.

6. CONCLUSIONS AND RECOMMENDATIONS

This report documents the results of a comprehensive traffic impact assessment prepared for Sand Control Systems Ltd. Specifically, this report assesses and evaluates the traffic impacts associated with the proposed Industrial Subdivision in the County of Vermilion River.

6.1 Conclusions

Based on the analysis and assessment completed, it has been determined that the proposed development can be accommodated from a transportation perspective. The following summarizes the key results of the assessments completed.

6.1.1 Traffic Signal Warrants

A signal warrant analysis based on the TACs Canadian Traffic Signal Warrant Matrix Procedure 2005 was completed for the Twp. Rd. 502/Range Road 12 (75 Avenue), and Twp. Rd. 502/62 Avenue intersections for all horizon years and for the Twp. Rd. 502/Range Road 13 intersection under total traffic conditions. Traffic signal control is not anticipated to be warranted at any of the intersections within the 2034 horizon under either the background or total traffic volume scenarios assessed.

6.1.2 Capacity Analysis

To evaluate the traffic operating conditions during the peak periods of traffic activity, capacity assessments were completed based on the methods outlined in the Highway Capacity Manual 2000, using Synchro 7.0 analysis software. Based on the assessment completed, the traffic conditions at the study area intersections are anticipated to operate at acceptable levels of service. No geometry improvements were identified to accommodate site generated traffic.

6.1.3 Lighting Analysis

Assessments were completed at the Twp. Rd. 502/Range Rd. 12 (75 Avenue) and the Twp. Rd. 502/Range Rd. 13 intersections using the TAC Guide for the Design of Roadway Lighting, 2006. Based on the assessments completed, illumination is not anticipated to be warranted at the Twp. Rd. 502/Range Rd. 13 intersection. The Twp. Rd. 502/Range Rd. 12 (75 Avenue) may warrant delineation lighting within the 20 year long term horizon. However, it is recommended that this intersection be evaluated as development occurs in the area to confirm projected growth and conditions.

APPENDIX A

TAC Signal Warrant Summaries

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502	Direction (EW or NS)	EW	Road Authority:	County of Vermilion River
Side Street (name)	RR 13	Direction (EW or NS)	NS	City:	Lloydminster
Quadrant / Int #		Comments	2014 Total	Analysis Date:	2012 Apr 19, Thu
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			Count Date:	
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	Upstream Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 13	NB				1				
RR 13	SB								
Are the RR 13 NB right turns significantly impeded by through movements? (y/n)							n		

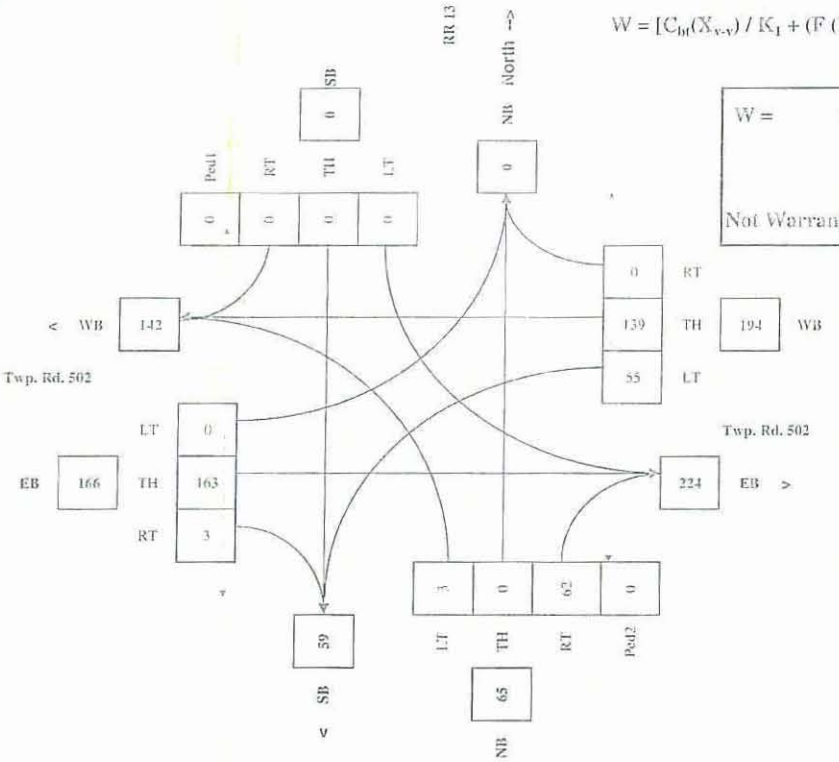
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	80	16.0%	n	
RR 13	NS		67.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS	NS	EW	EW
													W Side	E Side	N Side	S Side
7:00 - 8:00	2	0	32	0	0	0	156	192	0	0	268	9	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	8	0	182	0	0	0	138	352	0	0	436	9	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	9	0	155	0	0	0	38	289	0	0	272	2	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	19	0	369	0	0	0	332	833	0	0	976	20	0	0	0	0
Average (6-hour peak)	3	0	62	0	0	0	55	139	0	0	163	3	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	10	10	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502	Direction (EW or NS)	EW
Side Street (name)	RR 13	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2034 Total
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 13	NB				1				
RR 13	SB								
Are the RR 13 NB 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	(#)	31,000
Central Business District	(y/n)	n

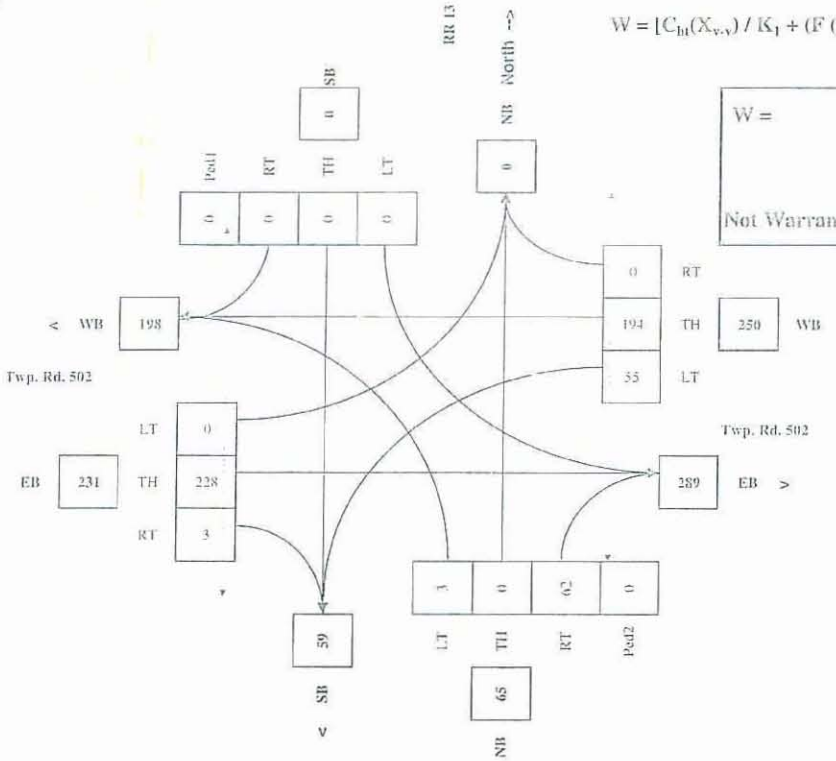
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	80	16.0%	n	
RR 13	NS		67.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	2	0	32	0	0	0	156	268	0	0	376	9	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	8	0	182	0	0	0	138	493	0	0	611	9	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	9	0	155	0	0	0	38	405	0	0	380	2	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	19	0	369	0	0	0	332	1,166	0	0	1,367	20	0	0	0	0
Average (6-hour peak)	3	0	62	0	0	0	55	194	0	0	228	3	0	0	0	0

Average 6-hour Peak Turning Movements

$$W = [C_{bl}(X_{v.v}) / K_1 + (F(X_{v.p}) L) / K_2] \times C_i$$



W =	15	15	0
		Veh	*Ped*

Not Warranted - Vs<75

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502
Side Street (name)	RR 12
Quadrant / Int #	
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET
Direction (EW or NS)	EW
Direction (EW or NS)	NS
Comments	2012 Existing
Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 12	NB				1				
RR 12	SB				1				

Are the RR 12 NB right turns significantly impeded by through movements? (y/n)	n	
Are the RR 12 SB right turns significantly impeded by through movements? (y/n)	n	

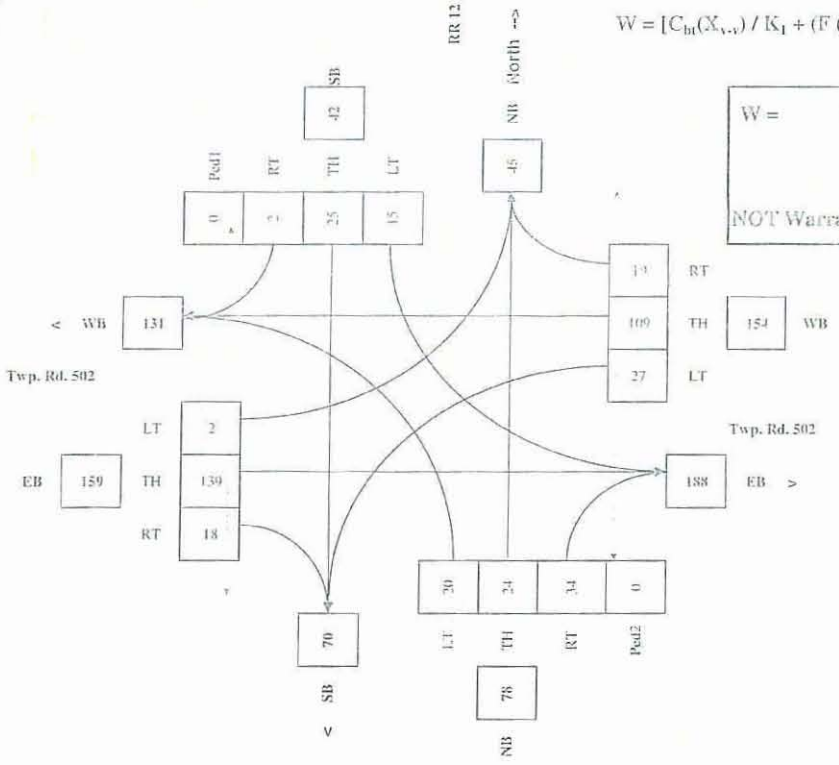
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	80	17.0%	n	
RR 12	NS		8.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1	Ped2	Ped3	Ped4
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	NS W Side	NS E Side	EW N Side	EW S Side
7:00 - 8:00	39	24	48	26	61	4	37	141	24	4	237	31	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	50	61	98	37	58	6	48	373	37	4	396	32	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	31	61	57	29	30	3	75	237	50	2	302	47	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	120	146	203	92	149	13	160	651	111	10	935	110	0	0	0	0
Average (6-hour peak)	20	24	34	15	25	2	27	109	19	2	139	18	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	25	25	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502	Direction (EW or NS)	EW
Side Street (name)	RR 12	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2014 Background
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 12	NB				1				
RR 12	SB				1				

Are the RR 12 NB right turns significantly impeded by through movements? (y/n)	n	
Are the RR 12 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	(#)	31,000
Central Business District	(y/n)	n

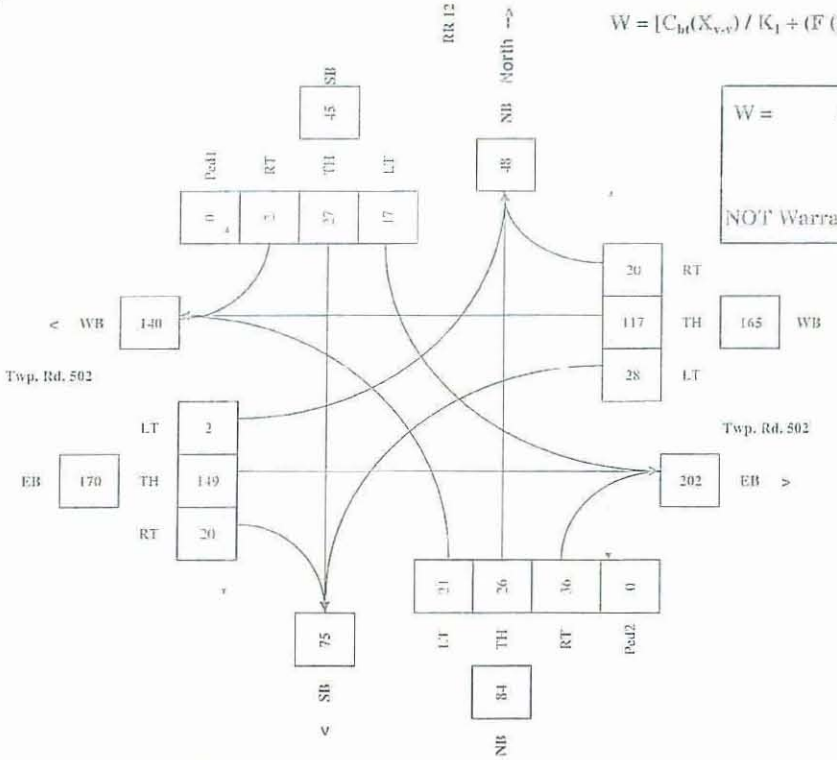
Other Input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	80	17.0%	n	
RR 12	NS		8.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	41	26	52	28	65	4	39	152	26	4	253	33	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	52	66	105	40	62	6	51	293	20	4	424	35	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	33	66	60	31	32	3	30	254	53	2	216	51	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	126	158	217	99	159	13	170	699	119	10	893	119	0	0	0	0
Average (6-hour peak)	21	26	36	17	27	2	28	117	20	2	149	20	0	0	0	0

Average 6-hour Peak Turning Movements

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



W =	29	29	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502	Direction (EW or NS)	EW
Side Street (name)	RR 12	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2014 Total
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th/RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 12	NB				1				
RR 12	SB				1				
Are the RR 12 NB right turns significantly impeded by through movements? (y/n)							n		
Are the RR 12 SB right turns significantly impeded by through movements? (y/n)							n		

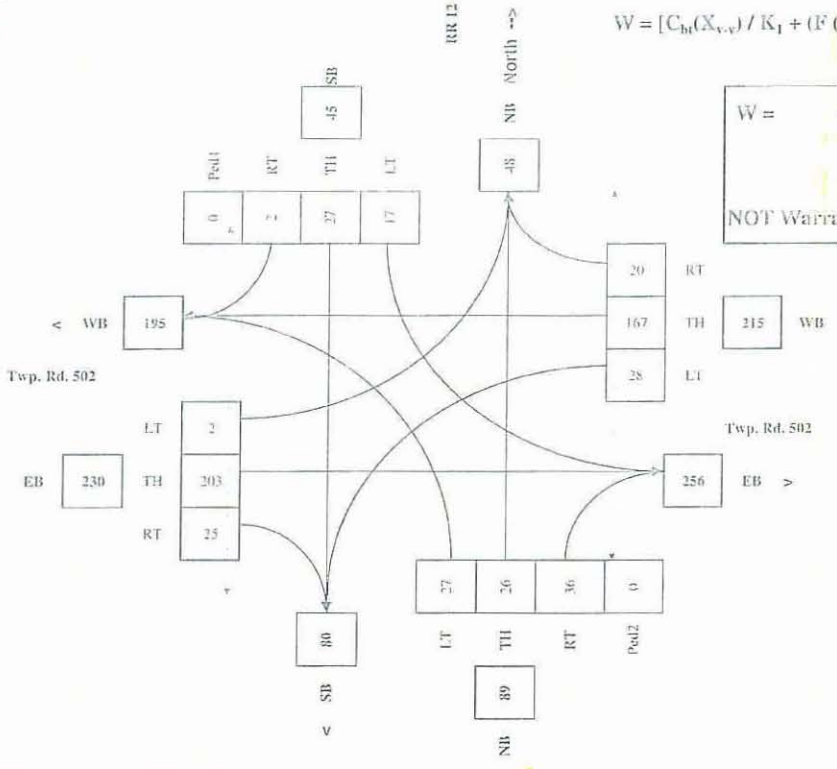
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	21,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	50	17.0%	n	
RR 12	NS		8.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	57	26	52	28	65	4	79	294	26	4	283	37	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	66	66	105	40	62	6	51	417	40	4	579	44	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	36	66	60	31	32	3	30	259	53	2	356	70	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	159	158	217	99	159	13	170	1,000	119	10	1,218	151	0	0	0	0
Average (6-hour peak)	27	26	36	17	27	2	28	167	20	2	203	25	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	40	40	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502	Direction (EW or NS)	EW
Side Street (name)	RR 12	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2034 Background

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 12	NB				1				
RR 12	SB				1				

Are the RR 12 NB right turns significantly impeded by through movements? (y/n) n

Are the RR 12 SB right turns significantly impeded by through movements? (y/n) n

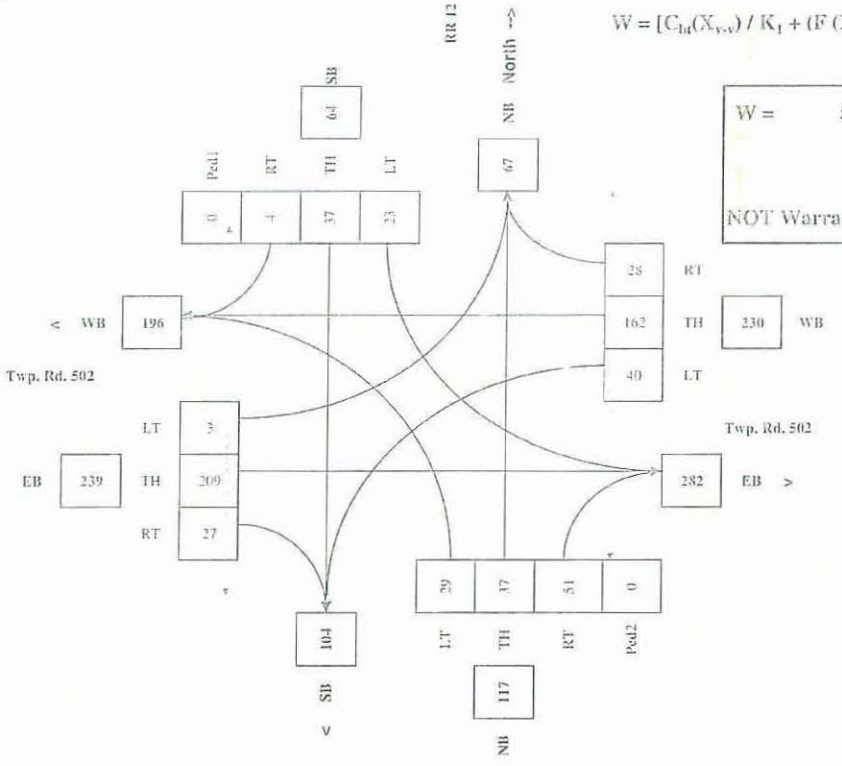
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	80	17.0%	n	
RR 12	NS		8.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS W Side	Ped2 NS E Side	Ped3 EW N Side	Ped4 EW S Side
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT				
7:00 - 8:00	57	37	72	39	91	6	96	211	35	6	355	46	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	73	92	148	55	86	11	72	408	55	7	593	48	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	46	92	86	43	45	6	112	353	75	4	303	70	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	176	221	306	137	222	23	240	974	165	17	1,251	164	0	0	0	0
Average (6-hour peak)	29	37	51	23	37	4	40	162	28	3	209	27	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	57	57	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	Twp. Rd. 502	Direction (EW or NS)	EW
Side Street (name)	RR 12	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2034 Total
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	Up/Station Signal (m)	# of Thru Lanes
Twp. Rd. 502	WB				1			2,500	1
Twp. Rd. 502	EB				1			2,500	1
RR 12	NB				1				
RR 12	SB				1				
Are the RR 12 NB right turns significantly impeded by through movements? (y/n)							n		
Are the RR 12 SB right turns significantly impeded by through movements? (y/n)							n		

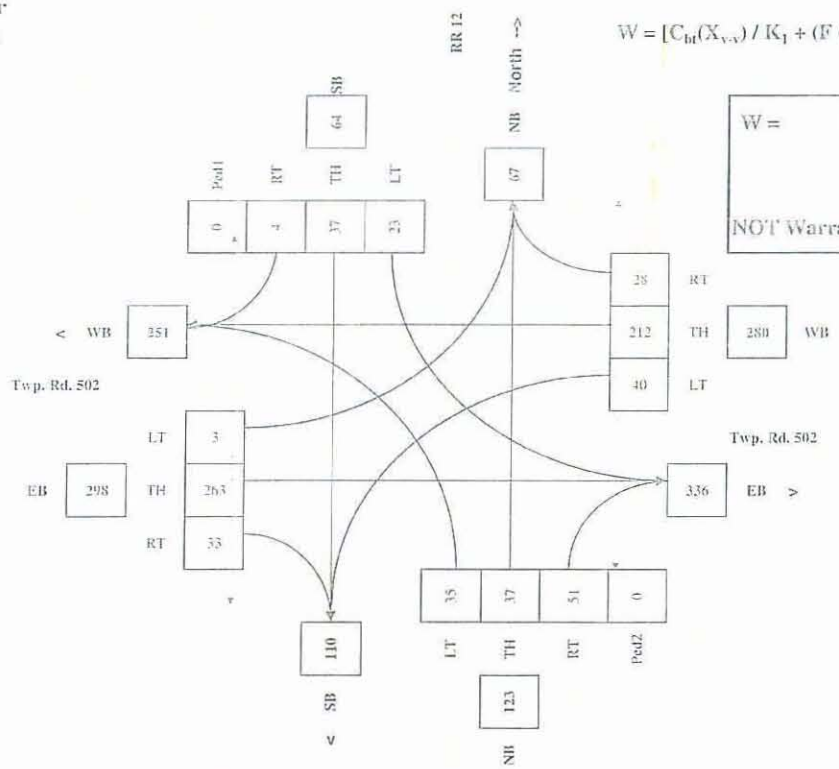
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Twp. Rd. 502	EW	80	17.0%	n	
RR 12	NS		8.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS W Side	Ped2 NS E Side	Ped3 EW N Side	Ped4 EW S Side
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT				
7:00 - 8:00	74	37	72	39	91	6	56	353	35	6	385	50	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	87	92	148	55	86	11	72	532	55	7	748	57	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	50	92	86	43	45	6	112	389	75	4	442	88	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	211	221	306	137	222	23	340	1,274	165	17	1,575	195	0	0	0	0
Average (6-hour peak)	35	37	51	23	37	4	40	212	28	3	263	33	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 =	73	73	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	62 Avenue	Direction (EW or NS)	EW
Side Street (name)	Twp Rd 502	Direction (EW or NS)	NS
Qnadrant / Int #		Comments	2012 Existing
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th-RT-LT	Th & RT	Excl RT	Upstream Signal (m)	# of Thru Lanes
62 Avenue	WB				1			2,500	1
62 Avenue	EB	1		1				2,500	1
Twp Rd 502	NB								
Twp Rd 502	SB	1					1		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

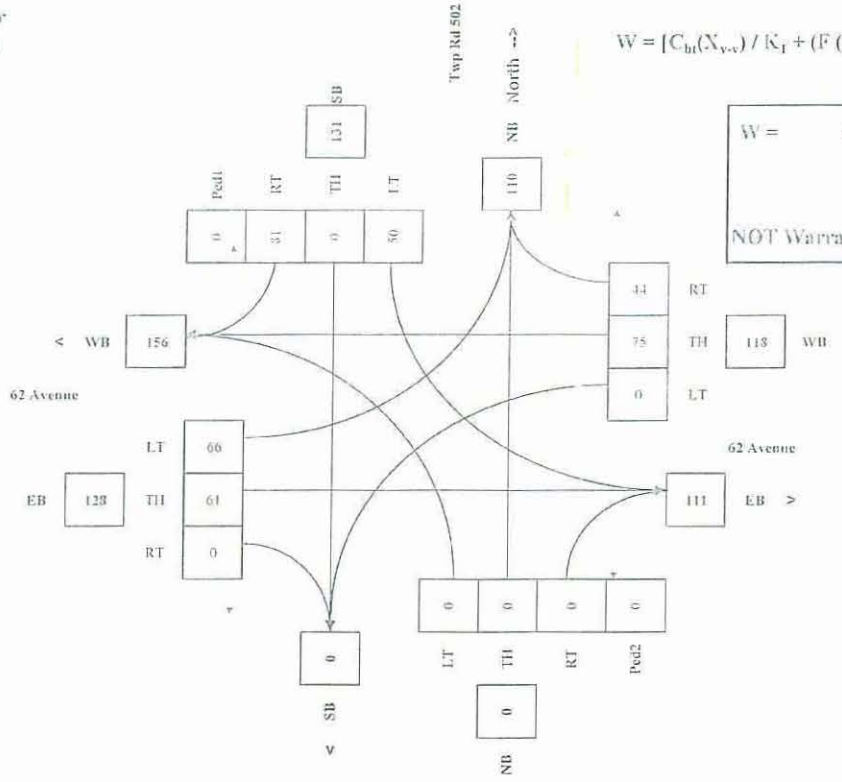
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
62 Avenue	EW	80	21.0%	n	
Twp Rd 502	NS		18.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0	0	90	0	165	0	169	32	96	131	0	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	0	0	0	84	0	140	0	114	65	119	103	0	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	0	0	0	123	0	161	0	163	115	183	153	0	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	0	0	0	297	0	486	0	448	262	398	367	0	0	0	0	0
Average (6-hour peak)	0	0	0	50	0	81	0	75	44	66	61	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 =	15	15	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	62 Avenue	Direction (EW or NS)	EW
Side Street (name)	Twp. Rd. 502	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2014 Background
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th/RT/LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
62 Avenue	WB				1			2,500	1
62 Avenue	EB	1		1				2,500	1
Twp. Rd. 502	NB								
Twp. Rd. 502	SB	1					1		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

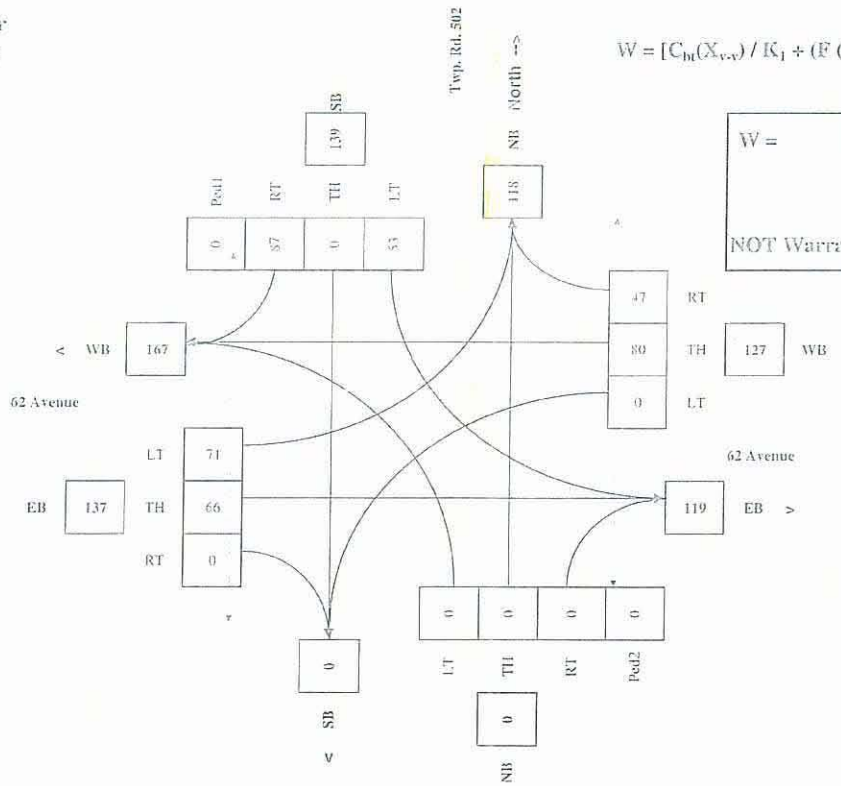
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
62 Avenue	EW	80	21.0%	n	
Twp. Rd. 502	NS		18.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0	0	96	0	198	0	181	88	101	141	0	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	0	0	0	89	0	150	0	122	69	128	111	0	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	0	0	0	131	0	172	0	176	123	196	143	0	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	0	0	0	316	0	520	0	479	280	428	395	0	0	0	0	0
Average (6-hour peak)	0	0	0	53	0	87	0	80	47	71	66	0	0	0	0	0

Average 6-hour Peak Turning Movements

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



W =	17	17	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	62 Avenue	Direction (EW or NS)	EW
Side Street (name)	Twp. Rd. 502	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2014 Total
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET		

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
62 Avenue	WB				1			2,500	1
62 Avenue	EB	1		1				2,500	1
Twp. Rd. 502	NB								
Twp. Rd. 502	SB	1					1		

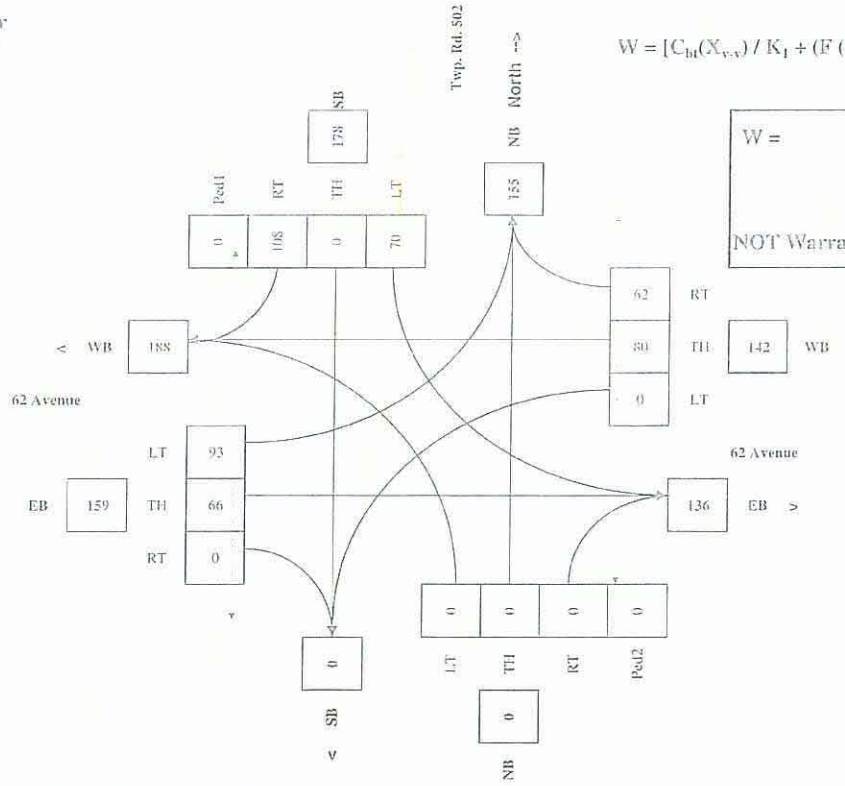
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (v/h)	Median (m)
62 Avenue	EW	80	21.0%	n	
Twp. Rd. 502	NS		18.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0	0	109	0	212	0	181	138	182	141	0	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	0	0	0	119	0	185	0	122	93	165	111	0	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	0	0	0	191	0	250	0	176	140	212	143	0	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	0	0	0	419	0	647	0	479	371	559	395	0	0	0	0	0
Average (6-hour peak)	0	0	0	70	0	108	0	80	62	93	66	0	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	25	25	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	62 Avenue	Direction (EW or NS)	EW
Side Street (name)	Twp. Rd. 502	Direction (EW or NS)	NS
Quadrant / Int #		Comments	2034 Background

for Warrant Calculation Results, please hit 'Page Down'

CHECK SHEET

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	Upstream Signal (m)	# of Thru Lanes
62 Avenue	WB				1			2,500	1
62 Avenue	EB	1		1				2,500	1
Twp. Rd. 502	NB								
Twp. Rd. 502	SB	1					1		

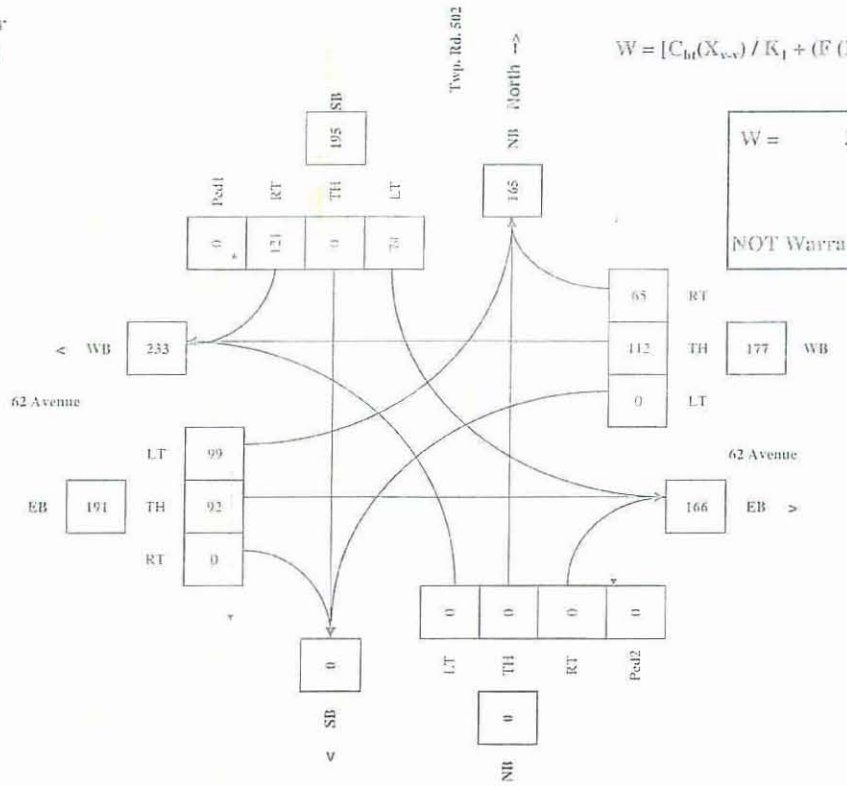
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
62 Avenue	EW	80	21.0%	n	
Twp. Rd. 502	NS		18.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0	0	134	0	277	0	254	122	144	197	0	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	0	0	0	125	0	210	0	170	97	178	155	0	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	0	0	0	185	0	241	0	246	172	274	200	0	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	0	0	0	444	0	728	0	670	391	596	552	0	0	0	0	0
Average (6-hour peak)	0	0	0	74	0	121	0	112	65	99	92	0	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	34	34	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

County of Vermilion River - Traffic Signal Warrant Analysis

Main Street (name)	62 Avenue
Side Street (name)	Twp. Rd. 502
Quadrant / Int #	
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET

Direction (EW or NS)	EW
Direction (EW or NS)	NS
Comments	2034 Total

Road Authority:	County of Vermilion River
City:	Lloydminster
Analysis Date:	2012 Apr 19, Thu
Count Date:	
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	Upstream Signal (m)	# of Thru Lanes
62 Avenue	WB				1			2,500	1
62 Avenue	EB	1		1				2,500	1
Twp. Rd. 502	NB								
Twp. Rd. 502	SB	1					1		

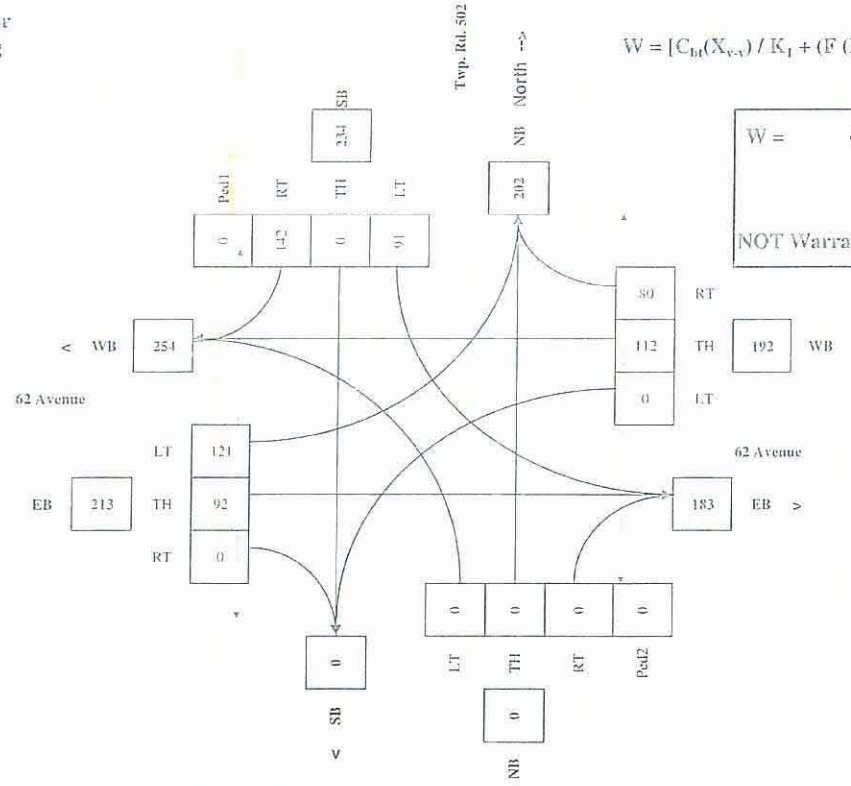
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	31,088
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
62 Avenue	EW	80	21.0%	n	
Twp. Rd. 502	NS		18.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	0	0	0	147	0	291	0	254	172	223	197	0	0	0	0	0
8:00 - 9:00													0	0	0	0
11:30 - 12:30	0	0	0	155	0	245	0	170	120	215	155	0	0	0	0	0
12:30 - 13:30													0	0	0	0
16:00 - 17:00	0	0	0	245	0	318	0	246	189	290	200	0	0	0	0	0
17:00 - 18:00													0	0	0	0
Total (6-hour peak)	0	0	0	547	0	854	0	670	481	728	552	0	0	0	0	0
Average (6-hour peak)	0	0	0	91	0	142	0	112	80	121	92	0	0	0	0	0

Average 6-hour Peak Turning Movements



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

W =	45	45	0
		Veh	*Ped*

NOT Warranted

RESET SHEET

APPENDIX B

Synchro Assessment Summaries

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	220	5	86	148	1	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	239	5	93	161	1	20
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			245		590	242
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			245		590	242
tC, single (s)			4.7		7.0	6.8
tC, 2 stage (s)						
tF (s)			2.8		4.1	3.9
p0 queue free %			91		100	97
cM capacity (veh/h)			1035		349	668

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	245	254	21
Volume Left	0	93	1
Volume Right	5	0	20
cSH	1700	1035	637
Volume to Capacity	0.14	0.09	0.03
Queue Length 95th (m)	0.0	2.3	0.8
Control Delay (s)	0.0	3.8	10.8
Lane LOS		A	B
Approach Delay (s)	0.0	3.8	10.8
Approach LOS			B

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	150	1	22	169	5	88
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	163	1	24	184	5	96
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			164		395	164
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			164		395	164
tC, single (s)			4.7		7.0	6.8
tC, 2 stage (s)						
tF (s)			2.8		4.1	3.9
p0 queue free %			98		99	87
cM capacity (veh/h)			1116		496	744

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	164	208	101
Volume Left	0	24	5
Volume Right	1	0	96
cSH	1700	1116	725
Volume to Capacity	0.10	0.02	0.14
Queue Length 95th (m)	0.0	0.5	3.7
Control Delay (s)	0.0	1.1	10.8
Lane LOS		A	B
Approach Delay (s)	0.0	1.1	10.8
Approach LOS			B

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	35.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	210	1	22	237	5	88
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	228	1	24	258	5	96
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			229		534	229
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			229		534	229
tC, single (s)			4.7		7.0	6.8
tC, 2 stage (s)						
tF (s)			2.8		4.1	3.9
p0 queue free %			98		99	86
cM capacity (veh/h)			1050		406	680

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	229	282	101
Volume Left	0	24	5
Volume Right	1	0	96
cSH	1700	1050	656
Volume to Capacity	0.13	0.02	0.15
Queue Length 95th (m)	0.0	0.5	4.1
Control Delay (s)	0.0	0.9	11.5
Lane LOS		A	B
Approach Delay (s)	0.0	0.9	11.5
Approach LOS			B

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	42.2%	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)	2	128	17	20	76	13	21	13	26	14	33	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	139	18	22	83	14	23	14	28	15	36	2
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	97			158			306	293	148	321	295	90
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	97			158			306	293	148	321	295	90
tC, single (s)	4.1			4.2			7.1	6.5	6.7	7.2	6.6	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.8	3.6	4.1	3.3
p0 queue free %	100			98			96	98	96	97	94	100
cM capacity (veh/h)	1509			1369			611	611	786	569	599	974

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	160	118	65	53
Volume Left	2	22	23	15
Volume Right	18	14	28	2
cSH	1509	1369	676	600
Volume to Capacity	0.00	0.02	0.10	0.09
Queue Length 95th (m)	0.0	0.4	2.4	2.2
Control Delay (s)	0.1	1.5	10.9	11.6
Lane LOS	A	A	B	B
Approach Delay (s)	0.1	1.5	10.9	11.6
Approach LOS			B	B

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	29.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Twp. Rd. 502 & RR 12 (75 Ave)

5/1/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	137	18	21	82	14	22	14	28	15	35	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	149	20	23	89	15	24	15	30	16	38	2
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	104			168			327	313	159	343	315	97
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	104			168			327	313	159	343	315	97
tC, single (s)	4.1			4.2			7.1	6.5	6.7	7.2	6.6	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.8	3.6	4.1	3.3
p0 queue free %	100			98			96	97	96	97	93	100
cM capacity (veh/h)	1500			1356			589	594	775	547	583	965

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	171	127	70	57
Volume Left	2	23	24	16
Volume Right	20	15	30	2
cSH	1500	1356	660	581
Volume to Capacity	0.00	0.02	0.11	0.10
Queue Length 95th (m)	0.0	0.4	2.7	2.4
Control Delay (s)	0.1	1.5	11.1	11.9
Lane LOS	A	A	B	B
Approach Delay (s)	0.1	1.5	11.1	11.9
Approach LOS			B	B

Intersection Summary				
Average Delay	3.9			
Intersection Capacity Utilization	31.1%	ICU Level of Service	A	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
4: Twp. Rd. 502 & RR 12 (75 Ave)

5/1/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	153	20	21	159	14	31	14	28	15	35	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	166	22	23	173	15	34	15	30	16	38	2
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	188			188			429	415	177	435	418	180
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	188			188			429	415	177	435	418	180
tC, single (s)	4.1			4.2			7.3	6.5	6.7	7.2	6.6	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.7	4.0	3.8	3.6	4.1	3.3
p0 queue free %	100			98			93	97	96	97	93	100
cM capacity (veh/h)	1398			1334			473	521	756	473	510	867

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total	1	189	211	79	57
Volume Left	1	1	23	34	16
Volume Right	0	22	15	30	2
cSH	1398	1398	1334	564	506
Volume to Capacity	0.00	0.00	0.02	0.14	0.11
Queue Length 95th (m)	0.0	0.0	0.4	3.7	2.8
Control Delay (s)	7.6	0.0	1.0	12.4	13.0
Lane LOS	A	A	A	B	B
Approach Delay (s)	0.1		1.0	12.4	13.0
Approach LOS				B	B

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	36.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	123	25	30	147	17	20	39	33	18	15	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.50	0.84	0.75	0.60	0.65	0.88	0.42	0.82	0.75	0.50	0.54	0.50
Hourly flow rate (vph)	4	146	33	50	226	19	48	48	44	36	28	4
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	245			180			525	517	163	575	524	236
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	245			180			525	517	163	575	524	236
tC, single (s)	4.1			4.6			7.2	6.6	6.3	7.4	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.7			3.6	4.1	3.4	3.8	4.0	3.3
p0 queue free %	100			96			88	89	95	89	94	100
cM capacity (veh/h)	1332			1153			409	436	859	327	440	808

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	184	295	139	68
Volume Left	4	50	48	36
Volume Right	33	19	44	4
cSH	1332	1153	503	381
Volume to Capacity	0.00	0.04	0.28	0.18
Queue Length 95th (m)	0.1	1.0	8.5	4.9
Control Delay (s)	0.2	1.7	14.9	16.5
Lane LOS	A	A	B	C
Approach Delay (s)	0.2	1.7	14.9	16.5
Approach LOS			B	C

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	35.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Twp. Rd. 502 & RR 12 (75 Ave)

5/1/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	202	34	30	167	17	22	39	33	18	15	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.50	0.84	0.75	0.60	0.65	0.88	0.42	0.82	0.75	0.50	0.54	0.50
Hourly flow rate (vph)	4	240	45	50	257	19	52	48	44	36	28	4
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	276			286			656	647	263	706	660	267
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	276			286			656	647	263	706	660	267
tC, single (s)	4.1			4.6			7.3	6.6	6.3	7.4	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.7			3.7	4.1	3.4	3.8	4.0	3.3
p0 queue free %	100			95			84	87	94	86	92	99
cM capacity (veh/h)	1298			1046			324	365	754	258	366	777

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	290	326	144	68
Volume Left	4	50	52	36
Volume Right	45	19	44	4
cSH	1298	1046	411	307
Volume to Capacity	0.00	0.05	0.35	0.22
Queue Length 95th (m)	0.1	1.1	11.8	6.3
Control Delay (s)	0.1	1.7	18.4	20.0
Lane LOS	A	A	C	C
Approach Delay (s)	0.1	1.7	18.4	20.0
Approach LOS			C	C

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	41.5%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Twp. Rd. 502 & RR 12 (75 Ave)

5/1/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	192	25	30	114	19	31	20	39	21	49	3
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	209	27	33	124	21	34	22	42	23	53	3
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	145			236			458	439	222	482	442	134
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	145			236			458	439	222	482	442	134
tC, single (s)	4.1			4.2			7.1	6.5	6.7	7.2	6.6	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.5	4.0	3.8	3.6	4.1	3.3
p0 queue free %	100			97			93	96	94	95	89	100
cM capacity (veh/h)	1450			1280			462	501	711	423	490	920

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	239	177	98	79
Volume Left	3	33	34	23
Volume Right	27	21	42	3
cSH	1450	1280	556	478
Volume to Capacity	0.00	0.03	0.18	0.17
Queue Length 95th (m)	0.1	0.6	4.8	4.5
Control Delay (s)	0.1	1.6	12.9	14.0
Lane LOS	A	A	B	B
Approach Delay (s)	0.1	1.6	12.9	14.0
Approach LOS			B	B

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	39.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	3	208	27	30	191	19	40	20	39	21	49	3
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	226	29	33	208	21	43	22	42	23	53	3
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	228			255			560	541	241	584	545	218
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	228			255			560	541	241	584	545	218
tC, single (s)	4.1			4.2			7.3	6.5	6.7	7.2	6.6	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.3			3.7	4.0	3.8	3.6	4.1	3.3
p0 queue free %	100			97			88	95	94	94	88	100
cM capacity (veh/h)	1352			1259			366	438	693	359	428	827

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	259	261	108	79
Volume Left	3	33	43	23
Volume Right	29	21	42	3
cSH	1352	1259	469	413
Volume to Capacity	0.00	0.03	0.23	0.19
Queue Length 95th (m)	0.1	0.6	6.7	5.3
Control Delay (s)	0.1	1.2	14.9	15.8
Lane LOS	A	A	B	C
Approach Delay (s)	0.1	1.2	14.9	15.8
Approach LOS			B	C

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	46.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Twp. Rd. 502 & RR 12 (75 Ave)

5/1/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	172	34	42	205	24	28	54	47	25	21	4
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.50	0.84	0.75	0.60	0.65	0.88	0.42	0.82	0.75	0.50	0.54	0.50
Hourly flow rate (vph)	8	205	45	70	315	27	67	66	63	50	39	8
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	343			250			740	726	227	808	735	329
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	343			250			740	726	227	808	735	329
tC, single (s)	4.1			4.6			7.2	6.6	6.3	7.4	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.7			3.6	4.1	3.4	3.8	4.0	3.3
p0 queue free %	99			94			76	80	92	75	88	99
cM capacity (veh/h)	1228			1081			272	322	790	198	325	717

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	258	413	195	97
Volume Left	8	70	67	50
Volume Right	45	27	63	8
cSH	1228	1081	369	252
Volume to Capacity	0.01	0.06	0.53	0.38
Queue Length 95th (m)	0.1	1.6	22.5	13.1
Control Delay (s)	0.3	2.0	25.2	27.9
Lane LOS	A	A	D	D
Approach Delay (s)	0.3	2.0	25.2	27.9
Approach LOS			D	D

Intersection Summary			
Average Delay	8.9		
Intersection Capacity Utilization	45.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Twp. Rd. 502 & RR 12 (75 Ave)

5/1/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	4	251	43	42	225	24	30	54	47	25	21	4
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.50	0.84	0.75	0.60	0.65	0.88	0.42	0.82	0.75	0.50	0.54	0.50
Hourly flow rate (vph)	8	299	57	70	346	27	71	66	63	50	39	8
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	373			356			871	857	327	939	872	360
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	373			356			871	857	327	939	872	360
tC, single (s)	4.1			4.6			7.3	6.6	6.3	7.4	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.7			3.7	4.1	3.4	3.8	4.0	3.3
p0 queue free %	99			93			66	75	91	67	86	99
cM capacity (veh/h)	1196			980			212	268	694	151	268	689

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	364	443	200	97
Volume Left	8	70	71	50
Volume Right	57	27	63	8
cSH	1196	980	297	199
Volume to Capacity	0.01	0.07	0.67	0.49
Queue Length 95th (m)	0.2	1.8	34.3	18.2
Control Delay (s)	0.2	2.1	38.9	39.1
Lane LOS	A	A	E	E
Approach Delay (s)	0.2	2.1	38.9	39.1
Approach LOS			E	E

Intersection Summary			
Average Delay	11.4		
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	50	68	112	59	49	119
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.81	0.97	0.87	0.77	0.71
Hourly flow rate (vph)	79	84	115	68	64	168
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	183				392	149
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	183				392	149
tC, single (s)	4.4				6.7	6.3
tC, 2 stage (s)						
tF (s)	2.5				3.8	3.4
p0 queue free %	94				88	81
cM capacity (veh/h)	1250				518	869

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	79	84	183	231
Volume Left	79	0	0	64
Volume Right	0	0	68	168
cSH	1250	1700	1700	1199
Volume to Capacity	0.06	0.05	0.11	0.19
Queue Length 95th (m)	1.5	0.0	0.0	5.4
Control Delay (s)	8.1	0.0	0.0	10.9
Lane LOS	A			B
Approach Delay (s)	3.9		0.0	10.9
Approach LOS				B

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	26.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	54	73	120	63	52	128
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.81	0.97	0.87	0.77	0.71
Hourly flow rate (vph)	86	90	124	72	68	180
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	196				421	160
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	196				421	160
tC, single (s)	4.4				6.7	6.3
tC, 2 stage (s)						
tF (s)	2.5				3.8	3.4
p0 queue free %	93				86	79
cM capacity (veh/h)	1235				494	857

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	86	90	196	248
Volume Left	86	0	0	68
Volume Right	0	0	72	180
cSH	1235	1700	1700	1178
Volume to Capacity	0.07	0.05	0.12	0.21
Queue Length 95th (m)	1.7	0.0	0.0	6.0
Control Delay (s)	8.1	0.0	0.0	11.2
Lane LOS	A			B
Approach Delay (s)	4.0		0.0	11.2
Approach LOS				B

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	27.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: 62 Ave & Twp Rd 502

5/1/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	95	73	120	99	59	137
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.81	0.97	0.87	0.77	0.71
Hourly flow rate (vph)	151	90	124	114	77	193
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	238				572	181
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	238				572	181
tC, single (s)	4.5				6.8	6.4
tC, 2 stage (s)						
tF (s)	2.6				3.8	3.4
p0 queue free %	87				79	77
cM capacity (veh/h)	1123				369	827

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	151	90	238	270
Volume Left	151	0	0	77
Volume Right	0	0	114	193
cSH	1123	1700	1700	1156
Volume to Capacity	0.13	0.05	0.14	0.23
Queue Length 95th (m)	3.5	0.0	0.0	6.9
Control Delay (s)	8.7	0.0	0.0	12.6
Lane LOS	A			B
Approach Delay (s)	5.4		0.0	12.6
Approach LOS				B

Intersection Summary			
Average Delay	6.3		
Intersection Capacity Utilization	32.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	113	70	71	68	76	87
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.71	1.00	1.00	0.81	0.95	0.70
Hourly flow rate (vph)	159	70	71	84	80	124
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	155				501	113
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	155				501	113
tC, single (s)	4.2				6.5	6.4
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.5
p0 queue free %	88				82	86
cM capacity (veh/h)	1384				452	901

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	159	70	155	204
Volume Left	159	0	0	80
Volume Right	0	0	84	124
cSH	1384	1700	1700	1153
Volume to Capacity	0.12	0.04	0.09	0.18
Queue Length 95th (m)	3.0	0.0	0.0	4.9
Control Delay (s)	7.9	0.0	0.0	11.6
Lane LOS	A			B
Approach Delay (s)	5.5		0.0	11.6
Approach LOS				B

Intersection Summary			
Average Delay	6.2		
Intersection Capacity Utilization	29.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: 62 Ave & Twp Rd 502

5/1/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	121	75	76	73	81	93
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.71	1.00	1.00	0.81	0.95	0.70
Hourly flow rate (vph)	170	75	76	90	85	133
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	166				537	121
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	166				537	121
tC, single (s)	4.2				6.5	6.4
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.5
p0 queue free %	88				80	85
cM capacity (veh/h)	1370				426	891

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	170	75	166	218
Volume Left	170	0	0	85
Volume Right	0	0	90	133
cSH	1370	1700	1700	1089
Volume to Capacity	0.12	0.04	0.10	0.20
Queue Length 95th (m)	3.2	0.0	0.0	5.7
Control Delay (s)	8.0	0.0	0.0	12.0
Lane LOS	A			B
Approach Delay (s)	5.6		0.0	12.0
Approach LOS				B

Intersection Summary			
Average Delay	6.3		
Intersection Capacity Utilization	30.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: 62 Ave & Twp Rd 502

5/1/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	131	75	76	83	118	135
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.71	1.00	1.00	0.81	0.95	0.70
Hourly flow rate (vph)	185	75	76	102	124	193
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	178				571	127
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	178				571	127
tC, single (s)	4.2				6.7	6.5
tC, 2 stage (s)						
tF (s)	2.3				3.8	3.6
p0 queue free %	86				67	77
cM capacity (veh/h)	1334				379	851

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	185	75	178	317
Volume Left	185	0	0	124
Volume Right	0	0	102	193
cSH	1334	1700	1700	967
Volume to Capacity	0.14	0.04	0.10	0.33
Queue Length 95th (m)	3.6	0.0	0.0	10.9
Control Delay (s)	8.1	0.0	0.0	13.8
Lane LOS	A			B
Approach Delay (s)	5.8		0.0	13.8
Approach LOS				B

Intersection Summary			
Average Delay	7.8		
Intersection Capacity Utilization	34.1%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: 62 Ave & Twp Rd 502

5/1/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	75	102	168	88	73	179
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.81	0.97	0.87	0.77	0.71
Hourly flow rate (vph)	119	126	173	101	95	252
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	274				588	224
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	274				588	224
tC, single (s)	4.4				6.7	6.3
tC, 2 stage (s)						
tF (s)	2.5				3.8	3.4
p0 queue free %	90				75	68
cM capacity (veh/h)	1153				378	789

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	119	126	274	347
Volume Left	119	0	0	95
Volume Right	0	0	101	252
cSH	1153	1700	1700	1086
Volume to Capacity	0.10	0.07	0.16	0.32
Queue Length 95th (m)	2.6	0.0	0.0	10.5
Control Delay (s)	8.5	0.0	0.0	13.3
Lane LOS	A			B
Approach Delay (s)	4.1		0.0	13.3
Approach LOS				B

Intersection Summary			
Average Delay	6.5		
Intersection Capacity Utilization	33.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: 62 Ave & Twp Rd 502

5/1/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	116	102	168	124	80	188
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.63	0.81	0.97	0.87	0.77	0.71
Hourly flow rate (vph)	184	126	173	143	104	265
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	316				739	244
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	316				739	244
tC, single (s)	4.5				6.8	6.4
tC, 2 stage (s)						
tF (s)	2.6				3.8	3.4
p0 queue free %	82				63	65
cM capacity (veh/h)	1045				278	761

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	184	126	316	369
Volume Left	184	0	0	104
Volume Right	0	0	143	265
cSH	1045	1700	1700	985
Volume to Capacity	0.18	0.07	0.19	0.37
Queue Length 95th (m)	4.8	0.0	0.0	13.3
Control Delay (s)	9.2	0.0	0.0	16.0
Lane LOS	A			C
Approach Delay (s)	5.5		0.0	16.0
Approach LOS				C

Intersection Summary			
Average Delay	7.6		
Intersection Capacity Utilization	38.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	169	105	106	102	114	130
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.71	1.00	1.00	0.81	0.95	0.70
Hourly flow rate (vph)	238	105	106	126	120	186
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	232				750	169
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	232				750	169
tC, single (s)	4.2				6.5	6.4
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.5
p0 queue free %	82				60	78
cM capacity (veh/h)	1296				297	837

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	238	105	232	306
Volume Left	238	0	0	120
Volume Right	0	0	126	186
cSH	1296	1700	1700	756
Volume to Capacity	0.18	0.06	0.14	0.40
Queue Length 95th (m)	5.1	0.0	0.0	15.0
Control Delay (s)	8.4	0.0	0.0	16.3
Lane LOS	A			C
Approach Delay (s)	5.8		0.0	16.3
Approach LOS				C

Intersection Summary			
Average Delay	7.9		
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
8: 62 Ave & Twp Rd 502

5/1/2012

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	179	105	106	112	151	172
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.71	1.00	1.00	0.81	0.95	0.70
Hourly flow rate (vph)	252	105	106	138	159	246
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						4
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	244				784	175
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	244				784	175
tC, single (s)	4.2				6.7	6.5
tC, 2 stage (s)						
tF (s)	2.3				3.8	3.6
p0 queue free %	80				39	69
cM capacity (veh/h)	1260				261	798

Direction, Lane #	EB 1	EB 2	WB 1	SB 1
Volume Total	252	105	244	405
Volume Left	252	0	0	159
Volume Right	0	0	138	246
cSH	1260	1700	1700	665
Volume to Capacity	0.20	0.06	0.14	0.61
Queue Length 95th (m)	5.7	0.0	0.0	31.5
Control Delay (s)	8.6	0.0	0.0	22.0
Lane LOS	A			C
Approach Delay (s)	6.1		0.0	22.0
Approach LOS				C

Intersection Summary			
Average Delay	11.0		
Intersection Capacity Utilization	42.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	157	5	86	106	1	18
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	171	5	93	115	1	20
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			176		476	173
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			176		476	173
tC, single (s)			4.7		7.0	6.8
tC, 2 stage (s)						
tF (s)			2.8		4.1	3.9
p0 queue free %			92		100	97
cM capacity (veh/h)			1104		414	734

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	176	209	21
Volume Left	0	93	1
Volume Right	5	0	20
cSH	1700	1104	706
Volume to Capacity	0.10	0.08	0.03
Queue Length 95th (m)	0.0	2.1	0.7
Control Delay (s)	0.0	4.3	10.3
Lane LOS		A	B
Approach Delay (s)	0.0	4.3	10.3
Approach LOS			B

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	33.3%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX C

TAC Street Lighting Warrant Summaries

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 13	Minor Road
Lloydminster	City/Town

Date: April 20, 2012
Other: 2014 Total

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
					Geometric Factors Subtotal	3

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)		0	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	0
AADT on Minor Road (2-way)		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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	15

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	Enter **either** the annual frequency (See Table 1(C), note #4) **OR** the number of collisions / MEV (Unused values should be set to Zero)	OK	0
OR						
Collision Rate over last 3 years, due to inadequate lighting (/MEV)		0	0		OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	3
Operational Factor Subtotal	15
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	18

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 13	Minor Road
Lloydminster	City/Town

Date: April 20, 2012
Other: 2034 Total

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	0	3	Rounded to nearest tenth of a percent	OK	0
Number of Intersection Legs	3	1	3	Number of legs = 3 or more	OK	3
					Geometric Factors Subtotal	3

OPERATIONAL FACTORS

Is the intersection signalized ? (Y/ N)	n			Calculate the Signalization Warrant Factor		
AADT on Major Road (2-way)		0	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	0
AADT on Minor Road (2-way)		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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	50	0	5	Refer to Table 1(B), note #3	OK	0
					Operational Factors Subtotal	15

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	Enter **either** the annual frequency (See Table 1(C), note #4) **OR** the number of collisions / MEV (Unused values should be set to Zero)	OK	0
OR						
Collision Rate over last 3 years, due to inadequate lighting (/MEV)		0	0		OK	0
Is the average ratio of all night to day collisions >= 1.5 (Y/N)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	3
Operational Factor Subtotal	15
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	18

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 12	Minor Road
Lloydminster	City/Town

Date: April 20, 2012

Other: 2012 Existing

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	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)		0	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	0
AADT on Minor Road (2-way)		0	20		OK	0
Signalization Warrant	Descriptive	1	30		OK	30
					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	0	5	Refer to Table 1(B) for ratings	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	60

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	Enter **either** the annual frequency (See Table 1(C), note #4) **OR** the number of collisions / MEV	OK	0
OR						
Collision Rate over last 3 years, due to inadequate lighting (/MEV)		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)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	60
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	66

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 12	Minor Road
Lloydminster	City/Town

Date: April 20, 2012

Other: 2014 Background

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	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)		0	10	Either Use the two AADT inputs **OR** the Descriptive Signalization	OK	0
AADT on Minor Road (2-way)		0	20	Warrant (Unused values should be set to Zero) Refer to Table	OK	0
Signalization Warrant	Descriptive	1	30	1(B) for description and rating values for signalization warrant.	OK	30
					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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	60

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	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	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	60
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	66

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 12	Minor Road
Lloydminster	City/Town

Date: April 20, 2012

Other: 2014 Total

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	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)		0	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	0
AADT on Minor Road (2-way)		0	20		OK	0
Signalization Warrant	Descriptive	1	30		OK	30
					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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	60

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	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	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	60
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	66

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 12	Minor Road
Lloydminster	City/Town

Date: April 20, 2012

Other: 2034 Background

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	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)		0	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	0
AADT on Minor Road (2-way)		0	20		OK	0
Signalization Warrant	Descriptive	2	30		OK	60
					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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	90

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	Enter **either** the annual frequency (See Table 1(C), note #4) **OR** the number of collisions / MEV (Unused values should be set to Zero)	OK	0
OR						
Collision Rate over last 3 years, due to inadequate lighting (/MEV)		0	0		OK	0
Is the average ratio of all night to day collisions >= 1.5 (Y/N)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

LIGHTING IS NOT WARRANTED

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	90
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	96

Guide for the Design of Roadway Lighting

LIGHTING WARRANT SPREADSHEET

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Please enter information in the cells with yellow background

INTERSECTION CHARACTERISTICS

Twp. Rd. 502	Main Road
Range Road 12	Minor Road
Lloydminster	City/Town

Date: April 20, 2012
Other: 2034 Total

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)			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)	80				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 =		0				
Posted Speed Category =	C	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%)	0.0	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)		0	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	0
AADT on Minor Road (2-way)		0	20		OK	0
Signalization Warrant	Descriptive	3	30		OK	90
					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	0	5	Refer to Table 1(B) for ratings.	OK	0
Operating Speed or Posted Speed on Major Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
Operating Speed on Minor Road (km/h)	80	3	5	Refer to Table 1(B), note #3	OK	15
					Operational Factors Subtotal	120

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	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	(Unused values should be set to Zero)	OK	0
Is the average ratio of **all** night to day collisions >= 1.5 (Y/N)		0			Use Y or N	
					OK	
					Collision History Subtotal	Check Entry

Check Intersection Signalization:
Intersection is not Signalized

ILLUMINATION WARRANTED
DELINEATION LIGHTING TO ILLUMINATE PEDESTRIANS OR CROSS STREET TRAFFIC

SUMMARY	
Geometric Factors Subtotal	6
Operational Factor Subtotal	120
Environmental Factor Subtotal	0
Collision History Subtotal	Check Entry
TOTAL POINTS	126

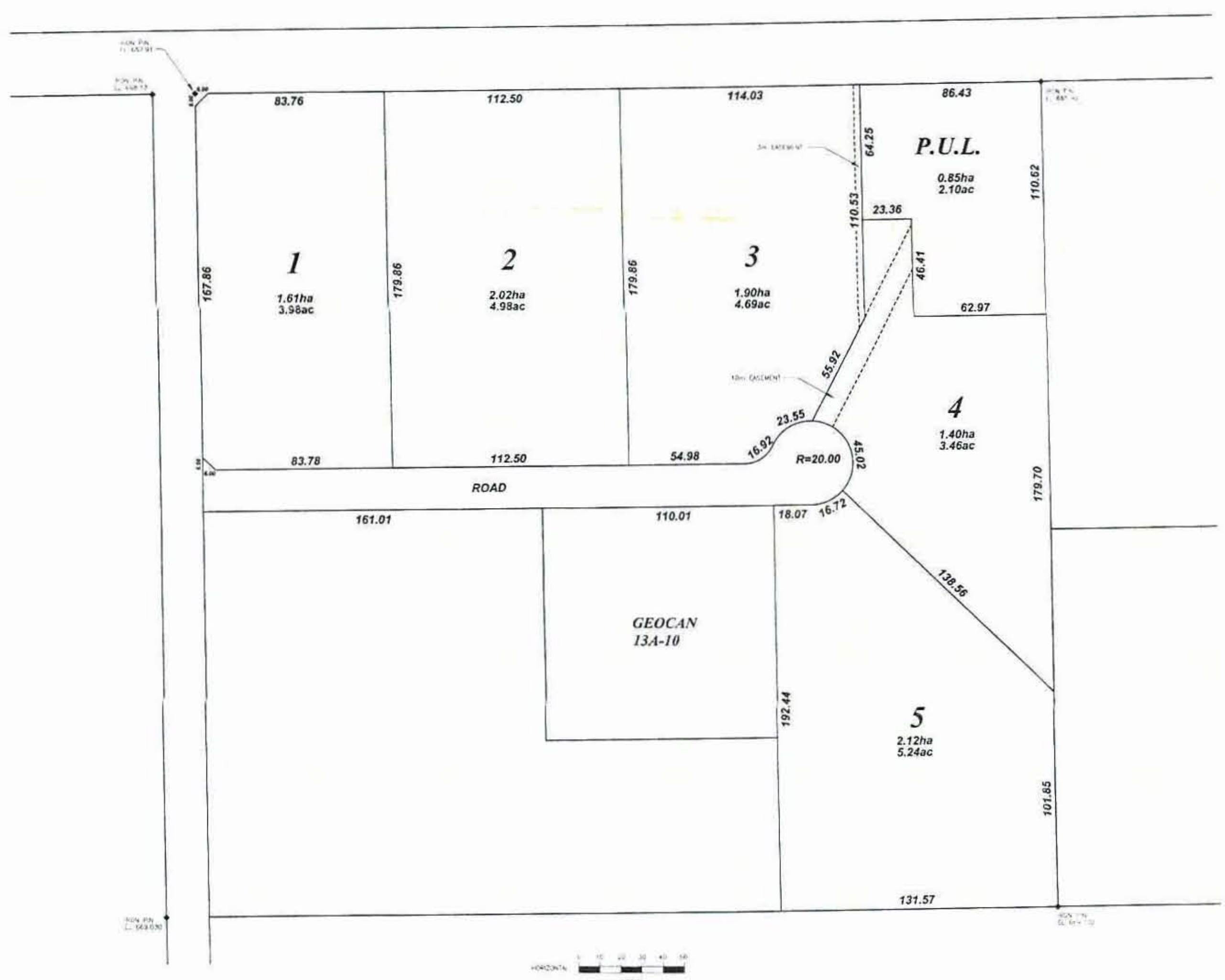
SAND CONTROL SYSTEMS LTD.

INDUSTRIAL DEVELOPMENT
NW 10-50-1W4M

BAR Engineering

BAR Project No.: 11-2024

List of Drawings	
Sheet No.	Title
1	Site Plan
2	Existing Topography
3	Drainage Plan
4	Catchment Areas
5	Road Profiles and Sections
6	Pond Sections
7	Intake Section



LEGEND

NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY
1	ISSUED FOR APPROVAL	KNS	RTC	04/04/2012
0	ISSUED FOR APPROVAL (CONCEPTUAL)	KNS	RTC	01/25/2012

REVISIONS

PERMIT TO PRACTICE
BAR ENGINEERING CO. LTD.
Date 2012/04/11
PERMIT NUMBER: P7266
The Association of Professional Engineers, Geologists, and Geophysicists of Alberta

BAR Engineering

PROJECT #: 11-2024
DRAWING #: 11-202 REV1.dwg
SCALE: AS SHOWN

SAND CONTROL SYSTEMS LTD.
INDUSTRIAL DEVELOPMENT
NW 10-50-1W4

SITE PLAN

LEGEND

NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY
1	ISSUED FOR APPROVAL	KNS	RTC	04/04/2012
0	ISSUED FOR APPROVAL (CONCEPTUAL)	KNS	RTC	01/25/2012

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Date 2012/04/11
PERMIT NUMBER: P7266
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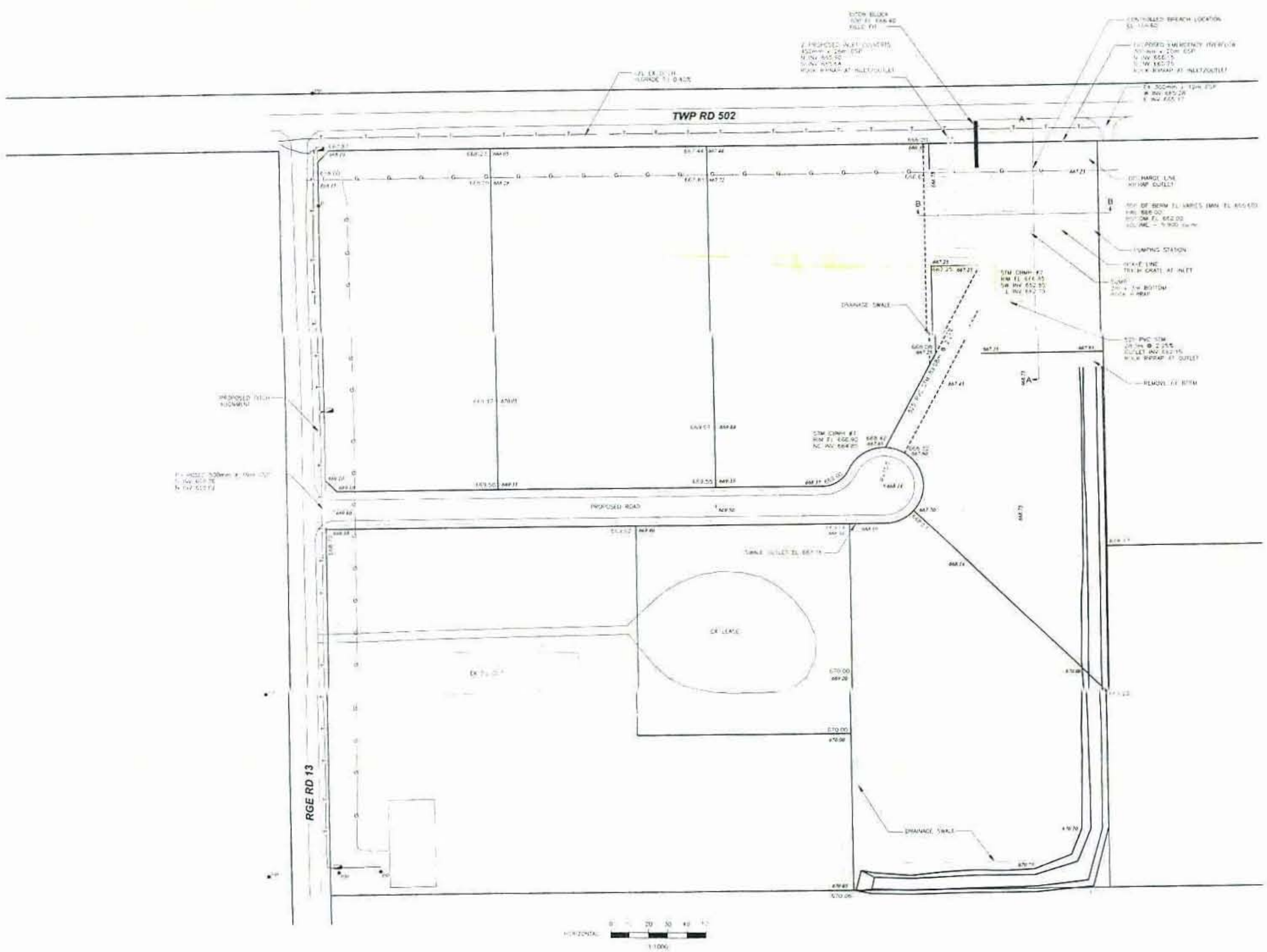
INDUSTRIAL DEVELOPMENT
NW 10-50-1W4

PROJECT #:	11-2024
DRAWING #:	11-2024 REV1.dwg
SCALE:	AS SHOWN

EXISTING TOPOGRAPHY

SHEET #: 2 of 7



1	ISSUED FOR APPROVAL	KNS	RTC	04/04/2012
0	ISSUED FOR APPROVAL (CONCEPTUAL)	KNS	RTC	01/25/2012
NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY

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Signature
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PERMIT NUMBER: P7256
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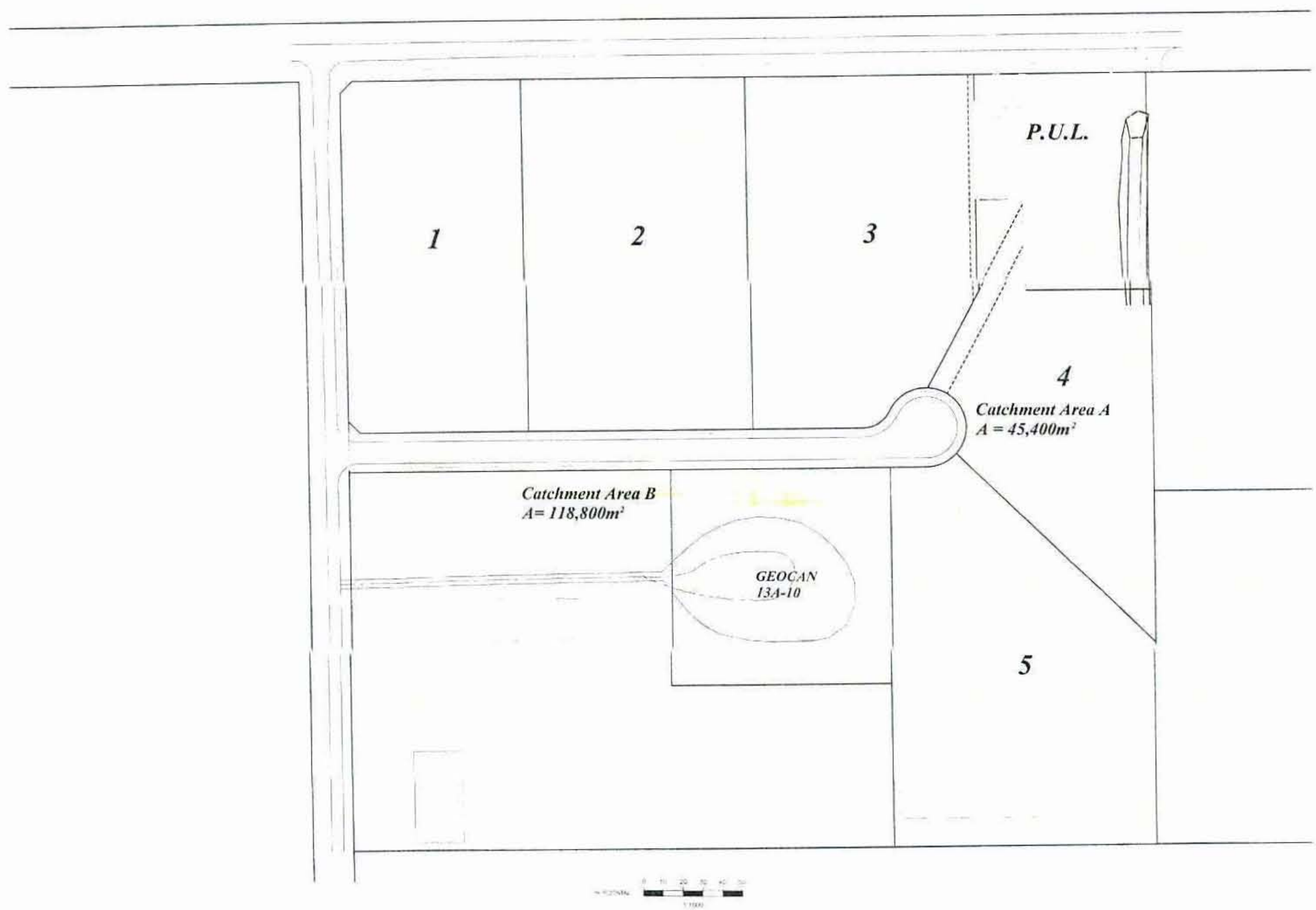
BAR Engineering

PROJECT #: 11-2024
DRAWING #: 11-2024 REV1.dwg
SCALE: AS SHOWN

SAND CONTROL SYSTEMS LTD.
INDUSTRIAL DEVELOPMENT
NW 10-50-1W4

DRAINAGE PLAN

SHEET #: 3 of 7



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NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY
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0	ISSUED FOR APPROVAL (CONCEPTUAL)	KNS	[illegible]	[illegible]

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PROJECT #: 11-2024
DRAWING #: 11-[illegible] REV1.dwg

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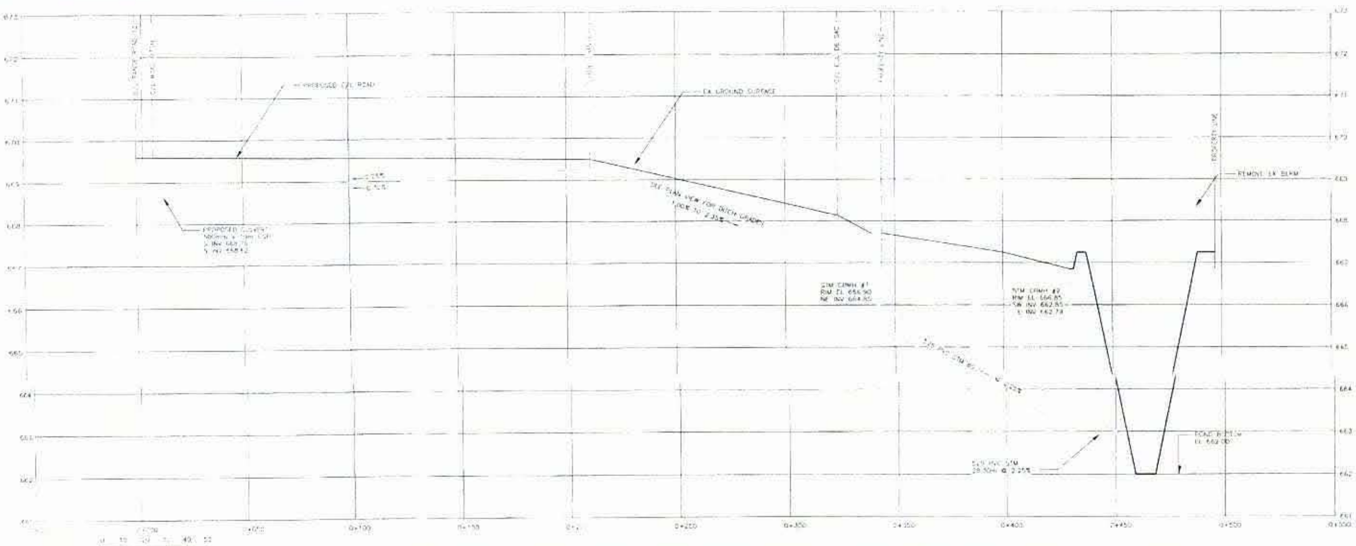
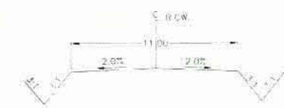
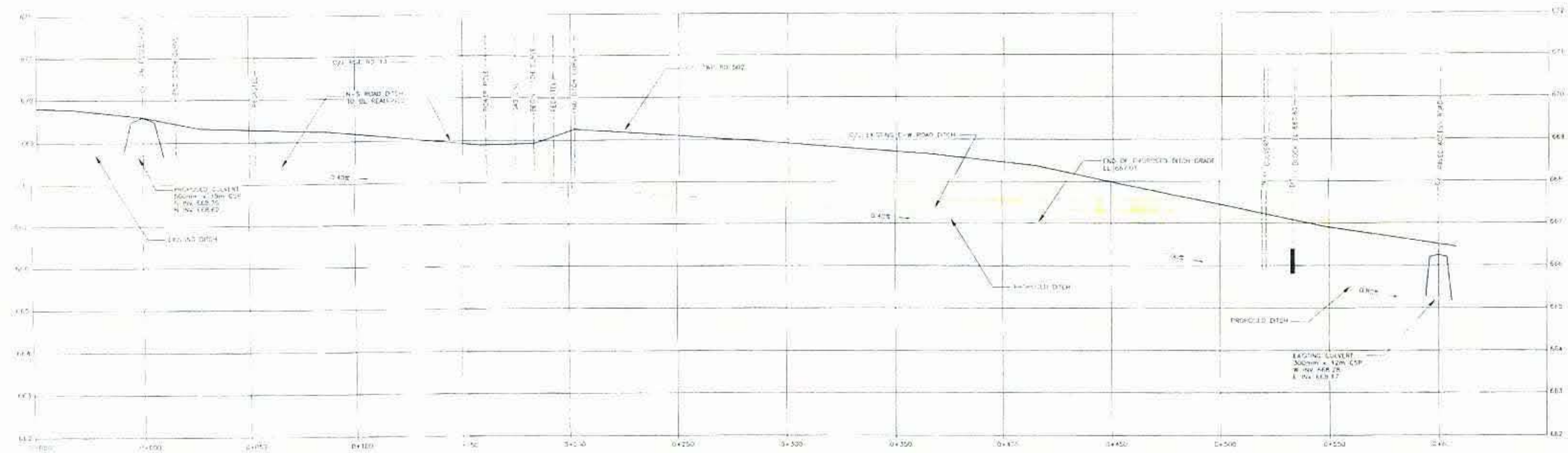
CATCHMENT AREAS



PROFILE ON C/L PROPOSED ROAD AND DRAINAGE DITCH



TYPICAL SECTION OF ROAD



PROFILE ON C/L RGE RD 13 AND TWP RD 402

NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY
1	ISSUED FOR APPROVAL	KNS	RTC	04/04/2012
0	ISSUED FOR APPROVAL (CONCEPTUAL)	KNS	RTC	01/25/2012

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PROJECT #: 11-2024
DRAWING #: 11-2024 REV1.dwg
SCALE: AS SHOWN

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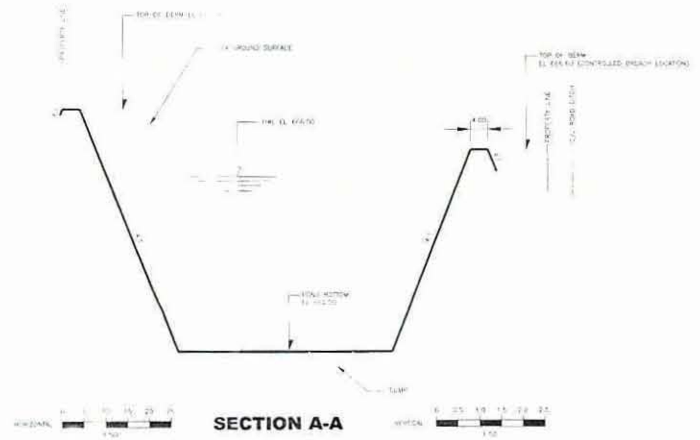
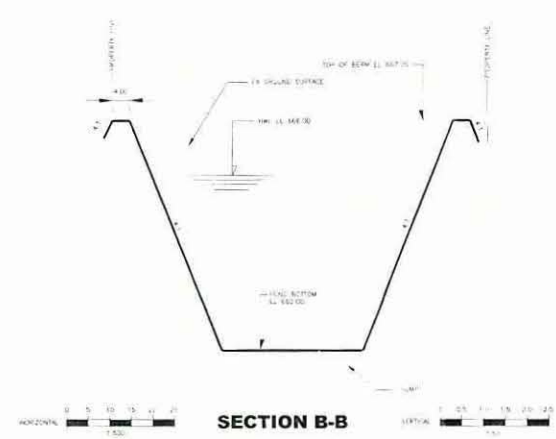
ROAD PROFILES AND SECTIONS

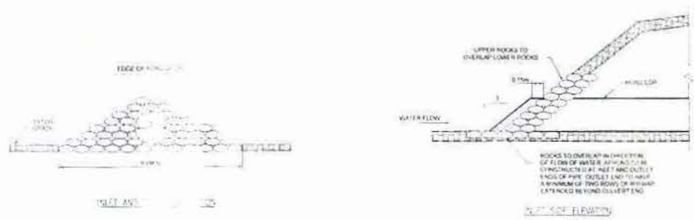
SHEET #: 5 of 7



SECTION A-A

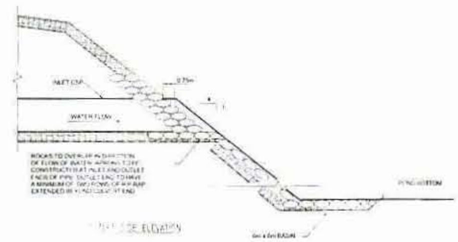


SECTION B-B



CSP RIPRAP DETAILS (ROAD CULVERTS)

NTS



POND INLET DETAIL

NTS

LEGEND

NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY
1	ISSUED FOR APPROVAL	KNS	RIC	04/04/2012
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Signature
Date 2012/04/11
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The Association of Professional Engineers, Geologists, and Geophysicists of Alberta

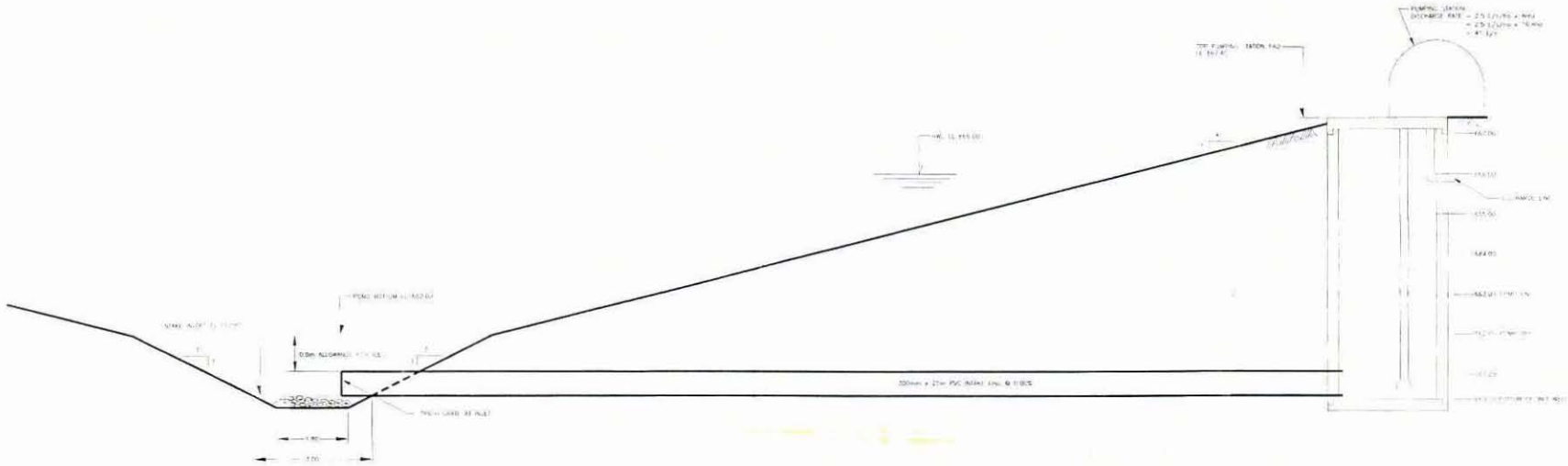
BAR Engineering

PROJECT #: 11-2024
DRAWING #: 11-2024 REV1.dwg
SCALE: AS SHOWN

SAND CONTROL SYSTEMS LTD.
INDUSTRIAL DEVELOPMENT
NW 10-50-1W4

POND SECTIONS

SHEET #: 6 of 7



INTAKE STRUCTURE

LEGEND

	PROPOSED	EXISTING
Elevations	555.00	555.00
Door		
Culvert		

	PROPOSED	EXISTING
Sanitary Sewer Main		
Storm Sewer Main		
Manhole		
Catchbasin		
Catchbasin		

	PROPOSED	EXISTING
Power Pole		
Light Standard		
Hydrant		
Gas Lines		
Telus Lines		
Power Lines		
Fence		

Note:
The location of the utilities shown is approximate only. Other utilities may exist that are not shown. The exact location of all utilities shall be verified by contacting the municipal authorities and utility companies concerned. The contractor shall also verify the size, location and invert elevation of all connections before commencement of construction.

NO.	DESCRIPTION	DRAWN	CHECKED	MM/DD/YY
	ISSUED FOR APPROVAL	KNS	RTC	04/04/2012
0	ISSUED FOR APPROVAL (CONCEPTUAL)	KNS	RTC	01/25/2012

REVISIONS

ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS AND GEOPHYSICISTS OF ALBERTA

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BAR ENGINEERING CO. LTD.
Signature
Date
PERMIT NUMBER: P7266
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BAR Engineering

PROJECT #:	11-2024
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SCALE:	AS SHOWN

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INDUSTRIAL DEVELOPMENT
NW 10-50-1W4

INTAKE SECTION

SHEET #: 7 of 7