Leduc County

Township Road 510
Functional Planing Study





Report

April 2009

LEDUC COUNTY

Associated Engineering

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Executive Summary

1 INTRODUCTION

Township Road 510 is located between the northern section of the Nisku Business Park and the Town of Beaumont, 3.2 kilometres north of Alberta Provincial Highway 625. Township Road 510 was identified as a major arterial roadway by Leduc County in the North Major Area Structure Plan to provide a link between the Nisku Industrial Park and Highway 814 and Beaumont. As well, Township Road 510 will function to collect and distribute traffic within future developments in northern Leduc County. This road will also become more important as the area develops because it will provide a link between major commercial and industrial centres in the greater Edmonton region.

The Township Road 510 Functional Planning Study was commissioned by Leduc County to recommend improvements to the roadway required to meet immediate and long term traffic demands. Specific recommendations regarding improvements to the design standards, horizontal alignment, profile changes, right-of-way requirements, staging, triggering for staging, intersection requirements, and access control are all elements of this study.

The study area covers the existing Township Road 510 alignment between the proposed future Nisku Spine Road (west of Range Road 250 [north]) and east of Highway 814 (50 Street). Tie-ins to existing and potential future cross-roads are included in the functional plan, including potential conceptual realignment of the existing intersections.

The Associated Engineering project team and project steering committee developed a list of critical issues that would require investigation and resolution or recommendations within the Township Road 510 Functional Planning Study. These issues include:

- Roadway classification and lane requirements
- Edmonton Ring Roads
- Offset Intersections
- Nisku Spine Road
- Existing Utilities
- Irvine Creek Crossing
- Coordination with the Town of Beaumont
- Access Management
- Environmental and Drainage

A project steering committee was set up consisting of Associated Engineering project team members and Leduc County administration. The steering committee met at milestone dates through the course of the study.

2 BACKGROUND INFORMATION REVIEW

Several types of background information and reports applicable to the Township Road 510 study area were available. These included development plans, previous roadway studies, and other studies including environmental reports. These studies included:

Development Plans

- Leduc County Municipal Development Plan (1999)
- Leduc County North Major Area Structure Plan (2004)
- Beaumont Outline Plan NE ¼ sec. 34-50-24-W4 (2002)
- Beaumont Dansereau Meadows Outline Plan NW ¼ Sec. 34-50-24-W4 (2007)

Roadway studies

- Beaumont 50th Street Functional Planning Study (2007)
- Leduc County Nisku Spine Road Functional Planning Study and Update (2008)
- 91 Street Connector (Highway 625 to City of Edmonton) (1990)

Other studies

- LeBlanc Canal Hydraulic Performance Upgrading Analysis (2006)
- LeBlanc Canal Intermunicipal Drainage Study (2001)
- Beaumont Public Works Site

In addition to a comprehensive review of background information, Associated Engineering performed intersection turning movement traffic counts at all existing major intersections along Township Road 510 within the study area. These counts were used as a base year for determining future traffic within the study area. Additionally, this information was used to calculate existing intersection operations to determine if there are currently any operational problems.

3 TRAFFIC ANALYSIS

Edmonton Regional Travel Model

The Associated Engineering project team had originally planned to utilize output from the Edmonton Regional Travel Model (developed jointly by Alberta Transportation and the City of Edmonton). This travel model predicts long-term traffic volumes within the Edmonton Capital Region. However, due to updates and delays, the modelling information was not available through the course of the study. Therefore, the project steering committee developed an alternative method for estimating long-term traffic volumes.

Regional Connectivity

The Associated Engineering project team compiled and detailed the existing and proposed regional connections to and from the Township Road 510 study area. Highway 814 (50 Street) is currently the only existing major north-south route through the study area. The Nisku Spine Road will be the second major north-south route through the study area. Furthermore, because of flyover connectivity over Anthony Henday Drive and the potential for a flyover or interchange at the proposed Edmonton Regional Ring Road, the 66 Street extension (Range Road 243 [north]) was also considered as a minor regional connector. The

potential Edmonton Regional Ring Road is currently identified to exist about 800 metres north of Township Road 510, and Highway 625 exists about 3.2 kilometres south of Township Road 510.

Future Area Development

Based on existing development plans and discussions through project steering committee meetings, a future development scenario was developed. The current development plans identify lower-density residential development for the majority of the land around the Township Road 510 study area. Leduc County identified that some of these areas may develop to higher density residential neighbourhoods; however, none of these plans were approved during the Township Road 510 Functional Planning Study.

Background Traffic Growth

Background traffic from the 2007 traffic counts were used as a base year to calculate background traffic. A typical Alberta-wide background traffic growth rate of 2.5% was used to a projected build-out of about 40 years. The existing daily traffic on Township Road 510 is about 2,500 vehicles. The projected future background traffic was therefore calculated to approximately double to about 5,000 vehicles per day.

Township Road 510 Development Tributary Area

Based on regional connectivity, a tributary area was defined for development that would use Township Road 510 to access the regional network. This area included lands within Leduc County between the proposed Nisku Spine Road and Highway 814 (50 Street). The northern extent was the potential location of the Edmonton Regional Ring Road, 800 metres north of Township Road 510; the southern extent was Township Road 505 (about 1600 metres south of Township Road 510), which is about halfway between Township Road 510 and Highway 625 to the south. A small undeveloped area within the Town of Beaumont was also identified as having primary access to Township Road 510 via Range Road 243 [south].

Trip Generation, Distribution, and Assignment

The tributary area defined above was broken down into smaller development areas that were then used to generate and distribute traffic onto Township Road 510. Because of uncertainty in area development, these lands were identified as primarily residential or industrial, according to existing development plans. Trip generation rates for single family detached housing and general light industrial land uses were obtained from the Institute of Transportation Engineers' Trip Generation Manual and applied to each development area. Trip distribution and assignment was carried out based on proximity to regionally significant roadways and other development areas.

Estimated Future Traffic Volumes

Future traffic volumes were estimated to be about 20,000 vehicles per day based on the above described method. Added to projected background traffic, the average annual daily traffic on Township Road 510 was estimated to be about 25,000 vehicles in the full build-out horizon. Upon the project steering committee's request, the Associated Engineering project team also performed a sensitivity analysis to determine projected future volumes on Township Road 510 with increased development densities. Taking into account lower trip generation rates for higher-density developments and increased opportunities for internal trip capture, the Associated Engineering project team estimated the full build-out horizon for the increased density scenario to be about 33,000 vehicles per day, including background traffic growth.

Modelling Criteria

Base year traffic analysis was completed for the traffic volumes counted during the data collection phase. The Associated Engineering project team utilized two Highway Capacity Manual 2000 (HCM) service function indicators to determine the existing operations of the intersections within the Township Road 510 study area. Synchro/SimTraffic 7 software was used to calculate the HCM indicators and to model the existing conditions within the study area. The project steering committee determined that acceptable service functions within the study area would be a level of service indicator of D or better, and a volume-to-capacity ratio of no greater than 1.0, but ideally less than 0.9. A level of service D or better corresponds to an average vehicle delay at an intersection of less than 55 seconds (signalized) or 35 seconds (unsignalized). A volume-to-capacity ration of 1.0 indicates that the intersection is at capacity.

Base Year Traffic Analysis

The Associated Engineering project team performed traffic analysis on all existing major intersections within the study area. All intersections operated at acceptable levels of service and volume-to-capacity ratios except for one intersection. The Township Road 510 intersection at Highway 814 (50 Street) currently operates at an F level of service with unacceptably high volume-to-capacity ratios.

Interim Improvements at Highway 814 (50 Street)

With unacceptable service indicators at this intersection, a signal warrant analysis was carried out based on the Canadian Traffic Signal Warrant Matrix Procedure developed by the Transportation Association of Canada. This analysis generates a score based on traffic volumes from six daytime hours; a score of 100 or more generally indicates a need for signalization. Using counted volumes from 2007, the signal warrant matrix procedure produced a score of 117, indicating a need for signals at this location.

Further Synchro/SimTraffic modelling was completed with the addition of traffic signals at the Highway 814 (50 Street) intersection. However, even with the addition of signals, the intersection still operated at unacceptable levels of service and volume-to-capacity rations. Therefore, additional improvements are required. The intersection was modelled with a modified lane configuration; this produced acceptable levels of service and volume-to-capacity ratios. The recommended lane reconfiguration could be done in such a way that no grade widening or additional road surface would be necessary – the lane configuration could be altered by simply repainting the lane markings at the intersection to develop dedicated left turn lanes with a shared through-right lane in both the north and south directions.

These recommended improvements to this intersection would bring the current intersection operation to an acceptable level with the existing volumes.

4 FUNCTIONAL PLANS

A comprehensive set of design considerations were developed because detailed travel model information was not available. A comprehensive review of background information and expected growth was conducted, and industry best practices and local conditions were reviewed. Good engineering judgement was required to distil the collected information into a plan that can be used to guide development along Township Road 510.

Cross-section

Typically, two lane arterial roadways can carry about 10,000 vehicles each day, and four lane arterials can carry upwards of 30,000 to 40,000 vehicles each day in an urban environment. The Associated Engineering project team identified several four lane arterial corridors in the City of Edmonton that carry between 30,000 and 44,000 vehicles each day. With predicted future traffic volumes of between 25,000 and 33,000 vehicles each day, the project steering committee agreed that with the best information available, a four lane cross-section would be appropriate for long-term development along Township Road 510.

As part of Leduc County's strategy to increase development densities in the lands around Township Road 510 within the study area, the county wishes to develop a more urban environment in the area. As such, the project steering committee proposed an urban cross-section for Township Road 510 with full curb and gutter and below ground stormwater drainage. The Township Road 510 functional plans reflect this recommendation; benefits include reduced right of way required, however costs to develop the roadway are greater.

Consistent with providing an urban cross-section in an urban area, considerations were made for pedestrians and other non-vehicular users such as bikes, wheelchairs, and strollers. The project steering committee agreed to provide a 3.0 metre multi-use trail along the south side of the roadway and a standard 1.5 metre boulevard walkway on the north side of the roadway. The multi-use trail will also provide logical connections to the Town of Beaumont's trail and pedestrian system.

Consideration was also given to noise attenuation along the Township Road 510 corridor. An arterial roadway with over 30,000 vehicles a day generates significant noise which could be a nuisance to local residents. Leduc County does not currently have noise attenuation guidelines for roadways. However, the Associated Engineering project team has integrated a small 1.0 metre high berm into the roadway cross-section when near residential lands. Recommendations have also been made for maximum allowable sound levels based on a City of Edmonton bylaw that outlines noise restrictions. Upon development of residential lands adjacent to Township Road 510, sound modelling exercises should be carried out to determine if sound attenuation measures in addition to the 1.0 metre berm are required. Such additional sound attenuation measures should be provided upon detailed design by the developers.

Intersection Treatment

In the absence of detailed traffic volume information, an alternative solution was required to determine intersection configurations. Typically, projected future turning movements would be analyzed to determine lane, turn bay, and channelization requirements. However, due to uncertainties in traffic volume and development information, an alternative strategy was developed to ascertain intersection configurations depending on the functionality of each intersecting roadway. As identified previously, there are major and minor road crossings of Township Road 510. Through the study area, there are three types of intersections: major arterial, minor arterial, and collector roadways.

There are two major arterials within the study are – the Nisku Spine Road and Highway 814 (50 Street). These intersections will be developed to the highest standards and will be able to convey the highest amount of turning traffic through double slotted left turn bays and channelized right turn lanes.

There are several minor arterial roadways within the study area – at each existing range road. Due to the offsets as a result of Township Road 510 being a correction line, the offset intersections have been realigned north of Township Road 510. These minor arterial road intersections have been designed to

accommodate moderate turning volume through single left turn lanes and channelized right turns. As Range Road 244 [south]/Range Road 243 [north] may provide future connectivity to 66 Street in Edmonton, this intersection has been planned to accommodate a single slotted left turn that could accommodate double left turn lanes if required at a future date.

Major collector roadways connect the neighbourhoods with the arterial road system. Several future collector roads intersections will be developed within the Township Road 510 study area. The Township Road 510 functional plans identify right-of-way and plans for developing these intersections to accommodate single left turn lanes and turn bays plus channelized right turn movements.

Geometric Design Criteria

The Associated Engineering project team and the project steering committee developed a set of geometric design criteria for Township Road 510 within the study area. The geometric design criteria was developed based on Leduc County's engineering and roadway design standards, the Transportation Association of Canada's Geometric Design Guide for Canadian Roads, Alberta Transportation's Highway Geometric Design Guide and the Geometric Design Guide Urban Supplement. The City of Edmonton's Design and Construction Standards were also referenced in developing urban intersection treatments and details.

Roadway Staging

As development in the area will take several years to fully develop, Leduc County may wish to construct Township Road 510 in two stages – a first stage consisting of two lanes, and final stage completing the additional two lanes. In the first stage, the southern two lanes (ultimate eastbound lanes) would be constructed along with the multi-use trail, street lighting for those two lanes, and the southern berm. The ultimate westbound lanes would be rough graded and temporarily seeded until which point the full four lane cross-section would need to be constructed.

Access Management Strategy

As a major arterial roadway, the main function of Township Road 510 is to convey traffic east-west through the study area. To ensure that Township Road 510 maintains this function as adjacent areas area developed, the Township Road 510 Functional Planning Study must define an access management strategy to guide potential future access to the roadway.

The Township Road 510 Functional Planning Study defines a recommended intersection spacing of about 800 metres between major intersections, but no less than 400 meters for all-directional intersections. Private accesses should be discouraged, but could be provided under certain circumstances as long as the access provides only right-in/right-out movements and the access is 200 metres from the nearest intersection. The spacing requirements ensure that such private accesses do not interfere with the intersection treatments at the major intersections.

There are several existing accesses to local lands along Township Road 510 within the study area. Long-term, the access management strategy outlines complete removal of existing accesses or conformance to the requirements set out above. For existing accesses to Township Road 510, in most cases these will remain in the interim until a reasonable alternate access is developed or the land is redeveloped. In the event that Township Road 510 is developed into the ultimate four lane roadway before existing private accesses are removed or relocated, the existing accesses will be allowed to remain temporarily as right-

in/right-out access only provided they do not impact the operation of public road intersections along Township Road 510.

Functional Plans

The Township Road 510 Functional plans include plan and profile drawings illustrating the ultimate configuration and profile of the roadway within the study area. Additional drawings outline each intersection as well as specific cross-sections at each intersection. A typical cross-section illustrating staging is also included.

5 PUBLIC CONSULTATION

The public information and community consultation process for the Township Road 510 Functional Planning Study consisted of two elements: stakeholder profiling interviews and a public open house. Stakeholder profiling interviews were held with individual landowners along the study area to inform them of the functional planning study and to obtain local information from them. These meetings were held at the beginning of the study so that local information could be taken into account when developing the functional plans. Common themes that arose from the profiling interview include high speed traffic, delays at the 50 Street intersection, roadway structure damage, flooding near the LeBlanc Canal, and concerns for future access to private land from a redeveloped Township Road 510.

A public open house was held near the end of the study as an informal drop-in format. Information presented included relevant planning documents, a consolidated land use plan, proposed access control information, and recommended functional plans. Open house attendees were given comment forms to help the project team obtain information from the public. Common themes obtained from the stakeholders through informal conversations and the comment forms included intersection capacity and treatment at 50 Street, an impression that these plans are good foresight before development occurs, and a need for pedestrian and non-motorized mode accommodation.

6 DRAINAGE CONSIDERATIONS

The Associated Engineering project team completed a drainage review and developed conceptual recommendations for drainage requirements to accommodate the recommended functional pans. The existing drainage along Township Road 510 is through a series of ditches and culverts that ultimately drain to Irvine Creek. The floodplains of Irvine Creek may affect the development and location of stormwater management facilities in the area. There are two major crossings on Township Road 510 within the project area. Irvine Creek passes through a 3700 mm culvert under Township Road 510 at Range Road 244 [north]. The LeBlanc Canal passes through two 900 mm culverts under Township Road 510 just west of the Town of Beaumont.

The stormwater management drainage concept developed as part of the Township Road 510 Functional Planning Study identifies suggested release rates for discharge into the LeBlanc Canal and Irvine Creek. Roadway profiles dictate that four stormwater management facilities will be required, two each near Irvine Creek and the LeBlanc Canal, with a combined total storage of about 12,500 cubic metres. These storage

facilities can be integrates with stormwater management plans required for future development along the Township Road 510 corridor once those development areas are better defined.

7 STRUCTURAL CONSIDERATIONS

As identified previously, Township Road 510 crosses Irvine Creek within the study area. As this crossing is considered a bridge sized culvert, more detailed information is available on this crossing. The Associated Engineering project team reviewed existing available information on this crossing and detailed an assessment report outlining options for carrying an upgraded Township Road 510 over Irvine Creek. The existing culvert was installed in 1978 and has had several inspections since. Currently, the structural condition and sufficiency rating is poor, indicating a need for potential upgrades, repairs, or replacement in the near future. Other controlling factors with respect to this crossing include geotechnical issues, environmental issues, roadway geometrics, future development, and traffic accommodation.

Three options for repair/rehabilitation or replacement are presented; these include a do-nothing scenario, rehabilitation, and replacement. Because of the existing condition, increased road right-of-way, and other controlling factors, the do-nothing option is not considered viable. The rehabilitation option would include culvert extension by a minimum 25 metres, and extensive repairs to the existing section of culvert. Because of the significant work required to rehabilitate, this option is not favourable. Complete replacement could be accomplished with a new culvert or bridge structure.

A comparison of conceptual life cycle costs was developed to identify the most economical option for bridge replacement. The Associated Engineering project team recommends that the existing culvert be replaced when Township Road 510 is reconstructed, or during the year 2018, whichever comes first.

8 ENVIRONMENTAL CONSIDERATIONS

An initial environmental evaluation was developed to identify potential impacts or sensitive area which might be impacted by proposed improvements to Township Road 510. The initial environmental evaluation discusses vegetation, wildlife, surface and groundwater, historical and other special places, noise and air quality, land and soil, health and safety, socio-economic factors, and aesthetics. The Associated Engineering project team identified appropriate environmental regulations or legislation and regulatory agencies for applicable issues.

Several recommendations were made that should be completed during detailed design prior to construction. These include completing a detailed vegetation assessment of the wetland areas and creek crossing areas, a wildlife assessment to identify if there are potential construction constraints due to species at risk inhabiting the area, a soil assessment to identify the stripping requirements for the project, and a Phase I Environmental Site Assessment to identify if there are potential environmental concerns associated with the post or current land uses within the proposed alignment or adjacent to the project. Several regulatory agencies should also be contacted regarding project notifications or requests for approvals. These include Alberta Environment, Alberta Sustainable Resource Development, Fisheries and Oceans Canada, and Transport Canada Navigable Water Section.

9 CONCEPTUAL COST ESTIMATES

The Associated Engineering project team developed conceptual cost estimates based on the functional plans presented within this report. Cost estimates include full construction of the roadways, bridge structures, storm drainage, and electrical components on Township Road 510 and parts of the connecting roadways.

Costs have been separated into two general categories – the cost to build Township Road 510 and the incremental costs associated with building each intersection. The total cost estimated for construction of Township Road 510 within the study area is about $32,900,000. The total cost estimated for completing the intersections connecting to Township Road 510 near the study area is about $18,800,000. With a 15% contingency and 12.5% engineering and administration fee, the total estimated project cost is about $67,000,000.

The Associated Engineering project team has also broken the costs into a per linear metre estimate for full development and for a stage one construction. The estimated cost for a two-lane stage one construction is about $3,500 per linear metre, and the estimated cost for full development of the four-lane cross-section is about $2,100 per linear metre.

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1 Introduction

1.1 STUDY BACKGROUND

Leduc County is situated immediately south of the City of Edmonton and is located within the fifth largest metropolitan area in Canada. Leduc County is a dynamic municipality; it provides the opportunity for acreage living in many of its subdivisions, extensive diverse farming operations, and heavy industrial businesses in the Nisku Business Park.

The Nisku Industrial Business Park is western Canada's largest business and industrial park, encompassing roughly 2200 hectares of industrially zoned land within Leduc County. Since its inception in 1972, the park has grown to accommodate over 400 companies, employing more than 20,000 highly skilled trades and professional workers. Business in the Edmonton Capital Region has experienced rapid growth in recent years, resulting in increased pressures to expand and upgrade the local infrastructure.

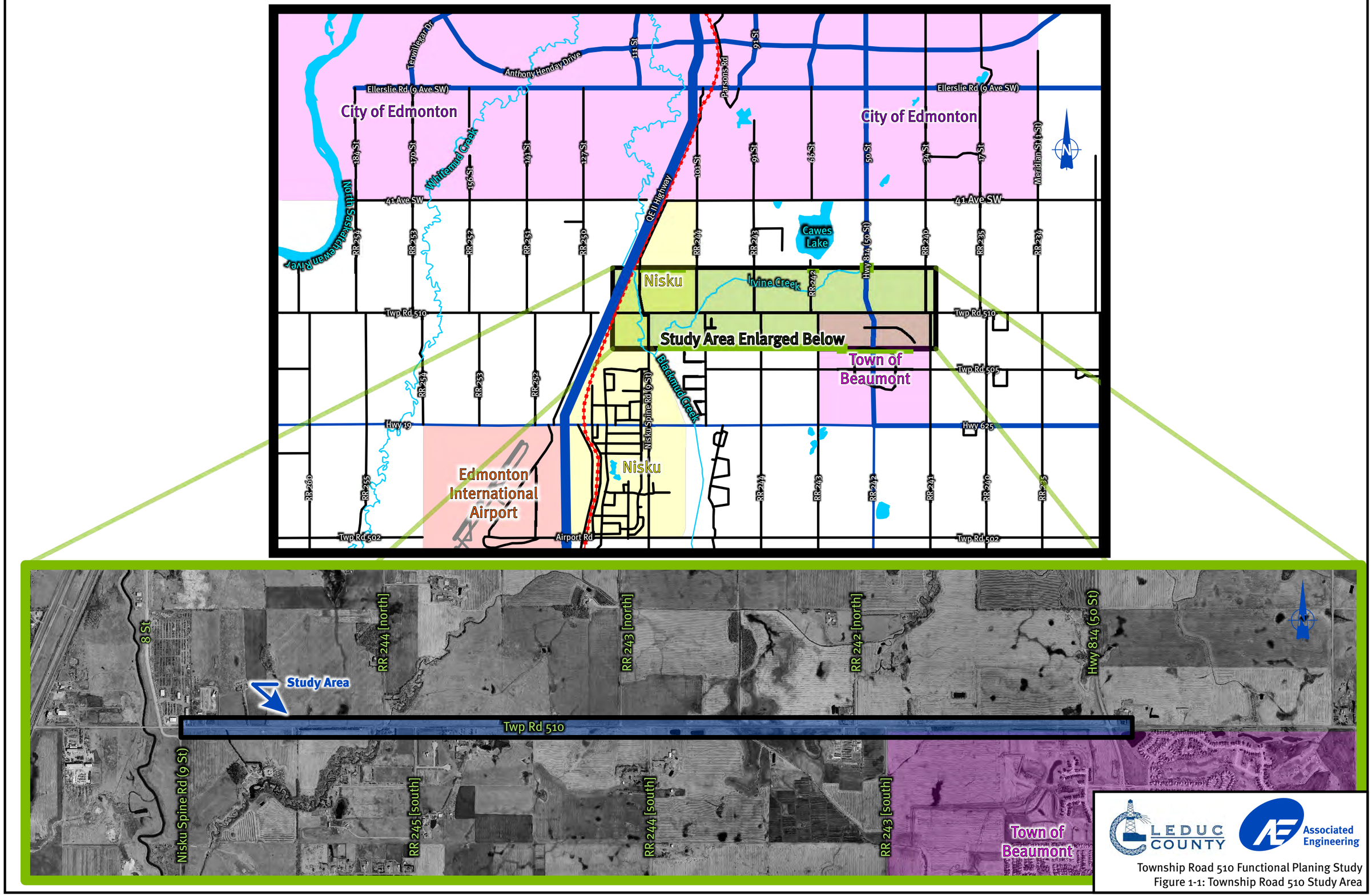
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1.2 STUDY PURPOSE AND SCOPE

The Township Road 510 Functional Planning Study was commissioned by Leduc County to recommend improvements to the roadway required to meet immediate and long term traffic demands. Specific recommendations regarding improvements to the existing roadway structure, design standards, horizontal alignment, profile changes, right-of-way requirements, staging, triggering for staging, intersection requirements, and access control are all elements of this study.

The study area covers the existing Township Road 510 alignment between the proposed future Nisku Spine Road (west of Range Road 250 [north]) and east of Highway 814 (50 Street). Tie-ins to existing and potential future cross-roads are included in the functional plan, including potential conceptual realignment of the existing intersections.

Figure 1-1 illustrates the study area for the Township Road 510 Functional Planning Study.



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Township Road 510 Functional Planing Study
Figure 1-1: Township Road 510 Study Area

1.3 PROJECT ISSUES

The Associated Engineering project team and project steering committee developed a list of critical issues that would require investigation and resolution or recommendations within the Township Road 510 Functional Planning Study. These issues and a brief summary of each are included below.

Roadway classification and lane requirements – The North Major Area Structure Plan identifies Township Road 510 as a major arterial with two or four lanes. This study determines the appropriate classification and cross-section of Township Road 510 by applying Leduc County's Engineering Standards, Alberta Transportation's Highways Geometric Design Guide, and the Transportation Association of Canada's Geometric Design Guide.

Edmonton Ring Roads – Alberta Transportation has developed the Anthony Henday Drive as a freeway that provides limited access to the facility. Near the Township Road 510 study area, Anthony Henday Drive provides interchange access at 91 Street and 50 Street. Through north-south movements are maintained at 66 Street by use of a flyover; there is no access to Anthony Henday Drive at this location. Alberta Transportation has indicated that there may be a second ring road developed just north of Township Road 510; this future road has been referred to in a number of documents as the Edmonton Regional Ring Road. The Alberta government has now acknowledged a need for such a facility. Alberta Transportation is currently undertaking long range planning for the Edmonton Regional Ring Road. However, assumptions can be made based on regional connectivity that access to this facility will be via 50 Street and the Nisku Spine Road (91 Street extension).

Offset Intersections – Township Road 510 is a correction line, and as a result has numerous offset intersections. While low volume country roads operate acceptably with such offset intersections, major arterials, such as Township Road 510 is proposed to be, will develop traffic flow and safety concerns at closely spaced intersections. To rectify this situation, consideration is given to regional connectivity and roadway alignments to determine if certain roadways can be relocated or closed. Due to a desire to maintain regional connectivity as well as uncertainty in the location of the Edmonton Regional Ring Road, the plans propose the north-south roadways (Range Roads) to typically be realigned north of Township Road 510 to provide 4-way access at major intersections – with intersections roughly at right angles – instead of sets of two 3-way intersections. The location of Irvine Creek and the future Nisku Spine Road also influenced the location of north-south connections at the west end of the study area.

Nisku Spine Road – The proposed Nisku Spine Road crosses the existing Township Road 510 at a significant angle due to a number of constraints. The Nisku Spine Road ties into the existing 9 Street (Nisku) to the south, and the existing 101 Street (Edmonton) to the north. Specific constraints near Township Road 510 include the potential Edmonton Regional Ring Road, approximately 800 metres north of Township road 510, and existing buildings in the area. Some realignment of Township Road 510 is required to develop an adequate intersection with the Nisku Spine Road.

Existing Utilities – There are some existing utilities within the existing and proposed right of way along Township Road 510. Crossing agreements or relocation options may need to be developed before construction can proceed. Overhead and buried power and transmission lines, pipeline crossings, and telephone lines are identified and must be considered in the detailed design and construction phases.

Irvine Creek Crossing – Township Road 510 crosses Irvine Creek at Range Road 244 [north] at bridge file 00537. The existing bridge structure is a 3.7 metre diameter corrugated steel culvert about 17 metres long that is approaching the end of its service life. Additionally, the existing bridge structure carries just two rural lanes across Irvine Creek. Additional lanes, potential realignment, and increased traffic will also contribute to requirements for upgrade or replacement of this bridge structure. A bridge assessment has been completed that gives recommendations to address the future requirements at this crossing.

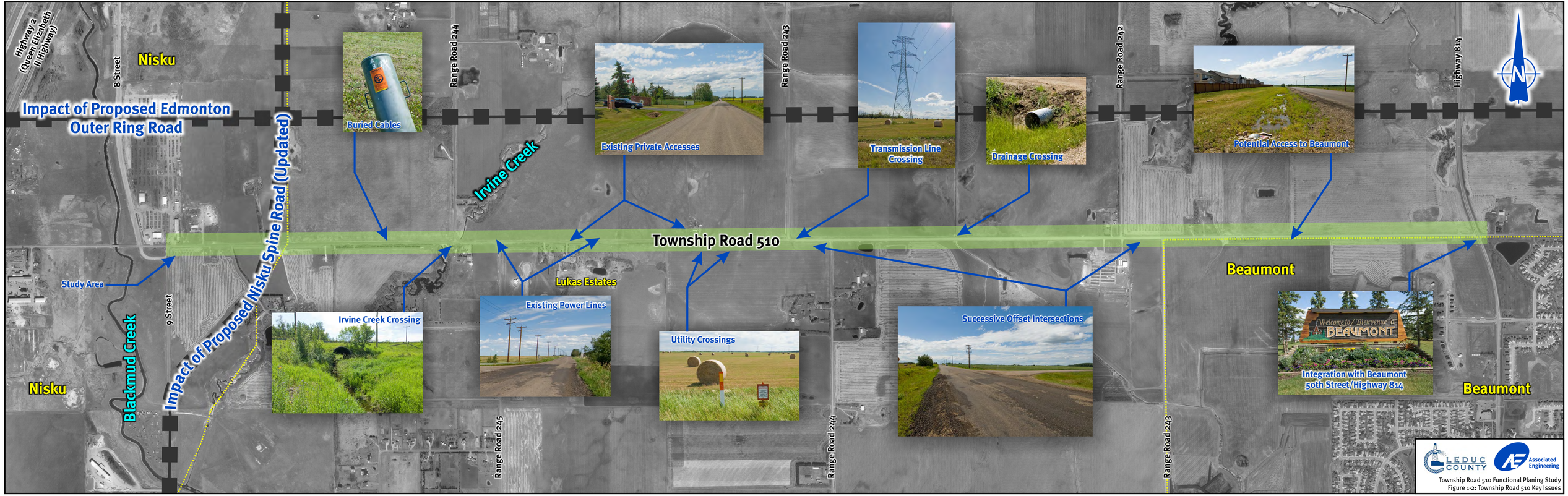
Coordination with the Town of Beaumont – The Town of Beaumont has experienced sustained growth over the last decade, and future plans identify increased development in the northwest sector of town, adjacent to the Township Road 510 study area. Development plans for these areas were reviewed and the project team met with Town of Beaumont administrative staff to discuss future development plans and potential impacts to the Township Road 510 Study. Although development plans identified access from Beaumont to Township Road 510 from the Dansereau Meadows area, this access was restricted during detailed design and construction to an emergency and pedestrian/multi-use trail access only. Other considerations with respect to the Town of Beaumont include their public works yard just north of Township Road 510, west of 50 Street, and integration with the Town's proposed multi-use trail along the south side of Township Road 510.

Access Management – There are several existing private driveway accesses to Township Road 510. Because Township Road 510 is proposed to be a major arterial roadway, significant consideration is given to the amount of private access to the roadway. An access management plan has been developed that will provide a strategy for providing access to Township Road 510 through public road intersections and private driveways. Where feasible, private driveways will be maintained on Township Road 510 until the area is redeveloped.

Environmental and Drainage – Two major drainage courses cross Township Road 510 within the study area. Irvine Creek flows from north to south and crosses Township Road 510 at Range Road 244 [north]. A tributary to Irvine Creek, the LeBlanc Canal, carries stormwater flows from Beaumont to Irvine Creek. The LeBlanc Canal crosses Township Road 510 about 800 metres west of Range Road 243 [south] and flows from south to north. Flows within Irvine Creek will be examined and taken into account when recommendations are made with respect to the bridge crossing at Township Road 510.

A study investigating the LeBlanc Canal provided recommendations for improvements to mitigate existing flooding concerns. Two major recommendations were presented to develop a consistent cross-sectional area – clean the slopes and bottom of the canal or increase the bottom width and decrease the sideslopes. Based on the study's recommendations, the crossing under Township Road 510 would need to provide a minimum flow rate of between 5.4 and 6.8 m^3/s. The extents of the drainage system create some restrictions to what type of development flows can be released and how these systems can be designed. The two main catchment areas that affect the study area are Blackmud Creek and Irvine Creek. Flow through these two catchment areas and watercourses continue through to the North Saskatchewan River. Drainage and Stormwater designs need to accommodate for both the current capacities of both Blackmud Creek and Irvine Creek as well as any future development or roadway flows.

Figure 1-2 illustrates some of the key issues investigated as part of the Township Road 510 Functional Planning Study.



LEDUC COUNTY

Associated Engineering

Township Road 510 Functional Planing Study
Figure 1-2: Township Road 510 Key Issues

1.4 PROJECT TEAM

The Associated Engineering Project Team consisted primarily of **Bryan Petzold**, **Shawn Benbow**, **Ryan Batty**, and **Jessica Peters**. When required, other members of Associated Engineering's multi-disciplinary team assisted in tasks such as bridge/structural, electrical/street lighting, and drainage concepts.

Bryan Petzold, P.Eng. is the Alberta Manager for Associated Engineering's transportation department. Bryan's role was to provide quality assurance, review, and ongoing advice throughout the project's duration.

Shawn Benbow, E.I.T. was the project manager and lead transportation planning engineer within this study. His role was to coordinate all aspects of the functional planning study and lead the transportation component.

Ryan Batty, P.Eng. was the project engineer within the study. He was responsible for traffic engineering, projections, and recommendations through the study.

Jessica Peters, CET, was the lead designer for the Township Road 510 functional planning study. Her role was to develop design plans throughout the study.

1.5 PROJECT STEERING COMMITTEE

A Project Steering Committee was developed and acted as the primary mode of information sharing between Leduc County and Associated Engineering. The Project Steering Committee met several times over the course of the study, and consisted of members of the Associated Engineering design team along with Leduc County Administration.

Representatives from Leduc County included:

- **Khushnud Yousafzai**, Engineering Coordinator (principal contact)
- **Des Mryglod**, Engineering Manager
- **Rick Stuckenberg**, Manager of Long Range Planning

From time to time, other Leduc County representatives attended project steering committee meetings, including local councillors and other members of the Leduc County administration.

2 Background Information Review

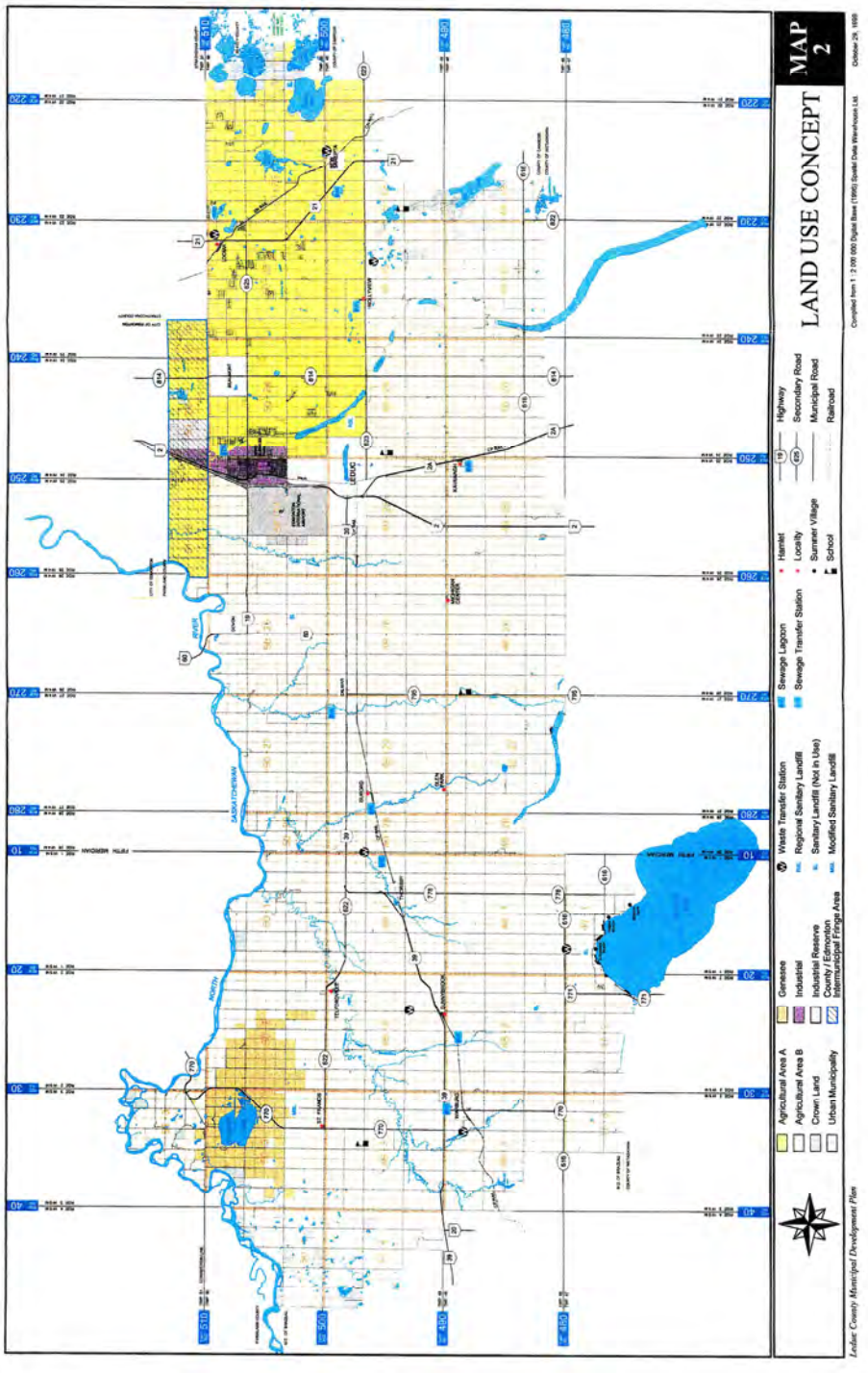
2.1 AVAILABLE DEVELOPMENT PLANS

2.1.1 Leduc County Municipal Development Plan (1999)

As required by Section 632 of the Municipal Government Act and the Provincial Land Use Policies, the Council of Leduc County adopted the Leduc County Municipal Development Plan in 1999. The purpose of this plan is to manage development land use and subdivisions to increase the present and future quality of life for the people of the Leduc County. This plan is a basis for the land use within Leduc County, including all area structure plans and subdivisions. If there is any conflict with existing area structure or redevelopment plans, the specifications of the Leduc County Municipal Development Plan are to govern. The Municipal Development Plan is also required to follow the Edmonton/Devon Restricted Development Area Regulations of October 1974, and the Edmonton International Airport Vicinity Protection Area Regulation.

The Leduc County Municipal Development Plan includes the Edmonton Intermunicipal Fringe Area, which refers to the areas adjacent to the City of Edmonton boundaries. The Leduc County Municipal Development Plan's land use concept is presented in **Figure 2-1.**

Figure 2-1: Leduc County Municipal Development Plan Land Use Concept



2.1.2 Leduc County North Major Area Structure Plan (October 2004)

The Leduc County North Major Area Structure Plan was adopted in Bylaw 14-04 in October 2004, and includes an area roughly 8,290 ha which consists primarily of a two mile wide strip bordered on the west by the North Saskatchewan River, the north by the City of Edmonton, the east by Strathcona County, and the south by Township Road 510, but also includes an area of just more than four sections directly to the west of Beaumont. With the extensive development in the Nisku area, a strategic plan was required to provide a long range land use strategy and to establish goals and policies to guide the community development and guide land use change in the area.

The area structure plan proposes three major north-south arterials and several minor or potential major arterials within the study area. These north-south arterials are critical to providing access from the City of Edmonton to Leduc County. Township Road 510 is also identified as a potential major arterial that would provide east-west connectivity within the plan area.

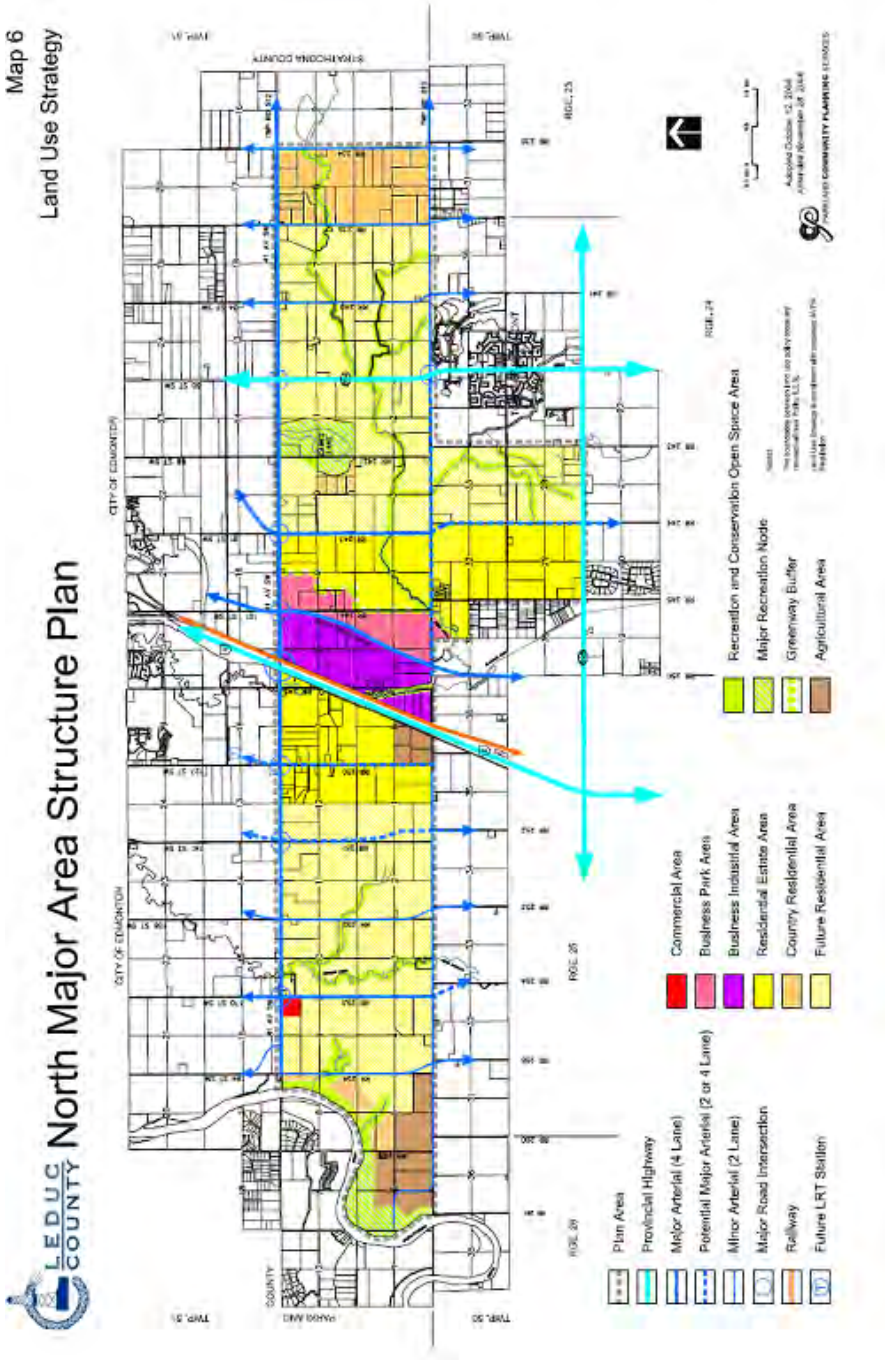
Between the Nisku Spine road and the Queen Elizabeth II Highway (Highway 2), land use is designated as primarily business industrial. Small areas east of the Nisku Spine road are identified as business park and commercial bounded by a greenway buffer. Extensive residential estate, country residential, and future residential zones are identified east of the industrial/commercial area. Recreation and conservation open space areas are located throughout the plan at natural drainage creeks and wetlands.

Leduc County administration identified that future development may not strictly follow the low density residential concepts identified in this plan. Leduc County intends to encourage increased development densities near the City of Edmonton.

At the time this study was underway, a neighbourhood concept for the East Vistas area was being developed for about two sections of land south of Township Road 510 between Irvine Creek and Range Road 244. This proposed area structure plan identifies increased residential neighbourhood densities as compared to the North Major Area Structure Plan. Additionally, this proposed plan identifies a potential community commercial node on the southwest corner of the Township Road 510 intersection with Range Road 244.

Figure 2-2 illustrates the land use strategy outlined in the North Major Area Structure Plan.

Figure 2-2: Leduc County North Major Area Structure Plan Land Use Strategy



2.1.3 Outline Plan NE ¼ Sec. 34-50-24-W4 (June 2002)

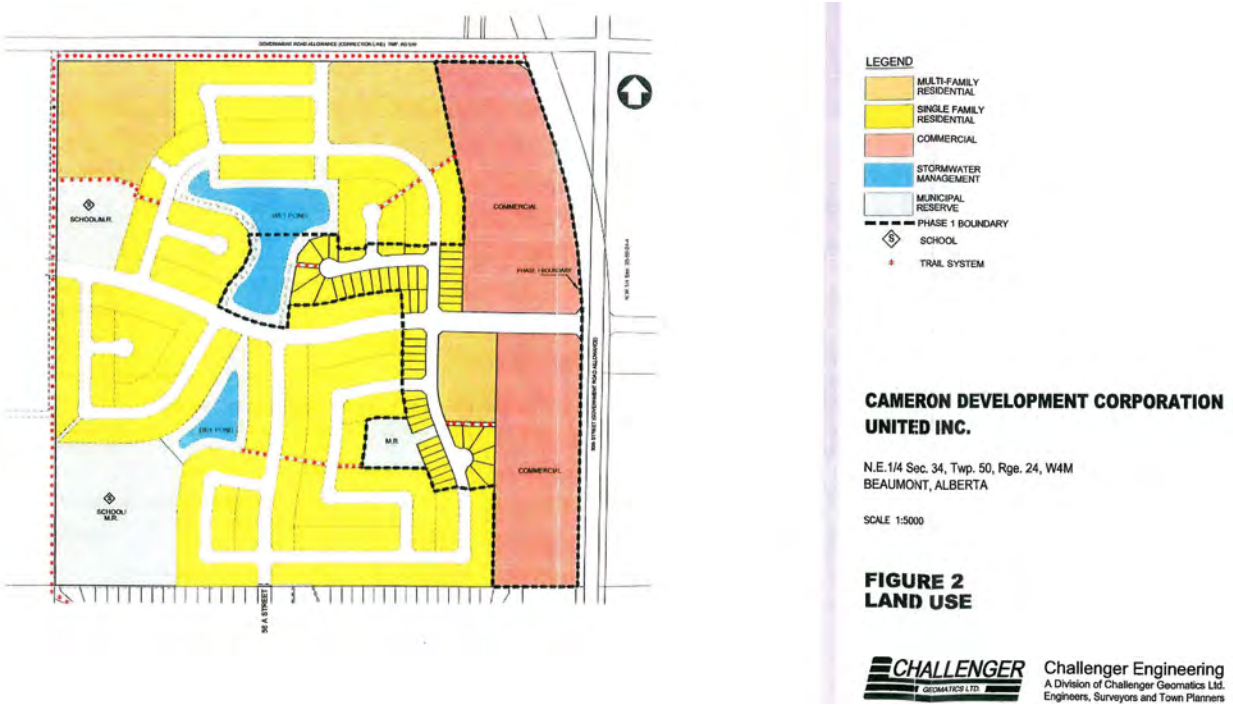
The Outline Plan for NE ¼ Sec. 34-50-24-W4 was created for the Town of Beaumont after the annexation of a larger area in January of 1999 from the Leduc County. The annexation area included lands north to Township Road 510 and west to Range Road 243. This Outline Plan includes the quarter section bordered by Township Road 510 on the north and 50 Street on the east.

Access to Township Road 510 is proposed via a collector roadway roughly in the center of the section, which continues to a main arterial road which forms part of the Beaumont external ring road (Rue Montalet).

This area is planned to include mostly single family residential, which accounts for just over two-thirds of its area. Multi-family residential areas are planned to be located in the northeast and northwest of the plan area; both multi-family areas back onto Township Road 510. Commercial areas are proposed along the east side of the plan area along 50 Street from Township Road 510 to the outer ring road. A collector road connection from the residential neighbourhood is identified to connect with Township Road 510 to the north. The land use plan and preliminary roadway layout from the outline plan is shown in **Figure 2-3.**

Much of this development has proceeded and significant portions of this outline plan were completed as the Township Road 510 Functional Planning Study was completed. Of significant importance, the collector road from this plan area to Township Road 510 has been replaced with a simple multi-use trail with knock-down bollards, to provide emergency access into the neighbourhood from Township Road 510. As developed, there is no vehicular access from this outline plan area to Township Road 510 except for emergency vehicles via the multi-use trail connector.

Figure 2-3: NE 1/4 Sec 34-50-24-W4 Outline Plan Land Use Plan



2.1.4 Dansereau Meadows Outline Plan NW ¼ Sec. 34-50-24-W4 (July 2007)

The Dansereau Meadows Outline Plan was created for the Town of Beaumont for part of the newly annexed area in January 1999. The Dansereau Meadows Outline Plan covers the quarter section south of Township Road 510 and east of Range Road 243.

Two arterial roadways bordering Dansereau Meadows are Township Road 510 and Range Road 243; Township Road 510 has no proposed direct access to the plan area while Range Road 243 has a proposed access about 400 metres south of Township Road 510. A collector roadway connects Range Road 243 through the proposed Dansereau Meadows area.

The majority of this plan area is designated as single family residential with the southeast corner reserved for a school. The southwest corner is identified to accommodate additional stormwater storage for the LeBlanc Canal and an urban services institutional area for the town. A large storm water retention pond is proposed near the center of the plan area, and an extensive pathway system follows a large section of the storm pond.

There are two emergency access routes proposed from Township Road 510; both are roughly in the middle of the plan area. These routes are primarily used as part of the town's multi-use trail system to provide non-motorized access to Township Road 510. There is no vehicular access from this outline plan area to Township Road 510 except for emergency vehicles via the two multi-use trail connectors.

The land use plan and preliminary roadway layout for the Dansereau Meadows Outline Plan is shown in **Figure 2-4.**

Figure 2-4: Dansereau Meadows Land Use Plan



2.2 PREVIOUS ROADWAY STUDIES

2.2.1 Town of Beaumont 50th Street Functional Planning Study (February 2007)

The 50th Street Functional Planning Study was developed for the Town of Beaumont to address increasing demands for traffic accommodation along the roadway. While maintaining Beaumont's small town setting, a plan was developed that improves traffic accommodation along 50 Street within the study area. In 2004, Alberta Transportation transferred the 6.4 km length of 50 Street

between 41 Avenue SW (Edmonton) and Township Road 510 to the Town of Beaumont. The 50th Street Functional Planning Study includes that 6.4 km and the length of 50 Street within the Town of Beaumont corporate limits; this includes 50 Street from 41 Avenue SW to Highway 625. This roadway serves as means of connections among Wetaskiwin, Rollyview, Leduc, Beaumont, Nisku, Edmonton, and the residents in the area. Previous minor improvements include selective surface widening, addition of intersection controls, and curb replacements. A strong focus of any improvements on 50 Street included attempts to maintain the 'small town' feel along the corridor.

According to the 50th Street Functional Planning Study, the existing (2007) Average Annual Daily Traffic (AADT) on 50 Street north of Township Road 510 averages about 14,000 vehicles. According to warrants in Alberta Transportation's highway design guide, the section of road between 41 Avenue SW and Township Road 510 warrants upgrades and additional lanes. Selective other improvements are also recommended between Township Road 510 and Highway 625.

Recommendations for improvements on 50 Street in southern Beaumont are to widen the right-of-way and create a 4 lane undivided roadway. Proposed improvements in northern Beaumont (up to Township Road 510) include a consistent 4 lane divided roadway while giving special considerations for access to the commercial businesses on the west side. To maintain Beaumont's small town effect and promote slower traffic, roadway dimensions within the Town of Beaumont are proposed to be reduced and limited to two lanes in each direction. North of the town, a large four lane divided cross section is proposed that includes a wide median and turning lanes at major intersections. The intersection with Township Road 510 is proposed to include four lanes north-south plus left and right turn bays. The 50 Street functional plan identifies a shared through/right turn lane and a shared through/left turn lane in each direction on Township Road 510 at the 50 Street intersection; no consideration was given for potential turn bays or channelization. **Figure 2-5** identifies the proposed typical cross-section on 50 Street immediately south of Township Road 510. **Figure 2-6** illustrates the proposed intersection configuration for 50 Street at Township Road 510.

Figure 2-5: Proposed 50 Street Cross-section South of Township Road 510

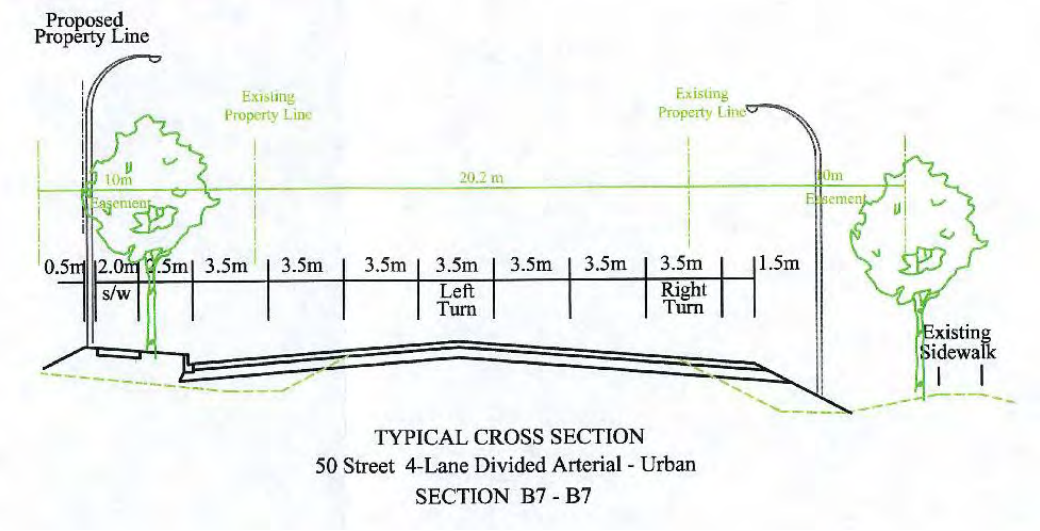
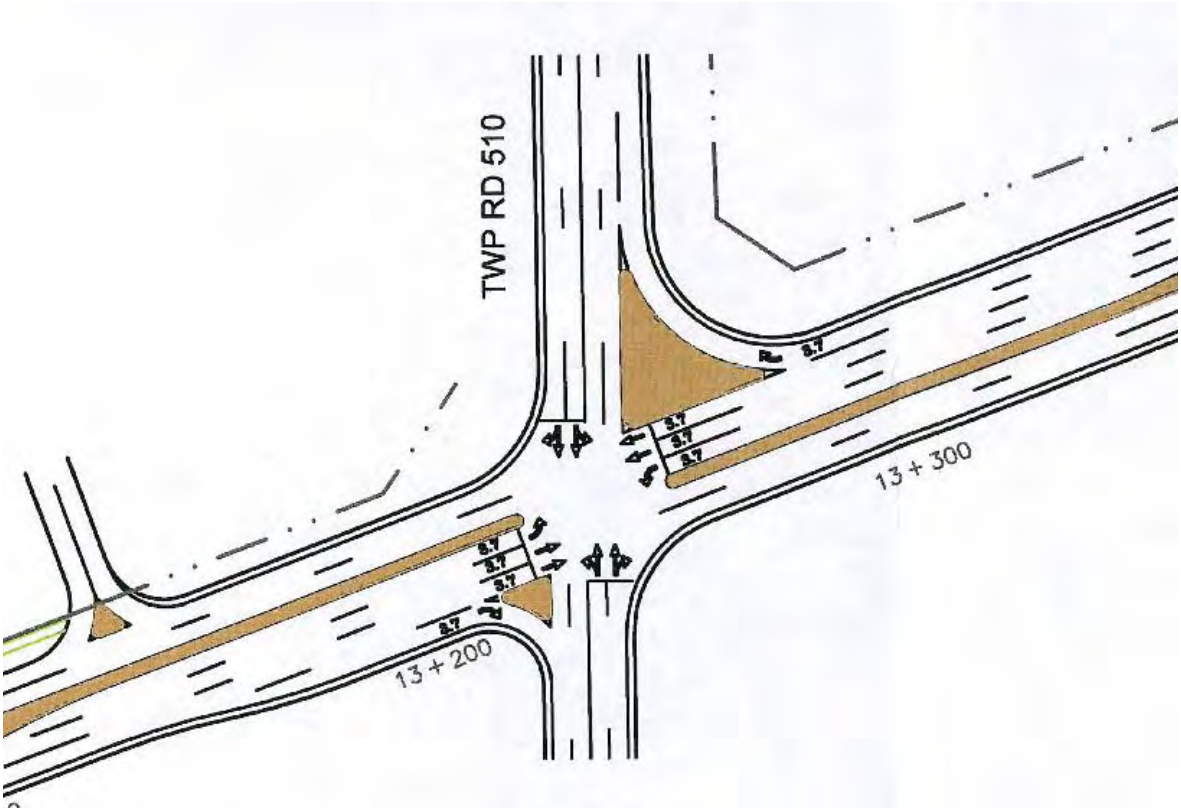


Figure 2-6: Proposed Intersection at 50 Street and Township Road 510



2.2.2 Nisku Spine Road Functional Planning Study (2006) and Update (2008)

Leduc County recently completed the 9th Street (Nisku Spine Road) Functional Planning Study that identified the future extension of 9th Street to connect with Edmonton's existing 101 Street (future 91 Street). This plan was completed in 2006, and proposed approximately four kilometres of new alignment and right of way between Township Road 510 and 41 Avenue SW. However, soon after finalizing this report, Alberta Transportation released a conceptual interchange configuration at the proposed Edmonton Regional Ring Road, just north of Township Road 510. Because of the proximity of the Nisku Spine Road interchange and the Queen Elizabeth II Highway interchange on the Edmonton Regional Ring Road, Leduc County was required to shift the alignment of the proposed Nisku Spine Road further east. An update to the functional plan was completed in 2008 which provided an updated alignment consistent with Alberta Transportation's plans for the Edmonton Regional Ring Road.

2.2.3 91 Street Connector (Highway 625 to County of Leduc Boundary) – Project Location Report Alignment Evaluation

In July of 1990 the City of Edmonton in conjunction with Leduc County and Alberta Transportation and Utilities commissioned a study of possible road alignments for 91 Street south of the City of Edmonton. The study area was from Highway 625 within Leduc County and the City of Edmonton Boundary at 41 Avenue SW, which is a distance of roughly 6.4 kilometres. This potential major route would provide additional north-south access that may help to reduce traffic volumes traveling through Beaumont.

The study developed several alignment options within the study area. Two major options propose an alignment along the same 1.4 kilometres of original right of way immediately south of the City of Edmonton boundary. Continuing south, there are two base alignments with different variations within each. The two major alignments each have different variations because of multiple constraints and considerations.

Alignment A follows the initial road alignment on the north end and intersects with township Road 510 after jogging east to go through the northeast corner of NE 32-50-24-4 and continues south along Range Road 244 to Highway 625. The constraints on this alignment include a power transmission line crossing, pipeline crossings, conflicts with existing residences, and land splitting. Alignment B does not realign to Range Road 244 but rather moves west to pass over the northwest corner of NE 32-50-24-4 and then continue south at an angle until meeting Highway 625 between Range Road 244 and Range Road 245. Potential issues with Alignment B include pipeline crossings, existing development south of Highway 625 which limits future extension to the south, land splitting, and a power transmission line crossing.

The recommendation of this study are to follow the alignment of option A as the costs roughly the same between the two options and because option A utilizes a greater amount of original right of way and thereby minimizes the amount of additional right of way required. Additionally, this alignment is most compatible with the existing development as it interferes the least with private property.

2.3 OTHER STUDIES

2.3.1 LeBlanc Canal Hydraulic Performance Upgrading Analysis (Town of Beaumont, May 2006)

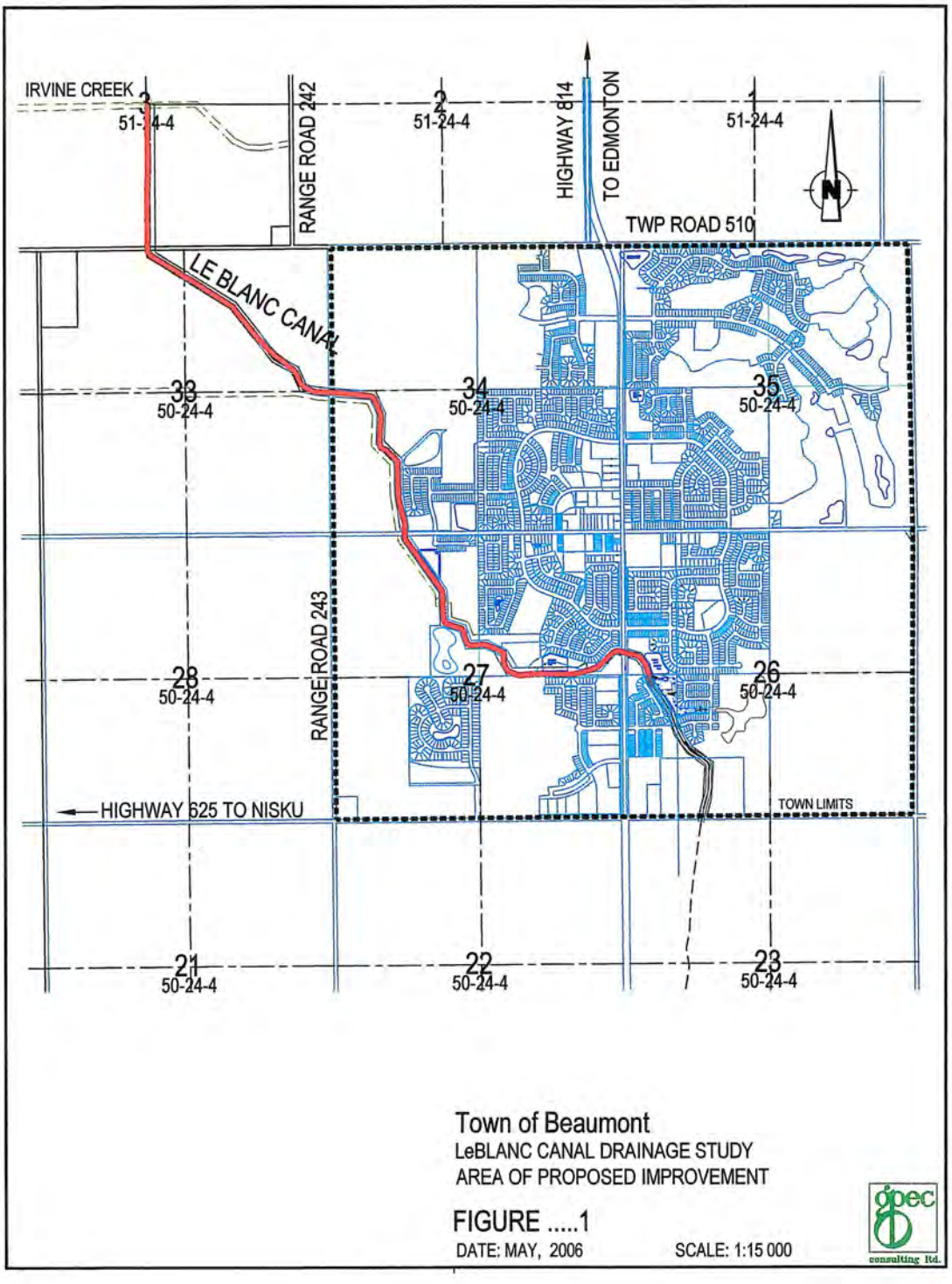
The LeBlanc Canal flows from the south side of Beaumont to the northwest and flows into Irvine Creek; this canal is the main drainage path for the storm runoff flows from development in the town. The LeBlanc Canal crosses Township Road 510 near the northeast corner of NE Sec. 33-50-24-W4 and enters into the southeast corner of SW Sec. 3-51-24-W4 before flowing into Irvine Creek in the northeast corner of that same section. In recent years, flooding along the canal has become common. This flooding is likely due to two factors – increased stormwater volumes from increased development in Beaumont, and sedimentation and plant growth within the canal itself.

The LeBlanc Canal Hydraulic Performance Upgrading study was completed to determine the canal's capacity differential after sedimentation and significant plant growth, and provides solutions that will limit the potential flooding along the channel path. The solution included two models, labelled A and B. Model A proposes that the channel's side slopes and floor to be cleaned. Model B recommends widening the canal floor to an average of 4.0 meters and ensuring all side slopes are 5:1; this model also made some recommendations for minor changes to the alignment of the canal itself. Model A would not require any additional right of way while model B would encroach on adjacent land due to sideslope widening and additional right-of-way area required.

The study concluded that field culverts at Township Road 510 would need to be upgraded to accommodate the increase for future predictions and flow rates. Each model gives a different flow rate at that location: model A predicts a peak flow of 5.4 m^3/s while model B predicts a peak flow of 6.8 m^3/s.

Areas identified for potential upgrades in the study are illustrated in **Figure 2-7**

Figure 2-7: LeBlanc Canal Drainage Study Area of Proposed Improvement



2.3.2 LeBlanc Canal Intermunicipal Drainage Study, Leduc County (August 2001)

The LeBlanc Canal was constructed around 1910 to provide drainage for the south end of Beaumont into Irvine Creek because large scale ponding was wiping out viable farmland. Initially the LeBlanc Canal was constructed to provide flood protection for a maximum of 1:5 year storm. Storm retention ponds were built in an attempt to increase the capacity of the system incrementally to 1:25 year storms and then to 1:100 year storms. Even with these upgrades, the capacity of the release system has not been able to accommodate continued growth, and increased flooding has been reported in recent years.

The purpose of the LeBlanc Canal study was to locate and observe major drainage routes to determine if storage is sufficient and make recommendations on how to most efficiently utilize the system. The Irvine Creek Water Management Plan (April 1990), the Town of Beaumont Municipal Infrastructure Study (August 2000) and other plans and material, including aerial photos, were brought together to develop a feasible drainage system that would provide the desired capacity. Each study provided some information regarding the possible storage, flows, and release rates in existing storm water facilities and surrounding areas which provides a basis to determine the future configuration of the required system.

The primary recommendations of the LeBlanc Canal study was to control the release of existing retention ponds, and increase the required storage capacity in stormwater facilities in all new developments. With increased retention within the Town of Beaumont, the study recommended a release rate of 2.15 m^3/s, which was identified in the 1990 Irvine Creek Water Management Study. This study recommended further studies on the hydraulic capacity of both Irvine Creek and Blackmud Creek to address the impact of increased flows in the LeBlanc Canal.

2.3.3 Town of Beaumont Public Works Site

Through stakeholder consultation with the Town of Beaumont, the Associated Engineering project team identified the future site of the Beaumont Public Works shop and site to be north of Township Road 510 from about 600 metres to 800 metres west of 50 Street. This development is planned to have direct access to Township Road 510 at a location about 700 metres west of 50 Street. Upon consultation with Town Administration, the Town identified that the site could be reconfigured for ultimate access to a collector road along the east edge of the site. Town administration estimated a total of about 100 vehicles accessing the site each day, regardless of season.

2.4 EXISTING TRAFFIC VOLUMES

Leduc County does not have a specific traffic count program, and therefore little was known about the specific traffic patterns along the Township Road 510. The Associated Engineering project team completed turning movement counts at major intersections along the Township Road 510 study area. Most counts were completed in September 2007; one count was completed in February 2007. The count completed in February 2007 was done as part of another project in the County. As there were only a few months between counts and no significant development or traffic patterns had changed over that time, the

Associated Engineering project team concluded that the counts would be consistent with the September 2007 counts.

AM and PM peak hour turning movement volumes for all major intersections within the Township Road 510 study area are summarized in **Table 2-1** through **Table 2-7**. Detailed traffic count information is presented in **Appendix A**.

Table 2-1: Year 2007 Traffic Volumes on Township Road 510 at Range Road 244 [north]

Control	Stop Controlled					
Travel Direction	Eastbound		Westbound		Southbound	
Geometry						
Control	Free		Free		Stop	
AM Peak Hour Volume	9	8	146	144	40	154
PM Peak Hour Volume	160	121	24	80	81	26

Table 2-2: Year 2007 Traffic Volumes on Township Road 510 at Range Road 245 [south]

Control	Stop Controlled					
Travel Direction	Eastbound		Westbound		Northbound	
Geometry						
Control	Free		Free		Stop	
Movement	T	R	L	T	L	R
AM Peak Hour Volume	25	32	80	306	45	4
PM Peak Hour Volume	273	44	8	42	60	87

Table 2-3: Year 2007 Traffic Volumes on Township Road 510 at Range Road 243 [north]

Control	Stop Controlled					
Travel Direction	Eastbound		Westbound		Southbound	
Geometry						
Control	Free		Free		Stop	
Movement	L	T	T	R	L	R
AM Peak Hour Volume	1	24	241	6	2	27
PM Peak Hour Volume	38	219	35	3	7	1

Table 2-4: Year 2007 Traffic Volumes on Township Road 510 at Range Road 244 [south]

Control	Stop Controlled					
Travel Direction	Eastbound		Westbound		Northbound	
Geometry						
Control	Free		Free		Stop	
Movement	T	R	L	T	L	R
AM Peak Hour Volume	24	1	0	234	4	1
PM Peak Hour Volume	218	6	4	35	3	1

Table 2-5: Year 2007 Traffic Volumes on Township Road 510 at Range Road 242 [north]

Control	Stop Controlled					
Travel Direction	Eastbound		Westbound		Southbound	
Geometry						
Control	Free		Free		Stop	
Movement	L	T	T	R	L	R
AM Peak Hour Volume	1	22	240	1	1	1
PM Peak Hour Volume	2	221	40	2	1	0

Table 2-6: Year 2007 Traffic Volumes on Township Road 510 at Range Road 243 [south]

Control	Stop Controlled					
Travel Direction	Eastbound		Westbound		Northbound	
Geometry						
Control	Free		Free		Stop	
Movement	T	R	L	T	L	R
AM Peak Hour Volume	18	3	2	222	20	2
PM Peak Hour Volume	197	30	4	31	5	7

Table 2-7: Year 2007 Traffic Volumes on Township Road 510 at Highway 814 (50 Street)

Control	Stop Controlled											
Travel Direction	Eastbound			Westbound			Northbound			Southbound		
Geometry												
Control	Stop			Stop			Free			Free		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
AM Peak Hour Volume	7	1	14	14	31	30	152	1111	43	13	534	162
PM Peak Hour Volume	126	22	103	30	4	23	17	558	27	41	1098	11

3 Traffic Analysis

After identifying major issues along the corridor, the project team met with the Project Steering Committee to determine the functionality of major roads within the study area. 50th Street (Highway 814) and the Nisku Spine Road were identified as the major north-south routes within the study area, and Range Road 243 [north]/244 [south] was identified as a potential minor north-south route. Then, considerable attention was given to resolving the functionality of Township Road 510 considering future development in the area and region, and regional connectivity of adjacent or connecting roadways.

3.1 EDMONTON REGIONAL TRAVEL MODEL

Alberta Transportation and the City of Edmonton jointly maintain a regional travel model that contains an inventory of all major existing and proposed roadways within the Edmonton Region. The model is updated when additional information such as future roadway plans, area structure or development plans, or zoning changes become available. This model serves to provide transportation planners a consistent set of future traffic volumes to use as a base for future roadway plans.

Until 2007, the Regional Travel Model consisted of a projected population forecast of 2.5 million people in the Edmonton Region. This growth included full buildout within the City of Edmonton's corporate limits (total Edmonton population of 1.5 million) plus additional growth in adjacent municipalities. This model did not take into account proposed medium-density future residential growth in Leduc County near the Township Road 510 study area. Additionally, there were some inconsistencies with the location of the proposed Nisku Spine Road and where it was modelled. However, information obtained from this version of the regional travel model indicated that Township Road 510 would require only two traffic lanes carrying up to 5000 daily trips.

In 2007 and 2008, the model administrators undertook a complete overhaul of the Regional Travel Model. The new model is to provide information for a 3.2 million regional population horizon, which includes some additional growth in Leduc County near the Township Road 510 study area. Unfortunately, at the time the Township Road 510 Functional Planning Study was being completed, this updated model information was not available.

Due to uncertainty in timelines for the Regional Travel Model completion, the project steering committee determined that an alternative method for developing lane and intersection treatments would be required. Specifically, regional connectivity and future/proposed land use were identified as major criteria for developing the Township Road 510 functional plan.

3.2 REGIONAL CONNECTIVITY

Leduc County's Nisku Spine Road Functional Planning Study identifies the Nisku Spine Road to carry an ultimate six lanes of traffic across Township Road 510. Significant turning movements have been assumed in that study, warranting protection for double left turning lanes and right turn channelization.

The Town of Beaumont's 50 Street Functional Planning Study identifies 50 Street as a major north-south route carrying four lanes of traffic across Township Road 510. Protection was given for left turn lanes and right turn channelization from 50 Street to Township Road 510 in each direction; however no consideration was given to future volume increases on Township Road 510. As proposed in the 50 Street Functional Plan, Township Road 510 would provide a shared through/right lane and a shared through/left lane in each direction. Considering future residential and other developments along Township Road 510 and the limited connectivity to the region, Township Road 510 is likely to carry significant volumes to 50 Street, and likewise this intersection may be expected to have substantial turning movements in all directions.

The Range Road 243 [north]/Range Road 244 [south] roadway was identified as the 91 Street Connector in its study completed in the early 1990s. However, changes to the City of Edmonton's road network in South Edmonton has resulted in numerous road relocations and name changes. Currently, Range Road 243 [north] is proposed as the future 66 Street extension from the City of Edmonton.

Both the Nisku Spine Road (connects as Edmonton's 91 Street) and 50 Street connect to the regional highway network at Edmonton's ring road, the Anthony Henday Drive (Highway 216). These two roadways are also identified in the Capital Region Integrated Growth Management Plan to have interchange connections with the future Edmonton Regional Ring Road, just north of Township Road 510.

66 Street in the City of Edmonton was constructed as a flyover at Anthony Henday Drive due to it's proximity to 50 Street and 91 Street. The Capital Region Integrated Growth Management Plan does not indicate a connection to the Edmonton Regional Ring Road at the 66 Street extension, however discussions among the project steering committee concluded that for the purposes of the Township Road 510 study, the 66 Street extension (Range Road 243) would be assumed to have at minimum a flyover at the Edmonton Regional Ring Road. From a community connectivity perspective, Range Road 243 is approximately three kilometres from 50 Street and two kilometres from the proposed Nisku Spine Road; therefore, maintaining a connection across the Edmonton Regional Ring Road would be desirable to provide additional north-south capacity to neighbouring communities.

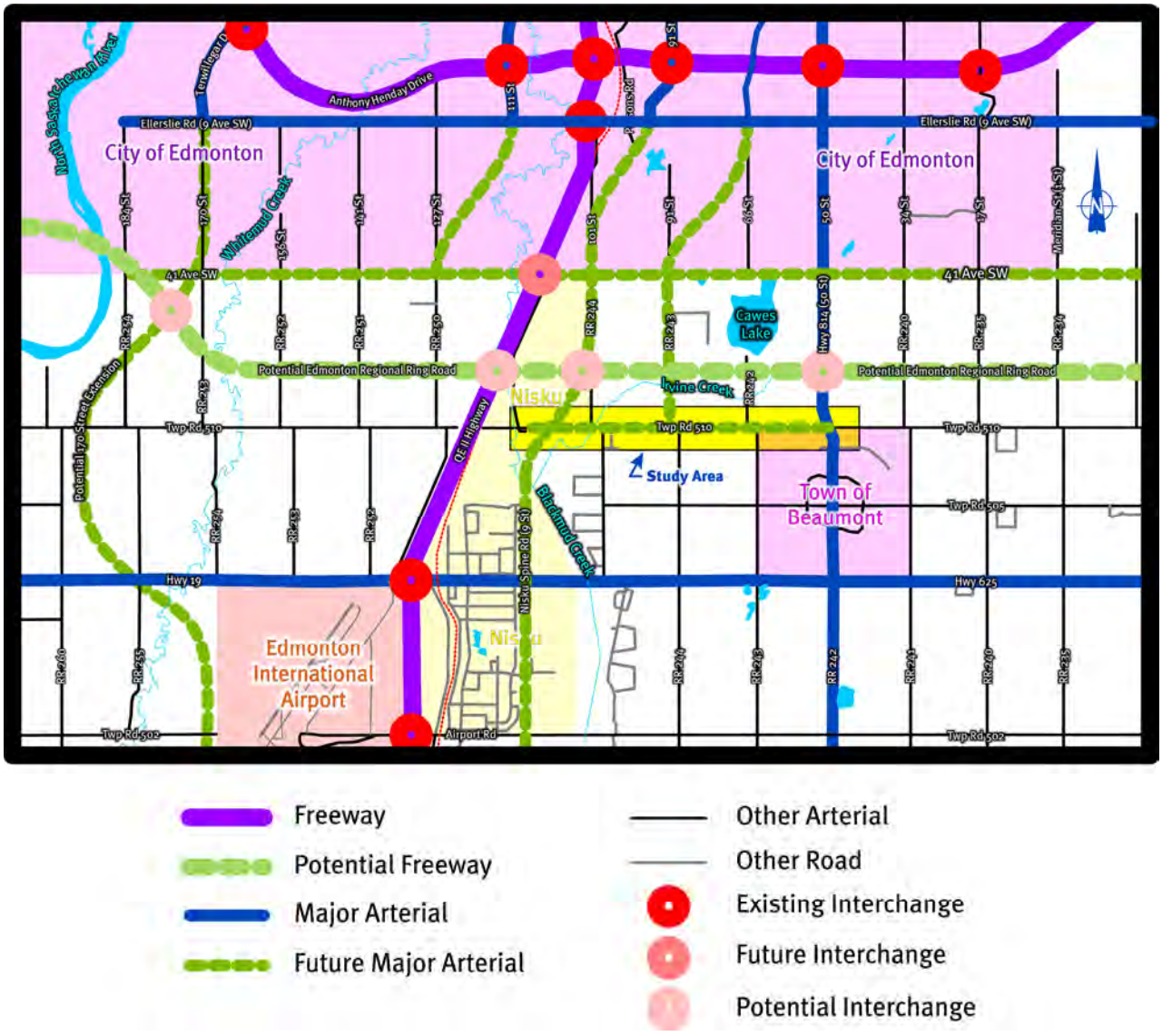
The proposed Edmonton Regional Ring Road is identified in the Capital Region Integrated Growth Management Plan to be located approximately 800 metres north of Township Road 510. Because such a high-class facility is in close proximity, this will affect the traffic patterns on the future Township Road 510. Specifically, because the Edmonton Regional Ring Road will carry significant regional through-traffic, very little regional traffic will use Township Road 510. In effect, the majority of the users on Township Road 510 will be local trips that begin or end in the communities near the roadway. However, there may still be some commuter trips between 50 Street and Nisku due to Township Road 510's location and direct connectivity. Another consideration that needs to be taken into account is that Alberta Transportation has not committed to developing this Edmonton Regional Ring Road. At the time the Township Road 510 Functional Planning Study was completed, the Edmonton Regional Ring Road was merely a concept and no funds for functional or detailed design, or construction were planned. Therefore, the design of Township Road 510 needs to reflect this uncertainty of whether the Edmonton Regional Ring Road will ever be constructed.

Highway 625 is located parallel to Township Road 510, about 3.2 kilometres south. Although not within the Township Road 510 study area, future plans for Highway 625 may affect future Township Road 510 traffic volumes. Currently, Alberta Transportation is completing a plan that identifies Highway 625 as a limited access expressway between Nisku and Beaumont. At a minimum, the highway will maintain 1.6 kilometre

spacing between intersections, or greater if required. This is significant to the Township Road 510 functional plan in that with such limited access to Highway 625, more local users may consider using Township Road 510 as their primary east-west route if connectivity to Township Road 510 is easier or greater.

Figure 3-1 illustrates the future regional road network in the region around the Township Road 510 study area.

Figure 3-1: Future Regional Road Network



3.3 FUTURE DEVELOPMENT

The Leduc County North Major Area Structure Plan identifies the land north of Highway 625 near the Township Road 510 study area as residential or future residential neighbourhoods. These areas are proposed to be developed to a density of approximately 320 units per quarter section. However, the Leduc County planning department identified through the project steering committee that expected development densities may be slightly higher due to the proximity of these lands to the City of Edmonton and the Town of Beaumont.

The East Vistas Local Area Structure Plan covers the area roughly between Township Road 510 and Highway 625 from Range Road 244 to Range Road 245. The Associated Engineering project team understands that some of the development in the East Vistas Local Area Structure Plan is proposed to provide higher density land uses than is identified in the North Major Area Structure Plan. However, at the time the Township Road 510 Functional Planning Study was completed, some public consultation on the local area structure plan was completed, but there has been no formal approval or acceptance from Leduc County. Project steering committee members expressed some desire to consider increased density development when developing long-term plans for Township Road 510. The proposed local area structure plan also identified a community commercial node at the southwest corner of Township Road 510 at Range Road 244.

3.4 FUNCTIONALITY

As noted previously, Township Road 510 has been identified as a future arterial between the Nisku Industrial Business Park and the Town of Beaumont. Goals of the Township Road 510 Functional Planning Study include determining the roadway's ultimate functionality to develop an ultimate cross-section and lane configurations. The City of Edmonton and Alberta Transportation's Edmonton regional travel model information was not available through the course of the functional planning study, and therefore the project team and project steering committee were required to develop an alternative solution to proceed forward with this study.

In investigating the regional connectivity and future growth in the area, the project steering committee and project team concluded that Township Road 510 was the obvious location of a major arterial roadway in the area. Highway 625, about three kilometres south would function as a limited access expressway, the potential Edmonton Regional Ring Road about one kilometre north would provide regional freeway access from 50 Street and the Nisku Spine Road, and therefore Township Road 510 would function as a major arterial to convey traffic to the regional system from the future neighbourhoods. Additionally, Township Road 510 will serve to provide regional connectivity between the north end of Beaumont and Nisku.

3.5 FUTURE TRAFFIC

As noted in previous sections, Alberta Transportation and the City of Edmonton's regional travel model information is not available to predict future traffic along Township Road 510. Associated Engineering has, therefore, developed a strategy for a high-level estimation of future traffic on Township Road 510 based on

predicted future development, regional connectivity, and roadway function. A brief summary of this strategy is outlined below.

3.5.1 Background Traffic

Based on traffic counts completed in 2007, the background traffic on Township Road 510 currently carries about 2,500 vehicles per day across the study area. Typical background traffic growth rates in Alberta are in the order of 2.5% per year. Assuming a build-out horizon of about 40 years, the background traffic may approximately double within this timeframe. The project team has therefore considered a background traffic component of about 5,000 vehicles per day.

There is a subdivision called The Vistas, located south of Township Road 510 west of Range Road 245 [south]. For the purposes of this study, this area has been included as part of the background traffic volumes because it is a well established neighbourhood. There is a second, newer development in the study area known as Lukas Estates. Lukas Estates is a small subdivision south of Township Road 510 east of Range Road 245 [south]. Because this subdivision is relatively new (constructed within the previous two to three years), and very few houses were occupied when the traffic counts were completed, this development has not been included in the background traffic. The Lukas Estates neighbourhood has therefore been included with the future development traffic.

3.5.2 Tributary Area

The land around the Township Road 510 study area is defined in Leduc County's North Major Area Structure Plan as future residential developments, and structured within the existing township grid road system. Highway 625 and the future Edmonton Regional Ring Road provide parallel east-west connectivity near Township Road 510. Range Road 505 currently exists east of Range Road 245 [south], connecting into the Town of Beaumont.

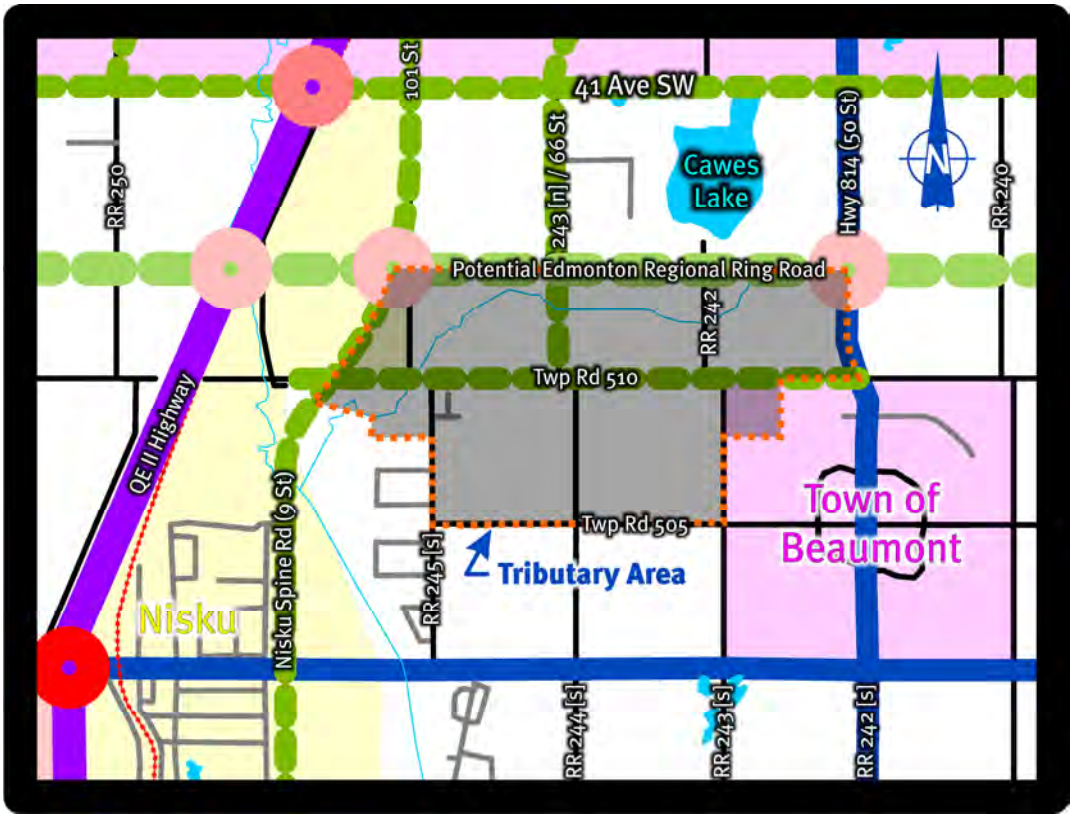
The Associated Engineering project team has developed a tributary area for development that will utilize Township Road 510. The tributary area has been defined from 50 Street in the east to the Nisku Spine Road in the west, from the proposed Edmonton Regional Ring Road in the north, to Range Road 505 in the south. As the Town of Beaumont does not provide any direct access to Township Road 510, the project team has estimated that about 50% of the Dansereau Meadows area may use Township Road 510 via the connection with Range Road 243 [south].

The proposed Edmonton Regional Ring Road serves as an obvious physical constraint to the tributary area as only select arterial roadways will cross this future freeway – the Nisku Spine Road, Range Road 243 [north], and 50 Street (Highway 814). For the purposes of this study, the project team has assumed that for the residential neighbourhoods between Township Road 510 and Highway 625, the trip distribution will be split 50/50 between Township Road 510 and Highway 625. With this in mind, the project team has simplified the tributary area to include just the 1.6 kilometre strip south of Township Road 510, to Township Road 505. Realistically, Range Road 505 may function to carry some traffic from these neighbourhoods into the Town of Beaumont. However the North Major Area Structure Plan does not identify future consideration for Range Road 505, and therefore its existence is uncertain. For the purposes of traffic generation along Township Road

510, the project team has taken the conservative estimate that the traffic generated in these neighbourhoods will all use Township Road 510.

Figure 3-2 illustrates the defined tributary area for development contribution to Township Road 510.

Figure 3-2: Township Road 510 Future Traffic Tributary Area



3.5.3 Traffic Generation

As defined in the Leduc County North Major Area Structure Plan, the residential development in the areas surrounding Township Road 510 are defined as future residential development at a density of about 320 units per quarter section. The trips generated from these units were estimated using the Institute of Transportation Engineers Trip Generation Manual (8th Edition). The trip generation rate for single-family detached housing (Land Use 210) was used in this study, which specifies 9.57 trips per day per unit. By utilizing the single family detached housing trip generation rate, which is the highest generation rate of all residential land uses, the project team has used the more conservative value for trip generation rates in the study area for the existing development zoning scenario.

Leduc County has advised the project team that they may consider denser land uses in these neighbourhoods. In the event that land zoning changes to include denser residential development, there are some implications to the residential trip generation rate. The project steering committee

has identified that increased density neighbourhoods may include townhouses or low rise apartments. The Institute of Transportation Engineers Trip Generation Manual identifies a trip generation rate of 5.81 trips per day per unit for a residential condominium/townhouse (Land Use 230) and a trip generation rate of 6.59 trips per day per unit for a low rise apartment (Land Use 221). Higher density developments also tend to lead to lower single family home trip generation rates due to modal split (such as transit or non-motorized transportation), and increased internal trip capture (due to increased employment and commercial opportunities within their neighbourhood). With these lower trip generation rates and theory, the project team has identified that the overall trip generation rates for the increased development scenario may be reduced by as much as 40%.

The proposed East Vistas Local Area Structure Plan identifies a small portion of land at the southwest corner of the intersection of Township Road 510 at Range Road 244 as a community commercial node.

As with any residential neighbourhood, a number of trips made from residences originate and end within a particular neighbourhood. These short trips may include a number of functions such as visiting a neighbour, trips to local schools, and trips to local commercial areas, such as that proposed near Range Road 244. Without detailed information from the proposed local area structure plan or development plans, it is challenging to identify trip generation rates from the potential commercial node. With this in mind, the project team has identified that a significant number of trips to the commercial node may be from pass-by trips that are already within the road network.

The Associated Engineering project team assumed all lands within the proposed East Vistas neighbourhood to be residential with respect to traffic generation. As explained above, a significant number of trips to the commercial area will be pass-by trips, and additional commercial trips can be accounted for by assuming a nominal generation rate, in this case a simple residential development. These assumptions are acceptable for this small commercial node because the expected traffic from this node is very small in comparison to the total traffic expected in all the development area around Township Road 510.

In addition to the residential neighbourhoods, there is a small portion of industrially-zoned land on the west end of the Township Road 510 study area. Traffic generation for this future development is based on the Institute of Transportation Engineers Trip Generation Manual land use 110: General Light Industrial. This land use identifies a trip generation rate of 51.80 trips per day per acre. This number has not been adjusted for internal trip capture because the nature of these future businesses is not known.

Table 3-1 outlines the expected trip generation rates for the Township Road 510 study area as discussed above.

Table 3-1: Trip Generation Rates for the Township Road 510 Study Area

Development Type	ITE Trip Generation Manual Rate
Single Family Detached (Land Use 210)	9.57 trips/day/unit
Residential Condominium/Townhouse (Land Use 230)	5.81 trips/day/unit
Low Rise Apartment (Land Use 221)	6.59 trips/day/unit
General Light Industrial (Land Use 110)	51.80 trips/day/acre

The Associated Engineering project team used the above information on expected land use zones within the defined tributary area to develop a system of development area zones that were used for trip generation with the proposed development. Figure 3-3 illustrates the eight development area zones and the corresponding development area numbers used in trip generation for the Township Road 510 functional planning study. The areas were broken down in such a way that each area had a typical common access location to Township Road 510. A summary of each areas' size, number of expected development units (for residential development), trip generation rates, and total daily trips per zone is included in Table 3-2. The total trips in each development area are used in the following sections to develop estimated daily trips on Township Road 510 for the full development scenario.

Figure 3-3: Development Area Numbers



Table 3-2: Trip Generation by Development Area

Area	Size (ha)	Units	Trip Generation Rate	Total Daily Trips
1	179.0	885	9.57 trips/unit	8,469
2	260.8	1,289	9.57 trips/unit	12,336
3	133.5	660	9.57 trips/unit	6,316
4	31.5	400	9.57 trips/unit	3,828
5	195.0	964	9.57 trips/unit	9,225
6	130.8	646	9.57 trips/unit	6,182
7	37.0	183	9.57 trips/unit	1,751
8	84.0	-	128.20 trips/ha	10,769

3.5.4 Trip Distribution

Without detailed origin-destination travel information, it is difficult to predict future vehicular traffic distribution in and out of the neighbourhoods in the Township Road 510 study area. Therefore, the

Associated Engineering project team has made a number of critical assumptions regarding trip distribution, all of which are outlined below.

Due to these areas' close proximity to the Nisku Industrial Business Park and the significant employment potential within Nisku, a significant number of trips are assumed to originate or end in Nisku. The City of Edmonton contains many major employment, commercial, and recreational centres, and is a draw for vehicular trips from all areas of the capital region. Thirdly, the Town of Beaumont is a small municipality with some commercial and recreational centres that may draw visitors from the Township Road 510 study area. The Associated Engineering project team has estimated that about 40% of the generated trips will be destined for the City of Edmonton, 30% will be to the Nisku Industrial Business Park, and 30% will be to the Town of Beaumont.

For vehicular trips originating or ending in the industrial development, the project team has assumed that 50% of these trips will be to the Nisku Industrial Business Park, and 50% will be to Edmonton via the Nisku Spine Road.

3.5.5 Trip Assignment

Because much of the trip generation, distribution, and assignment are estimated based on good engineering judgement, trip assignment was limited to average daily traffic on Township Road 510. Considering turning movements at intersections based on such limited knowledge may not be an accurate representation of intersection treatment required. Therefore, intersection treatments will be developed using a different strategy based on functionality, outlined in Section 3.6.2.

For trip assignment, the tributary area defined for this study has been broken into eight major areas according to proximity to major roadways. All trips destined for the Nisku Industrial Business Park were assigned to Township Road 510 travelling to the west. All trips destined for the Town of Beaumont were assigned to Township Road 510 travelling to the east (no trips were assigned to Range Road 505, due to uncertainty in the location or existence of Township Road 505 as noted previously). Three major roadways connect to the City of Edmonton from the study area. Trips destined for the City of Edmonton were distributed based on each area's proximity to these three roadways – the Nisku Spine Road, Range Road 243 [N], and 50 Street. Table 3-3 presents the origin/destination split and total daily traffic expected from each development area. Figure 3-4 illustrates the estimated daily traffic on each major segment of Township Road 510 within the study area.

Table 3-3: Trip Distribution

Area	Total Daily Trips	To Nisku		To Beaumont		To Edmonton via Nisku Spine Road		To Edmonton via Range Road 243 [north]		To Edmonton via 50 Street	
		%	Trips	%	Trips	%	Trips	%	Trips	%	Trips
1	8,469	30%	2,541	30%	2,541	25%	2,117	10%	847	5%	423
2	12,336	30%	3,701	30%	3,701	5%	617	30%	3,701	5%	617
3	6,316	30%	1,895	30%	1,895	10%	632	10%	632	20%	1,263
4	3,828	30%	1,148	30%	1,148	5%	191	10%	383	25%	957
5	9,225	30%	2,768	30%	2,768	10%	923	10%	923	20%	1,845
6	6,182	30%	1,855	30%	1,855	5%	309	30%	1,855	5%	309
7	1,751	30%	525	30%	525	25%	438	10%	175	5%	88
8	10,769	50%	5,385	0%	0	50%	5,385	0%	0	0%	0

Figure 3-4: Estimated Daily Traffic



3.5.6 Estimated Future Traffic Volumes

Based on the trip generation, distribution, and assignment presented in the preceding sections, the Associated Engineering project team has developed future traffic volume estimates for planned future development along the Township Road 510 study area. Using the methods described above, the project team has estimated a daily traffic of about 20,000 vehicles per day on Township Road 510 within the study area for the proposed development within the area. Summing the predicted future traffic with the predicted background traffic (5,000 vehicles per day), the estimated long-term traffic volumes are about 25,000 vehicles per day for the approved development scenario.

The Associated Engineering project team recognizes that Leduc County is considering increasing target development densities in the areas near the Township Road 510 study area. Therefore, the project team has performed a basic sensitivity analysis with respect to development densities. In the event that development densities approximately double, the average daily trips along Township Road 510 would increase substantially, but not double those of the proposed development scenario. As discussed in Section 3.5.3, increased development densities would increase the number of townhouse and apartment buildings, which typically have a lower trip generation rate than single family detached houses. As well, there would be additional internal trip capture because of increased employment and commercial opportunities within each neighbourhood. The Associated Engineering project team has estimated a daily traffic volume on Township Road 510 for a potential increased development scenario by doubling the estimated 20,000 vehicles per day and discounting it by 30% to account for lower trip generation rates and increased internal trip capture. This amounts to an estimated daily traffic volume of about 28,000 vehicles. Summing this projection with the predicted background traffic growth, the estimated long-term traffic volumes for this increased density scenario may be about 33,000 vehicles per day.

Table 3-4 presents the future traffic predictions on Township Road 510 within the study area.

Table 3-4: Future Traffic Predictions on Township Road 510

Scenario	Average Daily Traffic (AADT)
Background Traffic	2,500
Background Traffic Growth	2,500
Development Traffic (development densities as identified in the North Major ASP)	20,000
Increased Density Development Traffic (development densities double that identified in the North Major ASP)	28,000
Projected Future Traffic (proposed development densities)	**25,000**
Projected Future Traffic (increased development densities)	**33,000**

3.6 EXISTING TRAFFIC ANALYSIS

The Associated Engineering project team collected traffic movement counts at all major intersections along Township Road 510 within the study area in 2007. A summary of these counts is presented in Section 2.4. With these traffic counts, the project team completed a preliminary analysis to determine the Township Road 510 base year operation. Additionally, short-term improvements were investigated where existing intersections operated below an acceptable level of service.

3.6.1 Modelling Criteria

Base year traffic analysis was completed using methods for roadway and intersection levels of service and volume-to-capacity ratios as outlined in the Transportation Research Board's 2000 Highway Capacity Manual using Trafficware's Synchro/SimTraffic 7 software. Intersection operations are typically rated by two measures: level of service (LOS) and volume-to-capacity ratios (v/c).

Level of service is based on the estimated average delay per vehicle for all traffic passing through an intersection. Delays can be calculated for all traffic through an intersection, and can be averaged for each approach or for the intersection as a whole. It is important to investigate average approach delay as well as overall delays, because significant free-flow through movements may significantly reduce delay on stop-controlled movements, causing an artificially high level of service for an intersection. A high level of service is a result of very low average delay; the highest level of service is identified as LOS A. A low level of service is a result of a large average delay; typically, the lowest level of service is identified as LOS F. The level of service categories also vary depending on whether the intersection is signalized or stop- or yield- controlled. The Highway Capacity Manual

justifies this difference by noting that drivers stopped at a signal light will have more tolerance for delays. **Table 3-5** identifies the level of service criteria for intersections.

Table 3-5: Level of Service Criteria for Intersections

Level of Service	Average Signalized Control Delay per Vehicle (s)	Average Stop Control Delay per Vehicle (s)
A	less than 10	less than 10
B	10 – 20	10 – 15
C	20 – 35	15 – 25
D	35 – 55	25 – 35
E	55 – 80	35 – 50
F	more than 80	more than 50

The volume-to-capacity ratio of an intersection describes the extent to which the traffic volumes can be accommodated by the theoretical physical capacity of the road configuration and traffic control. As with levels of service, volume-to-capacity ratios can be calculated for an intersection approach or for an intersection as a whole. A value less than 0.9 indicates that there is generally sufficient capacity to accommodate the traffic on the approach or at the intersection. A value between 0.9 and 1.0 suggests unstable operations and congestion may occur as volumes are nearing the theoretical capacity of the roadway. A calculated value over 1.0 indicates that volumes are theoretically exceeding capacity. **Table 3-6** identifies the volume-to-capacity criteria for intersections.

Table 3-6: Volume-to-Capacity Criteria for Intersections

Volume-to-Capacity Ratio	Indication
less than 0.9	sufficient intersection capacity
0.9 to 1.0	volumes approaching intersection capacity
greater than 1.0	volumes exceed theoretical intersection capacity

Leduc County's roadway design guidelines do not provide intersection service criteria; therefore, the project team referenced guidelines accepted by Alberta Transportation and the City of Edmonton. Alberta Transportation outlines that primary roadways typically be maintained at a LOS C or higher. The City of Edmonton identifies that roadways within the city be maintained at a LOS of D or better. The City of Edmonton's design criteria provides for slightly lower levels of service because a driver in an urban environment is much more likely to accept longer delays at intersections. Because Township Road 510 will be developed into an urban arterial roadway, the Associated Engineering project team has investigated the intersection levels of service to obtain a LOS D or better. Level of service is used as the primary service indicator, while volume-to-capacity ratios are used as a supplement to ensure that the roadways volumes are sufficiently less than the theoretical capacity.

3.6.2 Base Year Traffic Analysis

The Associated Engineering project team modeled the existing network based on the collected turning movement traffic counts. Detailed summaries of all the intersections are presented in **Table 3-7** through **Table 3-13**. More detailed calculations for each intersection are included in **Appendix B**.

Table 3-7: Intersection Analysis on Township Road 510 at Range Road 244 [north]

Control		Stop Controlled					
Travel Direction		Eastbound		Westbound		Southbound	
Geometry							
Control		Free		Free		Stop	
Movement		L	T	T	R	L	R
AM Peak	Volume	9	8	146	144	40	154
	v/c	0.01	0.01	0.19	0.19	0.27	0.27
	Delay (s)	4.2	4.2	0.0	0.0	11.3	11.3
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.2	0.2	0.0	0.0	8.3	8.3
	Approach Delay (s)	4.2		0.0		11.3	
	Approach LOS	A		A		B	
	Intersection Delay (s)	4.5					
	Intersection LOS	A					
PM Peak	Volume	160	121	24	80	81	26
	v/c	0.12	0.12	0.07	0.07	0.23	0.23
	Delay (s)	4.8	4.8	0.0	0.0	14.2	14.2
	LOS	A	A	A	A	B	B
	95% Queue (m)	3.0	3.0	0.0	0.0	6.7	6.7
	Approach Delay (s)	4.8		0.0		14.2	
	Approach LOS	A		A		B	
	Intersection Delay (s)	5.9					
	Intersection LOS	A					

Table 3-8: Intersection Analysis on Township Road 510 at Range Road 245 [south]

Control		Stop Controlled					
Travel Direction		Eastbound		Westbound		Northbound	
Geometry							
Control		Free		Free		Stop	
Movement		T	R	L	T	L	R
AM Peak	Volume	25	32	80	306	45	4
	v/c	0.04	0.04	0.06	0.06	0.11	0.11
	Delay (s)	0.0	0.0	2.0	2.0	13.3	13.3
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.0	0.0	1.4	1.4	2.8	2.8
	Approach Delay (s)	0.0		2.0		13.3	
	Approach LOS	A		A		B	
	Intersection Delay (s)	2.9					
	Intersection LOS	A					
PM Peak	Volume	273	44	8	42	60	87
	v/c	0.20	0.20	0.01	0.01	0.24	0.24
	Delay (s)	0.0	0.0	1.3	1.3	12.0	12.0
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.0	0.0	0.2	0.2	7.0	7.0
	Approach Delay (s)	0.0		1.3		12.0	
	Approach LOS	A		A		B	
	Intersection Delay (s)	3.6					
	Intersection LOS	A					

Table 3-9: Intersection Analysis on Township Road 510 at Range Road 242 [north]

Control		Stop Controlled					
Travel Direction		Eastbound		Westbound		Southbound	
Geometry							
Control		Free		Free		Stop	
Movement		L	T	T	R	L	R
AM Peak	Volume	1	24	241	6	2	27
	v/c	0.00	0.00	0.16	0.16	0.04	0.04
	Delay (s)	0.3	0.3	0.0	0.0	9.9	9.9
	LOS	A	A	A	A	A	A
	95% Queue (m)	0.0	0.0	0.0	0.0	1.0	1.0
	Approach Delay (s)	0.3		0.0		9.9	
	Approach LOS	A		A		A	
	Intersection Delay (s)	1.0					
	Intersection LOS	A					
PM Peak	Volume	38	219	35	3	7	1
	v/c	0.03	0.03	0.02	0.02	0.01	0.01
	Delay (s)	1.3	1.3	0.0	0.0	10.6	10.6
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.6	0.6	0.0	0.0	0.3	0.3
	Approach Delay (s)	1.3		0.0		10.6	
	Approach LOS	A		A		B	
	Intersection Delay (s)	1.4					
	Intersection LOS	A					

Table 3-10: Intersection Analysis on Township Road 510 at Range Road 244 [south]

Control		Stop Controlled					
Travel Direction		Eastbound		Westbound		Northbound	
Geometry							
Control		Free		Free		Stop	
Movement		T	R	L	T	L	R
AM Peak	Volume	24	1	0	234	4	1
	v/c	0.02	0.02	0.00	0.00	0.01	0.01
	Delay (s)	0.0	0.0	0.0	0.0	9.8	9.8
	LOS	A	A	A	A	A	A
	95% Queue (m)	0.0	0.0	0.0	0.0	0.2	0.2
	Approach Delay (s)	0.0		0.0		9.8	
	Approach LOS	A		A		A	
	Intersection Delay (s)	0.2					
	Intersection LOS	A					
PM Peak	Volume	218	6	4	35	3	1
	v/c	0.14	0.14	0.00	0.00	0.01	0.01
	Delay (s)	0.0	0.0	0.8	0.8	10.0	10.0
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.0	0.0	0.1	0.1	0.1	0.1
	Approach Delay (s)	0.0		0.8		10.0	
	Approach LOS	A		A		B	
	Intersection Delay (s)	0.3					
	Intersection LOS	A					

Table 3-11: Intersection Analysis on Township Road 510 at Range Road 242 [south]

Control		Stop Controlled					
Travel Direction		Eastbound		Westbound		Southbound	
Geometry							
Control		Free		Free		Stop	
Movement		L	T	T	R	L	R
AM Peak	Volume	1	22	240	1	1	1
	v/c	0.00	0.00	0.15	0.15	0.00	0.00
	Delay (s)	0.3	0.3	0.0	0.0	9.9	9.9
	LOS	A	A	A	A	A	A
	95% Queue (m)	0.0	0.0	0.0	0.0	0.1	0.1
	Approach Delay (s)	0.3		0.0		9.9	
	Approach LOS	A		A		A	
	Intersection Delay (s)	0.1					
	Intersection LOS	A					
PM Peak	Volume	2	221	40	2	1	0
	v/c	0.00	0.00	0.03	0.03	0.00	0.00
	Delay (s)	0.1	0.1	0.0	0.0	10.1	10.1
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.0	0.0	0.0	0.0	0.0	0.0
	Approach Delay (s)	0.1		0.0		10.1	
	Approach LOS	A		A		B	
	Intersection Delay (s)	0.1					
	Intersection LOS	A					

Table 3-12: Intersection Analysis on Township Road 510 at Range Raod 243 [south]

Control		Stop Controlled					
Travel Direction		Eastbound		Westbound		Northbound	
Geometry							
Control		Free		Free		Stop	
Movement		T	R	L	T	L	R
AM Peak	Volume	18	3	2	222	20	2
	v/c	0.01	0.01	0.00	0.00	0.03	0.03
	Delay (s)	0.0	0.0	0.1	0.1	10.0	10.0
	LOS	A	A	A	A	B	B
	95% Queue (m)	0.0	0.0	0.0	0.0	0.8	0.8
	Approach Delay (s)	0.0		0.0		10.0	
	Approach LOS	A		A		B	
	Intersection Delay (s)	0.9					
	Intersection LOS	A					
PM Peak	Volume	197	30	4	31	5	7
	v/c	0.15	0.15	0.00	0.00	0.02	0.02
	Delay (s)	0.0	0.0	0.9	0.9	9.8	9.8
	LOS	A	A	A	A	A	A
	95% Queue (m)	0.0	0.0	0.1	0.1	0.4	0.4
	Approach Delay (s)	0.0		0.9		9.8	
	Approach LOS	A		A		A	
	Intersection Delay (s)	0.5					
	Intersection LOS	A					

Table 3-13: Intersection Analysis on Township Road 510 at Highway 814 (50 Street)

Control		Stop Controlled											
Travel Direction		Eastbound			Westbound			Northbound			Southbound		
Geometry													
Control		Stop			Stop			Free			Free		
Movement		L	T	R	L	T	R	L	T	R	L	T	R
AM Peak	Volume	7	1	14	14	31	30	152	1111	43	13	534	162
	v/c	Err	Err	Err	1.86	1.86	1.86	0.19	0.19	0.03	0.03	0.45	0.45
	Delay (s)	Err	Err	Err	605.9	605.9	605.9	7.2	7.2	0.0	11.7	11.7	0.45
	LOS	F	F	F	F	F	F	A	A	A	B	B	A
	95% Queue (m)	Err	Err	Err	63.6	63.6	63.6	5.4	5.4	0.0	0.6	0.0	0.0
	Approach Delay (s)	Err			605.9			7.0			0.2		
	Approach LOS	F			F			A			A		
	Intersection Delay (s)	Err											
	Intersection LOS	F											
PM Peak	Volume	126	22	103	30	4	23	17	558	27	41	1098	11
	v/c	4.3	4.3	4.3	2.57	2.57	2.57	0.02	0.02	0.05	0.05	0.71	0.71
	Delay (s)	Err	Err	Err	1052.7	1052.7	1052.7	0.9	0.9	0.0	9.0	0.0	0.0
	LOS	F	F	F	F	F	F	A	A	A	A	A	A
	95% Queue (m)	Err	Err	Err	58.8	58.8	58.8	0.8	0.8	0.0	1.1	0.0	0.0
	Approach Delay (s)	Err			1052.7			0.8			0.3		
	Approach LOS	F			F			A			A		
	Intersection Delay (s)	1247.9											
	Intersection LOS	F											

The analysis presented in the preceding tables illustrate that the existing traffic operates at high levels of service through most intersections along within the Township Road 510 study area. However, the intersection of Township Road and Highway 814 (50 Street) operates at unacceptable levels of service based on the Synchro/HCM analysis completed for the existing traffic volumes.

Because the HCM analysis indicates that the Highway 814 intersection does not operate acceptably, the project team investigated the warrants for signalization. A signal warrant matrix procedure was completed for the 2007 volumes at Township Road 510 and Highway 814 (50 Street). The Canadian Traffic Signal Warrant Matrix Procedure was developed by the Transportation Association of Canada in 2005 to determine the need for traffic signals at an intersection. The signal warrant matrix is based on the six peak hours of traffic during an average day. Using traffic count data obtained in September 2007, the six peak hours required by the signal warrant matrix were calculated and are presented in Table 3-14.

Table 3-14: Peak Hour Percentages for Signal Warrant Analysis

Period	Percentage of Peak Hour Traffic
07:00 - 08:00	100 % of AM peak
08:00 - 09:00	70 % of AM peak
11:30 - 12:30	45 % of AM/PM peak average
12:30 - 13:30	45 % of AM/PM peak average
16:45 - 17:45	100 % of PM peak
17:45 - 18:45	70 % of PM peak

The signal warrant matrix procedure identifies a score of 100 or higher as the basis for determining the need for traffic signals. The calculated signal warrant matrix score for the Township Road 510 intersection with Highway 814 (50 Street) was 117. Therefore, the signal warrant matrix procedure indicates a warrant for signals at this intersection. Detailed results of the signal warrant analysis are included in **Appendix B**.

The results of this analysis are consistent with local observations at this site obtained through the public consultation phase of the Township Road 510 Functional Planning Study. **Section 5** outlines the public consultation performed in this study.

3.6.3 Interim Improvements

Based on the analysis presented in **Section 3.6.2**, some interim improvements may be necessary to accommodate existing traffic volumes at the intersection of Township Road 510 and Highway 814 (50 Street). Analysis on the existing traffic volumes with the existing intersection configuration result in unacceptable levels of service and volume-to-capacity ratios. As noted above, this result is consistent with local resident's observations of the intersection.

As the recommended functional plans for Township Road are significantly different than what currently exists at the intersection of Township Road 510, most interim improvements may result in throwaway costs. Therefore, the project team has attempted to make interim recommendations that

will be simple to implement, have lower costs comparable to other upgrades, and may be carried forward to the ultimate intersection configuration when it is constructed.

The Associated Engineering project team performed analysis using Synchro/SimTraffic 7 to determine a minimum requirement to obtain an acceptable level of service and volume-to-capacity ratio (LOS D and v/c 0.9 or better). The analysis indicated that to obtain acceptable service functions the intersection would need to signalized. However, a Synchro analysis with the existing lane configuration indicated that there would still be operational problems, with several movements with unacceptable service functions, such as levels of service E or F. Table 3-15 presents the results of the Synchro/HCM analysis of the Township Road 510 intersection at Highway 814 (50 Street) with the existing lane configuration with added traffic signals.

Table 3-15: Intersection Analysis for Township Road 510 at Highway 814 (50 Street) with Signals and Existing Lane Configuration

Control		Stop Controlled											
Travel Direction		Eastbound			Westbound			Northbound			Southbound		
Geometry													
Control		Signal			Signal			Signal			Signal		
Movement		L	T	R	L	T	R	L	T	R	L	T	R
AM Peak	Volume	7	1	14	14	31	30	152	1111	43	13	534	162
	v/c	0.06	0.06	0.06	0.37	0.37	0.37	1.16	1.16	0.03	0.10	0.49	0.49
	Delay (s)	60.9	60.9	60.9	68.0	68.0	68.0	94.0	94.0	2.0	3.5	4.4	4.4
	LOS	E	E	E	E	E	E	F	F	A	A	A	A
	Approach Delay (s)	60.9			68.0			90.9			4.4		
	Approach LOS	E			E			F			A		
	Intersection Delay (s)	60.8											
	Intersection LOS	E											
PM Peak	Volume	126	22	103	30	4	23	17	558	27	41	1098	11
	v/c	0.87	0.87	0.87	0.16	0.16	0.16	0.58	0.58	0.02	0.0	0.89	0.89
	Delay (s)	64.7	64.7	64.7	32.0	32.0	32.0	8.3	8.3	3.5	4.1	18.5	18.5
	LOS	E	E	E	C	C	C	A	A	A	A	B	B
	Approach Delay (s)	64.7			32.0			8.1			18.0		
	Approach LOS	E			C			A			B		
	Intersection Delay (s)	21.2											
	Intersection LOS	C											

Based on this analysis, in addition to adding traffic signals, the lanes at the intersection would need to be reconfigured, by repainting to a different configuration. Both of these recommendations would need to be implemented to obtain acceptable levels of service and volume-to-capacity ratios. These changes are detailed below. A summary of the Synchro/HCM intersection analysis with the recommended improvements, including traffic signals and lane reconfiguration, is presented in **Table 3-16**. Detailed calculations of the traffic analysis with the recommended improvements are included in **Appendix B**.

Table 3-16: Intersection Analysis with Recommended Improvements on Township Road 510 at Highway 814 (50 Street)

Control		Stop Controlled											
Travel Direction		Eastbound			Westbound			Northbound			Southbound		
Geometry													
Control		Signal			Signal			Signal			Signal		
Movement		L	T	R	L	T	R	L	T	R	L	T	R
AM Peak	Volume	7	1	14	14	31	30	152	1111	43	13	534	162
	v/c	0.04	0.04	0.04	0.16	0.16	0.16	0.43	0.96	0.96	0.15	0.58	0.58
	Delay (s)	26.0	26.0	26.0	27.5	27.5	27.5	8.8	27.2	27.2	7.3	8.0	8.0
	LOS	C	C	C	C	C	C	A	C	C	A	A	A
	Approach Delay (s)	26.0			27.5			25.1			8.0		
	Approach LOS	C			C			C			A		
	Intersection Delay (s)	19.4											
	Intersection LOS	B											
PM Peak	Volume	126	22	103	30	4	23	17	558	27	41	1098	11
	v/c	0.81	0.81	0.81	0.15	0.15	0.15	0.19	0.48	0.48	0.10	0.91	0.91
	Delay (s)	51.4	51.4	51.4	27.6	27.6	27.6	8.5	6.7	6.7	4.3	21.3	21.3
	LOS	D	D	D	C	C	C	A	A	A	A	C	C
	Approach Delay (s)	51.4			27.6			6.8			20.7		
	Approach LOS	D			C			A			C		
	Intersection Delay (s)	20.6											
	Intersection LOS	C											

Traffic Signal Lights

The existing intersection controls traffic via stop signs in the eastbound and westbound directions. To obtain acceptable levels of service and volume-to-capacity ratios for all intersection approaches, traffic signal lights are be required. Although constructing the future recommended intersection will require a complete reconstruction of the intersection, the traffic signals, poles, and controller could be relocated and reused when the intersection is upgraded.

Lane Reconfiguration

The existing intersection functions as a single lane eastbound and a single lane westbound, providing through, left, and right movements from the same lane for those movements. The intersection provides a northbound dedicated right turn and a shared through-left turn lane. Southbound, the intersection provides a dedicated left turn lane and a shared through-right turn lane. Even with the addition of traffic signals at this location, the intersection will not operate adequately without reconfiguring the lanes. This is, however, a simple solution – the northbound and southbound lanes of the intersection would need to be repainted to provide a dedicated left turn lane and a shared through-right turn lane. Such changes should not require additional asphalt to be constructed; all reconfiguration should be accommodated within the existing road surface.

4 Functional Plans

4.1 DESIGN CONSIDERATIONS

In the absence of regional travel model information, a comprehensive review of background information and expected growth was conducted. Much of the background information as it relates to design considerations on Township Road 510 is presented in the preceding sections. Good engineering judgement was required to distil the collected information into a plan that can be used to guide development along Township Road 510.

4.1.1 Cross-section

As identified in section three, the previous regional travel model indicated that Township Road 510 would carry up to about 5000 vehicles per day on two lanes. Considering that residential neighbourhood densities proposed by Leduc County are significantly higher than those assumed in the previous regional travel model, it is likely that two lanes will not suffice along Township Road 510. Future traffic assumptions developed in section three identify an annual daily traffic of about 25,000 vehicles based on the development densities proposed in Leduc County's North Major Area Structure Plan. The future traffic on Township Road 510 could, however, be significantly higher, if future development near the Township Road 510 study area proceeds with increased development densities. For instance, if all development proceeds at a density double that proposed in the North Major Area Structure Plan, the predicted future traffic is about 33,000 vehicles per day.

Two lane arterial roads can typically carry about 10,000 vehicles per day, while four lane arterial roads can typically carry over 30,000 to 40,000 vehicles per day, as can be seen in similar arterial roadways in the region. Within the City of Edmonton, for example, there are several four-lane divided urban roadways similar to that proposed for Township Road 510 that carry upwards of 44,000 vehicles a day. Some examples within the City of Edmonton include 50 Street north of the Whitemud (41,700 AADT), 75 Street north of the Whitemud (43,900 AADT), 111 Street north of 34 Avenue (36,200 AADT), and 23 Avenue west of 91 Street (31,700 AADT). The project steering committee therefore agreed that with the best information available to date, a four lane cross-section would suffice for long term development along Township Road 510.

Urban Cross-section

As part of Leduc County's strategy to increase development densities in the lands around the Township Road 510 study area, the county wishes to develop a more urban environment with some medium-density developments such as townhouse or condo developments. In order to realize these projections, Leduc County requires that all new development in the area be to urban standards, including providing urban (curb and gutter) roadways that handle stormwater drainage below ground. The Township Road 510 study will maintain consistency with the proposed neighbourhoods, and provide an urban cross section. Benefits to this include slower traffic, because drivers expect to drive slower in urban areas, and decreased right-of-way required.

However, an urban cross-section may require more costs to develop the roadway and to handle stormwater drainage.

Non-motorized transportation modes

Consistent with providing an urban cross-section in an urban area, considerations must be made for pedestrians and other non-vehicular uses such as bikes, wheelchairs, and strollers. The project steering committee has agreed to provide a 3.0 metre multi-use trail along one side of the roadway, and a standard 1.5 metre sidewalk on the other side. Considering that the areas south of Township Road 510 will be developed before the areas to the north, and to provide a logical connection to the Town of Beaumont's trail system, the multi-use trail will be provided on the south side of Township Road 510.

Noise Attenuation

A major arterial roadway with upwards of 20,000 to 30,000 vehicles per day generates significant noise. Adjacent to primarily single family development, consideration must be given for noise attenuation to reduce the noise impact to nearby residences. Appropriate right-of-way has been allocated to provide a simple 1.0 metre high earth berm upon which a sound wall or fence could be built. Specifications for the sound wall, if required, would need to be modelled upon detailed design. A section of the Township Road 510 functional plan west of Range Road 245 [south] intersects proposed industrial development. No provisions for sound attenuation are provided though this segment of the Township Road 510 functional plans.

The project steering committee has indicated that Leduc County does not currently have noise requirements; however, they have indicated that noise levels should be controlled based on guidelines from the City of Edmonton's noise policy. The Associated Engineering project team reviewed the City of Edmonton's Community Standards Bylaw (#14600) for noise attenuation guidelines. These guidelines state that an acceptable noise level measured at the property line of a residential property should not exceed 65 dB(A) between 7 a.m. and 10 p.m., or 50 dB(A) between 10 p.m. and 7 a.m. The City of Edmonton identifies specific daytime exceptions, those being a measured noise level of 70 dB(A) for no more than two hours in a day, 75 dB(A) for no more than one hour in a day, 80 dB(A) for no more than 30 minutes in a day, and 85 dB(A) for no more than 15 minutes in a day.

Upon development of residential land use adjacent to Township Road 510, sound modelling exercises should be carried out to determine if sound attenuation measures in addition to the 1.0 metre berm are required. Such additional sound attenuation measures should be provided upon detailed design by the respective developer.

Characteristics of a Major Arterial Road

Table 4-1 provides an excerpt from the Transportation Association of Canada's Geometric Design Guide for Canadian Roads that illustrates the characteristics of a major arterial urban roadway. The Associated Engineering project team has referenced this guide in developing the design considerations and design criteria for the Township Road 510 Functional Planning Study.

Table 4-1: TAC Characteristics of Urban Roads

Road Classification	Major Arterial
Traffic service function	Traffic movement is primary consideration
Land service/access	Rigid access control
Traffic volume (vehicles/day), typical	10,000 – 30,000
Flow characteristics	Uninterrupted flow except at signals and crosswalks
Design speed (km/h)	60 – 100
Average running speeds (km/k), off-peak	50 – 90
Vehicle type	All types up to 20% trucks
Desirable connections	Collectors, arterials, expressways, freeways
Transit service	Express and local buses permitted
Accommodation of cyclists	Lane widening or separate facilities desirable
Accommodation of pedestrians	Sidewalks may be provided, separation from traffic lanes preferred
Parking (typically)	Prohibited or peak hour restriction
Minimum intersection spacing (m)	400
Right-of-way width (m), typically	20 – 45

Table adapted from Table 1.3.4.2 in the Transportation Association of Canada's Geometric Design Guide for Canadian Roads

4.1.2 Intersection Treatment

In the absence of detailed traffic volume information from the regional travel model, an alternative solution was required to determine intersection configurations. Typically, projected future turning movements would be analyzed to determine lane, turn bay, and channelization requirements. However, due to the absence of detailed traffic volume information or development information, the project steering committee developed a strategy to ascertain intersection configurations depending on the functionality of each cross-road.

As a major arterial, Township Road 510 will connect with a total of three different types of roadways: major arterial, minor arterial, and major collector. The Transportation Association of Canada's Geometric Design Guide for Canadian Roads outlines this typical connectivity, as illustrated in **Table 4-1**. Major arterials may also connect with expressways or freeways; however neither of these types of roadways exist within the Township Road 510 study area. Major arterials do not typically connect to local roads in new development areas.

Major Arterials

An intersection between two major arterials will have significant through and turning movement volumes. Along the Township Road 510 study area, this type of intersection has the most significance, and occurs twice – at 50 Street and the Nisku Spine Road. The Township Road 510 Functional Plan will identify right-of-way and plans for developing these intersections to

accommodate double slotted left turn lanes and turn bays, plus single channelized right turn lanes with turn bays.

Minor Arterials

A slightly lower class intersection than the intersection of two major arterials, a major to minor arterial intersection can still handle significant through and turning movement volumes. Within the Township Road 510 study area, there are several minor arterial roadways – the existing range roads. The Township Road 510 Functional Plan will identify right-of-way and plans for developing these intersections to accommodate either standard single left turn bays or single slotted left turn lanes and turn bays, plus single channelized right turn lanes with turn bays. The slotted left turn bays will be designed in such a way that if required in the future, an additional left turn lane could be accommodated within the median section. Range Road 244 [south]/Range Road 243 [north] may convey slightly higher volumes than other minor arterials within the study area because it may provide a north-south connection across the Edmonton Regional Ring Road. However, because there will not be an interchange with the Edmonton Regional Ring Road, the Associated Engineering project team has designated Range Road 244 [south]/Range Road 243 [north] as a minor arterial.

Major Collector

Major collector roadways connect the neighbourhoods with the arterial road system. Several future major collector road intersections will be developed along the Township Road 510 study area. The Township Road 510 Functional Plan will identify right-of-way and plans for developing these intersections to accommodate single left turn lanes and turn bays, plus single channelized right turn lanes.

4.2 GEOMETRIC DESIGN CRITERIA

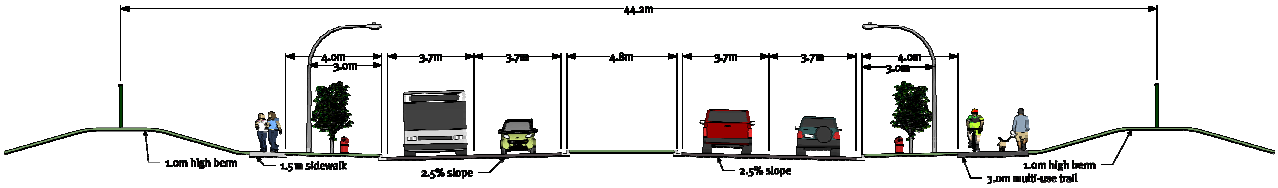
The Associated Engineering project team considered the previously identified design considerations when developing the geometric design criteria for the Township Road 510 Functional Planning Study. The geometric design criteria was developed based on Leduc County's engineering and roadway design standards, the Transportation Association of Canada's Geometric Design Guide for Canadian Roads, Alberta Transportation's Highway Geometric Design Guide, and Alberta Transportation's Highway Geometric Design Guide Urban Supplement. The City of Edmonton's Design and Construction Standards were also referenced in developing urban intersection treatments and details.

The geometric design criteria was reviewed and accepted by the project steering committee, and is presented in **Table 4-2**. The proposed typical cross-section for Township Road 510 adjacent to residential neighbourhoods is illustrated in **Figure 4-1**.

Table 4-2: Geometric Design Criteria for Township Road 510

Criteria			Township Road 510
Design Speed			80 km/h
Posted Speed			60 km/h
Classification			Major Arterial
Number of Core Lanes			4 lanes (divided)
Design Designation			UAD-407.4-80
Horizontal Alignment Min. Curve Radius (m)			250
Maximum Superelevation			6%
Vertical Alignment K=L(m)/A%	Crest	Passing sight K	560
		Min. stopping sight K	35
	Sag	Minimum K	35
		Comfort minimum K (illuminated sections)	17
	Decision Sight Distance (m)		230-310
	Gradient - desirable maximum		6%
Cross Section	Lane width (m)		3.7
	Right shoulder width (m)		0
	Left shoulder width (m)		0
	Finished pavement width (m)		2 @ 7.40
	Median width (m)		6
Minimum R/W Width - Residential (m)			45
Minimum R/W Width - Industrial (m)			35
Design Vehicle			WB-21

Figure 4-1: Proposed Typical Township Road 510 Cross-section Adjacent to Residential Areas



The Associated Engineering project team also developed a three dimensional rendering of a typical roadway segment. This rendering is illustrated in **Figure 4-2**.

Figure 4-2: Proposed Typical Township Road 510 Roadway Segment Rendering



4.2.1 Roadway Staging

As noted previously, a two lane roadway can typically carry about 10,000 vehicles a day before additional lanes are required. As is typical in suburban neighbourhoods, area development is typically staged and will occur over several years. As such, Leduc County may wish to construct Township Road 510 in two stages – a first stage consisting of two lanes, and a final stage completing the additional two lanes.

The project steering committee has indicated that the first areas to be developed within the Township Road 510 study area are those lands south of Township Road 510. Therefore, the Associated Engineering project team recommends developing the southern two lanes of Township Road 510 as part of the first stage of development. In this case, the full roadway structure for the ultimate eastbound lanes would be constructed along with the multi-use trail, street lighting for those two lanes, and the southern berm, if adjacent to residential or future residential development and/or sound modelling warrants noise attenuation. The ultimate westbound lanes would be rough

graded and temporarily seeded until which point the full four lane cross-section would need to be constructed.

4.3 ACCESS MANAGEMENT STRATEGY

As a major arterial roadway, the main function of Township Road 510 is to convey traffic east-west through the study area. To ensure that Township Road 510 maintains this function as adjacent areas are developed, the Township Road 510 Functional Planning Study must define an access management strategy to guide potential future access to the roadway. The access management strategy is divided into three sections: intersection spacing, private access, and existing access.

4.3.1 Intersection Spacing

Township Road 510 will function as a major arterial upon future development of the roadway and adjacent lands. The Transportation Association of Canada's Roadway Geometric Design Guide recommends that intersections on arterial roads be spaced a minimum 400 metres apart to allow for more continuous traffic flow. Additionally, turn bays and intersection treatment limit the proximity of major intersections. Typically, intersection treatments extend over 100 metres from an intersection; therefore geometry may also limit the spacing between intersections to over 300 metres. To allow for higher volume traffic flows along Township Road 510, the project team recommends an 800 metre intersection spacing where possible, with an absolute minimum 400 metre intersection spacing.

Township Road 510 is a correction line in the township grid road system. As such, the range roads north of Township Road 510 do not line up with the range roads south of Township Road 510. Within the study area, the range roads are offset by about 100 metres, and currently form subsequent offset three-way intersections. From an intersection spacing perspective, this is an undesirable offset. Discussions in project steering committee meetings lead to recommendations to realign offset intersections, where feasible, north of Township Road 510. Generally, realignments to the north have less impact on existing development, residences, and utilities. Such realignments apply to the intersections of Range Road 243[south] and Range Road 242[north], and Range Road 244[south] and Range Road 243[north].

Due to the proximity of Irvine Creek near Range Road 245[south], Range Road 245[south] is proposed to continue north into future developed land as a major collector roadway. As a result, Range Road 244[north] has been realigned west to meet the minimum 400 metre intersection spacing requirements. The future Nisku Spine Road is located where proposed in the Nisku 9th Street (Nisku Spine Road) Functional Planning Study, and is located approximately 400 metres west of the Range Road 244[north] intersection on Township Road 510.

The Township Road 510 Functional Plan identifies major collector roadways spaced approximately midway between each major north-south roadway, at the midpoint of each section. These major collectors are not based on development plans; they have been identified as a preferred location to access the future neighbourhoods and potential intersection configurations. Intersection locations

and configurations will need to be investigated in detail with any new development along Township Road 510.

4.3.2 Private Access

The Transportation Association of Canada's Geometric Design Guide for Canadian Roads identifies that Major Arterial roads should have rigid access control for private land service access. The project steering committee and project team developed recommendations for private access to Township Road 510.

Ideally, Township Road 510 should have no direct access to private lands; access to private lands should primarily be via collector roadways within the development areas. However, under certain circumstances and at Leduc County's discretion, private access to Township Road 510 may be considered with the following provisions.

Private access may be considered to Township Road 510 with right-in/right-out movements only. If all-directional movement is required, the intersection should be built to a collector road intersection standard and therefore the intersection location and configuration would be governed by the minimum intersection spacing defined in the previous section.

Secondly, private access may be considered provided that the access is a minimum 200 metres from an existing or future intersection. This ensures that the private access does not interfere with the intersection treatments along Township Road 510.

4.3.3 Existing Access

There are a few existing accesses to local lands along Township Road 510. Long-term, the access management strategy outlines complete removal of existing accesses, or conformance to the requirements set out in the previous sections. However, in the interim, until these lands are redeveloped, this access management strategy outlines a process for maintaining access to these local lands.

For existing accesses to Township Road 510 that are the only access to private land, or where it is not feasible to provide alternate access, in most cases these accesses will remain until redevelopment.

In the event that Township Road 510 is developed into an interim stage two-lane roadway, existing private accesses will be allowed to remain as all-directional accesses provided they do not impact the operation of public road intersections along Township Road 510.

In the event that Township Road 510 is developed into the ultimate four-lane roadway before existing private accesses are removed or relocated, the existing private accesses will be allowed to remain as a right-in/right-out provided they do not impact the operation of public road intersections along Township Road 510.

In the case that an existing private access impacts the operation of a public road intersection, for instance a private access is located within a turn bay at an intersection, attempts should be made to relocate the private access to the nearest location that does not impact the intersection.

4.4 PLANS

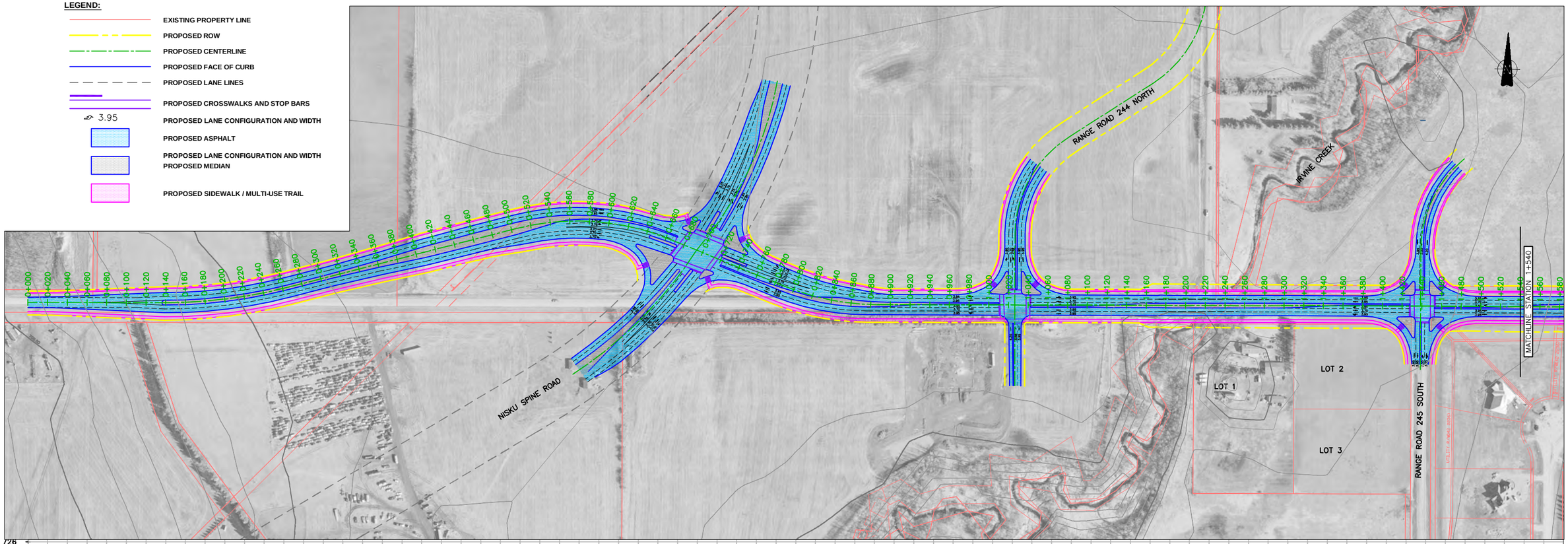
The recommended Township Road 510 functional plans include plans and profiles for the study area between Highway 814 (50 Street) and the Nisku Spine Road. Typical right-of-way, roadway widths, lane configuration, intersection configuration, multi-use trail, and sidewalk locations are included in the plans.

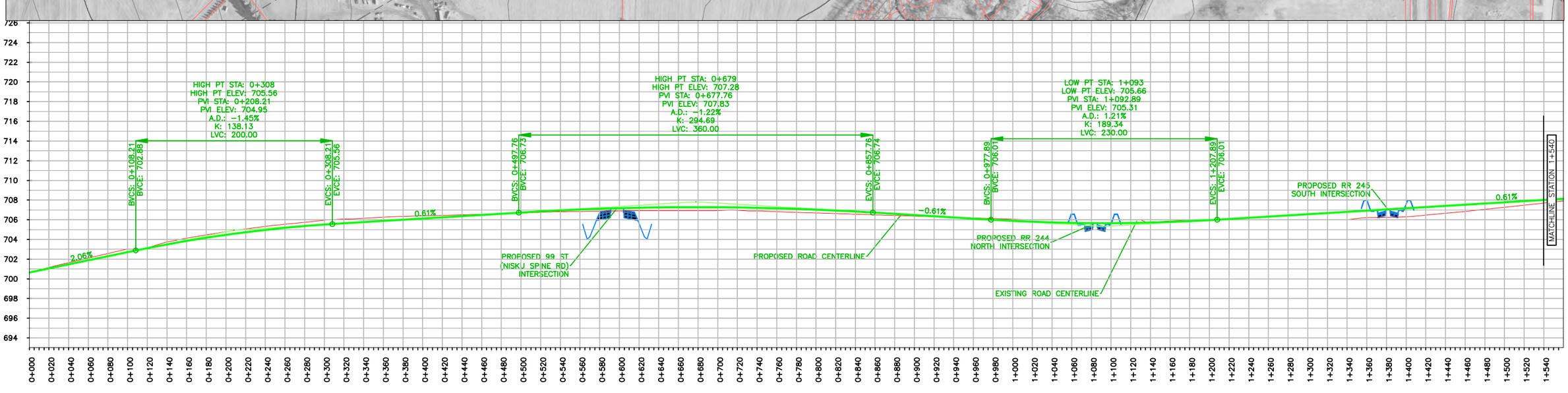
Drawings 3420-1-01 through 3420-1-05 provide a plan and profile overview of the entire study area. Drawings 3420-1-106 through 3420-1-115 detail each proposed intersection within the study area. Further, drawings 3420-1-116 through 3420-1-125 illustrate typical cross-sections at each intersection. Lastly, drawing 3420-1-126 illustrates a typical proposed Township Road 510 cross-section along with a first stage construction cross-section.

This Drawing Is For The Use Of The Client And Project Indicated
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LEGEND:

- EXISTING PROPERTY LINE
- PROPOSED ROW
- PROPOSED CENTERLINE
- PROPOSED FACE OF CURB
- PROPOSED LANE LINES
- PROPOSED CROSSWALKS AND STOP BARS
- 3.95 PROPOSED LANE CONFIGURATION AND WIDTH
- PROPOSED ASPHALT
- PROPOSED LANE CONFIGURATION AND WIDTH PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL





NO.	DATE	ENG.	BY	SUBJECT
A	2009-01-30	SB	JP	REPORT

REVISIONS

PRELIMINARY
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Associated Engineering

PROJECT No.	2007-3420		
SCALE	H:1:2000 V: 1:200		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	JANUARY 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

PLAN / PROFILE

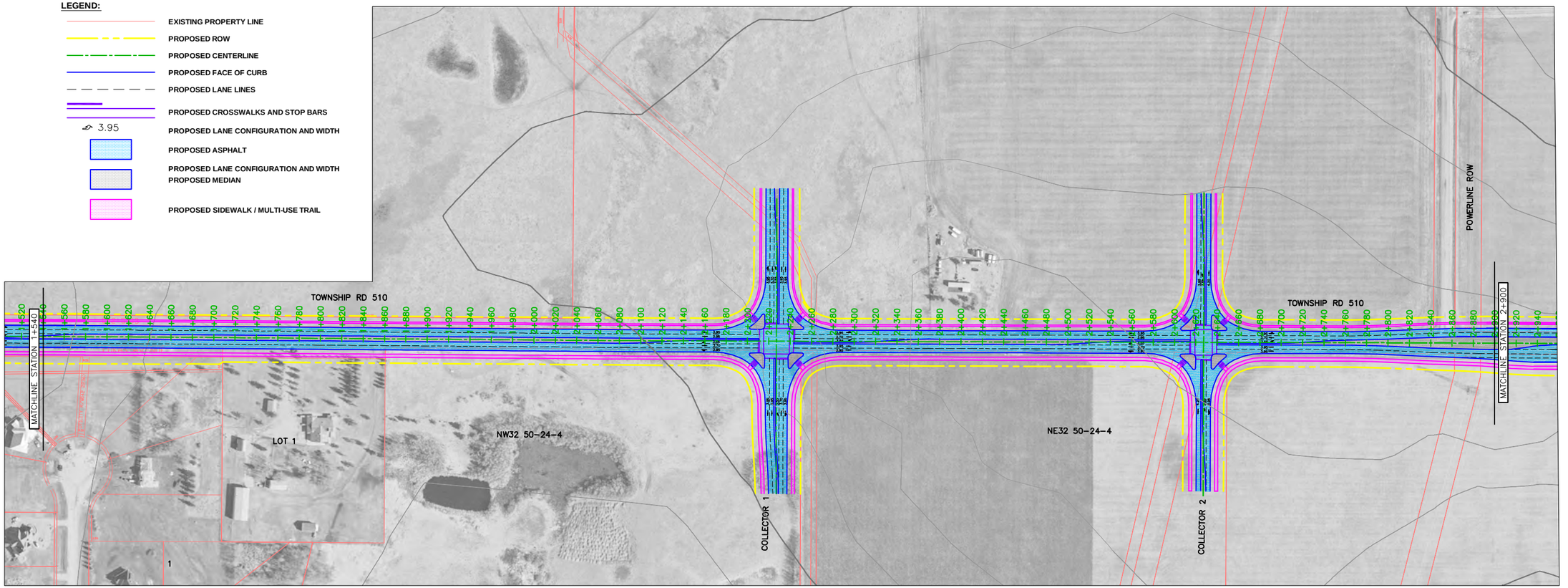
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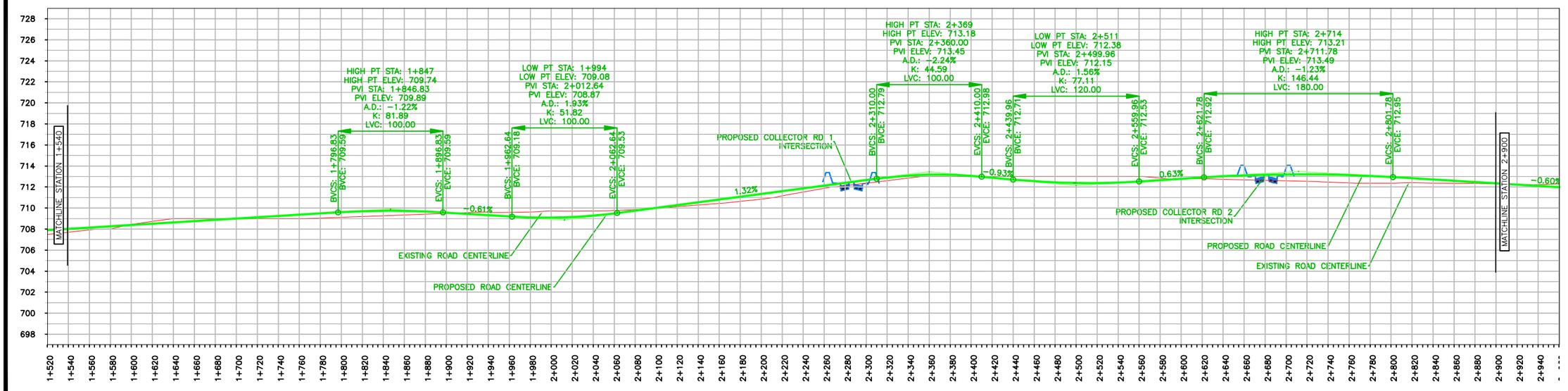
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- PROPOSED LANE CONFIGURATION AND WIDTH PROPOSED MEDIAN
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NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

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DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

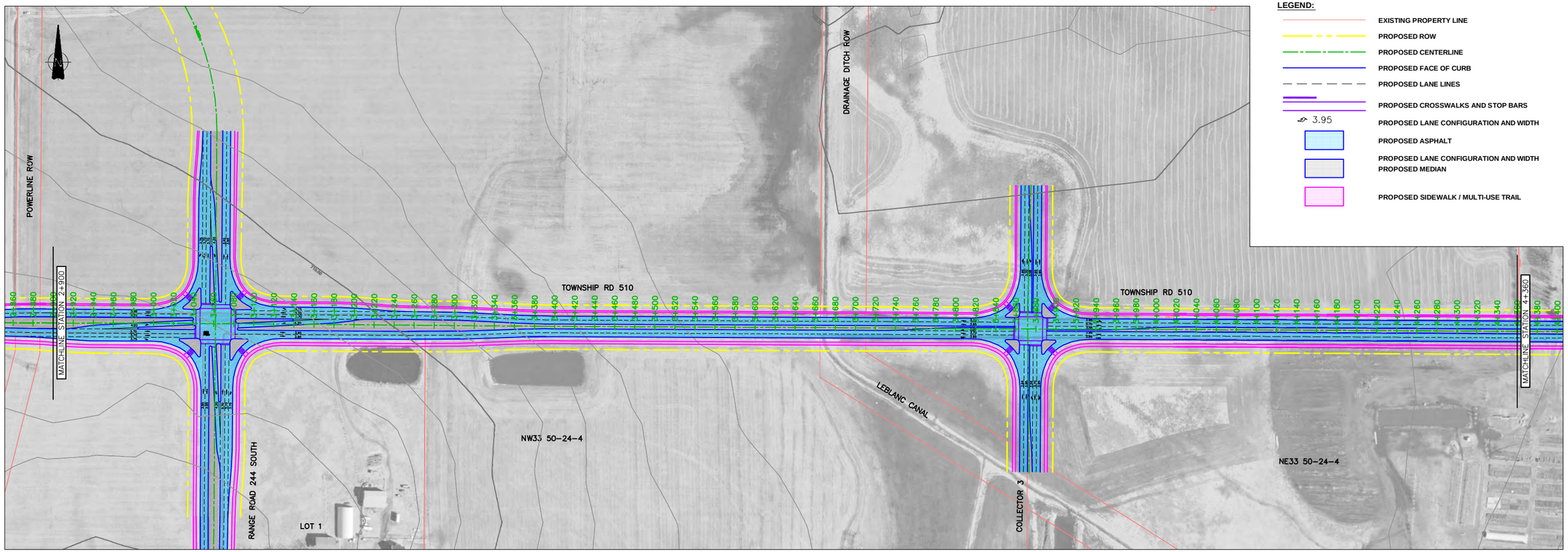
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

PLAN / PROFILE

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A	2009-04-03	SB	JP	REPORT

REVISIONS

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Associated Engineering

PROJECT No.	2007-3420		
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DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

PLAN / PROFILE

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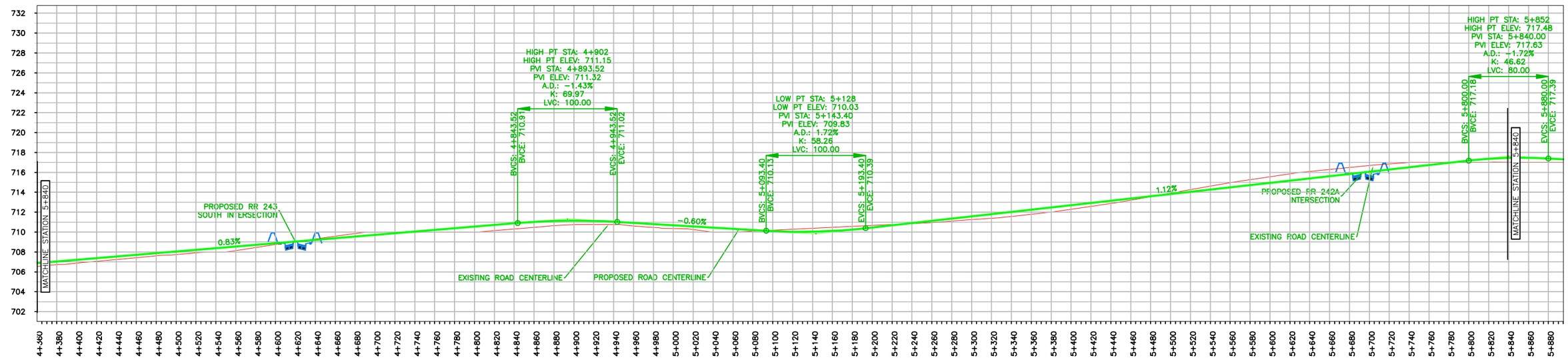
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- PROPOSED ASPHALT
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- PROPOSED SIDEWALK / MULTI-USE TRAIL





NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
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Associated Engineering

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DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

PLAN / PROFILE

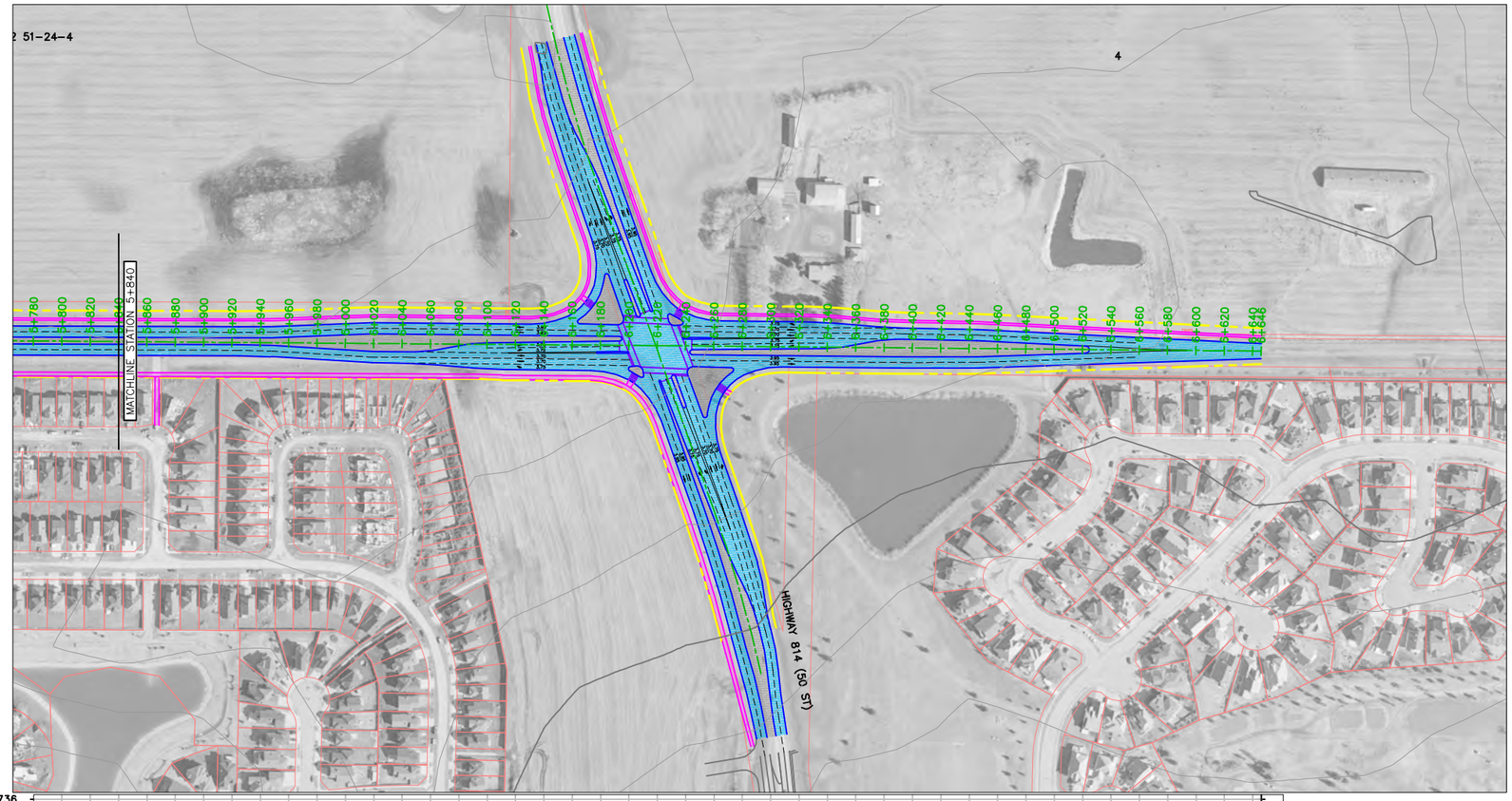
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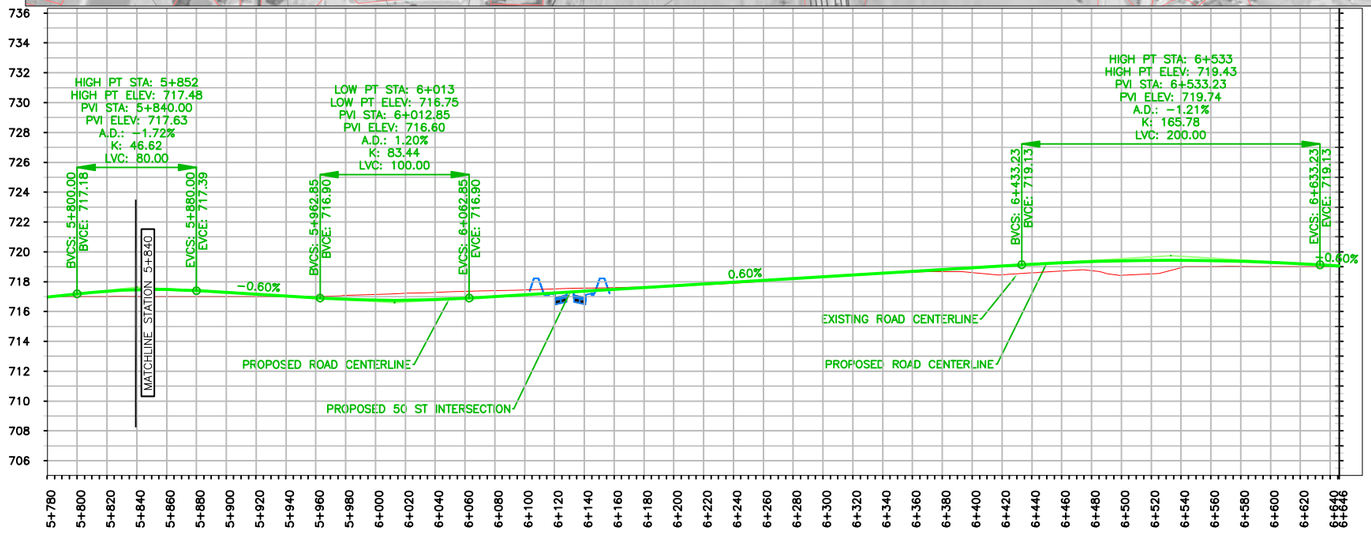
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NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
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DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

PLAN / PROFILE

DRAWING NUMBER	REV. NO.	SHEET
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LEGEND:

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- PROPOSED ROW
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- PROPOSED ASPHALT
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- PROPOSED SIDEWALK / MULTI-USE TRAIL

B 116

A 116

PROPOSED NISKU SPINE ROAD RIGHT-OF-WAY

TOWNSHIP ROAD 510

NISKU SPINE ROAD

3.95 3.95 3.75 3.75 3.70 3.70 3.75

3.75 3.75 3.70 3.70 3.75 3.95 3.95

3.95 3.95 3.75 3.75 3.70 3.70 3.75

3.75 3.70 3.70 3.75 3.75 3.95 3.95

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NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	1:500		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510 FUNCTIONAL PLANNING STUDY

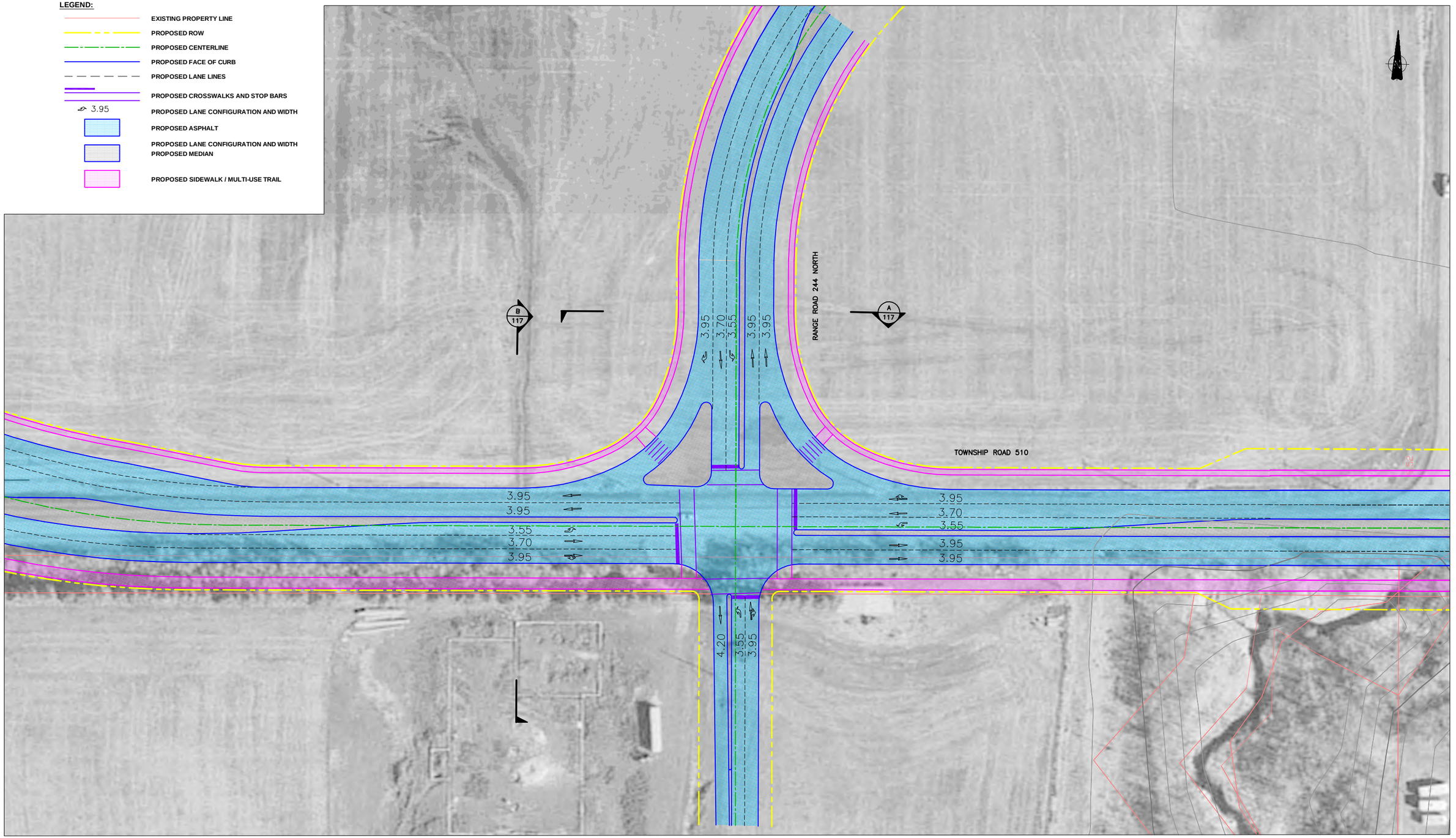
NISKU SPINE ROAD
INTERSECTION PLAN

DRAWING NUMBER	REV. NO.	SHEET
3420-1-106	A	6 / 26

This Drawing Is For The Use Of The Client And Project Indicated
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- PROPOSED FACE OF CURB
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NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
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Associated Engineering

PROJECT No.	2007-3420		
SCALE	1:500		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 244 NORTH
INTERSECTION PLAN

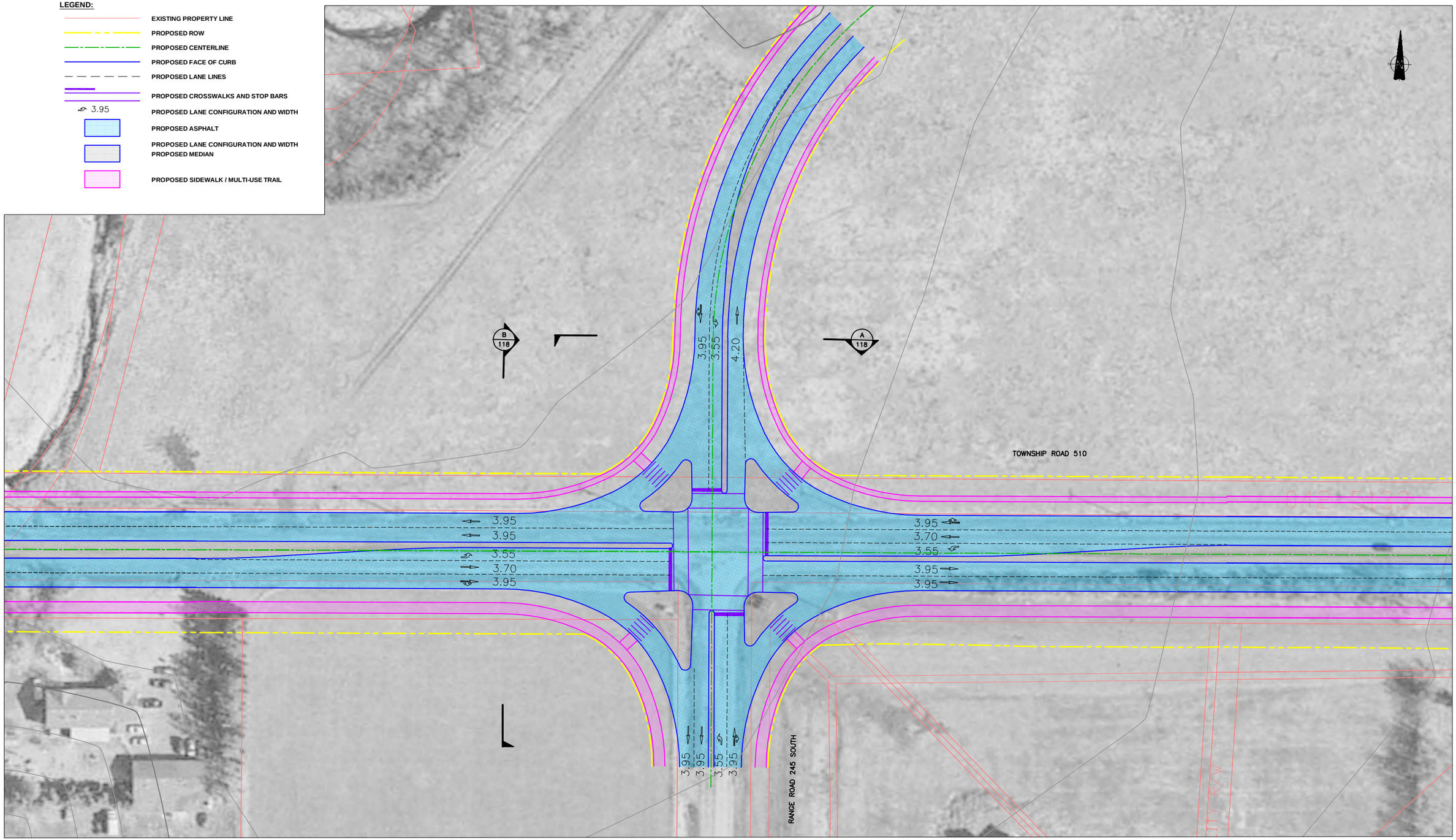
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LEGEND:

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- PROPOSED ROW
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- PROPOSED LANE CONFIGURATION AND WIDTH PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL



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NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	1:500		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

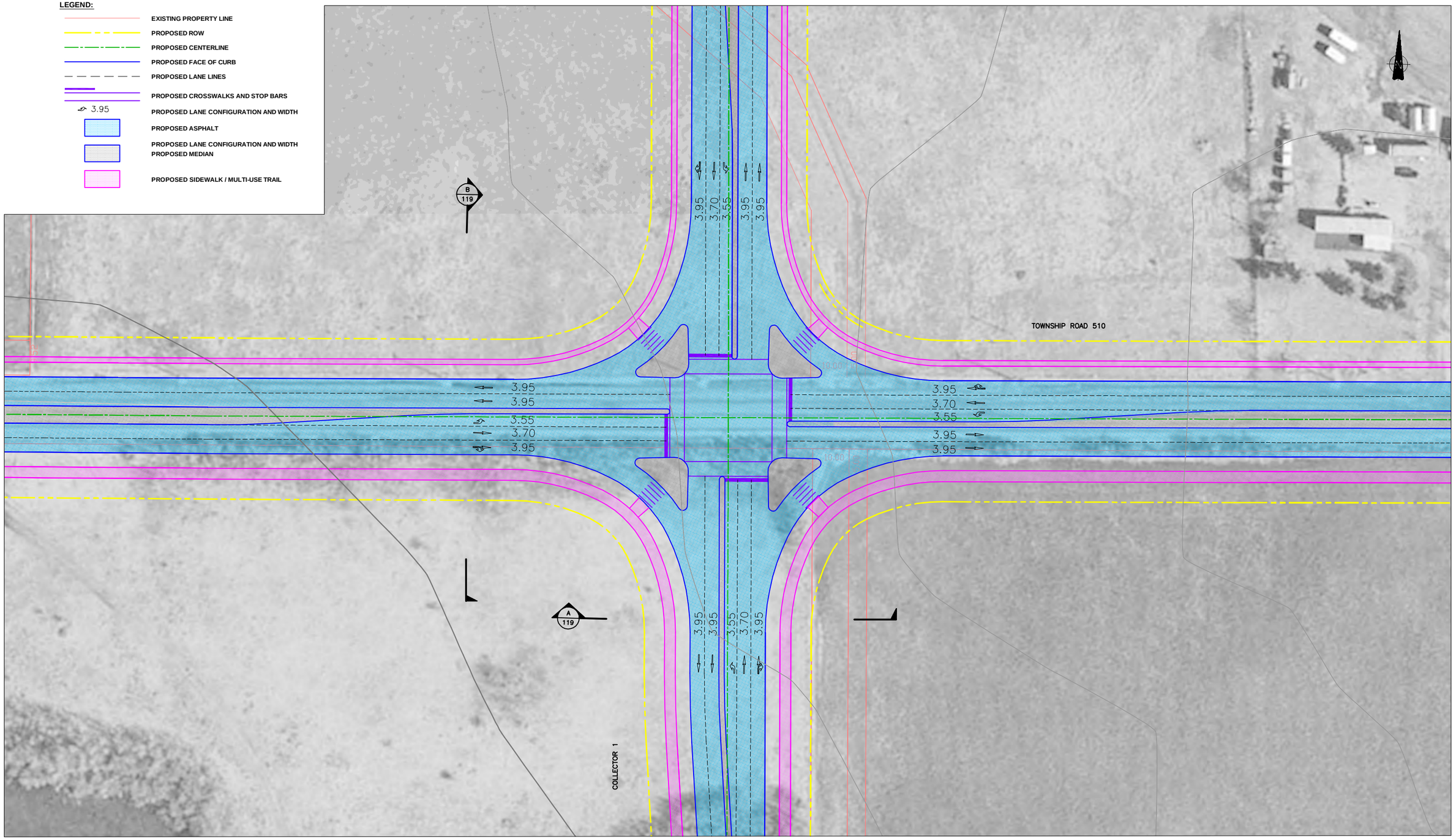
RANGE ROAD 245 SOUTH
INTERSECTION PLAN

DRAWING NUMBER	REV. NO.	SHEET
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NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
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DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

COLLECTOR 1
INTERSECTION PLAN

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

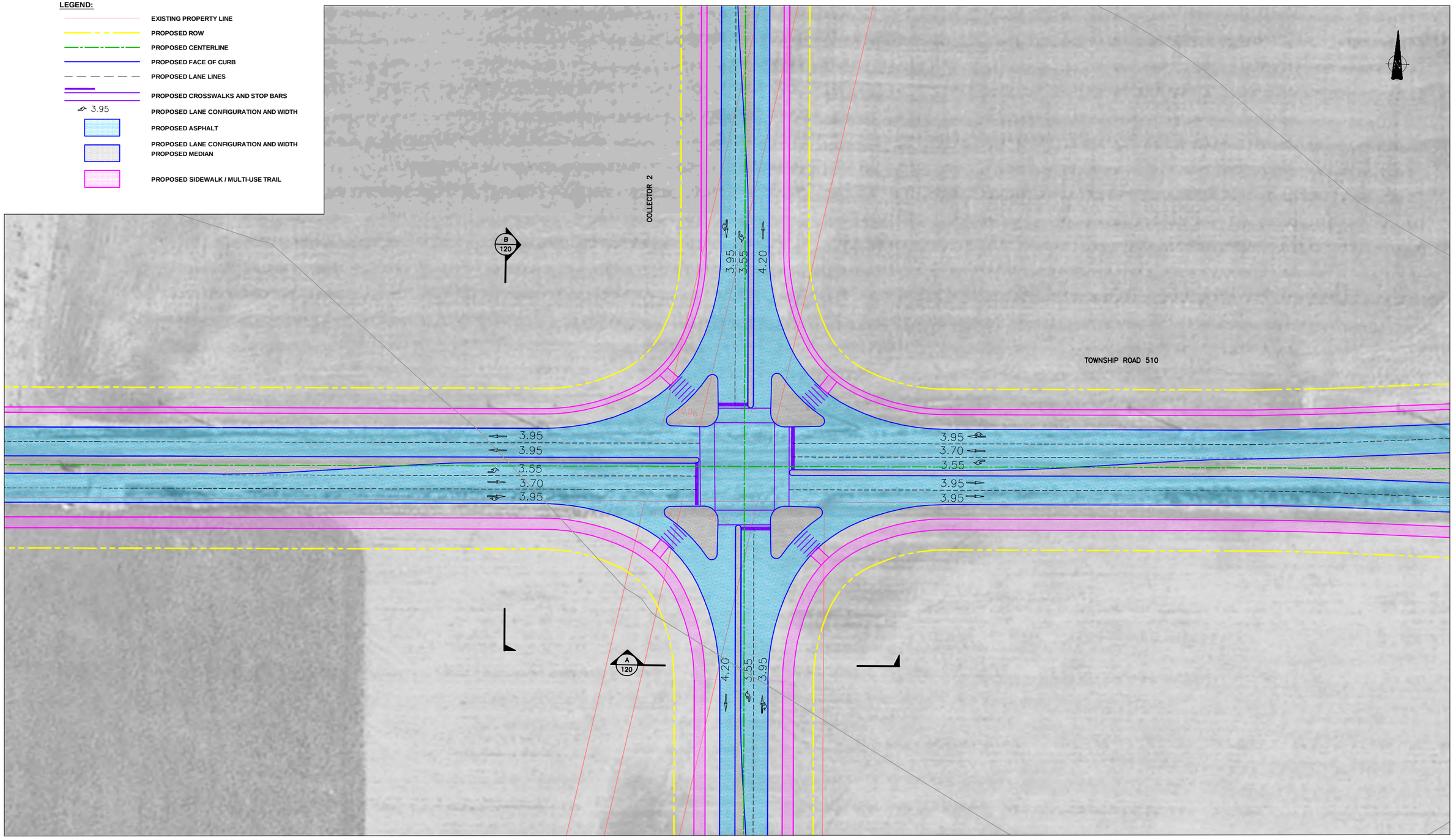
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NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
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Associated Engineering

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DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

COLLECTOR 2
INTERSECTION PLAN

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

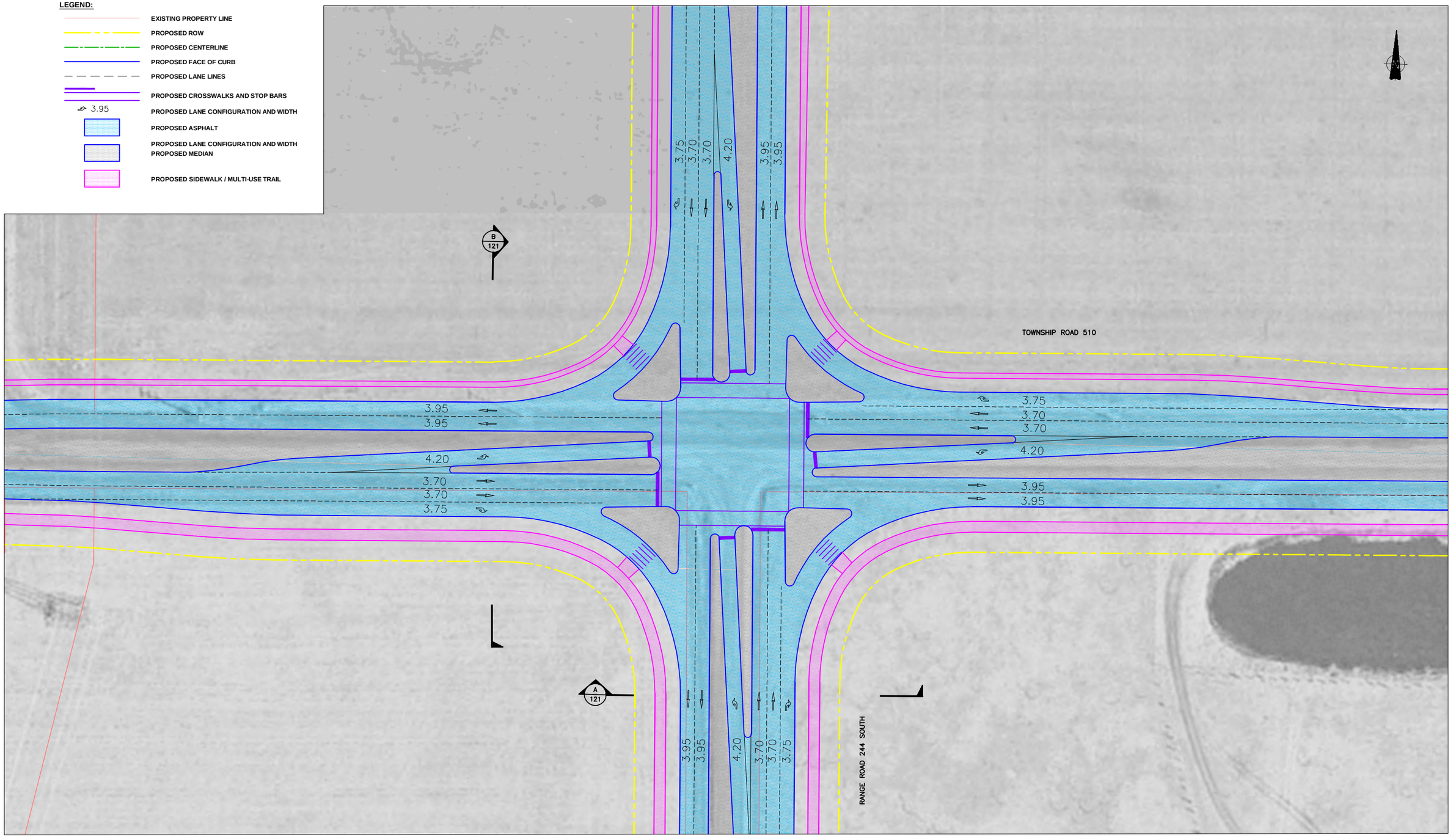
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NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
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Associated Engineering

PROJECT No.	2007-3420		
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DESIGNED	SHAWN BENBOW		-
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APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 244 SOUTH
INTERSECTION PLAN

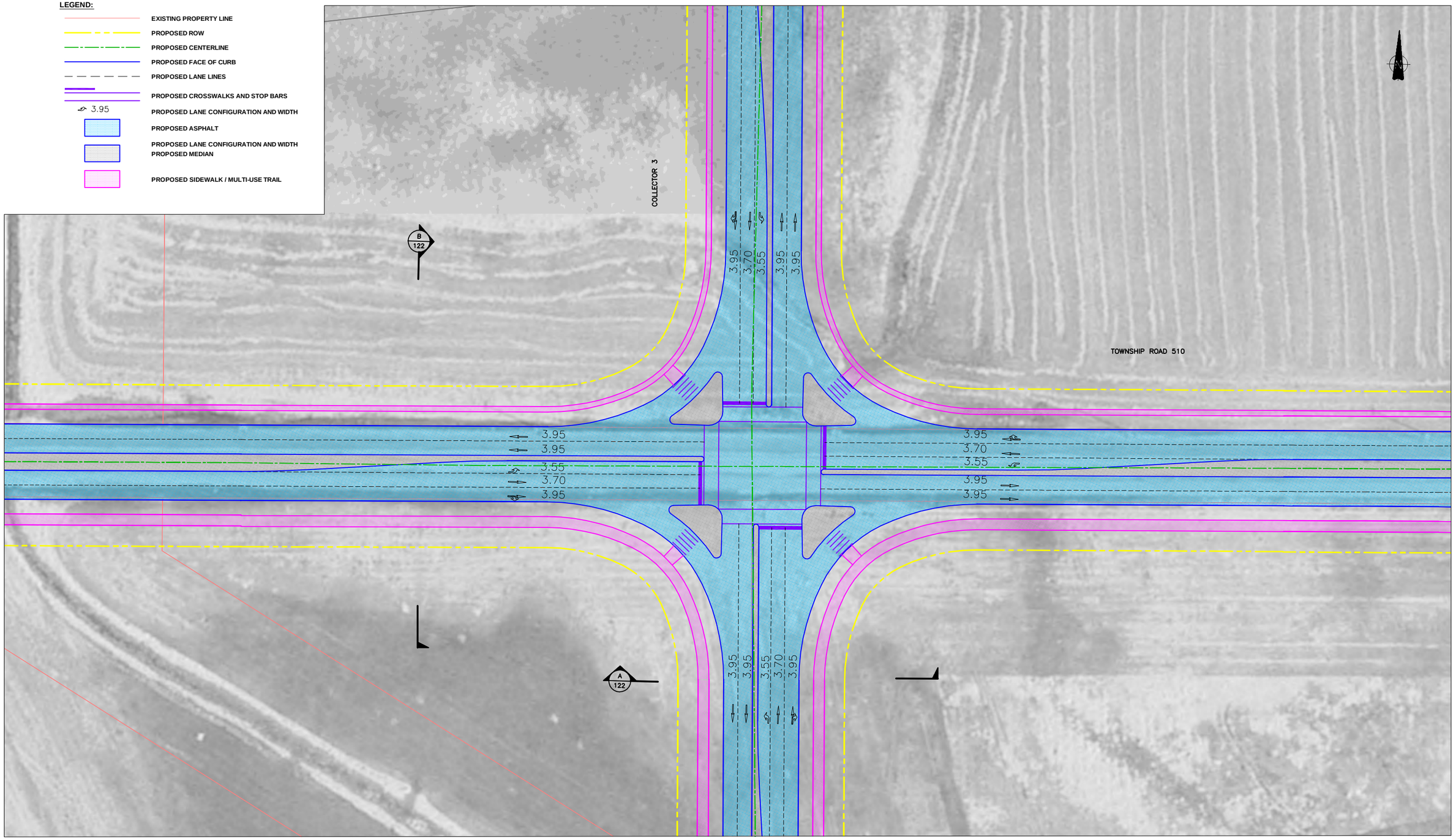
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This Drawing Is For The Use Of The Client And Project Indicated
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LEGEND:

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NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	1:500		
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DESIGNED	SHAWN BENBOW		-
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DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

COLLECTOR 3
INTERSECTION PLAN

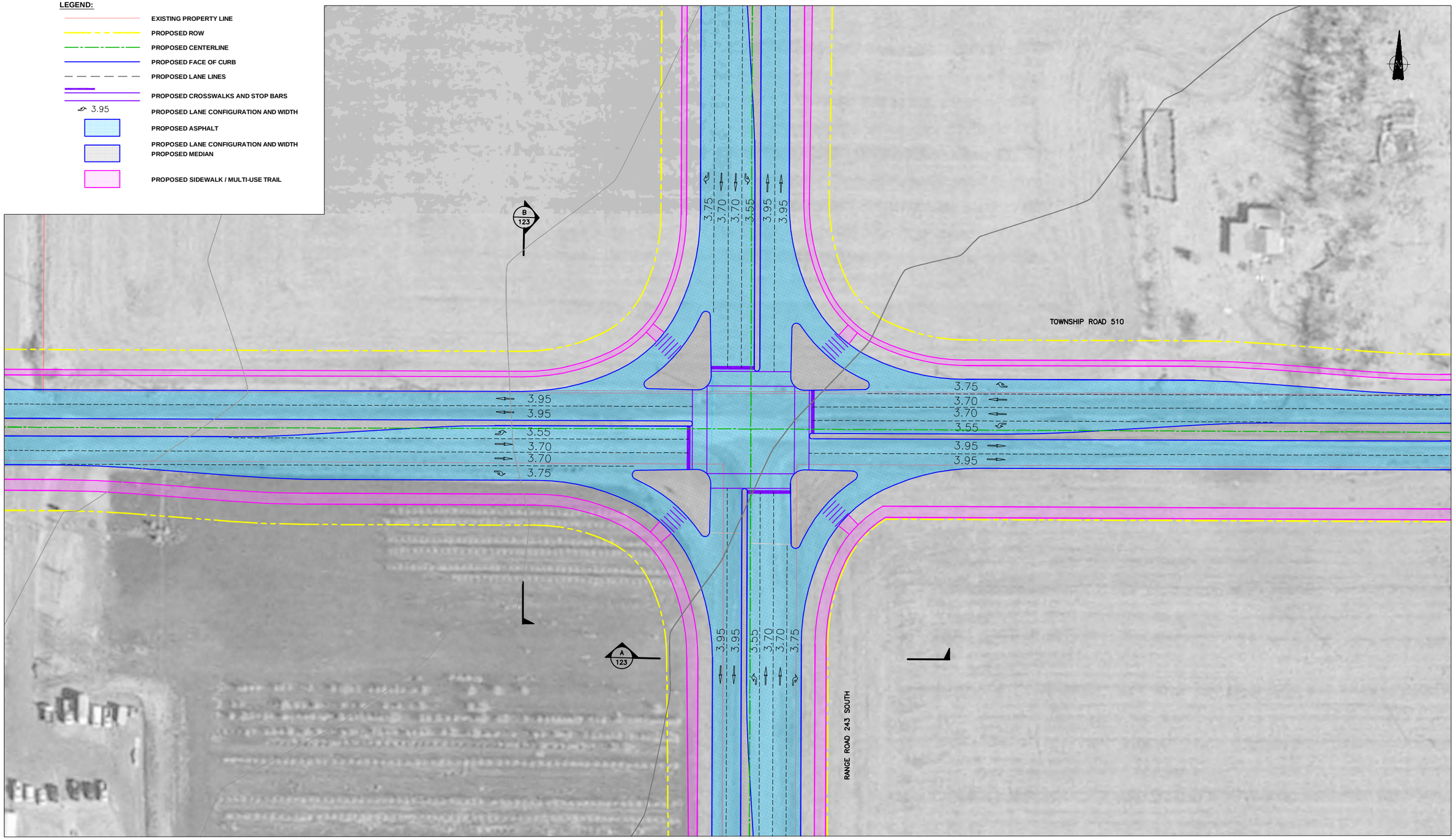
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

DRAWING NUMBER	REV. NO.	SHEET
3420-1-112	A	12/26

This Drawing Is For The Use Of The Client And Project Indicated
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REVISIONS

PRELIMINARY
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Associated Engineering

PROJECT No.	2007-3420		
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DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 243 SOUTH
INTERSECTION PLAN

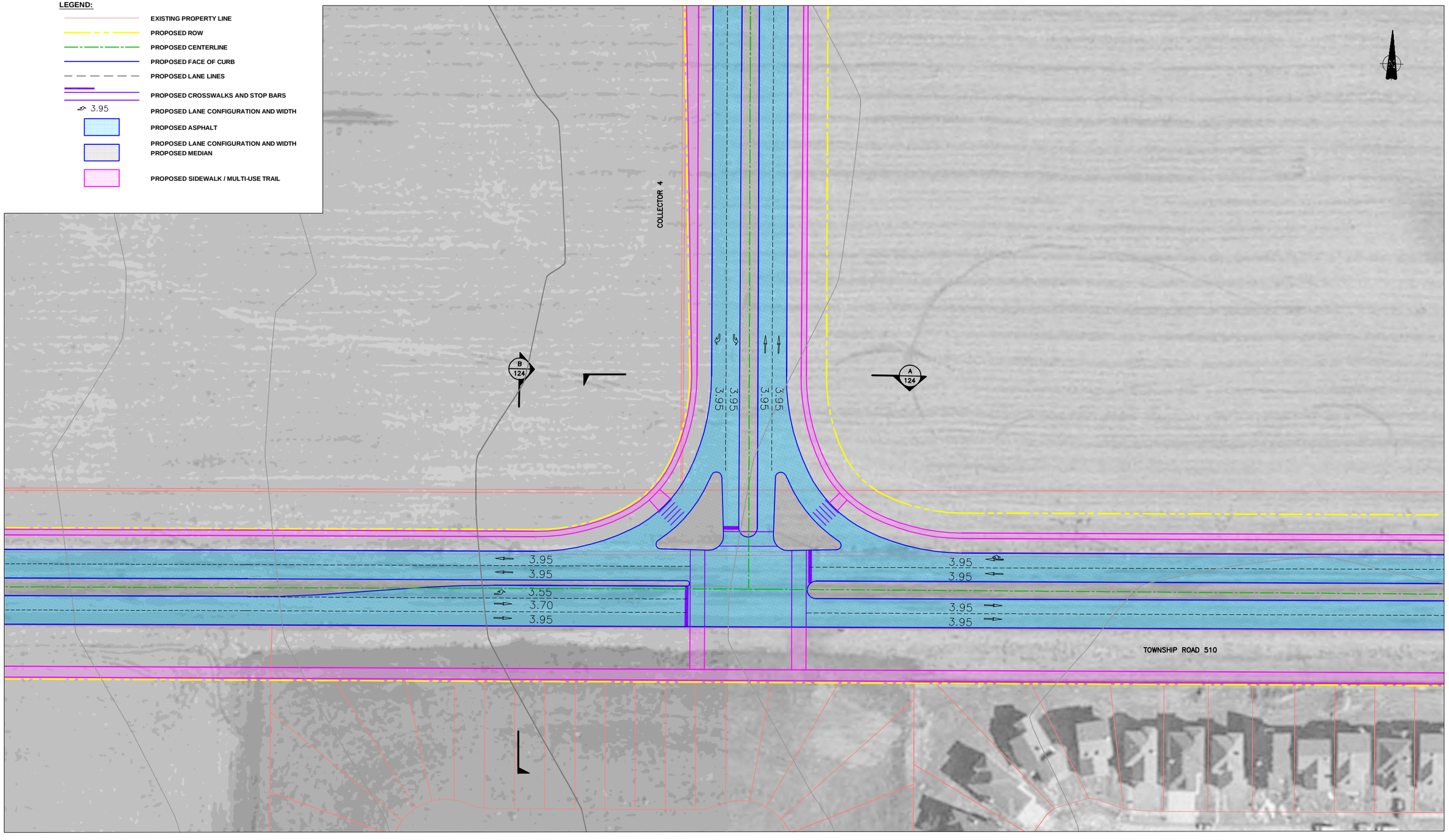
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LEGEND:

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  PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL



NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	1:500		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

COLLECTOR 4
INTERSECTION PLAN

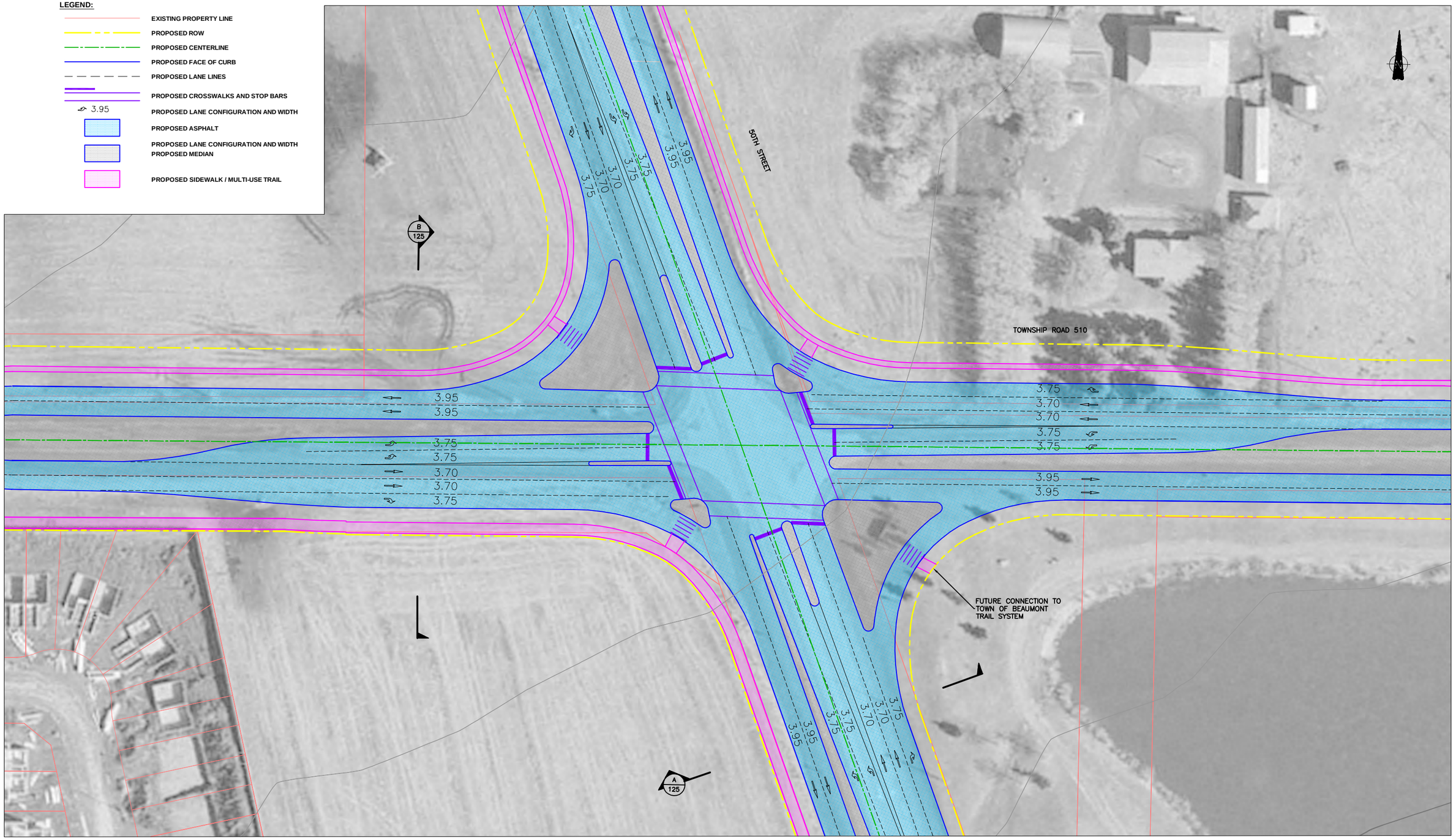
DRAWING NUMBER	REV. NO.	SHEET
3420-1-114	A	14 / 26

P:\2007\3420\00_Township Road 510\Working_Dwgs\100_Civil\Transportation\3420-1-114.dwg
DATE: 09/04/2009 8:37:34 PM, Jessica Peters

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LEGEND:

- EXISTING PROPERTY LINE
- PROPOSED ROW
- PROPOSED CENTERLINE
- PROPOSED FACE OF CURB
- PROPOSED LANE LINES
- PROPOSED CROSSWALKS AND STOP BARS
- 3.95 PROPOSED LANE CONFIGURATION AND WIDTH
- PROPOSED ASPHALT
- PROPOSED LANE CONFIGURATION AND WIDTH PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL



50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50

P:\2007-3420\05_Township Road 510\Working_Drgs\100_Civil\Transportation\3420-1-115.dwg
DATE: 09/Apr/2009 12:54:54 PM Jessica Peters

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	1:500		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

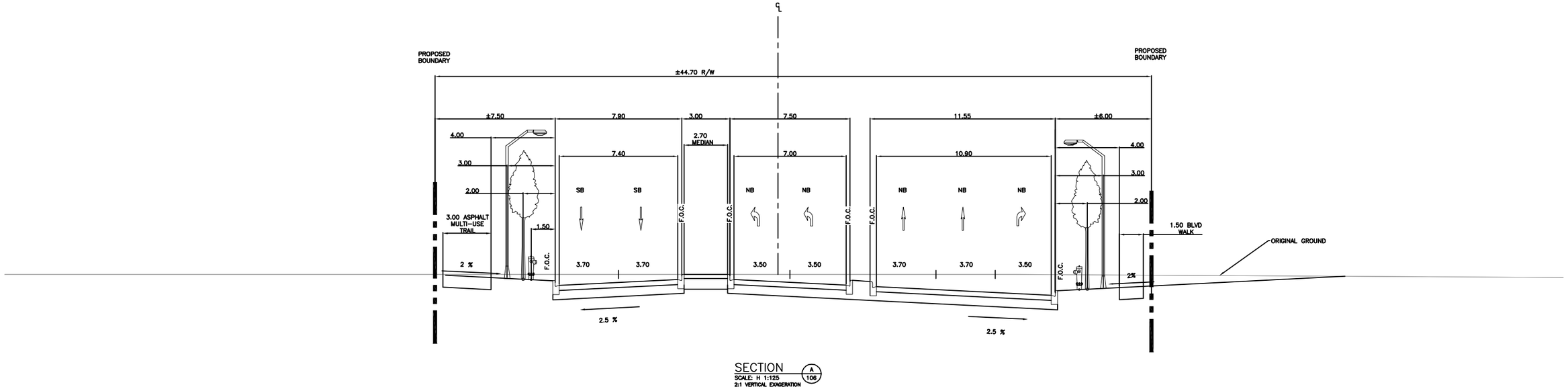
LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

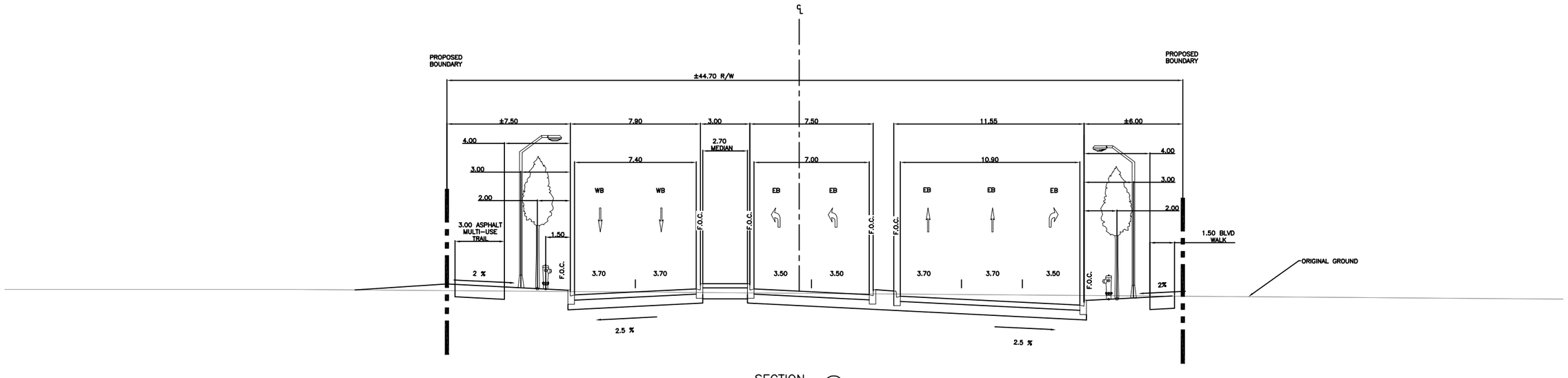
50TH STREET
INTERSECTION PLAN

DRAWING NUMBER	REV. NO.	SHEET
3420-1-115	A	15/25

This Drawing Is For The Use Of The Client And Project Indicated
No Representations Of Any Kind Are Made To Other Parties



SECTION (A/106)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION



SECTION (B/106)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

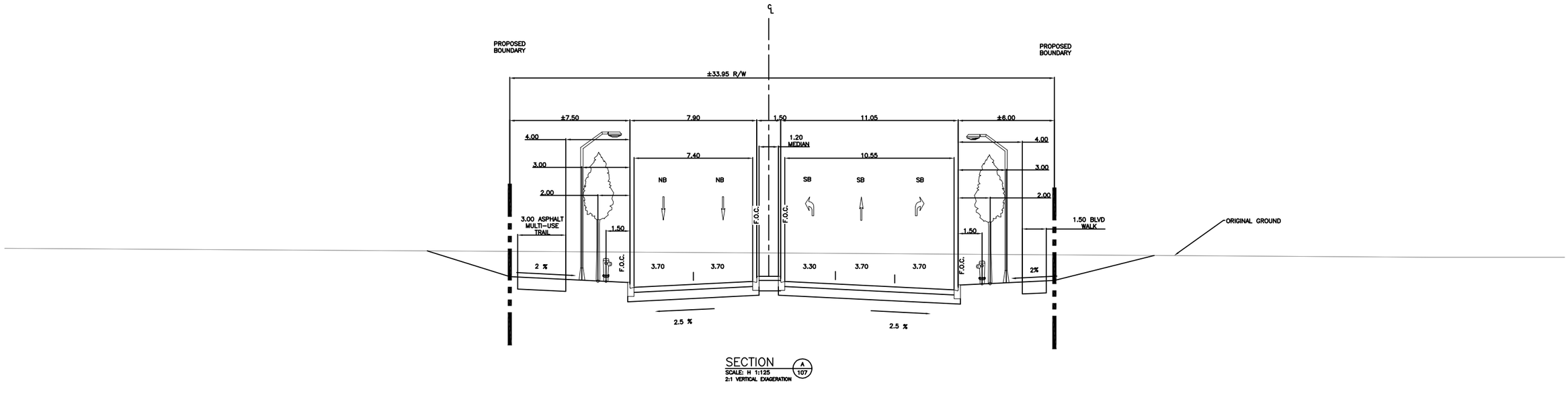
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

NISKU SPINE ROAD
INTERSECTION CROSS SECTIONS

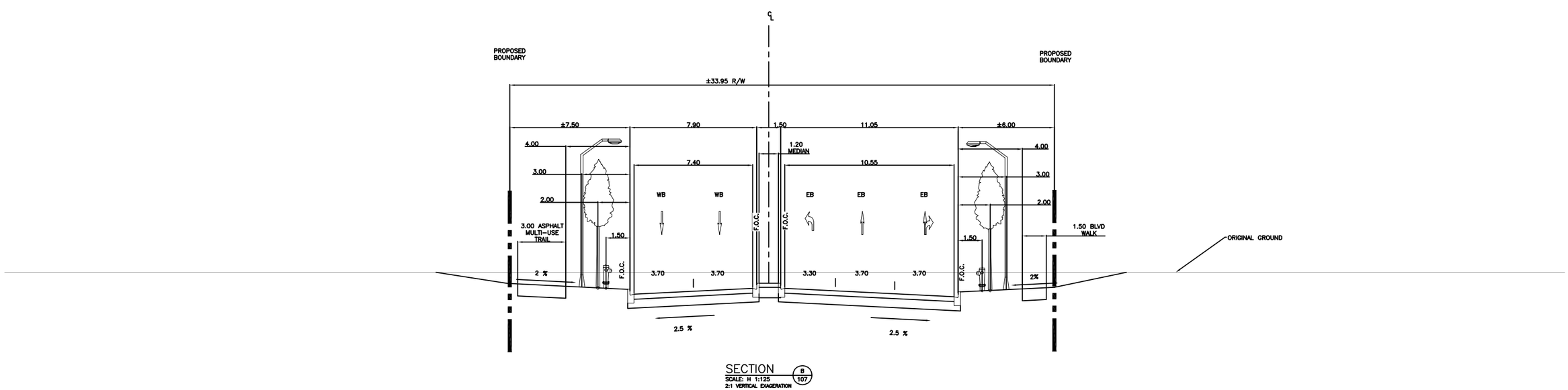
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3420-1-116	A	16 / 26

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DATE: 09/04/2009 8:18:40 PM, Jessica Peters

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SECTION (A/107)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION



SECTION (B/107)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

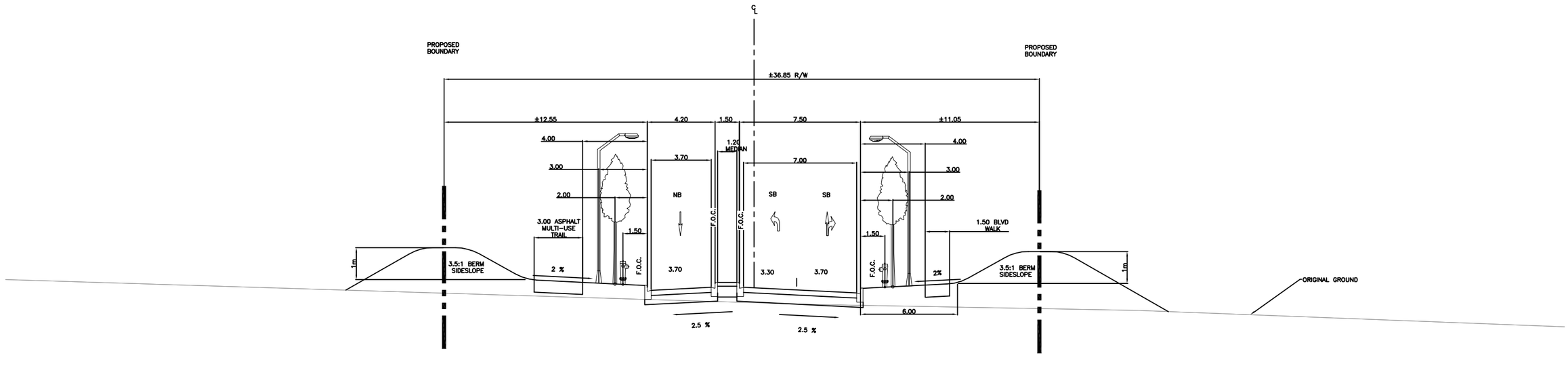
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 244 NORTH
INTERSECTION CROSS SECTIONS

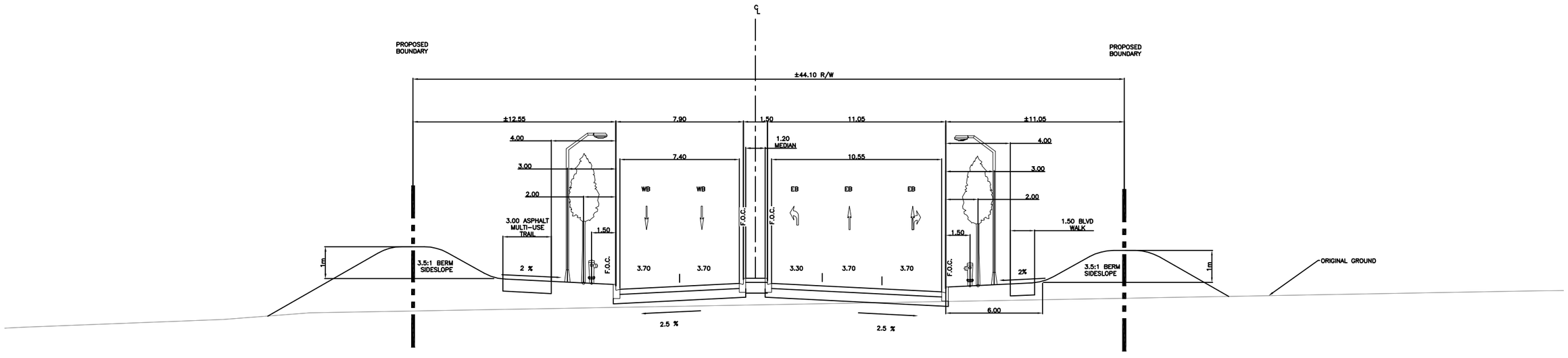
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3420-1-117	A	17/26

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DATE: 09/04/2009 8:16:25 PM, Jessica Peters

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SECTION A
SCALE: H 1:125
2:1 VERTICAL EXAGERATION
108



SECTION B
SCALE: H 1:125
2:1 VERTICAL EXAGERATION
108

NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

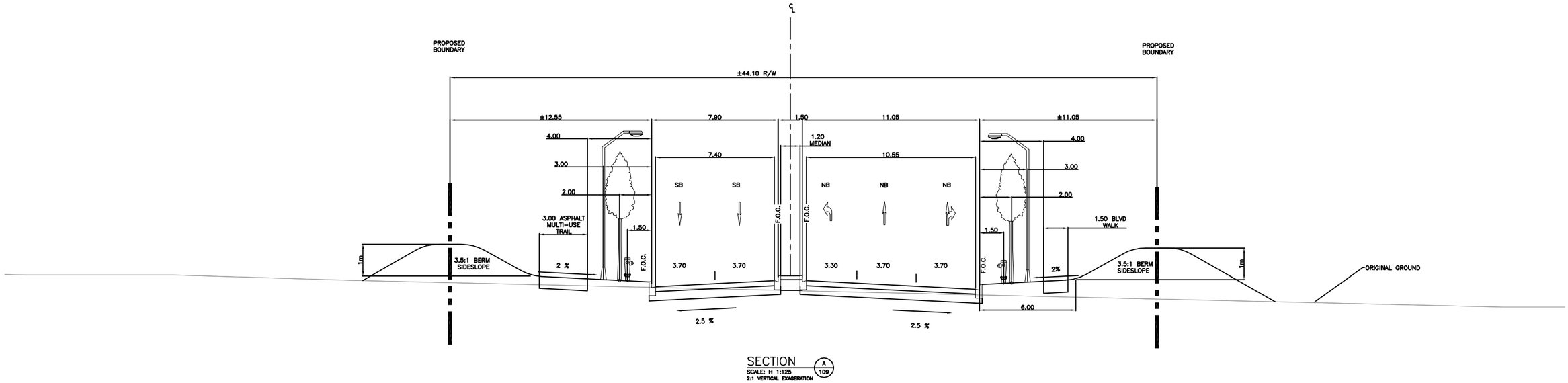
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 245 SOUTH
INTERSECTION CROSS SECTIONS

DRAWING NUMBER	REV. NO.	SHEET
3420-1-118	A	18/26

P:\2007\3420\00_Township Road 510\Working_Dwgs\100_Civil\Transportation\3420-1-118.dwg
DATE: 09/04/2009 8:16:22 PM, Jessica Peters

This Drawing Is For The Use Of The Client And Project Indicated
No Representations Of Any Kind Are Made To Other Parties



SECTION A 109
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

SECTION B 109
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

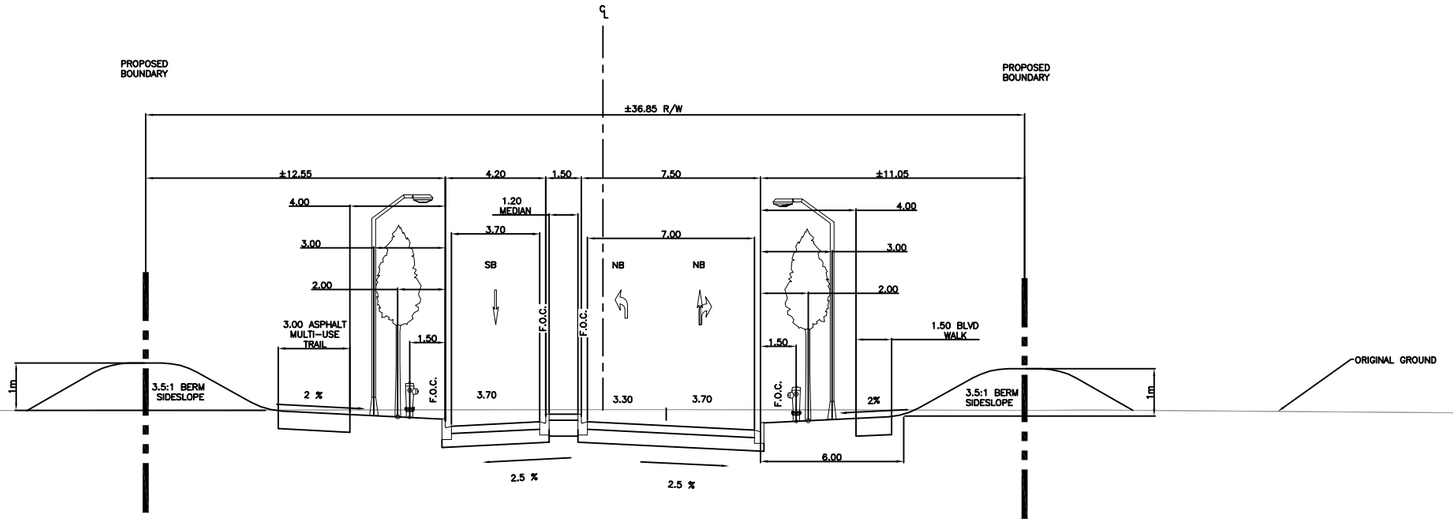
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

COLLECTOR 1
INTERSECTION CROSS SECTIONS

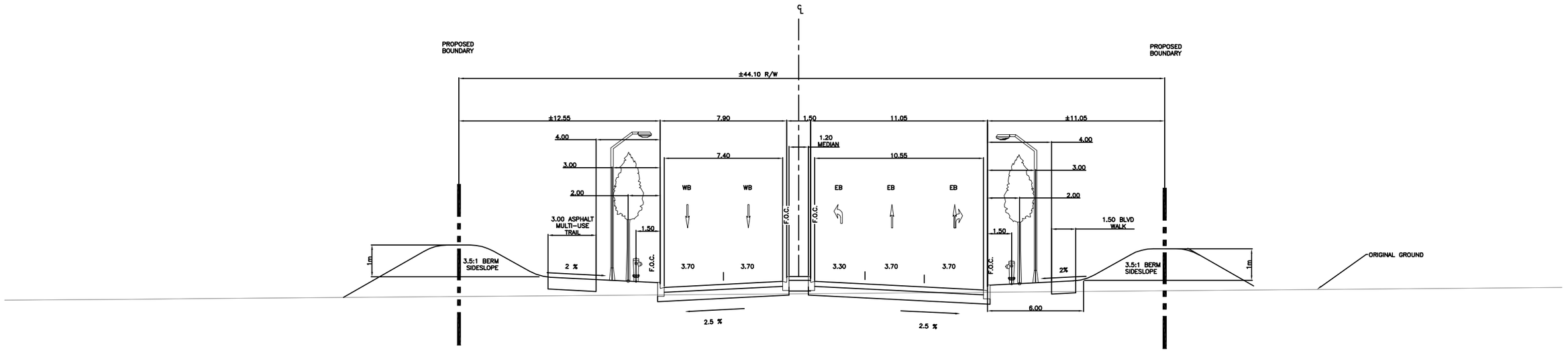
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DATE: 09/04/2009 8:18:19 PM, Jessica Peters

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SECTION A
SCALE: H 1:125
2:1 VERTICAL EXAGERATION
110



SECTION B
SCALE: H 1:125
2:1 VERTICAL EXAGERATION
110

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

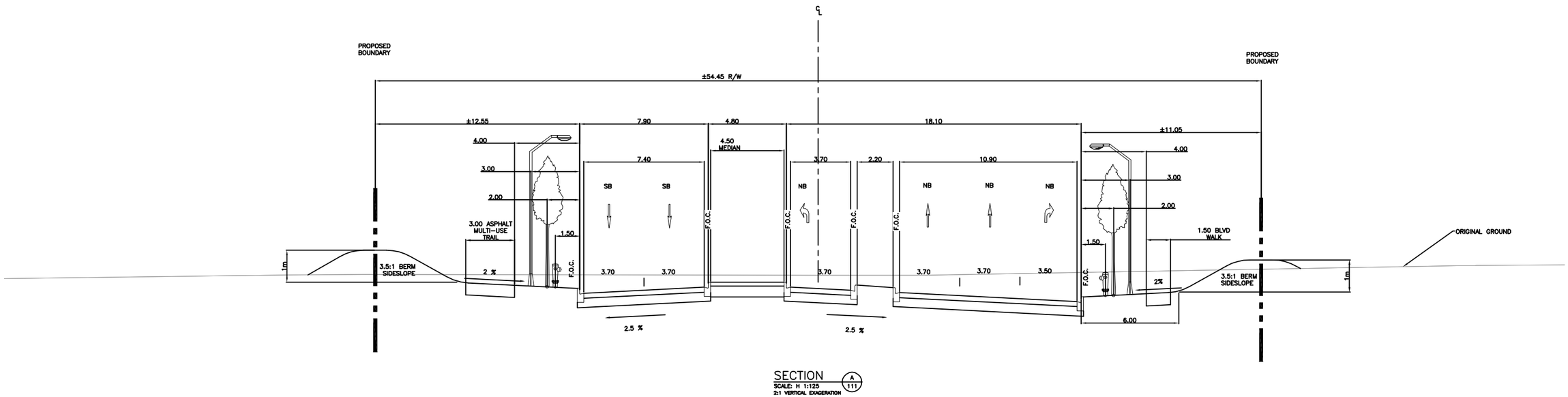
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

COLLECTOR 2
INTERSECTION CROSS SECTIONS

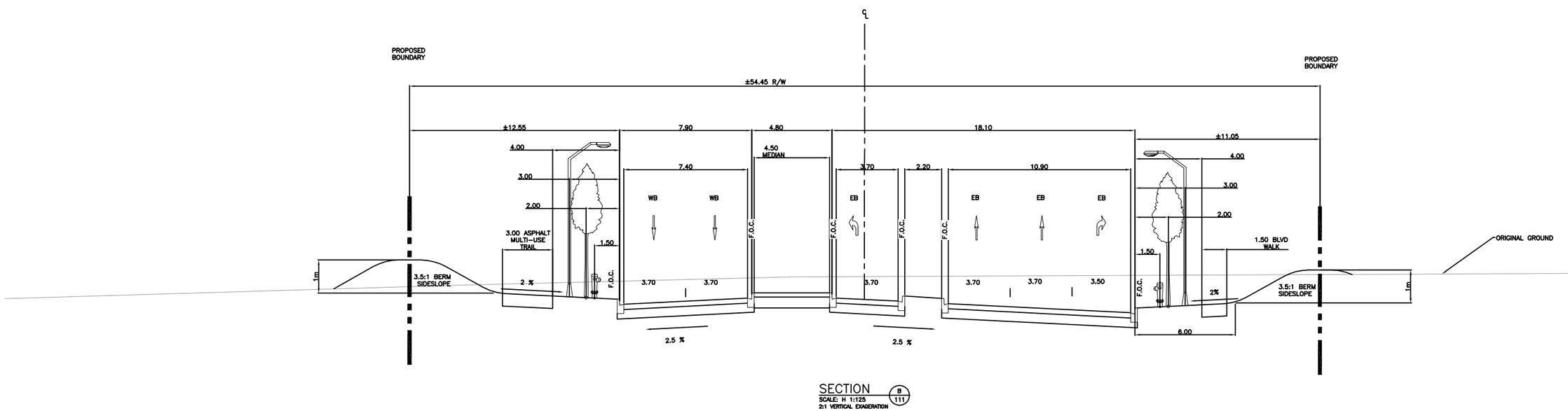
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3420-1-120	A	20/26

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DATE: 09/04/2009 8:16:17 PM, Jessica Peters

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SECTION (A/111)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION



SECTION (B/111)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

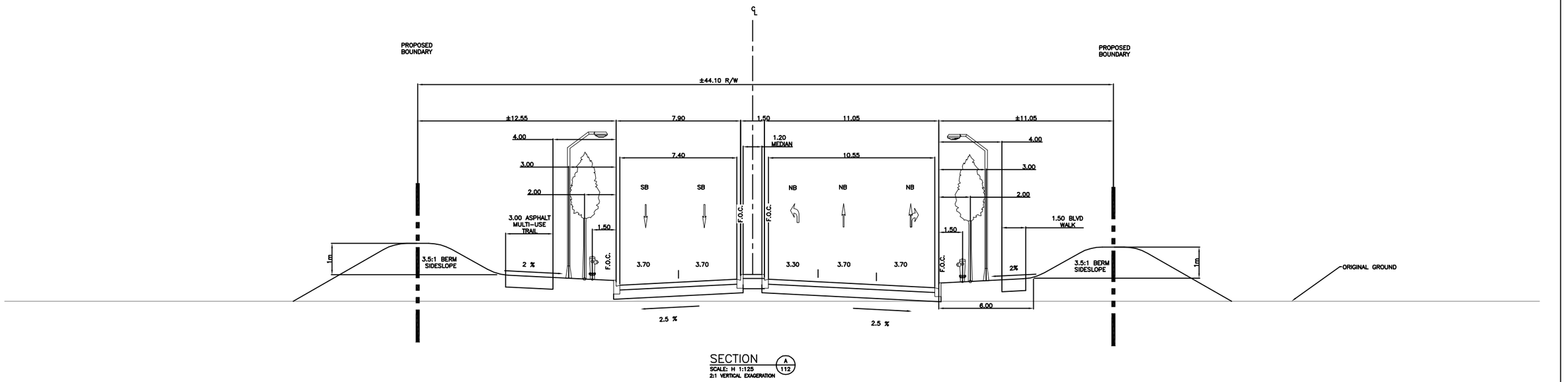
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 244 SOUTH
INTERSECTION CROSS SECTIONS

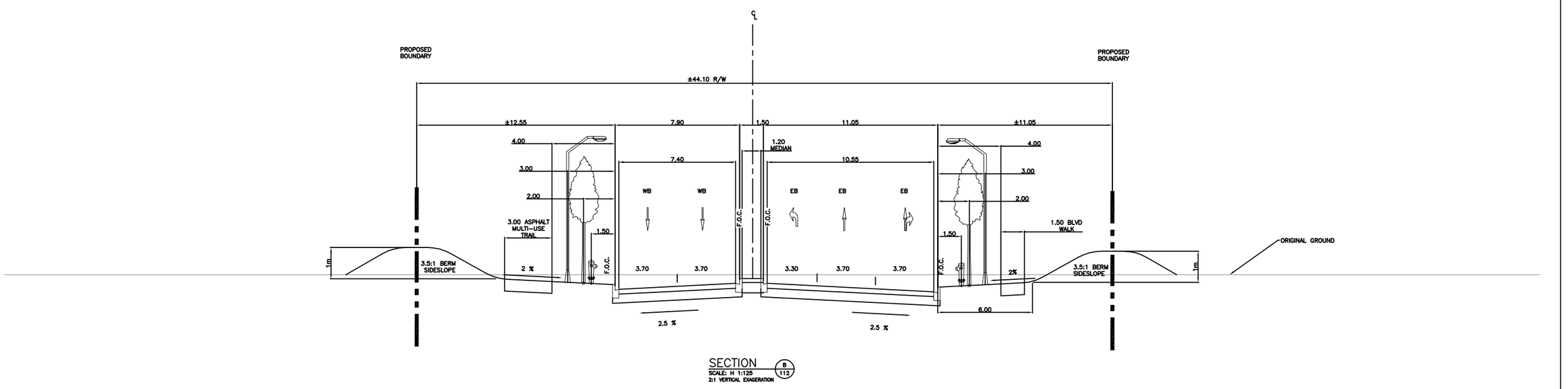
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DATE: 09/04/2009 8:16:14 PM, Jessica Peters

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SECTION (A 112)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION



SECTION (B 112)
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

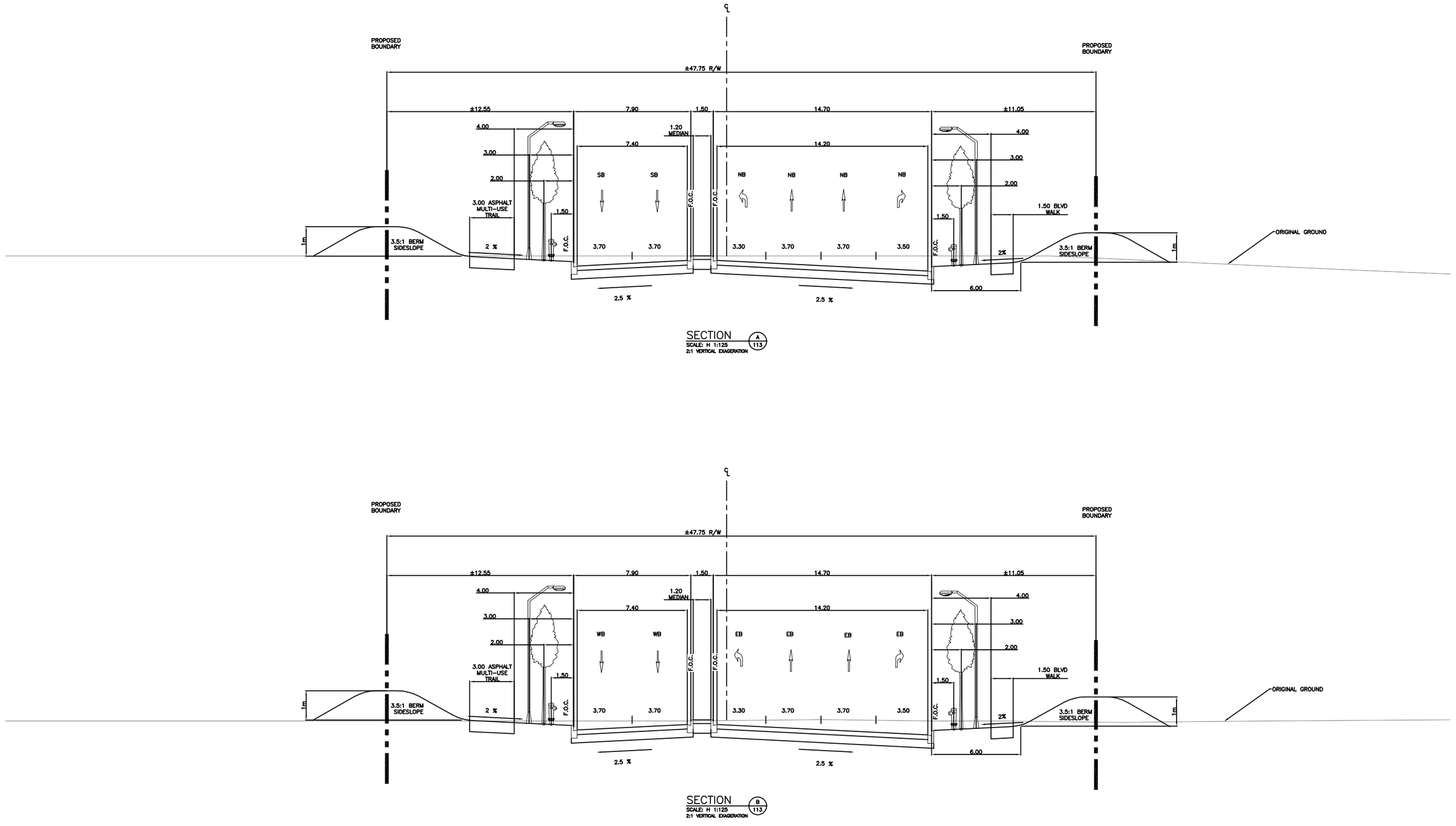
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

COLLECTOR 3
INTERSECTION CROSS SECTIONS

DRAWING NUMBER	REV. NO.	SHEET
3420-1-122	A	22 / 26

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DATE: 09/04/2009 8:16:11 PM Jessica Peters

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NO.	DATE	ENG.	BY	REVISIONS
A	2009-04-03	SB	JP	REPORT

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
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APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

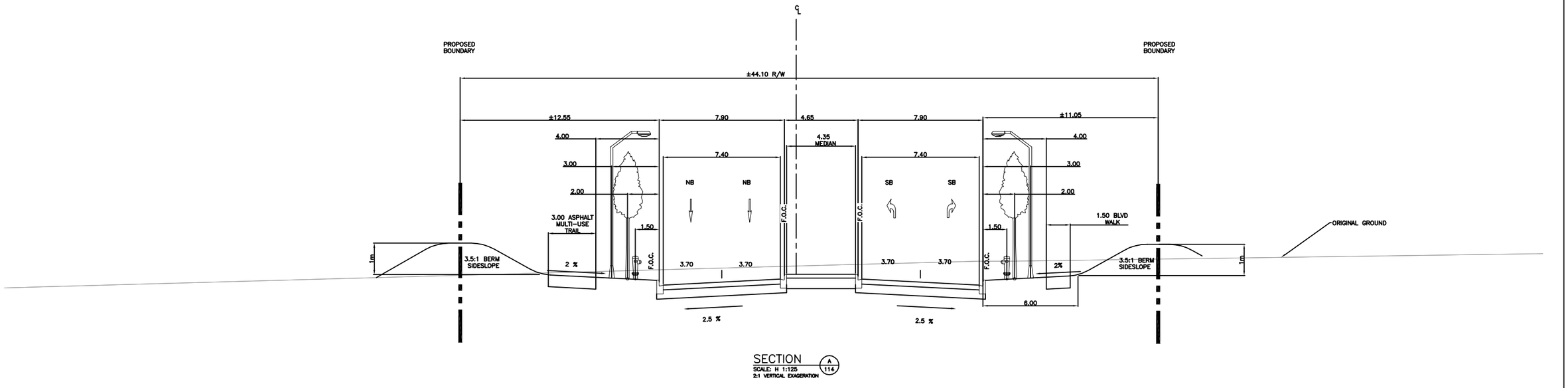
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

RANGE ROAD 243 SOUTH
INTERSECTION CROSS SECTIONS

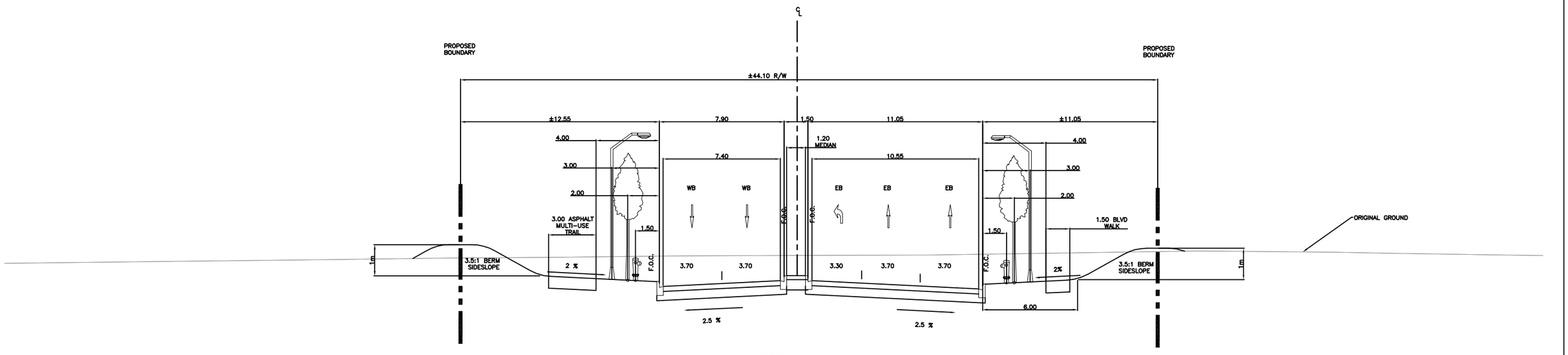
DRAWING NUMBER	REV. NO.	SHEET
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DATE: 09/04/2009 8:18:08 PM, Jessica Peters

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SECTION A/114
SCALE: H 1:125
2:1 VERTICAL EXAGERATION



SECTION B/114
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
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APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

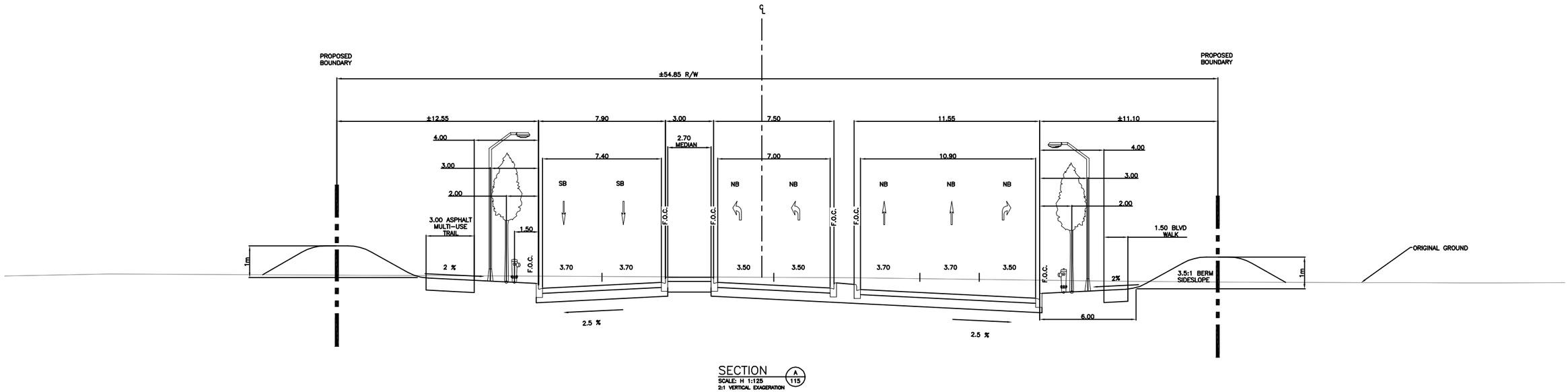
TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

COLLECTOR 4
INTERSECTION CROSS SECTIONS

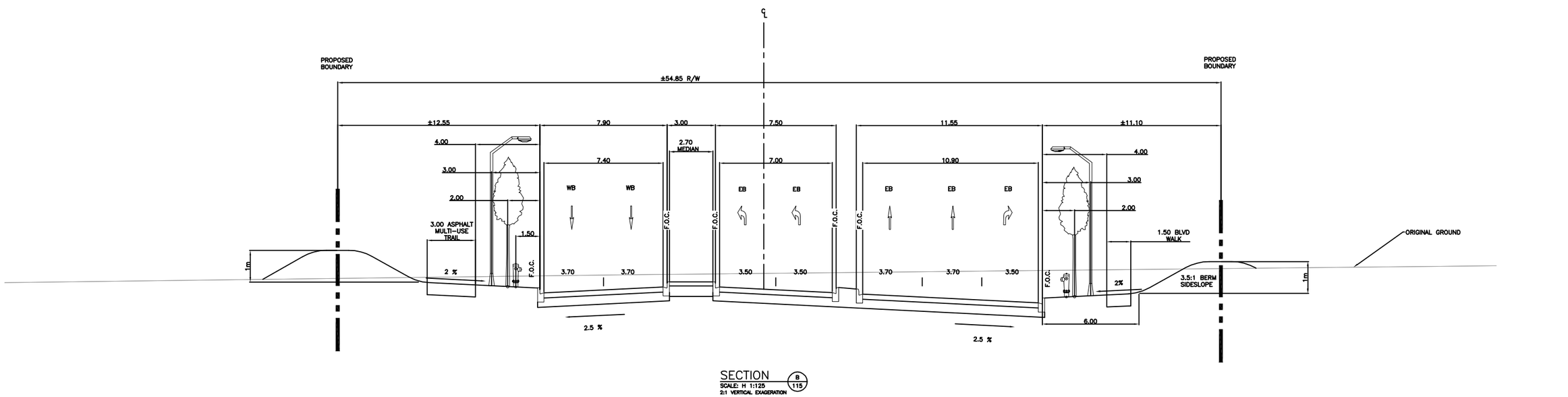
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DATE: 09/04/2009 8:18:03 PM, Jessica Peters

This Drawing Is For The Use Of The Client And Project Indicated
No Representations Of Any Kind Are Made To Other Parties



SECTION A/115
SCALE: H 1:125
2:1 VERTICAL EXAGERATION



SECTION B/115
SCALE: H 1:125
2:1 VERTICAL EXAGERATION

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	AS SHOWN		
DRAWN	JESSICA PETERS		-
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DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

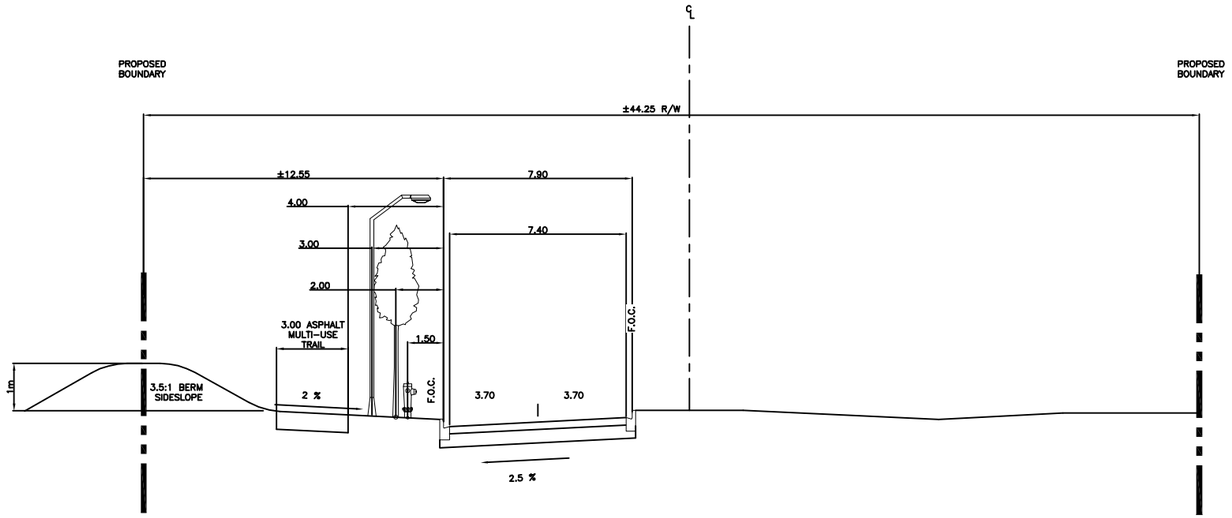
50TH STREET
INTERSECTION CROSS SECTIONS

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

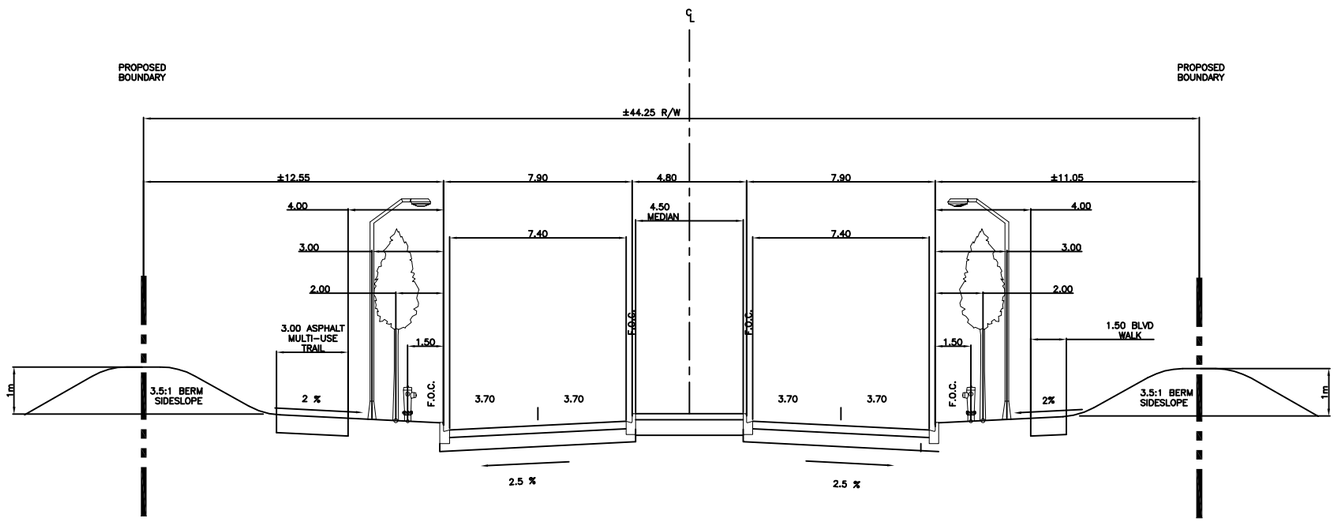
DRAWING NUMBER	REV. NO.	SHEET
3420-1-125	A	25/26

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DATE: 09/04/2009 8:15:58 PM, Jessica Peters

This Drawing Is For The Use Of The Client And Project Indicated
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TYPICAL FIRST STAGE CROSS SECTION



TYPICAL ULTIMATE CROSS SECTION

NO.	DATE	ENG.	BY	SUBJECT
A	2009-04-03	SB	JP	REPORT

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-3420		
SCALE	H 1:250 V 1:125		
DRAWN	JESSICA PETERS		-
DESIGNED	SHAWN BENBOW		-
CHECKED	BRYAN PETZOLD		-
APPROVED	BRYAN PETZOLD		-
DATE	APRIL 2009	INITIAL	

LEDUC COUNTY

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY

TYPICAL SECTIONS
PLAN / PROFILE

DRAWING NUMBER	REV. NO.	SHEET
3420-1-126	A	26 / 26

P:\2007-3420\05_Township Road 510\Working_Drgs\100_Civil\Transportation\3420-1-126.dwg
DATE: 09/04/2009 8:16:28 PM, Jessica Peters

5 Public Consultation

The public information and community consultation process for the Township Road 510 Functional Planning Study was comprised of two elements: stakeholder profiling interviews, and a public open house. Stakeholder profiling interviews were held with individual landowners along the study area to inform them of the functional planning study and to obtain local information from them. These meetings were held at the beginning of the study so that local information could be taken into account when developing the functional plans. The public open house was held near the end of the project, and functioned to present to the general public the functional plans and obtain comments and input.

5.1 STAKEHOLDER PROFILING INTERVIEWS

Upon initiating the Township Road 510 Functional Planning Study, the Associated Engineering project team acquired landowner information from Leduc County that identified individual landowners whose property was directly adjacent to Township Road 510 between Highway 814 (50 Street) and Range Road 244 [north]. Associated Engineering then performed research via publicly available government records, telephone searches, and other methods to obtain contact information for these landowners. The project team attempted to contact each of these property owners via telephone or fax to set up a meeting with each landowner.

A profiling interview form was developed to guide discussions between the project team and the landowners. The project team provided background on the purpose and objectives of the planning study, and a then asked series of questions relating to local issues and the planning study.

All local landowners were contacted a minimum of three times over a one month period to ensure the highest possible involvement rates. In all, about fifteen landowners were identified to be contacted by the project team. A few landowners did not wish to meet in person; telephone interviews were completed in these cases. However, most landowners agreed to meet with the project team. A few landowners, after numerous attempts to contact them, were not consulted because they did not return messages left for them.

A majority of the stakeholder profiling interviews took place in December 2007 and January 2008. Associated Engineering project team member Shawn Benbow attended all stakeholder profiling interviews; Associated Engineering project team member Bryan Petzold, and Leduc County's project manager, Khushnud Yousafzai, attended some interviews as well.

Common themes that arose from the profiling interviews include:

- Existing traffic on Township Road 510 travels at high speeds; landowners would like vehicles to be slowed down along the roadway.
- Significant delays are currently experienced at the Township Road 510 intersection with Highway 814 (50 Street), particularly in the AM and PM peak hours. Some residents detour through the Town of Beaumont to avoid turning movements at that intersection.

- Existing roadway conditions are perceived as poor because of significant rutting and roadway structure damage especially near Range Road 244 [south].
- Existing flooding along the roadway ditches near the LeBlanc Canal.
- Concerns for future access to private land from a redeveloped Township Road 510.

5.2 PUBLIC OPEN HOUSE

The Township Road 510 Functional Plan Open House was held on June 25, 2008 at the Nisku Inn & Conference Centre at 1101 - 4 St, Nisku. The open house was held as an informal drop-in format. Several large format display boards were provided in the venue to explain the study background and purpose.

Among the information presented were lists of stakeholders and relevant planning documents, a consolidated future land use plan, proposed access control information, and functional plans.

The proposed roadway cross-section and draft functional plan were provided for the public to view. Information detailed the proposed geometric standards and key roadway characteristics. A Copy of all open house displays are included in **Appendix C**. Refreshments and a light snack were also provided.

Seven project staff attended the open house: Shawn Benbow, Jessica Peters, and Wai Cheung from Associated Engineering, and Des Mryglod, Khushnud Yousafzai, Rick Stuckenberg, and Tom Schwerdtfeger from the Leduc County. Staff circulated throughout the room and engaged in discussions with the public, and provided supplemental information to answer questions presented.

The open house attendees were each given a comment form that asked for input, general comments, and specific likes and dislikes of the recommended plan, as well as any recommendations for staff to consider as the project proceeds. People were encouraged to fill out the forms before they left, or if necessary to fax or email the completed forms to Associated Engineering by July 4, 2008. A blank copy of the comment form is included in **Appendix C**.

Overall, 52 people attended the open house. 50 attendants completed sign-in forms. Thirteen comment forms were received, including one by email.

The following summarizes the comment forms and provides all the comments received from stakeholders and the public who attended the Open House.

5.2.1 General Open House Comments

How did you hear about the open house?

Signage	9
Sign and newspaper	1
Mail out	1
Word of mouth	3

Were the displays helpful?

Yes	13
No	1

It does not show what the actual intersection will look like tying into 50th Street.

Were project staff helpful?

Yes	11
Blank	2

While everyone was trying to be helpful, they could not say what an upgraded 50th Street will look like to tie in with this conceptual plan. Left us feeling like the picture was incomplete knowing full well 50th Street will play a very important role.

The information provided was:

Adequate	10
Just Right	2
Too little	1
Too Conceptual, Too Little	1

- Wanted to know how soon this would happen
- All drawings look good & entertaining
- Without possible time frames of little use
- People were helpful and concept was explained good
- Des provided any information that was asked to the best of what knowledge had been given to him
- Satisfied
- We are adjacent landowners on the east side of 50th Street, and were not consulted as the display board says. Could you provide the documentation to support this statement?

5.2.2 General Study Comments

- Now I know that 50 Street (Highway 814) is under Beaumont Town to look after, when you put lanes onto 510 - it ends up where? More traffic to 50 Street going from four lanes to two lanes on 50 Street. I think 50 Street needs to be upgraded as well.
- In 25 years it may be good.
- Present intersection like 50 Street & 510 TOWNSHIP are very busy right now. Whoever is responsible for those roads should look into need of traffic lights. They are must as they can save lives.
- Well done.

- Thought it was well presented considering that future plans of City of Edmonton with regards to ring road is substantially in the future.
- Good job.
- A smooth road with adequate shoulders as part 1 of this plan that would be implemented in the short term would be very helpful.
- Very informative and well put together.
- Beaumont is talking about a ring road and the Bunt Study says this is what the town's people want. How is this factored in to the conceptual plan?
- We found it interesting to know where major roads & highways are planned and which areas are intended to be residential, business parks, commercial and green spaces

5.2.3 Concept Likes

- Glad to see road upgrades to keep up with all the new housing construction in our area
- It is very good Area Structure Plan. What when to tying into 50 Street. We see the problem.
- No immediate plans for traffic problems
- Roadway cross-section will likely increase foot traffic letting people out of cars and into buses
- Can see there is foresight in planning
- Planning ahead
- Multi-use trail on south side
- The green space areas and the general layout

5.2.4 Concept Dislikes

- Traffic flows towards Town of Beaumont it will end up towards 50 Street.
- Impact studies have to be concluded in order for the next step in planning to be completed.
- The "main" corner at my property corner (major artery) is a concern but is inevitable.
- No access to Highway 2.
- As with the 41 Avenue SW study, it does not show what 50th Street is expected to look like. When we asked a consultant on hand to clarify "upgraded 50th Street" on one of the slides, he said it was a mistake? Was the display board then inaccurate? This is a very serious oversight.

5.2.5 Additional Issues and Ideas for the Project Team to Consider

- Upgrading RR 245 south of 510 to Hwy 625.
- Keeping in mind where the 510 traffic flow leads to.
- Was there any thought given to expanding Hwy 625 in lieu of 510?
- Move water & sewer along 510 more quickly than slowly.
- Noise attenuation fences/berms are very critical, as we back onto TOWNSHIP 510.
- Please show what 50th Street is expected to look like when tying into the intersection. Include what anticipated completion dates are for the Nisku Spine Road, 41 Avenue SW project,

upgrade to 50th Street. Giving ¼ of the picture makes this project look like piecemeal, hodge podge development…exactly what the residents and commuters don't want!

5.2.6 Additional Comments

- Glad to see they're keeping us informed.
- Thanks.
- Will the plans support shipping oversized loads on to the heavy haul corridor?
- It seems the plan allows for more alternative routes for traffic to enter the County from the City of Edmonton.
- I'm satisfied.
- Intersections like the one at Township 510 and Hwy 814 should be avoided if at all possible. They are very dangerous and difficult to enter. Traffic coming from Beaumont is accelerating at this point creating scary situations (we travel this area a lot as we live just west on 510).
- Extend the hours of future open houses – 3:00 – 9:00 p.m. Make limited hardcopies available to the public. Not everyone has a computer! Include the link where project information will be available.

5.2.7 Common Themes Identified by Stakeholders

Throughout the open house and via the open house comments forms, project staff compiled a selection of common themes – issues or ideas brought up by several stakeholders or community members. These major issues included:

- Intersection capacity of 50 Street/Highway 814
- Intersection treatment at 50 Street/Highway 814
- This project demonstrates good planning foresight
- Pedestrian and non-motorized mode accommodation is required

6 Drainage Considerations

6.1 BACKGROUND INFORMATION

The study area for this project includes Township Road 510 from the Nisku Spine Road to Highway 814. Leduc County plans to upgrade Township Road 510 from a 2 lane rural road to a major arterial roadway that will link the Town of Beaumont, the Nisku Business Park, and other developments in the area. Stormwater management facilities will be required to store and control runoff from the upgraded roadway as well as from future developments in the area.

6.2 LAND USE

The lands north and south of Township Road 510 within the project limits are primarily undeveloped and are currently being used for agriculture. There are some existing residential and industrial developments along Township Road 510. The Nisku Business Park and the Town of Beaumont are located to the south of Township Road 510 on the west and east ends of the study area, respectively.

There are also a number of existing utilities in the area including power lines and high pressure oil and gas pipelines. The alignments of these utilities will have to be confirmed as they may affect the locations of future stormwater management facilities.

The North Major Area Structure Plan, completed in 2004, identifies the future land uses on the north and south sides of Township Road 510. The proposed land uses are as follows:

- The area between the Nisku Spine Road and east of Range Road 244 [n] has been designated as business park and business park industrial (including the Nisku Business Park).
- The remaining area east of Range Road 244 [n] to Highway 814 has been designated primarily as residential estate with a small area of Country Residential around Cawes Lake.

6.3 EXISTING DRAINAGE

The drainage for the existing roadway is through a series of ditches and culverts that drain to Irvine Creek. Irvine Creek originates from an unnamed lake in Strathcona County and flows west until it connects to Blackmud Creek just east of the Nisku Spine Road. Irvine Creek has a basin area of between 5400 and 6700 ha, depending on whether the upstream lakes are included in the basin area. The LeBlanc Canal is a tributary of Irvine Creek and conveys flows from the west side of Beaumont. The canal was constructed in the early 1900s to provide drainage for the agricultural lands surrounding the town. It originates south of the Town of Beaumont and flows north before discharging to Irvine Creek. It also drains the Town of Beaumont through a series of stormwater management ponds that are designed to control the outflow.

The floodplains of Irvine Creek and Blackmud Creek create development issues and drainage constraints in the area. The floodplain limits, particularly along Irvine Creek, may affect the development and the location of stormwater management facilities as well as the vertical alignment of the roadway.

There are two major crossings on Township Road 510 within the project area. Irvine Creek passes through a 3700 mm culvert under Township Road 510 at Range Road 244 [N]. The LeBlanc Canal passes through two 900 mm culverts under Township Road 510 just west of the Town of Beaumont. There may also be a number of smaller culverts at field or driveway accesses which have not been identified.

6.4 EXISTING STRUCTURES

There are two existing culvert crossings on Township Road 510, within the project area.

6.4.1 Irvine Creek Crossing

Bridge File (BF) 00537 is located at the Irvine Creek crossing. A 3700 mm diameter steel plate culvert was installed in 1978. Alberta Infrastructure and Transportation provides Hydrotechnical Summaries for a number of the BF they have on file. The Hydrotechnical Summary for BF 00537 provides the following information:

- Channel Capacity of 10 m^3/s based on a base width of 2 m, a depth of 1.5 m and a longitudinal slope of 0.0015.
- A 1978 report notes a high water mark 0.3 m above the upstream crown.
- A 1994 BIM report notes a high water mark at 1.5 m above the creek bottom.
- Suggested culvert design flow is 14-24 m^3/s which is reasonably consistent with the flood estimates above.

The Blackmud Creek Floodplain Study indicates the 1:100 year flow for Irvine Creek is 21 m^3/s. The existing 3700 mm culvert has sufficient capacity for a flow of 21 m^3/s. At this time, there is insufficient information to determine if the existing structure meets the fish passage requirements. During the next stage of this project, a detailed hydrological assessment based on detailed site survey and an inspection of the existing structure should be conducted to confirm the design discharge and if any upgrades are required to the existing structure to accommodate road upgrades. If Irvine Creek is fish bearing, fish passage requirements will also need to be considered.

A detailed discussion including options for upgrading or replacing this bridge structure is presented in **Section 7** of this report.

6.4.2 LeBlanc Canal Crossing

The crossing at LeBlanc Canal does not have a Bridge File.

The Irvine Creek Water Management Project (1990) identifies the LeBlanc Canal drainage basin as being 19.7 km^2 (1970 ha) and having a peak 1:100 year discharge of 0.33 $m^3/s/km^2$ and 1:5 year discharge of 0.11 $m^3/s/km^2$. This translates into a peak discharge of 6.5 m^3/s and 2.17 m^3/s, respectively.

The LeBlanc Canal Intermunicipal Drainage Study (GPEC Consulting, 2001) included a detailed analysis of the capacity of the Leblanc Canal. The modelling of the LeBlanc Canal, conducted for that study, indicates the 1:100 year 24hr discharge from LeBlanc Canal into Irvine Creek is 4.5 m^3/s, roughly two thirds of the previous estimate. The modelling showed major flooding in most

reaches of the canal and backwater at most culverts, however there was no significant overtopping of the roadways because the excess flows flooded the fields upstream of the canal restrictions and culverts.

The maximum flow capacity of the LeBlanc Canal is indicated as being 2.15 m^3/s, which is comparable to the 1:5 year peak discharge of 2.17 m^3/s (Irvine Creek Water Management Project, 1990). However, it is also mentioned that sections of the canal did not have the capacity to pass even these flows.

Table 6-1 summarizes the drainage area and discharge data from this study.

Table 6-1: Drainage Area and Discharge Data

LeBlanc Canal Capacity	1:5 Year Peak Discharge [1]	1:100 Year Peak Discharge [1]	1:100 Year, 24 Hr Discharge Modeled from LeBlanc Canal to Irvine Creek
2.15 m^3/s	0.11 $m^3/s/km^2$ 2.17 m^3/s	0.33 $m^3/s/km^2$ 6.5 m^3/s	4.5 m^3/s

[1]Note: These numbers are from the Irvine Creek Water Management Project (1990) and are summarized in the LeBlanc Canal Intermunicipal Drainage Study (2001).

A survey conducted in September 2007 indicates there are two 900 mm diameter culverts at this crossing. These culverts have sufficient capacity for a discharge of approximately 3.4 m^3/s, which is greater than the capacity of the LeBlanc Canal but less than the 1:100 year flood discharge. With proposed development in the area, the LeBlanc Canal may be upgraded to accommodate a greater capacity. With this in mind, the culverts may need to be replaced with larger pipes to increase their capacity to handle a 1:100 year storm event.

Development within the future estate residential development area may require improvements to the LeBlanc Canal upstream of Township Road 510; however, this development may significantly increase flows discharged to Irvine Creek by reducing the flood plain storage. A detailed hydrologic assessment of these structures should be conducted in conjunction with development in the area to determine if any upgrades are required to accommodate the road upgrades or future development. Stormwater management will be required to control flows to pre-development rates to avoid aggravating downstream flooding and erosion problems.

6.5 STORMWATER MANAGEMENT DRAINAGE CONCEPT

The proposed upgrades to Township Road 510 include additional lanes and converting the roadside ditches with curb and gutter. Storm sewers will be required to convey the runoff from the roadway to stormwater management facilities. Storm sewers should be designed to convey discharge from a 1:5 year storm event. They will also need to accommodate runoff from a small strip of land adjacent to the roadway until those areas are developed.

Upgrading Township Road 510 will increase the amount of runoff from the roadway due to an increased paved surface area and elimination of roadside ditches. Runoff from the upgraded roadway and future development in the area will need to be controlled to predevelopment rates to prevent increased flooding in

Irvine and Blackmud Creeks. The municipal development plan for the Town of Beaumont indicates that stormwater runoff will be controlled, but does not specify a flow rate. Water quality improvements to stormwater runoff will also be required.

Recommended predevelopment flows rates for developments draining to Blackmud Creek have varied over the years. The following lists some previous recommendations:

- In 1983 Alberta Environment recommended a 1:100 year predevelopment flow rate of 1.7 L/s/ha.
- In 2001, EXH recommended a 1:25 year release rate of 1.64 L/s/ha.
- In 2001, GPEC Consulting recommended a 1:100 year release rate of 1.8 L/s/ha.
- In 2004, EXH recommended a 1:100 year release rate of 4.2 L/s/ha; this was increased slightly to 4.25 L/s/ha in the North Major Area Structure Plan Utility Plan and Stormwater Strategy completed by EXH in 2005.
- The North Major Area Structure Plan also recommended lower release rates of 3.3 L/s/ha for Irvine Creek and 1.8 L/s/ha for Leblanc Canal, which carries flows from Beaumont to Irvine Creek.

The Blackmud Creek Floodplain Study completed by the Alberta Department of Environment in 1985 states that the 1:100 year flows for Blackmud Creek upstream and downstream of Irvine Creek are 56 m^3/s and 77 m^3/s, respectively. The resulting 1:100 year flow for Irvine Creek is approximately 21 m^3/s. The basin area for Irvine Creek at its mouth is between 5400 and 6700 ha, depending on whether the upstream lakes are included in the basin area. This results in a predevelopment flow rate of 3.1 to 3.8 L/s/ha, which is comparable to the recommended release rate from the North Major Area Structure Plan for Irvine Creek as well as estimates for Blackmud creek. Note that no adjustments have been made for the Town of Beaumont or for lake routing.

A release rate of 3.3 L/s/ha for areas draining to Irvine Creek and 1.8 L/s/ha for areas draining to the LeBlanc Canal will be used to assess the stormwater management requirements for this project. Based on this release rate, IDF curves from the Edmonton International Airport, and the proposed road cross section, the required storage volume is 387 m^3/ha of roadway discharging to Irvine Creek and 452 m^3/ha of roadway discharging to LeBlanc Canal.

A high point along Township Road 510 at approximately Station 2+360, requires that runoff will be directed to four separate facilities, one located on each side of Irvine Creek and one located on each side of the LeBlanc Canal. The estimated required storage volume for these facilities is a combined total of 12,500 m^3. These facilities can be integrated with stormwater management plans required for future development along Township Road 510 once those are better defined.

Alberta Environment's Stormwater Best Management Practices recommend the following general design parameters for storm ponds:

- Provide storage for the 1:100 year storm
- Minimum surface area of 2 ha for wet ponds (No minimum specified for wetlands or dry ponds)
- Sideslopes of 5:1
- Minimum permanent pool depth of 2.0 m
- Maximum active storage depth of 1.5 m
- Detention time of 24 hours

It is recommended that the stormwater management facilities be constructed as wetlands to provide treatment and improve the quality of flow being discharged to either Irvine Creek or LeBlanc Canal.

6.6 ESTIMATED COSTS

Table 6-2 summarizes the estimated costs related to drainage of the proposed roadway upgrades at a conceptual level of detail. These costs are estimates based on the information available at this time and should be considered only approximate. During the next stage of this project, a more detailed cost analysis should be conducted.

Table 6-2: Conceptual Drainage Cost Estimates

Structure	Unit Cost	Quantity	Total Cost
450 mm pipe	$578/m	960 m	$555,000
600 mm pipe	$ 885/m	1,920 m	$1,700,000
750 mm pipe	$1,298/m	2,400 m	$3,115,000
900 mm pipe	$1,770/m	360 m	$637,000
900 mm culvert (LeBlanc Canal)	$1,256/m	50 m	$62,800
Catchbasins	$7000 ea	80	$560,000
Stormwater Wetlands	$100/$m^3$	12,400 m^3	$1,240,000
Hydrological Assessments	$50,000 ea	2	$100,000
		Subtotal	**$7,969,800**

Note that these costs do not include contingency, engineering or GST and should be considered preliminary, subject to review in detailed design. The costs estimate included one additional 900 mm diameter culvert at the LeBlanc Canal crossing and assumed that the existing two culverts are in adequate condition.

6.7 CONCLUSIONS

Stormwater management facilities will be required to store and control flows from upgraded Township Road 510. The facilities can be integrated with the stormwater management requirements of the future developments along Township Road 510.

Estimates of design discharge for the Irvine Creek Crossing range from 14 to 24 m^3/s. Associated Engineering's preliminary review indicates that the existing structure has capacity for 21 m^3/s. A detailed hydrologic assessment is required to confirm the design discharge; a detailed structural assessment is provided in **Section 7** of this report.

Estimates of the 1:100 year discharge on the LeBlanc Canal range from 4.5 to 6.5 m^3/s. The culvert crossing of Township Road 510 has a capacity of about 3.5 m^3/s. Preliminary investigation identifies that one additional 900 mm culvert will be required at this location to prevent the canal from overtopping the roadway. A detailed hydrologic assessment is required to confirm the design discharge as this will change if the LeBlanc Canal is upgraded upstream of Township Road 510, and to determine if the existing structure can adequately accommodate the road upgrades.

Preliminary costs for the proposed stormwater drainage work is estimated to be approximately $12 million plus engineering and GST, at a conceptual level of detail.

7 Structural Considerations

7.1 INTRODUCTION

Within the Township Road 510 study area there are two significant drainage crossings – the LeBlanc Canal and Irvine Creek. The LeBlanc Canal crossing is currently provided by two small culverts under Township Road 510. Irvine Creek, however, crosses under Township Road 510 via a bridge sized culvert.

This assessment report concerns Bridge File (BF) 00537, which is located at the crossing of Township Road 510 with Irvine Creek. The purpose of this assessment is to evaluate repair or rehabilitation options against replacement, within the context of the functional plan, and provide a recommended course of action for the site.

This report includes a description of the culvert and its history, the results of BIM inspections, a discussion of the controlling factors, the assessment options, life cycle and recommendations.

7.2 CULVERT DESCRIPTION

BF 00537, the Irvine Creek Culvert, carries Township Road 510 over Irvine Creek, which is located at the T-Intersection of Township Road 510 and Range Road 244 [north] (refer to the aerial photo in **Appendix D**). The culvert is located on a 25° Left Hand Forward (LHF) skew. Township Road 510 and Range Road 244 are currently classified as RLU-207G-060. The roadway width is 6.8 m and is paved with ACP.

The existing culvert comprises a 3.7 m diameter by 39.6 m long Structural Plate Corrugated Metal Plate (SPCMP) culvert and was constructed in 1978 to replace a hydraulically inadequate 2.4 m diameter culvert. The culvert was supplied by Armco, and was installed following the Alberta Transportation Culvert Installation Procedure described by standard drawing S-1086 (a copy of which is located in **Appendix D**). There is approximately 1 metre of fill on the culvert.

7.3 CULVERT HISTORY

A review of the history from Alberta Transportations' Bridge Files is provided in **Appendix D** and summarized as follows:

1903 -Constructed the first timber bridge – 20' span.

1957 -Replaced the bridge with a 96" SPCIP Culvert (90' long). The pipe was placed on 35° LHF skew.

1978 -Existing culvert considered hydraulically inadequate. Replaced with 144" SPCMP Culvert (130' long)

1994 -Level 1 BIM Inspection

2000 -Level 1 BIM Inspection

2005 -Level 1 BIM Inspection

7.4 SITE INSPECTION

The most recent Level 1 (visual) BIM Inspection of the bridge was conducted November 10th 2005. A copy of the BIM Inspection Report and photos are attached in **Appendix D**. A site visit was performed by Associated Engineering on October 20th 2007 (refer to **Appendix D** for photos). From BIM inspection reports, the ratings from previous inspections are compared, and summarized in **Table 7-1**.

Table 7-1: Irvine Creek Culvert Bridge Inspection Summary

BIM Level 1 Inspection Results	Jan. 1 1994	Apr. 18 2000	Nov. 10 2005	Remarks
Approach Road	6	6	7	T-intersection with the East-West road running through, the North-South road having a stop sign
Upstream End	5	5	4	Slope protection is bagged rip-rap in a wing wall type of layout with erosion at SE side
Barrel	5	5	2	Poorly nested sidewall seams, cracks Longitudinal seams with cracks Sidewall deflection Rust stains coming through bolt holes
Downstream End	6	6	4	Hole through bevelled portion
Channel	6	6	6	High water mark of 1.5 m taken from stains
Structural Condition	55.0 %	55.0 %	22.2 %	
Sufficiency Rating	50.8 %	50.8 %	43.7 %	

The most recent BIM Inspection report gave the estimated year of replacement as 2011.

7.5 CONTROLLING FACTORS

This section discusses the controlling factors that are usually considered in assessments and in determining a feasible repair strategy. These include the following factors:

- structural condition
- hydrotechnical issues
- geotechnical issues
- environmental issues
- roadway geometrics
- traffic usage
- future development
- other bridges or culverts, and
- traffic accommodation

Details of these factors are discussed below.

7.5.1 Structural Condition

From the November 2005 BIM Inspection, the existing culvert was found to be in poor condition as a result of the following conditions:

- Poorly nested sidewall seam
- Cracked seams
- Sidewall movement

The barrel was giving a rating of 2 indicating severe distress and a high maintenance priority for repair or replacement.

Based on the above findings, Structural Condition is a controlling factor.

7.5.2 Hydrotechnical Issues

Irvine Creek has its headwaters East of Looma in 26-50-22-E4M. From the crossing at Township Road 510 Irvine Creek flows South-West to its junction with Blackmud Creek.

The first culvert constructed at the site in 1957 had a 96" diameter. It was found in 1978 that this culvert was hydraulically inadequate and it was replaced with a 144" diameter culvert. There have since been no recorded hydraulic issues at the site.

Based on the above, hydraulic issues are not a controlling factor in this assessment.

7.5.3 Geotechnical Issues

A detailed Geotechnical Investigation was not carried out as part of the assessment. The culvert has been in service for 29 years, and shows no significant signs of movement or deflections. Also, over the history of the bridge site which begins in 1903 with a 20' span bridge, there have been no records which would indicate that special consideration for geotechnical issues are required.

Based on the above findings, geotechnical issued are not a controlling factor in this assessment.

7.5.4 Environmental Issues

The Irvine Creek area is described as naturally vegetated surrounded by agriculture lands. There is some vegetation growth along the banks of the creek.

Fish habitat was not assessed, but at this location Irvine Creek is a Class 'C' watercourse as defined by Alberta Environment's "Code of Practice for Watercourse Crossings" with no a Restricted Activity Period (RAP) between April 16 and June 30. The advice of a qualified aquatic specialist will be required before any in-stream work proceeds.

With respect to Navigable Waters, a review of recent Navigable Waters Protection Act (NWPA) decisions indicates that the following structures on Irvine Creek are not Navigable: BF 71293, BF 75068, BF 01182.

Therefore, it is likely the culvert is not navigable, however, Transport Canada should be contacted to formally ascertain the Navigability Status.

Based on the above findings, environmental issues are not a controlling factor in this assessment.

7.5.5 Geometrics

The Irvine Creek culvert is located at the intersection of Range Road 244 with Township Road 510. It is a T-intersection, with Township Road 510 running straight through and Range Road 244 having a stop sign (see **Appendix D** for the aerial photo of the site).

Irvine Creek runs from North-East to South-West, under the intersection, with the straight culvert oriented at 25º LHF with respect to Township Road 510.

The approach roads have side slopes of 4:1, there is 1.0 m of cover to the culvert, and the clear roadway width is 6.8 m.

The sideslope at the inside is protected with bagged rip rap and is sloped at 1:1.

Consideration of the geometrics with respect to the functional planning of Township Road 510 is important, as the functional study was the impetus for the culvert assessment. At this time it is anticipated that a four lane urban roadway section will be recommended. It will have a raised median and a multi-use trail, giving an approximate overall width of 26 m.

Based on the above findings, Geometrics is a controlling factor in this assessment.

7.5.6 Traffic Usage & Future Development

At present, AADT at the culvert is estimated at 2800 vehicles comprising residential, farmers, and commuters from Edmonton, Beaumont and Nisku.

As mentioned, a functional plan of Township Road 510 is underway. At this time it is expected the AADT will increase in the order of 10 times. The expected traffic will comprise a higher proportion of residential vehicles, while still serving commuters. Farm equipment usage is expected to decrease.

At this time, the functional plan is not complete, however, the future development and usage estimates are considered sufficient for this assessment of the culvert site. It is expected that the roadway will be upgraded in the next 5 to 10 years.

Based on the above observations, Traffic Usage and Future Developments are controlling factors.

7.5.7 Other Bridges or Culverts & Traffic Accommodation

In the event the culvert site needs to be temporarily closed for repairs or replacement, there are detour routes available. The map in **Appendix D** shows two possible traffic accommodations routes.

On the North detour route is BF 01139, a 6.1 m long and 6.1 m wide concrete girder bridge with no load restriction.

On the South detour route, two bridges are crossing. On secondary Hwy 625 is BF 08949, a three span standard precast concrete bridge with no restriction. On Range Road 250 is BF 00300, a three span standard precast concrete bridge. This bridge also has no load restriction.

As such, other bridge crossings and traffic accommodation are a consideration, but not a controlling factor.

7.6 ASSESSMENT OPTIONS

The major factors that control a future repair/rehabilitation or replacement at this site are summarized as follows:

- **Structural Condition** – Poorly nested sidewall seam, cracked seams and a severe distress rating of the barrel. From the BIM inspections, the culvert has an estimated remaining service life of 3-4 years. The current age of the culvert is 29 years.
- **Geometrics, Traffic Usage and Future Developments** – Township Road 510, which is carried over Irvine creek by BF 00537 is currently undergoing a Functional Study. The current roadway section (2 Lane Rural) is planned to be replaced by a 4 Lane Urban Section with a Multi-Use Trail. There is also a large skew (25º LHF) with respect to the creek.

As this assessment is being done in the context of the Functional Plan, the requirements of the Functional Plan must be met at this site for any option considered. The main requirement affecting the assessment options is supporting a four lane urban roadway with an AADT of 25000 to 30000.

7.6.1 Option 1: Do-Nothing

Typically when assessing a replacement structure, it is necessary to evaluate for comparative purposes a “Do-Nothing” solution. This option involves only those activities required to maintain the culvert’s current level of service.

As the options for this site are driven by the requirements of the Functional Plan, this option is not considered viable, and is therefore not considered further.

7.6.2 Option 2: Rehabilitation

The second option to consider is major repair or rehabilitation. This would involve all major repairs and rehabilitation necessary to achieve the functional requirements for the site.

To accommodate the future urban roadway, it is estimate that the existing culvert as aligned would need to be extended by a minimum of 25 m. This assumes the same finished roadway elevation and similar side slopes as existing roadway. Also, the existing culvert has a remaining life of just 4 years and as such, a long-term repair strategy is also required. This would entail using a culvert liner, or internal struts with seam repairs.

This option is not desirable for a number of reasons. First, at 65 m long, the culvert would likely be undesirable from a fish passage point of view, and the advice of qualified biologist would be required to determine its adequacy.

Second, the culvert has relatively shallow cover. Sufficient soil cover reduces the dynamic impact effect that vehicles have on buried structures. While shallow cover is adequate for low traffic volumes typical to local roads, it will not be sufficient for a high volume urban road with up to 10 times the current traffic volumes, and the structure's life will be reduced.

Any viable solution would require increasing the depth of cover, and consequently increasing the culvert length. Considering the required extension in culvert length, the repairs that would be required for the existing portion of the culvert and the reduced lifespan of the structure make this an uneconomic and undesirable option. For these reasons, this option is not considered further.

7.6.3 Option 3: Replacement

The third option for consideration at this site is replacement. The options considered are replacement with a culvert, and replacement with a bridge structure.

The culvert replacement would be designed to the criteria set out by AIT in "Design Guidelines for Bridge Size Culverts". Based on these guidelines, a replacement culvert on the same alignment would have an invert length of 75 m. It is assumed the culvert diameter of 3.7 m would be adequate.

The bridge structure replacement would have provide a 4.0 m channel width, sideslopes of 2:1, and thus have a total span of 21.0 m. The structure would be situated on skew to follow the creek alignment.

For either of these replacement options, the structure type will be chosen during preliminary design. The culvert options to consider include a standard CSP culvert, a concrete culvert arch, or a steel arch culvert. The bridge structure options to consider include precast concrete girders with a cast-in-place deck or premanufactured composite concrete-steel girders, such as the "pi" girder.

It is expected that the road will be upgraded in 5-10 years. For comparative purposes it is assumed the new roadway will not be completed for 10 years. While the current structure only has 3-4 years of serviceable life remaining, this presents two options. The first option is to replace the culvert in 2011 when it reaches the end of its serviceable life with one of the two structure alternatives. The second option is to provide repairs as required in 2011 to keep the structure safe until replacement in 2018. This would involve strutting and seam repairs, estimated at $35,000. Then the structure would be replaced in 2018 with one of the two structure alternatives.

7.7 LIFE CYCLE COSTS

In this section, a life cycle economic assessment is made to compare these options and shows the initial capital investment and related operating costs. In the end result, there is a "Net Present Value" cost that shows the estimated total "Life Cycle Cost" of each option.

In calculating the Net Present Value (in 2008 dollars), this assessment used an escalation rate of 4% (difference between bank and rate of inflation) and a service life of 50 Years.

From the above options, the estimated Life Cycle Costs are presented in **Appendix D** and summarized in **Table 7-2**.

Table 7-2: Life Cycle Costs for Irvine Creek Upgrade Options

Life Cycle Costs	Option 3a Replace with Culvert in 2012	Option 3b Replace with Culvert in 2018	Option 3c Replace with Bridge in 2012	Option 3d Replace with Bridge in 2018
Total Expenditure to 2058 (in 2008 dollars)	$1,755,500.00	$1,790,500.00	$1,904,500.00	$1,939,500.00
Net Present Value (in 2008 dollars)	$1,560,633.11	$1,217,067.77	$1,693,093.57	$1,317,726.83

Note that these costs do not include contingency, engineering or GST and should be considered preliminary, subject to review in detailed design.

Based on the above evaluation, the most economical option is Option 3b, repair the culvert in 2012 and replace in Year 2018. Option 3d has an 8% greater cost than Option 3b.

7.8 RECOMMENDATION

The Irvine Creek Culvert has an age of 30 years and an estimated remaining service life of 4 years. The road is anticipated to be upgraded from a two lane rural road to a 4 lane urban road in 5 to 10 years.

The Life Cycle Cost Analysis shows the most economic solution is Option 3b, to do the repairs required to keep the culvert in service until the road is upgraded. At which point the culvert is to be replaced. The cost comparison shows the culvert is the least expensive. Option 3d, the bridge replacement alternative, has an 8% greater cost.

As the accuracy for a Class 'A' estimate is +/- 20%, Option 3b and 3d can be considered equivalent and both should be considered in preliminary design.

It is recommended that the structure be repaired, as required to keep it serviceable until the road is upgraded. At that point the existing culvert should be replaced with a new culvert or bridge structure that is capable of accommodating the proposed roadway.

The estimated cost of repairs to keep the culvert serviceable is $35,000.

The estimated cost of removing the existing culvert and replacement is $1,755,500.

8 Environmental Considerations

8.1 INTRODUCTION

This initial environmental evaluation is intended to identify potential impacts or sensitive areas, which might be impacted by the proposed improvement and to identify applicable environmental regulations or legislation. This initial environmental evaluation report will discuss the following:

- Vegetation
- Wildlife
- Surface Water
- Ground water
- Historical and Other Special Places
- Noise and Air Quality
- Land and Soil
- Health and safety
- Socio-economic
- Aesthetics

8.1.1 Project Site Description

To study the existing site condition, a site visit and aerial photograph review were conducted. Based on the site visit conducted on April 2, 2008, the land within the project area is predominately used for grazing and agricultural uses. A few developed lands and on-going construction activities were observed in some lots along the roadway.

The general topography of the surrounding site is characterized as plain terrain. There are two water course crossings along Township Road 510. Irvine Creek crosses the roadway in the west, close to the intersection with Range Road 244 to the north. Trees are observed around the creek crossing and some other locations within the project area. The LeBlanc canal crossing, in the east, is located midway between the intersections with Range Road 244 to the south and Range Road 242 to the north.

A review of the air photos and the field visit indicate that there are several localized depressions around the proposed development area. Characteristic vegetation (willow, cattails etc.) observed in the low-lying areas indicated occasional ponding.

The key environmental issues are in-stream works to be conducted at the crossings of Irvine Creek and the LeBlanc Canal, and the removal of vegetation and potential wetland areas located within the proposed project area. The site location plan and potential environmental concerns are depicted on Figure 1.

8.1.2 Construction Method

Proposed road widening and roadway improvement would likely involve the following construction activities that can trigger potential environmental concerns:

- Clearing and grubbing,
- Stripping, excavating, filling and stockpiling,
- In-stream works, and
- Disturbance and/or removal of potential wetland areas.

8.2 VEGETATION

It is recommended that a preliminary vegetation assessment within the proposed right-of-way be conducted to determine if the subject area contains any vegetation species at risk as specified in the Species at Risk Act (SARA). Vegetation identification can be conducted to determine if the wetlands are considered to be permanent water bodies or localized depressions. A detailed assessment may be required for the potential wetland to identify the quality of the wildlife habitat and determine if the wetland compensation plan is required. No detailed vegetation assessment will likely be required for the remaining portion of the alignment, as commercial and grazing/cultivated lands are unlikely to contain native vegetation.

Applicable Environmental Legislations:

- Species at Risk Act (SARA), Government of Canada, June 2003.

8.3 WILDLIFE

A preliminary wildlife review should be conducted for the subject area to identify if species at risk inhabit the area. If a species at risk is identified, a more detailed study will need to be conducted to determine potential design or compensation issues. The wildlife review will also indicate if there are any potential construction constraints, related to wildlife migration or breeding seasons such as tree clearing.

Applicable Environmental Legislations:

- Species at Risk Act (SARA), Government of Canada, June 2003,
- Wildlife Act, Alberta Sustainable Resource Development, 1998;
- Migratory Bird Convention Act, Environment Canada, 1994.

8.4 SURFACE WATER

8.4.1 Water Courses

Based on the air photo review with stereoscope, it appears that surface water runoff in the area predominately drains towards the Irvine Creek and the LeBlanc Canal. Irvine Creek flows southwest and into Blackmud Creek, which flows north and eventually drains into the North

Saskatchewan River. The LeBlanc Canal flows from the Town of Beaumont to the Irvine Creek to the north. This Canal is the main drainage path for most of the Town's storm water flows.

The proposed widening of the right-of-way may require in-stream works, such as construction of new bridge or replacement/ extension of the current crossings. The crossing design should incorporate the 1:100 year flood level. Irvine Creek is classified as Class C water body, under Alberta Environment (AENV), Code of Practice (CoP) for Water Course Crossings and has a restricted activity period within April 16 through June 30. Construction work should not be carried out within this period unless a qualified aquatic environment specialist determines that works can be carried out within this period in accordance with some written specifications and recommendations (fish habitat assessment).

According to the CoP, if any unmapped water body enters into a Class C water body, the same restricted activity period is applied for the portion of the unmapped water body for a distance of 2 kilometres upstream from the mouth of the unmapped water body. The canal crossing is located around 800m upstream of the mouth. Although the canal is a man-made drainage channel maintained by the Leduc County, it is recommended that the restricted activity period be used for working within the Canal. During construction erosion and sediment control measures should be installed to prevent the siltation of Irvine Creek and the LeBlanc Canal.

There is a seasonal drainage along the proposed project area. This seasonal drainage is anticipated to only contain water during spring runoff or after heavy rainfall events. It is not anticipated that this seasonal drainage is covered by CoP for Water Course Crossing, but should be evaluated during the detailed design stages.

Prior to working in the water courses the following notification or authorizations will be required.

- Notification to Alberta Environment under the Code of Practice for Water Course Crossing, Water Act. Notification is required minimum of 14 days prior to construction.
- Notification to Fisheries and Oceans Canada, Water Management.
- Notification to Transport Canada, Navigable Waters Section.
- Notification to Leduc County, to work within the LeBlanc Canal.

8.4.2 Potential Wetlands

A review of the air photos for the site, and a field visit conducted on April 2, 2008, indicate that there are three potential wetlands and several localized depressions around the proposed development area. A more detailed assessment of these areas is required to determine if these are considered as water body under the Alberta Environment's Water Act. If designated as waterbodies, Alberta Environment should be consulted prior to the detailed design stage regarding the approval under the Water Act to work within these areas, which should include wetland compensation plan. Currently AENV is requiring a wetland compensation plan to provide a minimum of 3:1 replacement ratio for lost or removed habitat.

An approval under the Water Act from Alberta Environment under the Water Act is likely required for the proposed work within the water bodies. Typical time line for a Water Act approval is 6 to 9

weeks after the public notice period submission, which is typically 30 days. If the wetlands are considered to be under the Public Lands Act, Alberta Sustainable Resource Development (ASRD) needs to be consulted and it may take several months, prior to being authorized an approval.

8.4.3 Other Surface Water

There are two dugouts observed in the air photo to the south of the roadway. The owner of these dugouts should be consulted prior to initiating work within or near the dugouts.

8.4.4 Surface Water Management

Temporary

During construction it is recommended that the Environmental Construction Operation (ECO) Plan and/ or Erosion and Sedimentation Control (ESC) Plan be developed and implemented. These plans generally provide specific directions to surface water runoff controls, and temporary erosion and sediment control measures along with other significant environmental aspects.

Permanent

Surface water runoff from the roadway can be directed to either Irvine Creek, LeBlanc Canal or to another acceptable drainage feature, through drainage ditches and surface facilities. Surface water management should be in compliance with the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by Alberta Environment in January 2006. Permanent design controls should be put into place to minimize erosion, sedimentation of the receiving body and control the rate of storm discharge to pre-development rates.

8.5 GROUNDWATER

It is not expected that ground water will be impacted by this project. No groundwater impact assessment is proposed for this project.

8.6 HISTORICAL AND OTHER SPECIAL PLACES

A preliminary archaeological review of the area will be conducted prior to the detailed design of the project to identify if there are any historical, cultural or traditional lands, within the proposed alignment. If the archaeological review identifies significant historical or cultural areas, then the project stakeholders will be contacted to prior to proceeding.

8.7 NOISE

Sound attenuation measures should be investigated as part of detailed design as outlined in **Section 4** of this report. A noise modelling assessment may be required by developers to ensure that noise attenuation measures are appropriate.

8.8 LAND AND SOIL

A Phase 1, Environmental Site Assessment (ESA), should be conducted for the entire proposed alignment. The objective of the phase 1 ESA would be to determine if there are any potential, environmental concerns associated with the past or current land used either adjacent to or along the proposed alignment.

A soil assessment will be conducted to determine the stripping requirements for the project. Topsoil should be salvaged during excavation for re-vegetation.

8.9 HEALTH AND SAFETY

Health and safety, issues related to the proposed project will be assessed during the preliminary and detailed design stage of the project.

8.10 SOCIO-ECONOMIC

Township Road 510 has been identified as potential major arterial providing link between Nisku Industrial Park and Hwy 814, as well as the future residential areas depicted in the North Major Area Structure Plan 2005 (Leduc County). It can be expected that improving the existing road will improve the economic status and traffic flow to/from the area. There are a number of private accesses from Township Road 510 within the project alignment. Property owners along the proposed project area should be consulted throughout the project stages.

8.11 AESTHETICS

Disturbed areas associated with the project construction will be landscaped or seeded with grass to re-establish vegetation once construction is completed

8.12 RECOMMENDATIONS

The following work is recommended for the proposed development area:

- A detail vegetation assessment, of the wetland areas and creek crossing area.
- A wildlife assessment, to identify if species at risk inhabit the area and potential construction constraints.
- A soil assessment, to identify the stripping requirements for the project.
- Phase I ESA, to identify if there are any potential environmental concerns associated with the post or current land uses within the proposed alignment or adjacent to the project.

The following agencies should be contacted regarding project notifications or request for approvals:

Alberta Environment

- Notification under the Codes of Practice for Water Course Crossing, for replacing the Irvine Creek Culvert/ Bridge,
- Application for an Approval for works within a water body (potential wetland areas),

Alberta Sustainable Resource Development

- Application for an Approval for works within a public land (potential wetland areas),

Fisheries and Oceans Canada

- Notification for the replacement of the crossing facility across the Irvine Creek and LeBlanc Canal, appendices

Transport Canada, Navigable Water Section

- Notification for the replacement of the crossing facility across the Irvine Creek,

Leduc County

- Notification for the replacement of the crossing facility across the LeBlanc Canal.

9 Conceptual Cost Estimates

The project team generated conceptual cost estimates for the Township Road 510 Functional Planning Study. Cost estimates include full construction of the roadways, bridge structures, storm drainage, and electrical components on Township Road 510 and parts of the connecting roadways.

9.1 QUANTITIES AND BREAKDOWN STRATEGY

Costs have been separated into two general categories, the cost to build Township Road 510 and the incremental cost associated with building each intersection. Costs associated with each intersection include all incremental costs of building these intersections up to the beginning/end of all tapers or added lanes. Township Road 510 will be largely funded by the offsite levies; Leduc County uses these to recover capital costs incurred for improvements carried out to accommodate new development. This ensures that those who benefit from the capital infrastructure pay a fair share of the construction cost. The cost of the intersections will typically be recovered by other means, and have therefore been separated from the typical roadway costs.

9.2 UNIT COSTS

All costs are presented in year 2009 dollars. The unit prices used for generating the cost estimates were based on the unit prices for bids comparable to this project within the Edmonton capital region.

9.3 SUMMARY OF COST ESTIMATES

A summary of the cost estimates broken down by segment is presented in **Table 9-1**. The total cost estimated for construction of Township Road 510 within the study area is about $32,942,000. The total cost estimated for completing the roads connecting to Township Road 510 within the study area is about $18,804,000. A contingency of 15% and an estimated engineering and administration fee of 12.5% have been added to these estimates to determine a total estimated project cost of about $66,963,000.

Detailed summaries of the cost estimates and a more detailed breakdown are included in **Appendix E**.

Table 9-1: Township Road 510 Cost Estimate Summary

Item Description	Amount
Township Road 510 0+000 to 6+646	$32,942,000
Range Road 244 N	$1,346,000
Range Road 245 S	$1,468,000
Collector 1	$1,763,000
Collector 2	$1,681,000
Range Road 244 S	$3,687,000
Collector 3	$1,763,000
Range Road 243 S	$2,426,000
Collector 4	$1,268,000
50 Street	$3,402,000
Subtotal	**$51,746,000**
Contingency (15%)	$7,767,000
Total	**$59,519,000**
Engineering and Administration (12.5%)	$7,444,000
Grandtotal	**$66,963,000**

The Associated Engineering project team recognizes that Township Road 510 may not be constructed along the entire corridor length in the first stage, and that much of the funding for Township Road 510 will come from levies or development fees. The project team has therefore developed a roadway construction cost per linear metre for these purposes. Based on development of the full proposed roadway cross-section, the estimated cost for constructing Township Road 510 is about $3,500 per linear metre. Several item costs have been further broken out of this cost. The approximate cost for developing a berm is about $135 per linear metre; the approximate cost for developing the multi-use trail is about $250 per linear metre; the approximate cost for developing the sidewalk is about $280 per linear metre.

Leduc County has also indicated that they may wish to develop this roadway in stages; the first stage would involve constructing a two-lane urban roadway, and the second stage would complete the additional two lanes. The Associated Engineering project team has therefore developed a conceptual cost estimate for such a first stage of construction. The assumed construction in the first stage would include rough grading of the entire cross-section, full development of the southern two lanes (the ultimate eastbound lanes), the multi-use trail, and street lighting on the south side of the roadway. The estimated cost for constructing this first stage of Township Road is about $2,100 per linear metre.

The linear metre cost breakdowns do not include the bridge structure at Irvine Creek because it is a one-time item at one specific location. Additionally, the linear metre costs do not include drainage, as these costs cover full development of the stormwater system, including all proposed intersections.

10 Closure

This report was prepared for the Leduc County to provide functional plans for Township Road 510 between Highway 814 (50 Street) and the proposed Nisku Spine Road.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

Associated Engineering Alberta Ltd.

PROFESSIONAL ENGINEER ALBERTA
RYAN BATTY
RRRR

[signed]

Shawn Benbow, E.I.T.
Project Manager

[signed]

Ryan Batty, P.Eng.
Transportation Engineer

PERMIT TO PRACTICE
ASSOCIATED ENGINEERING ALBERTA LTD.
Signature _____
Date _____
PERMIT NUMBER: P 3979
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

[signed]

A Appendix A – Background Information

Turning Movement Summary Diagram

Reference No.: 1000176

Intersection of:
TWP RD 510 & RGE RD 244N 31-50-24-402150000

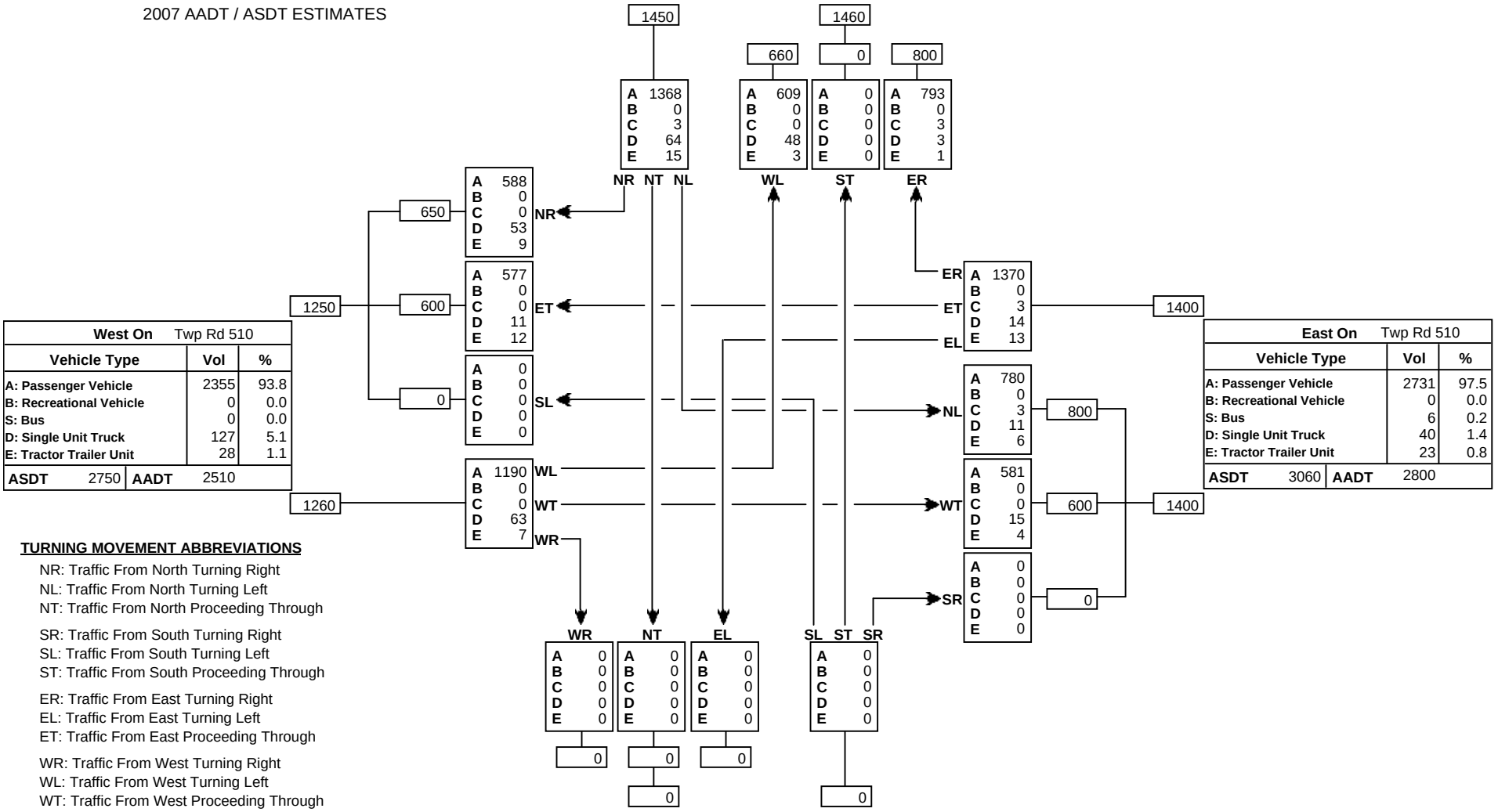
2007 AADT / ASDT ESTIMATES

North On Rge Rd 244		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2770	95.2
B: Recreational Vehicle	0	0.0
S: Bus	6	0.2
D: Single Unit Truck	115	4.0
E: Tractor Trailer Unit	19	0.7
ASDT 3190	**AADT** 2910	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2355	93.8
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	127	5.1
E: Tractor Trailer Unit	28	1.1
ASDT 2750	**AADT** 2510	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2731	97.5
B: Recreational Vehicle	0	0.0
S: Bus	6	0.2
D: Single Unit Truck	40	1.4
E: Tractor Trailer Unit	23	0.8
ASDT 3060	**AADT** 2800	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
ASDT	**AADT** 0	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 1000176

Intersection of:
TWP RD 510 & RGE RD 244N 31-50-24-402150000

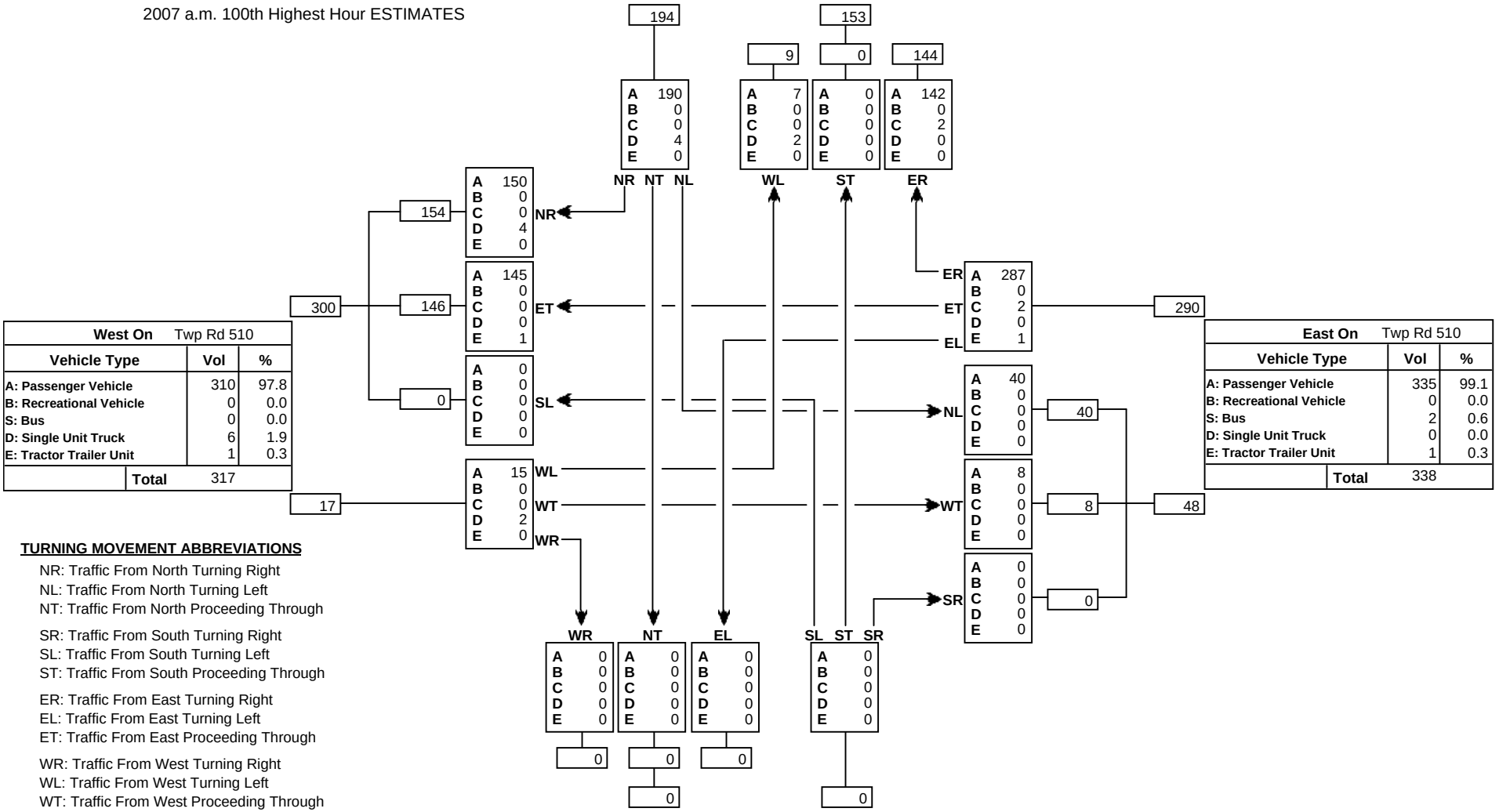
2007 a.m. 100th Highest Hour ESTIMATES

North On Rge Rd 244		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	339	97.7
B: Recreational Vehicle	0	0.0
S: Bus	2	0.6
D: Single Unit Truck	6	1.7
E: Tractor Trailer Unit	0	0.0
Total	347	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	310	97.8
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	6	1.9
E: Tractor Trailer Unit	1	0.3
Total	317	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	335	99.1
B: Recreational Vehicle	0	0.0
S: Bus	2	0.6
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	1	0.3
Total	338	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



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WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000176

Intersection of:
TWP RD 510 & RGE RD 244N 31-50-24-402150000

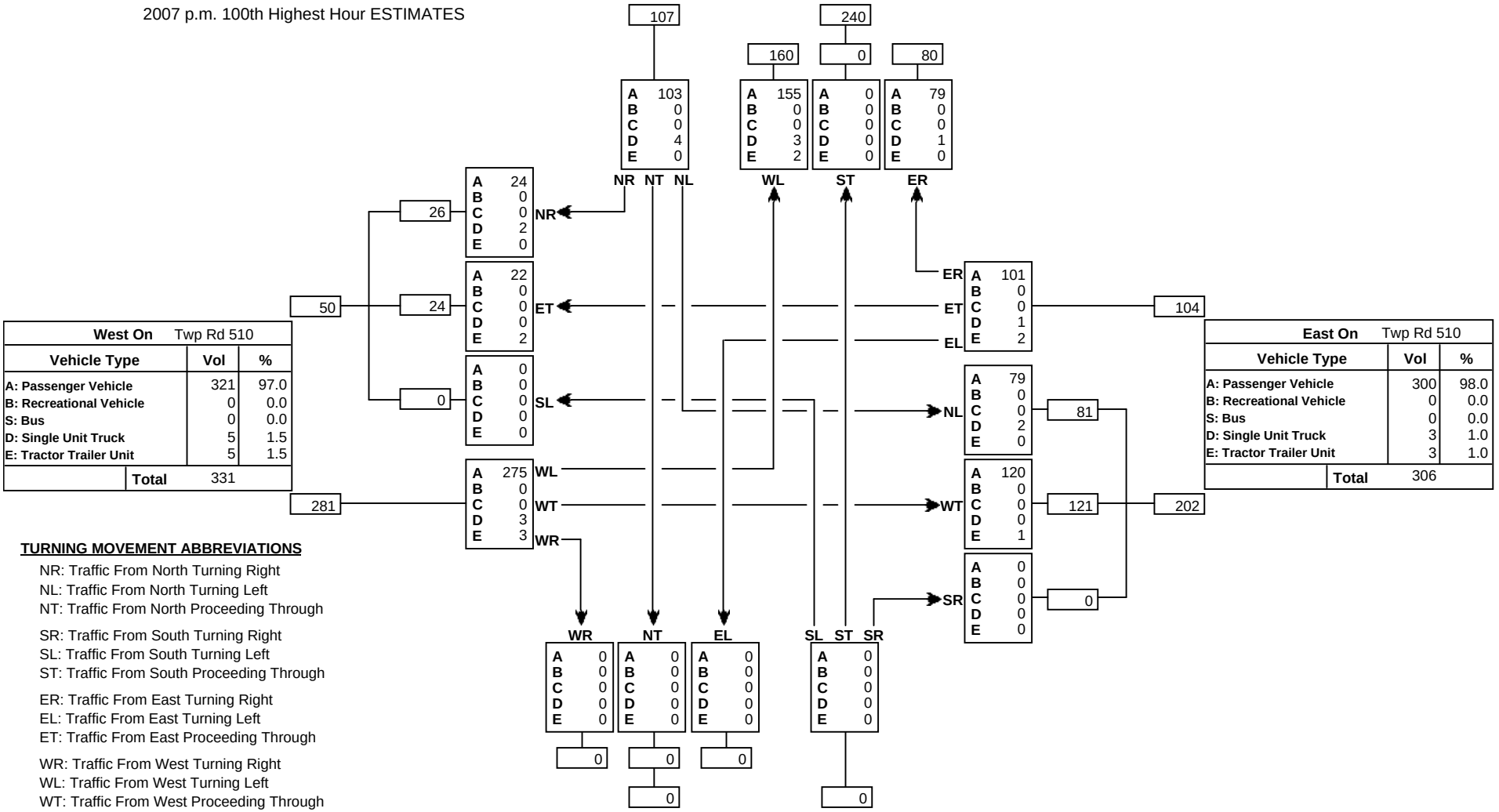
2007 p.m. 100th Highest Hour ESTIMATES

North On Rge Rd 244		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	337	97.1
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	8	2.3
E: Tractor Trailer Unit	2	0.6
Total	347	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	321	97.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	5	1.5
E: Tractor Trailer Unit	5	1.5
Total	331	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	300	98.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	3	1.0
E: Tractor Trailer Unit	3	1.0
Total	306	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



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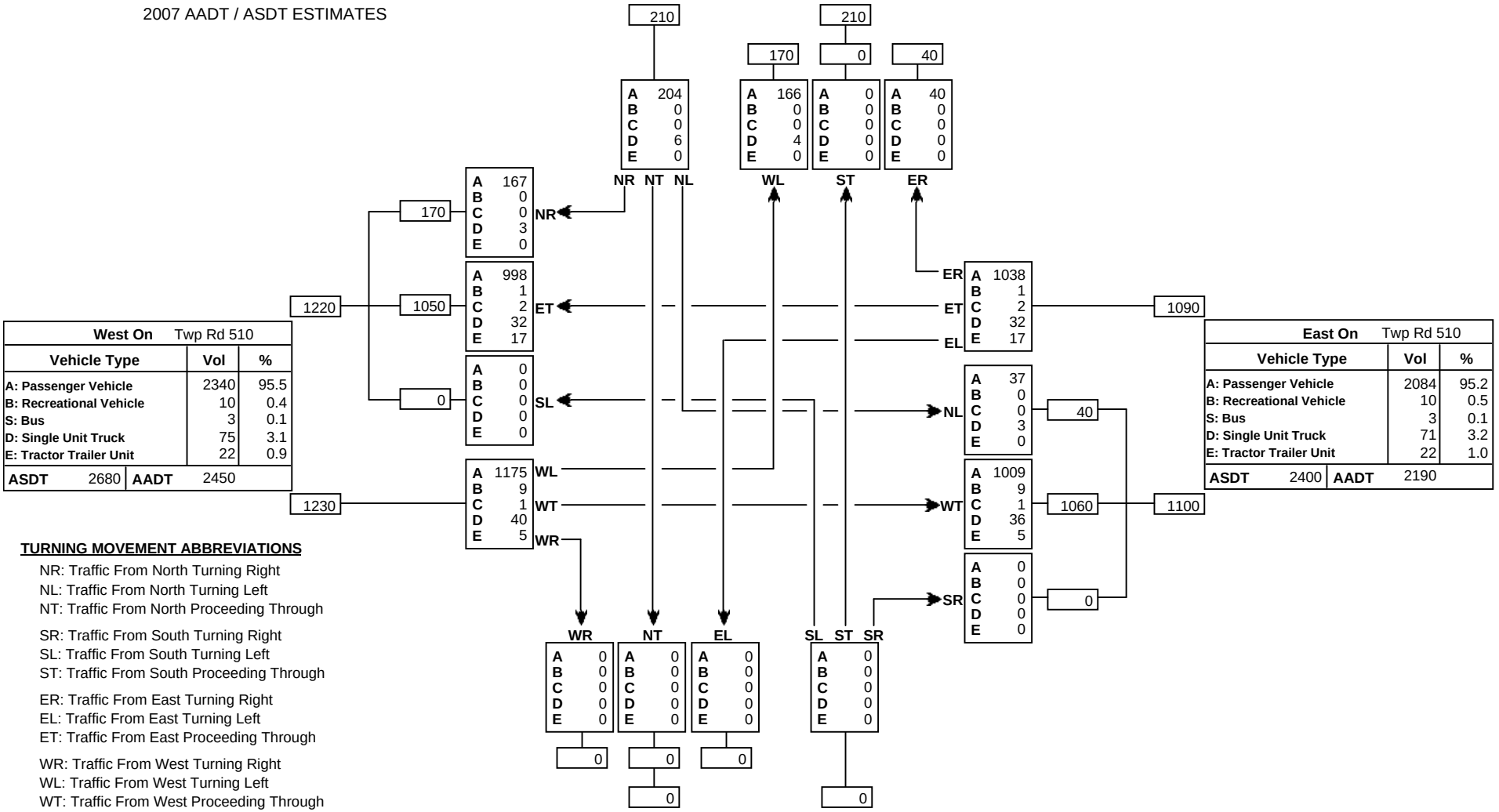
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000177

Intersection of:
TWP RD 510 & RGE RD 243N 32-50-24-402150000

2007 AADT / ASDT ESTIMATES



West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2340	95.5
B: Recreational Vehicle	10	0.4
S: Bus	3	0.1
D: Single Unit Truck	75	3.1
E: Tractor Trailer Unit	22	0.9
ASDT 2680	**AADT**	2450

North On Rge Rd 243		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	410	97.6
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	10	2.4
E: Tractor Trailer Unit	0	0.0
ASDT 460	**AADT**	420

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2084	95.2
B: Recreational Vehicle	10	0.5
S: Bus	3	0.1
D: Single Unit Truck	71	3.2
E: Tractor Trailer Unit	22	1.0
ASDT 2400	**AADT**	2190

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
ASDT	**AADT** 0	

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WT: Traffic From West Proceeding Through

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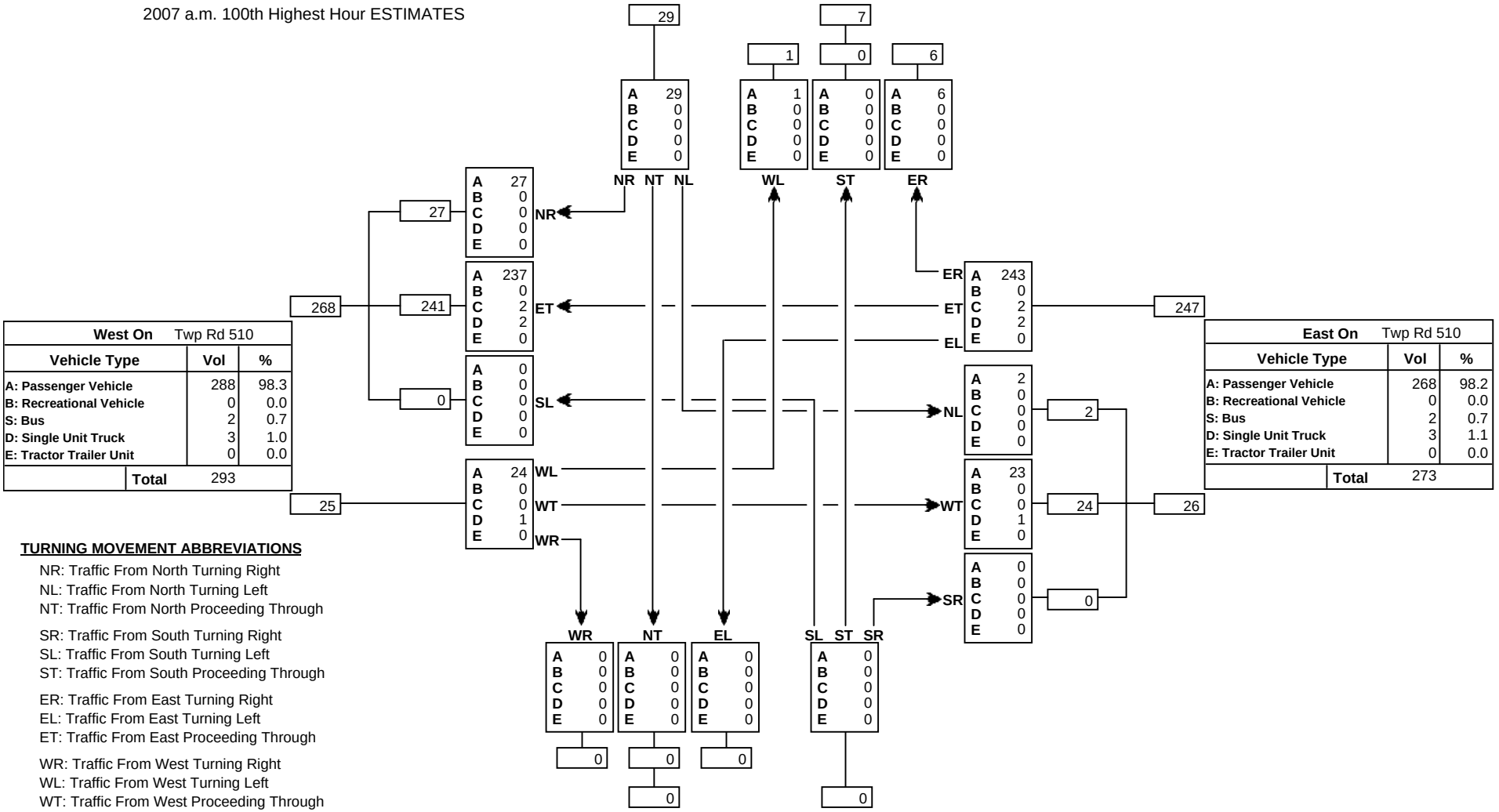
2007 a.m. 100th Highest Hour ESTIMATES

North On Rge Rd 243		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	36	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	36	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	288	98.3
B: Recreational Vehicle	0	0.0
S: Bus	2	0.7
D: Single Unit Truck	3	1.0
E: Tractor Trailer Unit	0	0.0
Total	293	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	268	98.2
B: Recreational Vehicle	0	0.0
S: Bus	2	0.7
D: Single Unit Truck	3	1.1
E: Tractor Trailer Unit	0	0.0
Total	273	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000177

Intersection of:
TWP RD 510 & RGE RD 243N 32-50-24-402150000

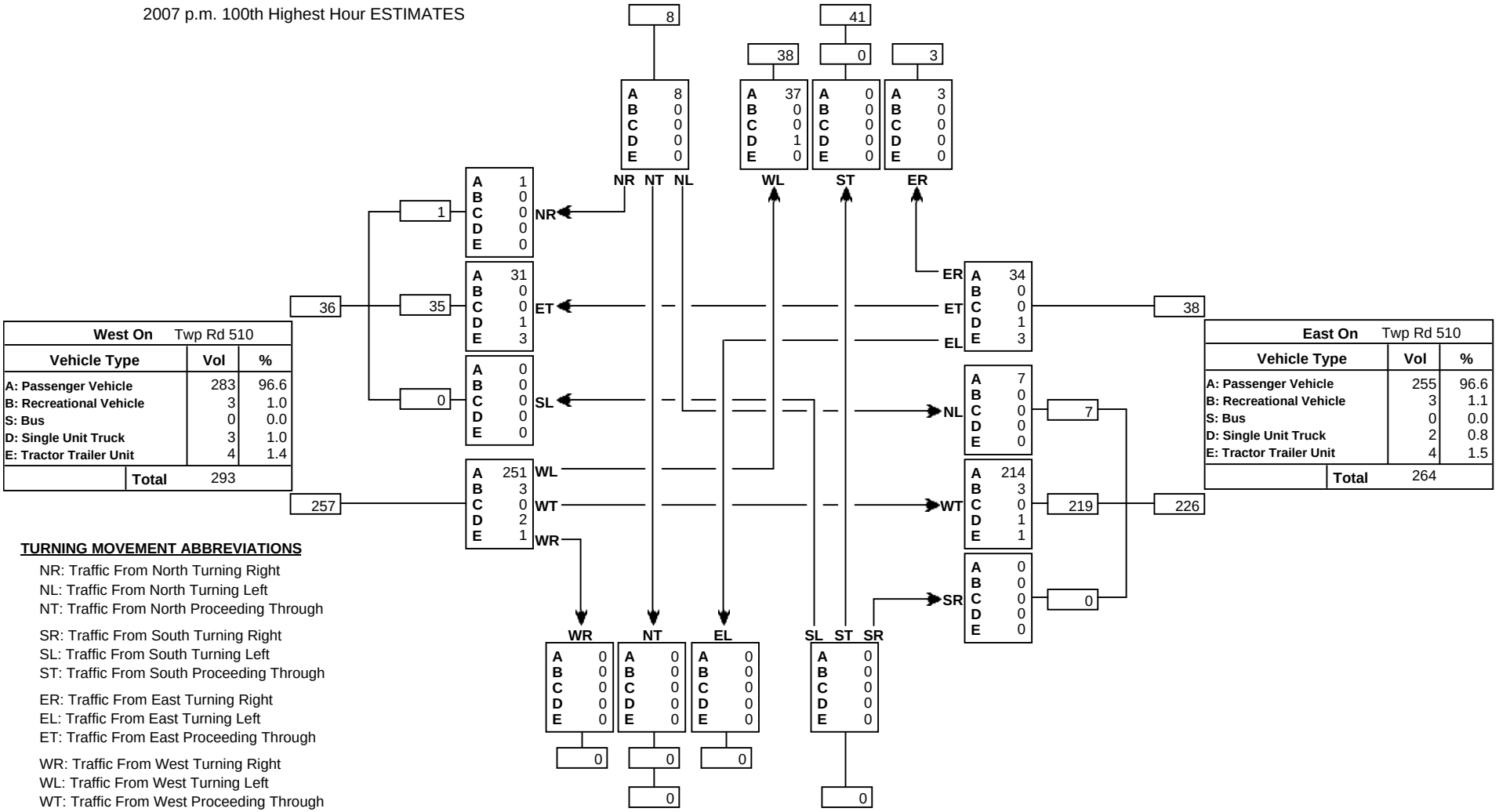
2007 p.m. 100th Highest Hour ESTIMATES

North On Rge Rd 243		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	48	98.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	1	2.0
E: Tractor Trailer Unit	0	0.0
Total	49	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	283	96.6
B: Recreational Vehicle	3	1.0
S: Bus	0	0.0
D: Single Unit Truck	3	1.0
E: Tractor Trailer Unit	4	1.4
Total	293	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	255	96.6
B: Recreational Vehicle	3	1.1
S: Bus	0	0.0
D: Single Unit Truck	2	0.8
E: Tractor Trailer Unit	4	1.5
Total	264	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



TURNING MOVEMENT ABBREVIATIONS

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ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

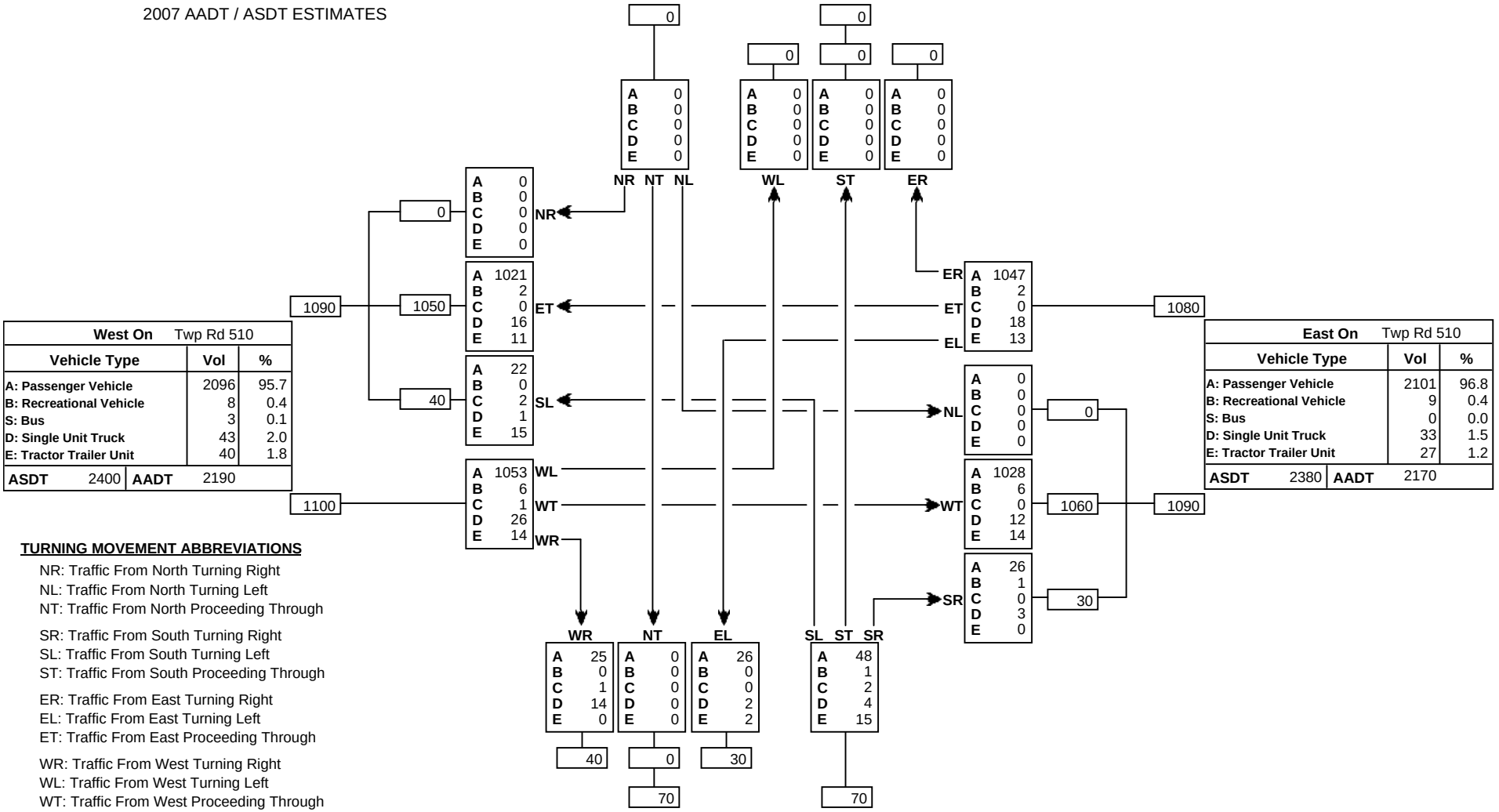
Reference No.: 1000178

Intersection of:

TWP RD 510 & RGE RD 244S 32-50-24-400000000

2007 AADT / ASDT ESTIMATES

North On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
ASDT	**AADT**	0



West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2096	95.7
B: Recreational Vehicle	8	0.4
S: Bus	3	0.1
D: Single Unit Truck	43	2.0
E: Tractor Trailer Unit	40	1.8
ASDT 2400	**AADT**	2190

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2101	96.8
B: Recreational Vehicle	9	0.4
S: Bus	0	0.0
D: Single Unit Truck	33	1.5
E: Tractor Trailer Unit	27	1.2
ASDT 2380	**AADT**	2170

South On Rge Rd 244		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	99	70.7
B: Recreational Vehicle	1	0.7
S: Bus	3	2.1
D: Single Unit Truck	20	14.3
E: Tractor Trailer Unit	17	12.1
ASDT 150	**AADT**	140

TURNING MOVEMENT ABBREVIATIONS

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SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

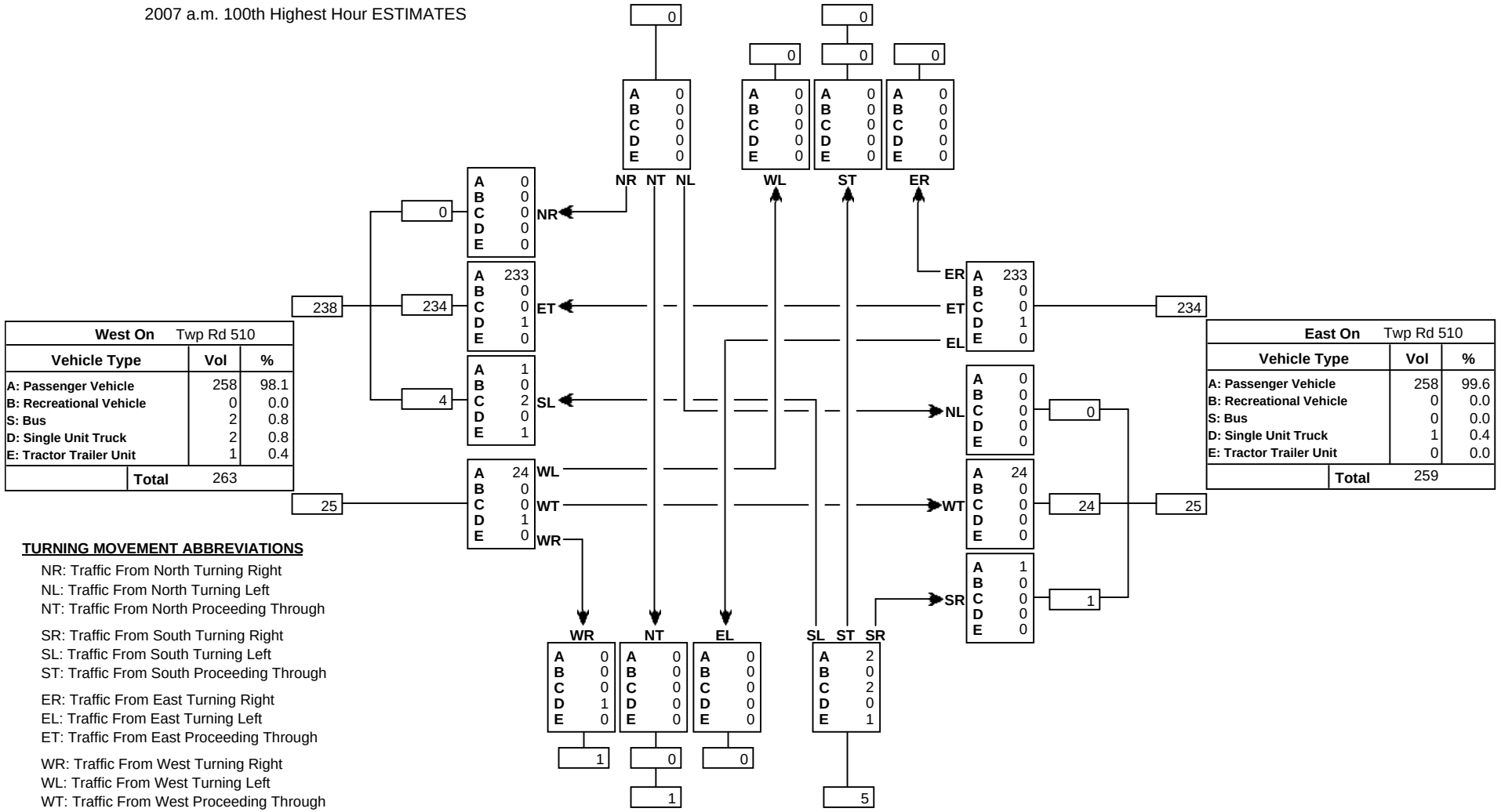
Turning Movement Summary Diagram

Reference No.: 1000178

Intersection of:
TWP RD 510 & RGE RD 244S 32-50-24-400000000

2007 a.m. 100th Highest Hour ESTIMATES

North On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	258	98.1
B: Recreational Vehicle	0	0.0
S: Bus	2	0.8
D: Single Unit Truck	2	0.8
E: Tractor Trailer Unit	1	0.4
Total	263	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	258	99.6
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	1	0.4
E: Tractor Trailer Unit	0	0.0
Total	259	

South On Rge Rd 244		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2	33.3
B: Recreational Vehicle	0	0.0
S: Bus	2	33.3
D: Single Unit Truck	1	16.7
E: Tractor Trailer Unit	1	16.7
Total	6	

TURNING MOVEMENT ABBREVIATIONS

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ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

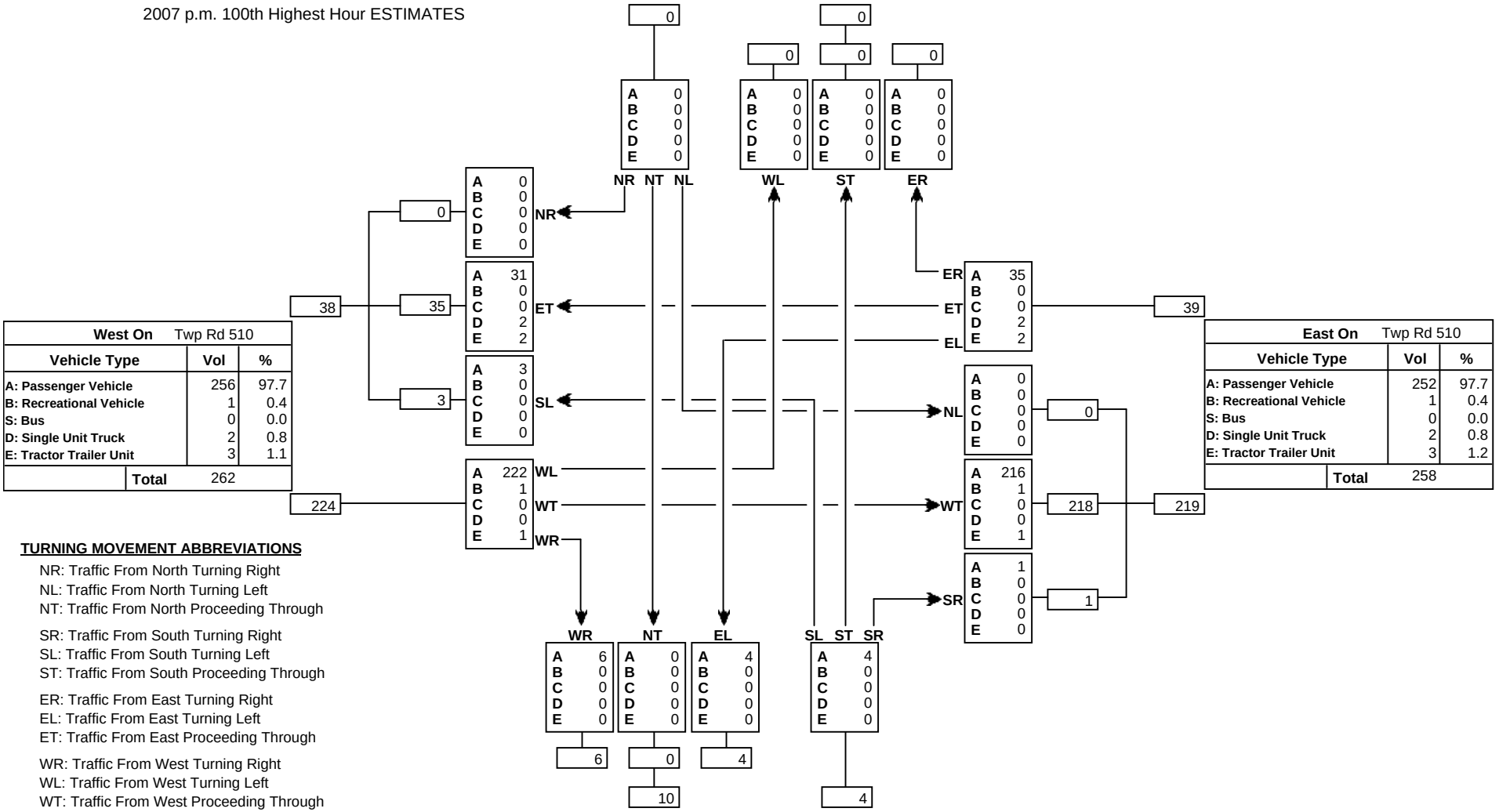
Turning Movement Summary Diagram

Reference No.: 1000178

Intersection of:
TWP RD 510 & RGE RD 244S 32-50-24-400000000

2007 p.m. 100th Highest Hour ESTIMATES

North On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	256	97.7
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	2	0.8
E: Tractor Trailer Unit	3	1.1
Total	262	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	252	97.7
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	2	0.8
E: Tractor Trailer Unit	3	1.2
Total	258	

South On Rge Rd 244		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	14	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	14	

TURNING MOVEMENT ABBREVIATIONS

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ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000179

Intersection of:
TWP RD 510 & RGE RD 242N 33-50-24-402150000

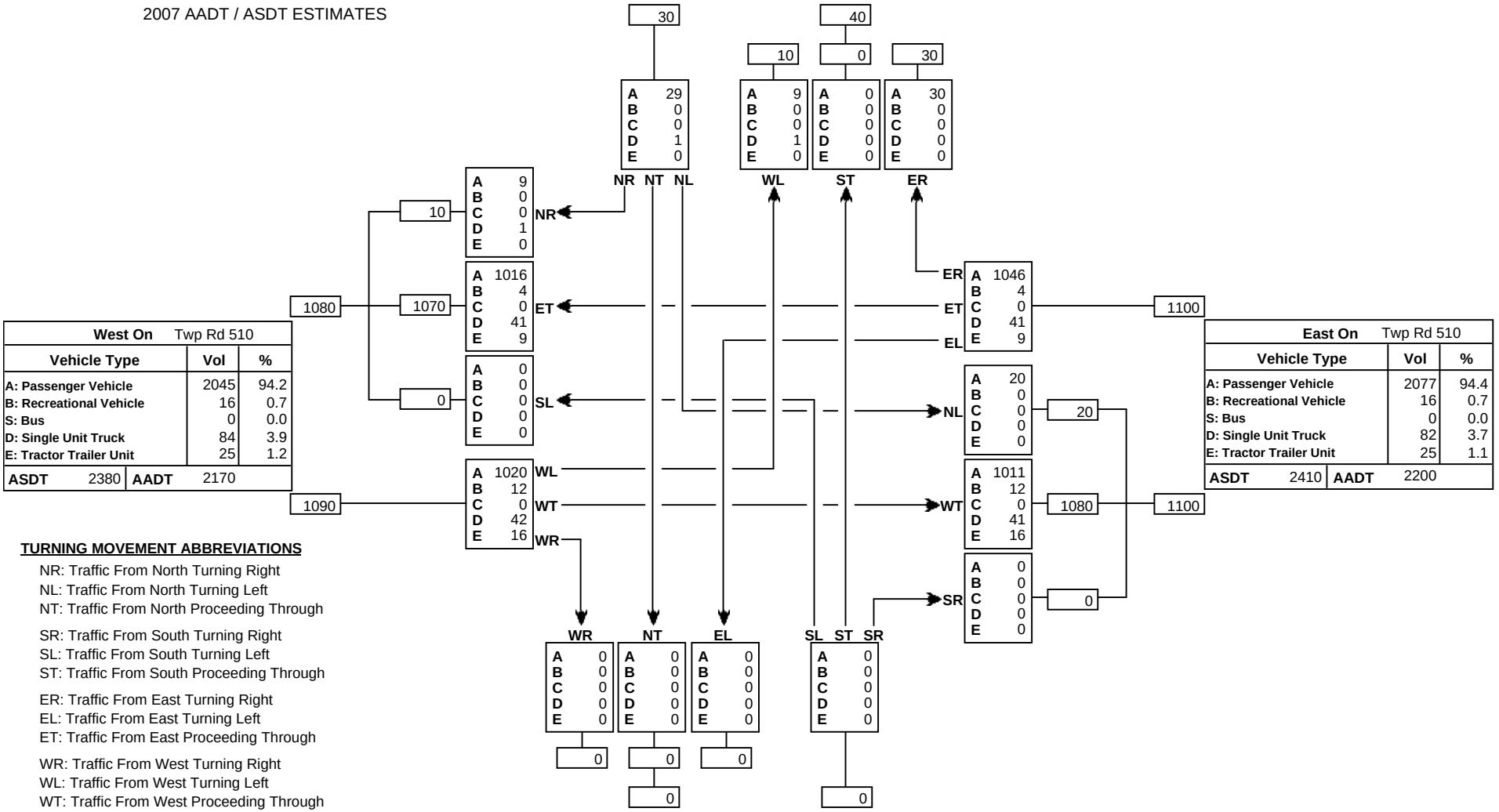
2007 AADT / ASDT ESTIMATES

North On Rge Rd 242		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	68	97.1
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	2	2.9
E: Tractor Trailer Unit	0	0.0
ASDT 80	**AADT**	70

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2045	94.2
B: Recreational Vehicle	16	0.7
S: Bus	0	0.0
D: Single Unit Truck	84	3.9
E: Tractor Trailer Unit	25	1.2
ASDT 2380	**AADT**	2170

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2077	94.4
B: Recreational Vehicle	16	0.7
S: Bus	0	0.0
D: Single Unit Truck	82	3.7
E: Tractor Trailer Unit	25	1.1
ASDT 2410	**AADT**	2200

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
ASDT	**AADT** 0	



TURNING MOVEMENT ABBREVIATIONS

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ET: Traffic From East Proceeding Through

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WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 1000179

Intersection of:
TWP RD 510 & RGE RD 242N 33-50-24-402150000

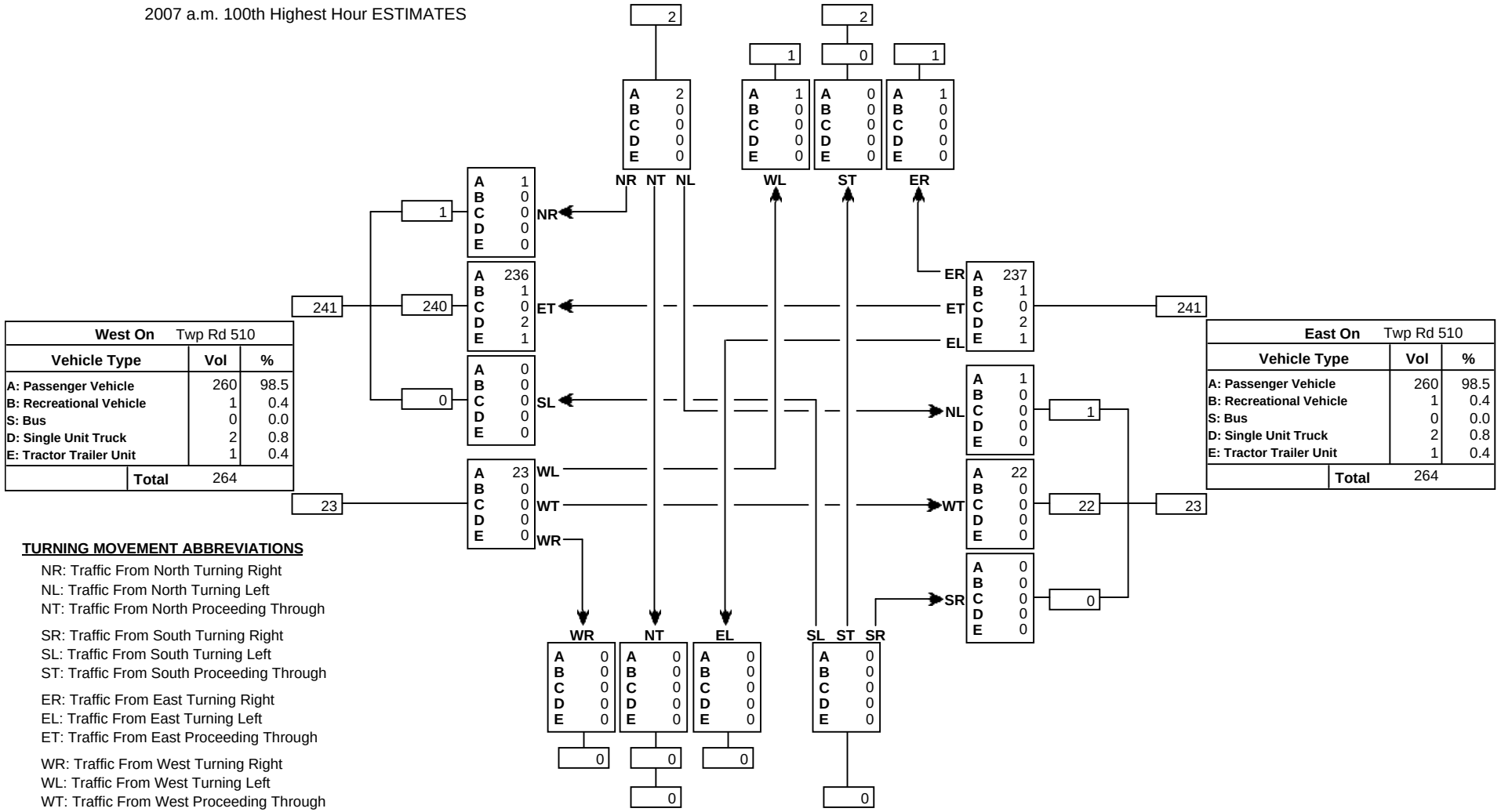
2007 a.m. 100th Highest Hour ESTIMATES

North On Rge Rd 242		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	4	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	4	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	260	98.5
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	2	0.8
E: Tractor Trailer Unit	1	0.4
Total	264	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	260	98.5
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	2	0.8
E: Tractor Trailer Unit	1	0.4
Total	264	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
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WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000179

Intersection of:
TWP RD 510 & RGE RD 242N 33-50-24-402150000

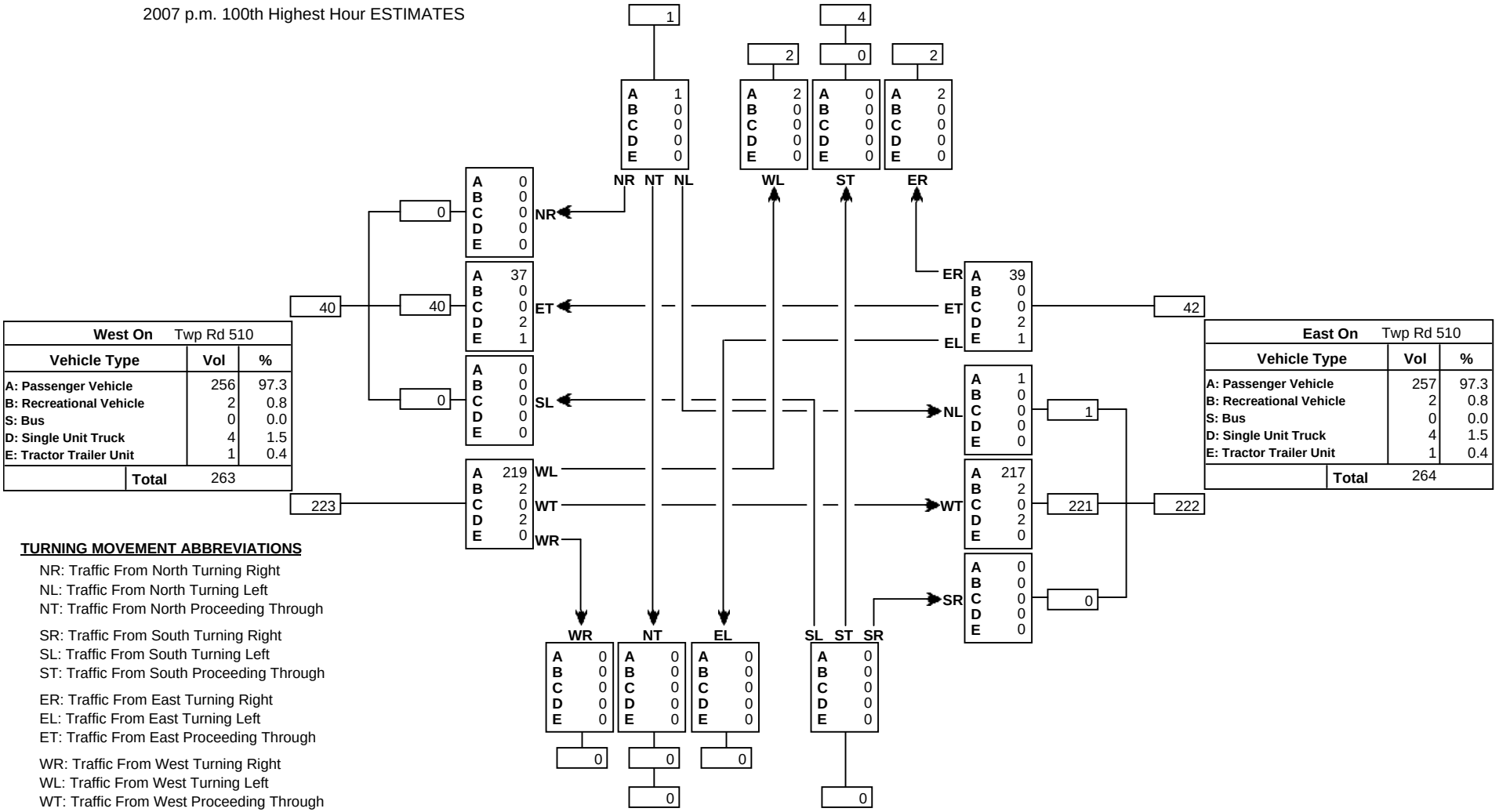
2007 p.m. 100th Highest Hour ESTIMATES

North On Rge Rd 242		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	5	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	5	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	256	97.3
B: Recreational Vehicle	2	0.8
S: Bus	0	0.0
D: Single Unit Truck	4	1.5
E: Tractor Trailer Unit	1	0.4
Total	263	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	257	97.3
B: Recreational Vehicle	2	0.8
S: Bus	0	0.0
D: Single Unit Truck	4	1.5
E: Tractor Trailer Unit	1	0.4
Total	264	

South On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



TURNING MOVEMENT ABBREVIATIONS

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SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

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EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

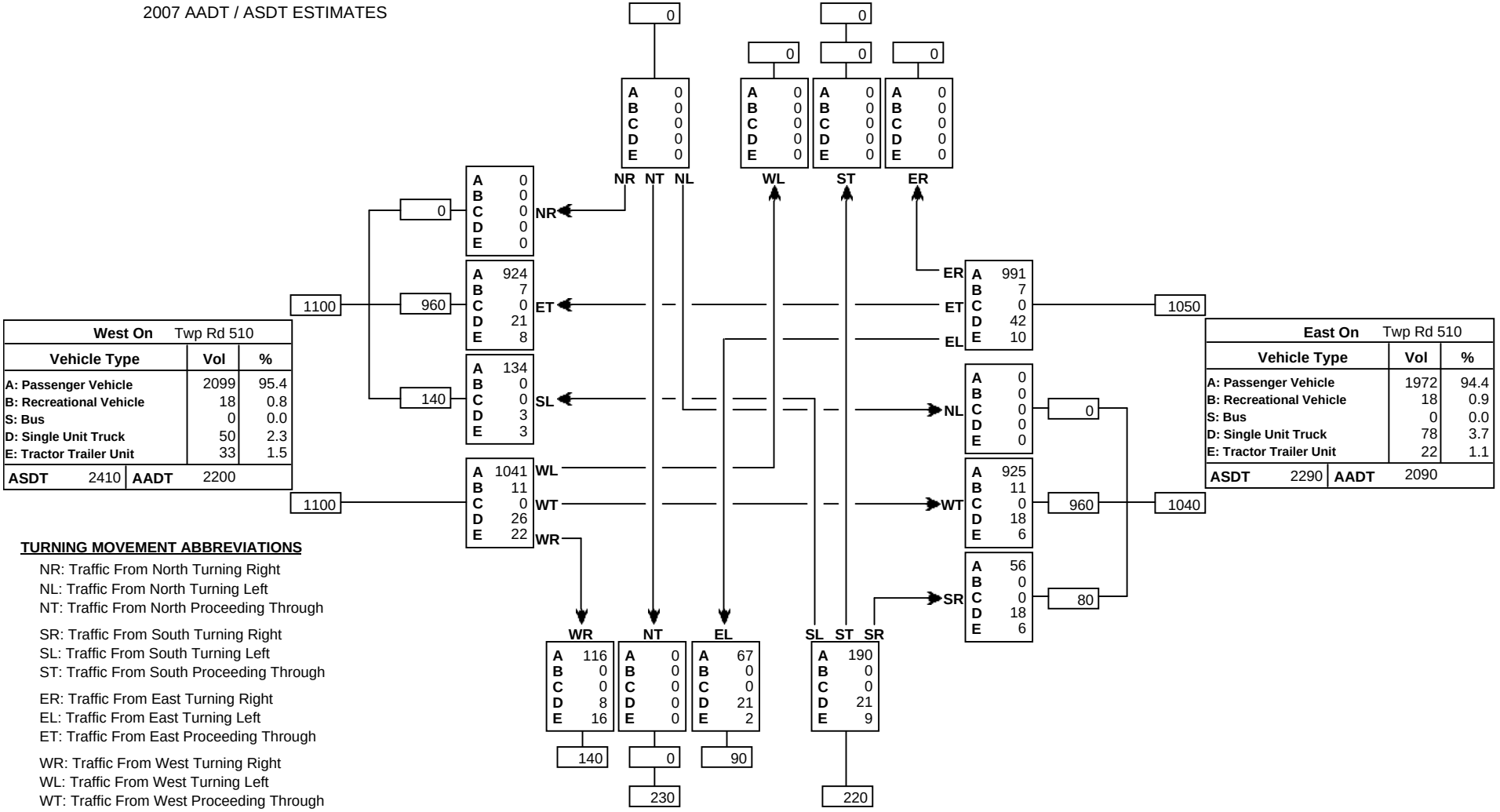
Reference No.: 1000180

Intersection of:

TWP RD 510 & RGE RD 243S 33-50-24-400000000

2007 AADT / ASDT ESTIMATES

North On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
ASDT	**AADT**	0



West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2099	95.4
B: Recreational Vehicle	18	0.8
S: Bus	0	0.0
D: Single Unit Truck	50	2.3
E: Tractor Trailer Unit	33	1.5
ASDT 2410	**AADT**	2200

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1972	94.4
B: Recreational Vehicle	18	0.9
S: Bus	0	0.0
D: Single Unit Truck	78	3.7
E: Tractor Trailer Unit	22	1.1
ASDT 2290	**AADT**	2090

South On Rge Rd 243		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	373	82.9
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	50	11.1
E: Tractor Trailer Unit	27	6.0
ASDT 490	**AADT**	450

TURNING MOVEMENT ABBREVIATIONS

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EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 1000180

Intersection of:
TWP RD 510 & RGE RD 243S 33-50-24-400000000

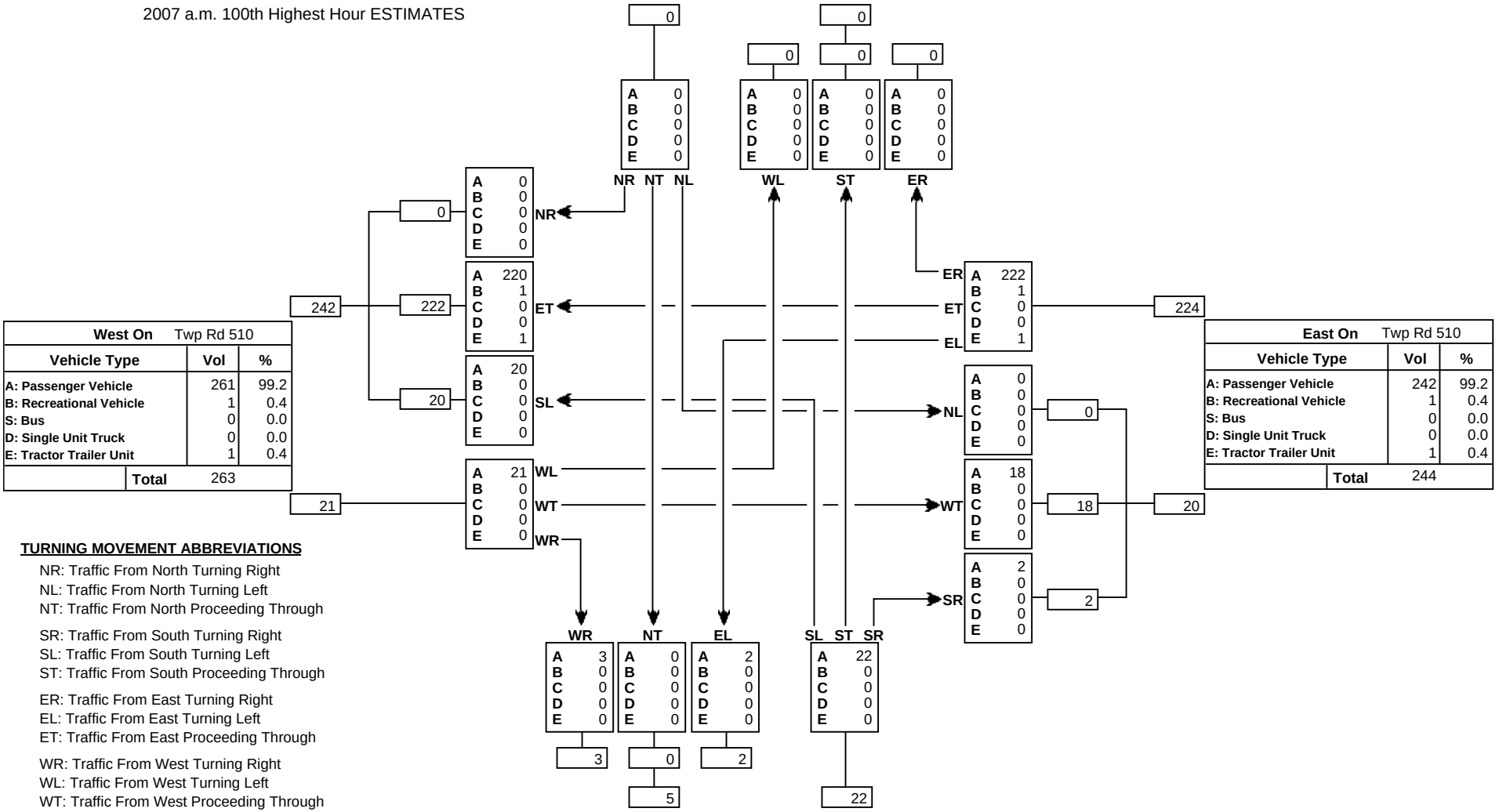
2007 a.m. 100th Highest Hour ESTIMATES

North On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	261	99.2
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	1	0.4
Total	263	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	242	99.2
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	1	0.4
Total	244	

South On Rge Rd 243		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	27	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	27	



TURNING MOVEMENT ABBREVIATIONS

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EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

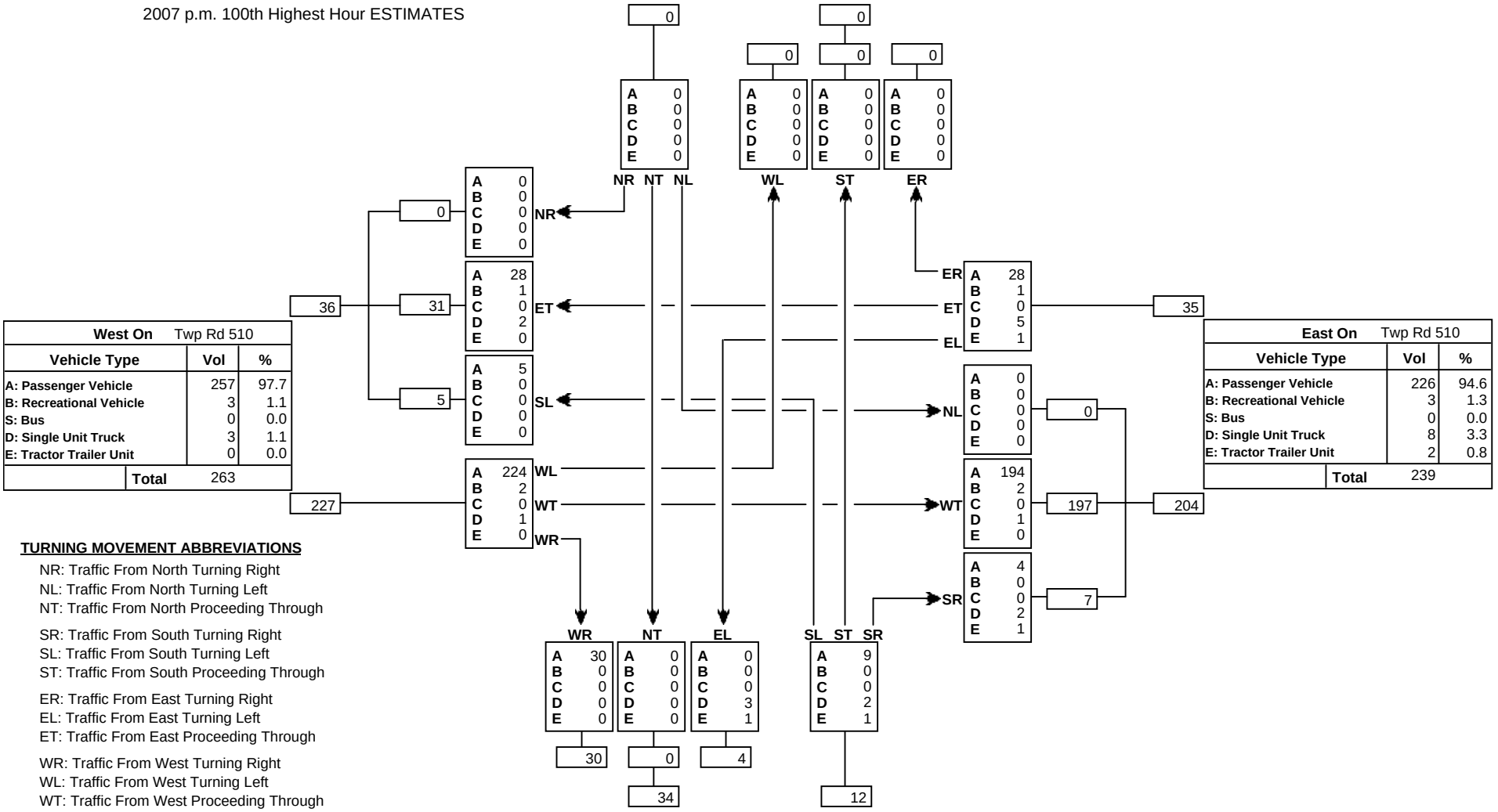
Turning Movement Summary Diagram

Reference No.: 1000180

Intersection of:
TWP RD 510 & RGE RD 243S 33-50-24-400000000

2007 p.m. 100th Highest Hour ESTIMATES

North On		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	0	0.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	0	



West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	257	97.7
B: Recreational Vehicle	3	1.1
S: Bus	0	0.0
D: Single Unit Truck	3	1.1
E: Tractor Trailer Unit	0	0.0
Total	263	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	226	94.6
B: Recreational Vehicle	3	1.3
S: Bus	0	0.0
D: Single Unit Truck	8	3.3
E: Tractor Trailer Unit	2	0.8
Total	239	

South On Rge Rd 243		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	39	84.8
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	5	10.9
E: Tractor Trailer Unit	2	4.3
Total	46	

TURNING MOVEMENT ABBREVIATIONS

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NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000181

Intersection of:
814 & TWP RD 510 34-50-24-400900000

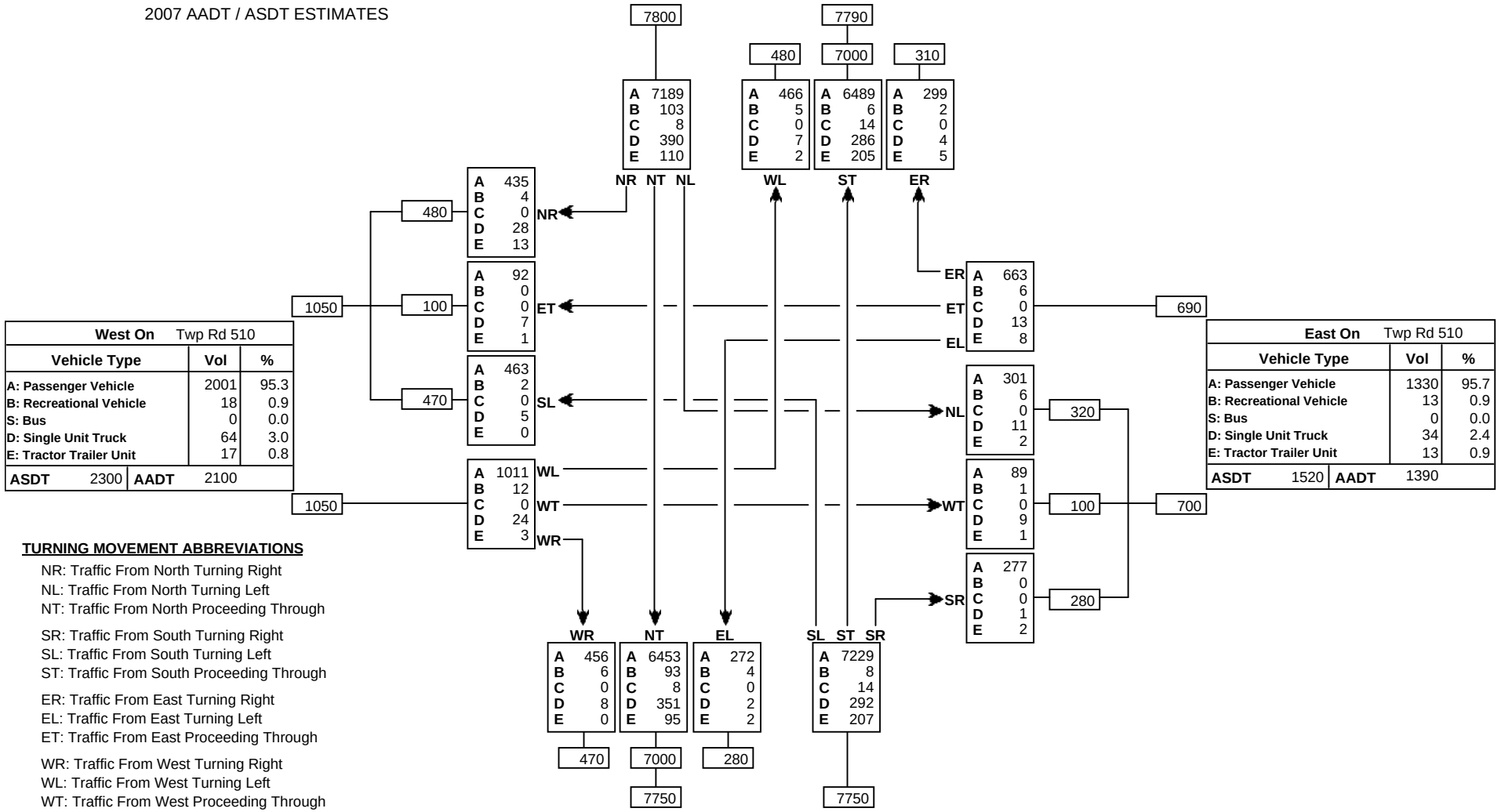
2007 AADT / ASDT ESTIMATES

North On 814		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	14443	92.6
B: Recreational Vehicle	116	0.7
S: Bus	22	0.1
D: Single Unit Truck	687	4.4
E: Tractor Trailer Unit	322	2.1
ASDT 17060	**AADT** 15590	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2001	95.3
B: Recreational Vehicle	18	0.9
S: Bus	0	0.0
D: Single Unit Truck	64	3.0
E: Tractor Trailer Unit	17	0.8
ASDT 2300	**AADT** 2100	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1330	95.7
B: Recreational Vehicle	13	0.9
S: Bus	0	0.0
D: Single Unit Truck	34	2.4
E: Tractor Trailer Unit	13	0.9
ASDT 1520	**AADT** 1390	

South On 814		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	14410	93.0
B: Recreational Vehicle	111	0.7
S: Bus	22	0.1
D: Single Unit Truck	653	4.2
E: Tractor Trailer Unit	304	2.0
ASDT 16960	**AADT** 15500	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 1000181

Intersection of:
814 & TWP RD 510 34-50-24-400900000

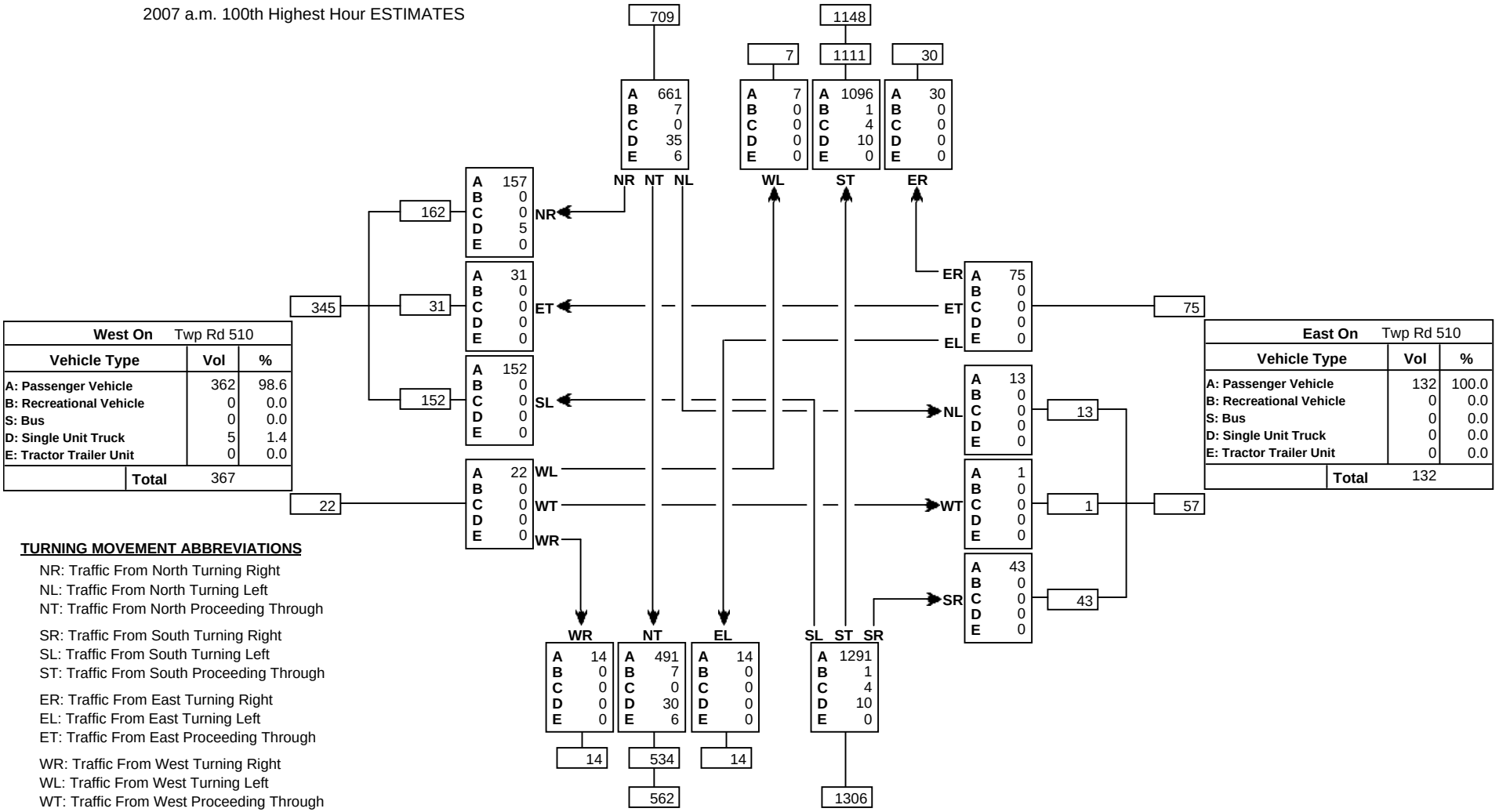
2007 a.m. 100th Highest Hour ESTIMATES

North On 814		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1794	96.6
B: Recreational Vehicle	8	0.4
S: Bus	4	0.2
D: Single Unit Truck	45	2.4
E: Tractor Trailer Unit	6	0.3
Total	1857	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	362	98.6
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	5	1.4
E: Tractor Trailer Unit	0	0.0
Total	367	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	132	100.0
B: Recreational Vehicle	0	0.0
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	132	

South On 814		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1810	96.9
B: Recreational Vehicle	8	0.4
S: Bus	4	0.2
D: Single Unit Truck	40	2.1
E: Tractor Trailer Unit	6	0.3
Total	1868	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 1000181

Intersection of:
814 & TWP RD 510 34-50-24-400900000

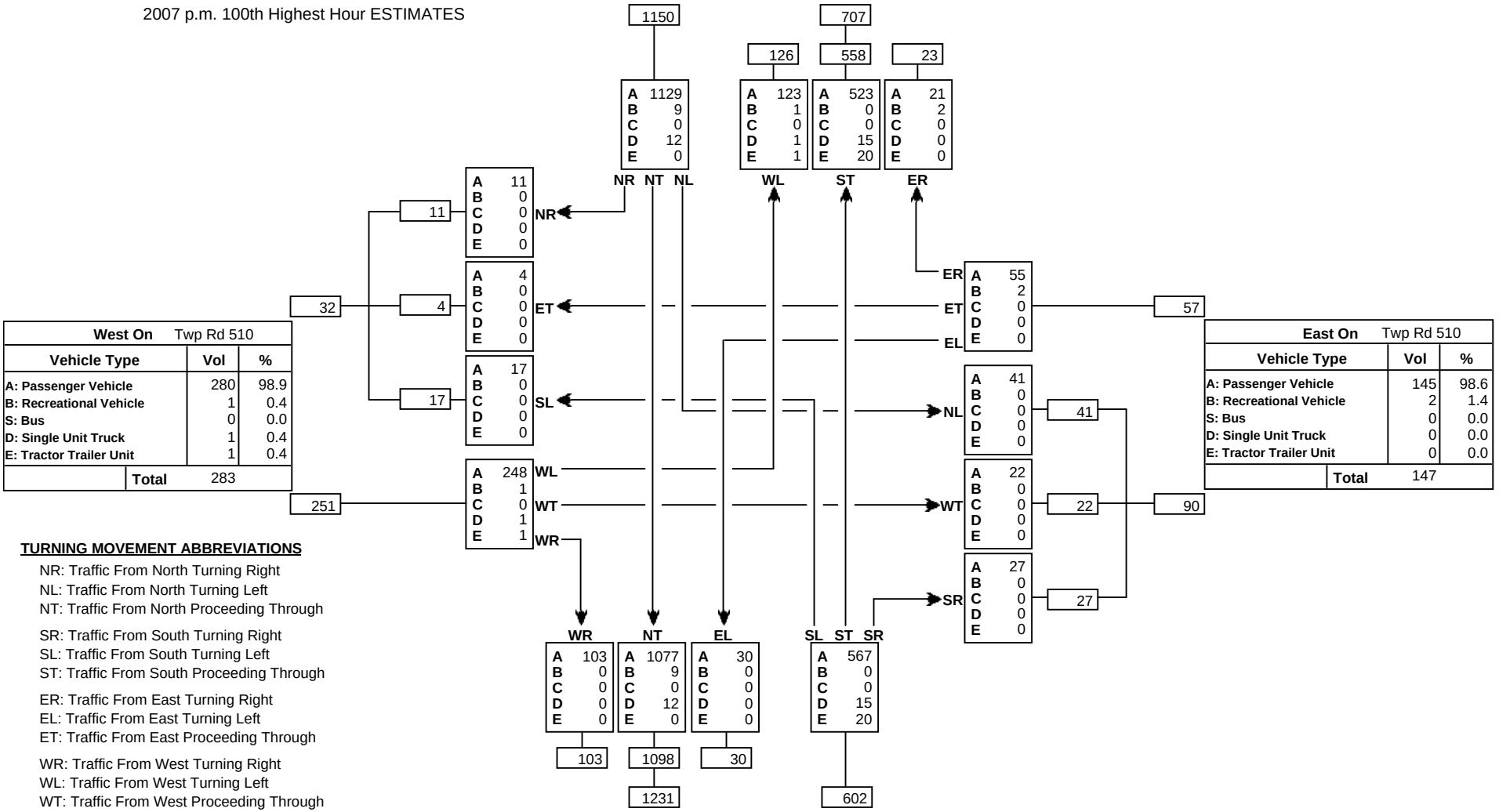
2007 p.m. 100th Highest Hour ESTIMATES

North On 814		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1796	96.7
B: Recreational Vehicle	12	0.6
S: Bus	0	0.0
D: Single Unit Truck	28	1.5
E: Tractor Trailer Unit	21	1.1
Total	1857	

West On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	280	98.9
B: Recreational Vehicle	1	0.4
S: Bus	0	0.0
D: Single Unit Truck	1	0.4
E: Tractor Trailer Unit	1	0.4
Total	283	

East On Twp Rd 510		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	145	98.6
B: Recreational Vehicle	2	1.4
S: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	147	

South On 814		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	1777	96.9
B: Recreational Vehicle	9	0.5
S: Bus	0	0.0
D: Single Unit Truck	27	1.5
E: Tractor Trailer Unit	20	1.1
Total	1833	



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
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SR: Traffic From South Turning Right
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ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

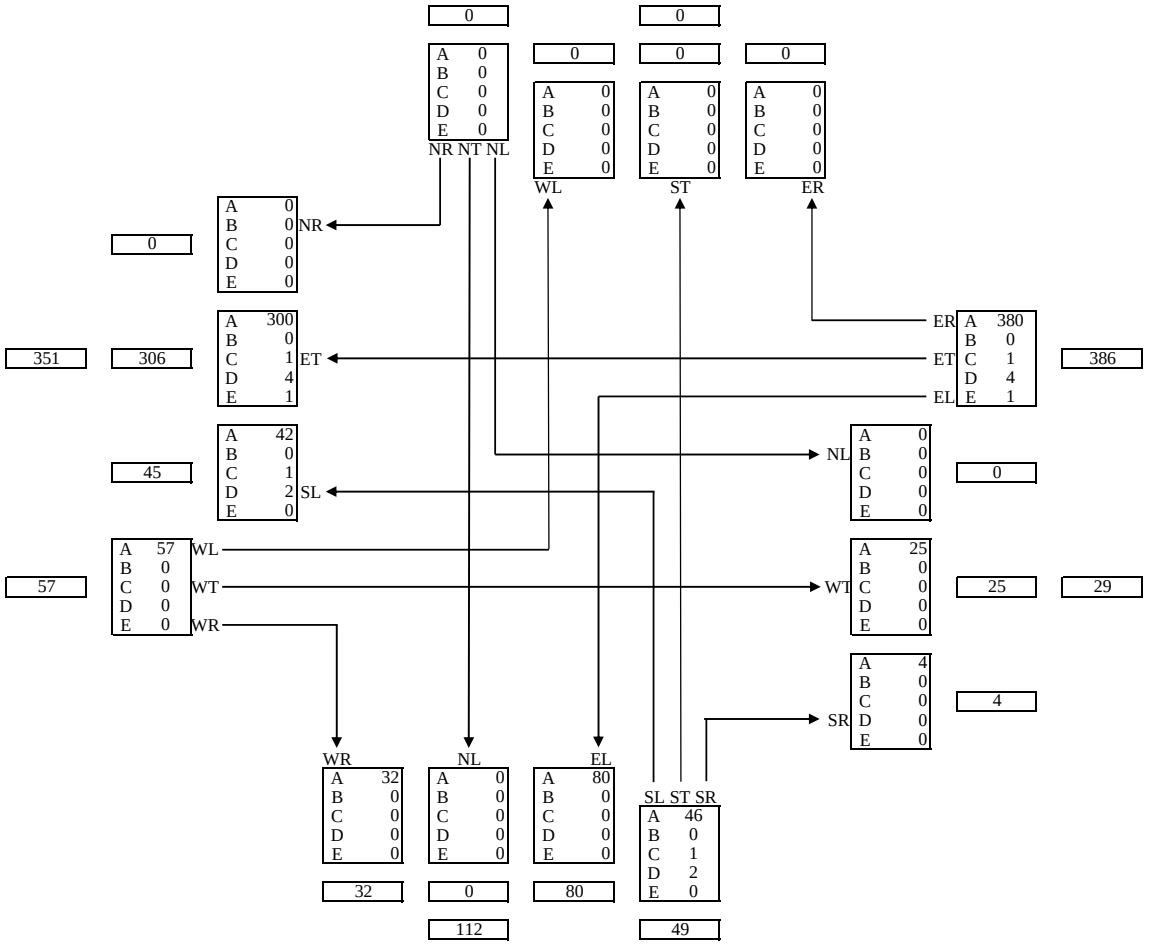
WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Intersection of Township Road 510 and Range Road 245 (S)

Observed AM Peak Hour Traffic Volumes

Vehicle Type	Volume	%
A - Passenger Vehicles	0	-
B - Recreational Vehicles	0	-
C - Buses	0	-
D - Single Unit Trucks	0	-
E - Tractor Trailer Combination	0	-
TOTAL		



West On Township Road 510		
Vehicle Type	Volume	%
A - Passenger Vehicles	399	97.8 %
B - Recreational Vehicles	0	0.0 %
C - Buses	2	0.5 %
D - Single Unit Trucks	6	1.5 %
E - Tractor Trailer Combination	1	0.2 %
TOTAL	408	

East On Township Road 510		
Vehicle Type	Volume	%
A - Passenger Vehicles	409	98.6 %
B - Recreational Vehicles	0	0.0 %
C - Buses	1	0.2 %
D - Single Unit Trucks	4	1.0 %
E - Tractor Trailer Combination	1	0.2 %
TOTAL	415	

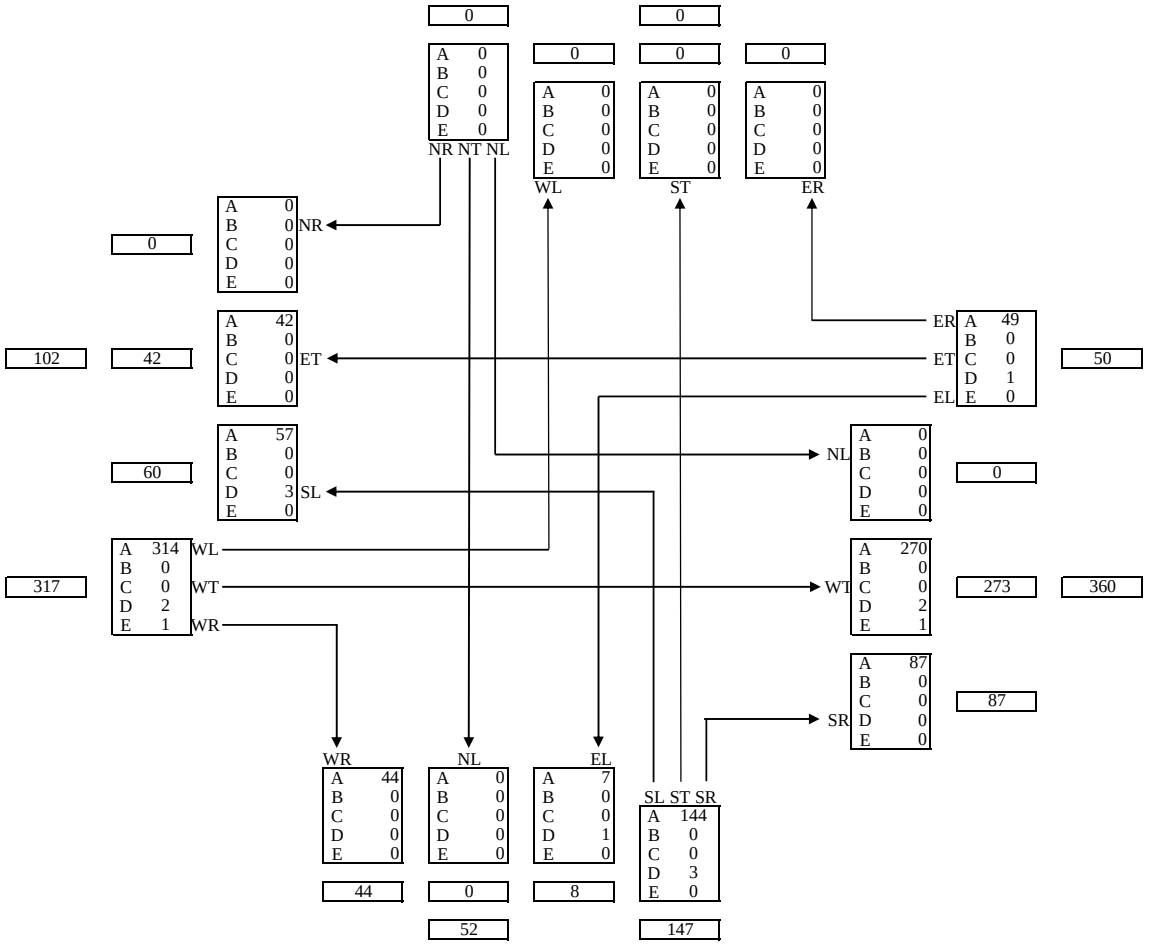
South On Range Road 245 (S)		
Vehicle Type	Volume	%
A - Passenger Vehicles	158	98.1 %
B - Recreational Vehicles	0	0.0 %
C - Buses	1	0.6 %
D - Single Unit Trucks	2	1.2 %
E - Tractor Trailer Combination	0	0.0 %
TOTAL	161	

Turning Movement Summary Diagram

Intersection of Township Road 510 and Range Road 245 (S)

Observed PM Peak Hour Traffic Volumes

Vehicle Type	Volume	%
A - Passenger Vehicles	0	-
B - Recreational Vehicles	0	-
C - Buses	0	-
D - Single Unit Trucks	0	-
E - Tractor Trailer Combination	0	-
TOTAL		



West On Township Road 510		
Vehicle Type	Volume	%
A - Passenger Vehicles	413	98.6 %
B - Recreational Vehicles	0	0.0 %
C - Buses	0	0.0 %
D - Single Unit Trucks	5	1.2 %
E - Tractor Trailer Combination	1	0.2 %
TOTAL	419	

East On Township Road 510		
Vehicle Type	Volume	%
A - Passenger Vehicles	406	99.0 %
B - Recreational Vehicles	0	0.0 %
C - Buses	0	0.0 %
D - Single Unit Trucks	3	0.7 %
E - Tractor Trailer Combination	1	0.2 %
TOTAL	410	

South On Range Road 245 (S)		
Vehicle Type	Volume	%
A - Passenger Vehicles	195	98.0 %
B - Recreational Vehicles	0	0.0 %
C - Buses	0	0.0 %
D - Single Unit Trucks	4	2.0 %
E - Tractor Trailer Combination	0	0.0 %
TOTAL	199	

B Appendix B - Traffic Analysis



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	9	8	146	144	40	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	5.0			5.0	0.0	5.0
Storage Lanes	0			0	1	0
Taper Length (m)	15.0			15.0	15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.933		0.893	
Flt Protected		0.974			0.990	
Satd. Flow (prot)	0	1834	1757	0	1665	0
Flt Permitted		0.974			0.990	
Satd. Flow (perm)	0	1834	1757	0	1665	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		1391.0	216.0		551.3	
Travel Time (s)		62.6	9.7		24.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	9	159	157	43	167
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	19	316	0	210	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	34.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	9	8	146	144	40	154
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)	10	9	159	157	43	167
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	315				265	237
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	315				265	237
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
po queue free %	99				94	79
cM capacity (veh/h)	1245				718	802

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	18	315	211
Volume Left	10	0	43
Volume Right	0	157	167
cSH	1245	1700	783
Volume to Capacity	0.01	0.19	0.27
Queue Length 95th (m)	0.2	0.0	8.3
Control Delay (s)	4.2	0.0	11.3
Lane LOS	A		B
Approach Delay (s)	4.2	0.0	11.3
Approach LOS			B

Intersection Summary			
Average Delay	4.5		
Intersection Capacity Utilization	34.9%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	25	32	80	306	45	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		5.0	5.0		0.0	5.0
Storage Lanes		0	0		1	0
Taper Length (m)		15.0	15.0		15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.924				0.990	
Flt Protected				0.990	0.956	
Satd. Flow (prot)	1740	0	0	1865	1783	0
Flt Permitted				0.990	0.956	
Satd. Flow (perm)	1740	0	0	1865	1783	0
Link Speed (k/h)	80			80	80	
Link Distance (m)	216.0			1409.5	498.9	
Travel Time (s)	9.7			63.4	22.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	35	87	333	49	4
Shared Lane Traffic (%)						
Lane Group Flow (vph)	62	0	0	420	53	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.7	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	37.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	25	32	80	306	45	4
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)	27	35	87	333	49	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			62		551	45
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			62		551	45
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
po queue free %			94		90	100
cM capacity (veh/h)			1541		467	1025

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	62	420	53
Volume Left	0	87	49
Volume Right	35	0	4
cSH	1700	1541	489
Volume to Capacity	0.04	0.06	0.11
Queue Length 95th (m)	0.0	1.4	2.8
Control Delay (s)	0.0	2.0	13.3
Lane LOS		A	B
Approach Delay (s)	0.0	2.0	13.3
Approach LOS			B

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	37.2%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	1	24	241	6	2	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	5.0			5.0	0.0	5.0
Storage Lanes	0			0	1	0
Taper Length (m)	15.0			15.0	15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.996		0.874	
Flt Protected		0.998			0.997	
Satd. Flow (prot)	0	1880	1876	0	1641	0
Flt Permitted		0.998			0.997	
Satd. Flow (perm)	0	1880	1876	0	1641	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		1409.5	203.5		521.2	
Travel Time (s)		63.4	9.2		23.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	26	262	7	2	29
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	27	269	0	31	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	1	24	241	6	2	27
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)	1	26	262	7	2	29
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	268				293	265
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	268				293	265
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
po queue free %	100				100	96
cM capacity (veh/h)	1295				697	773

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	27	268	32
Volume Left	1	0	2
Volume Right	0	7	29
cSH	1295	1700	768
Volume to Capacity	0.00	0.16	0.04
Queue Length 95th (m)	0.0	0.0	1.0
Control Delay (s)	0.3	0.0	9.9
Lane LOS	A		A
Approach Delay (s)	0.3	0.0	9.9
Approach LOS			A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	23.0%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	24	1	0	234	4	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		5.0	5.0		0.0	5.0
Storage Lanes		0	0		1	0
Taper Length (m)		15.0	15.0		15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.995				0.973	
Flt Protected					0.962	
Satd. Flow (prot)	1874	0	0	1883	1763	0
Flt Permitted					0.962	
Satd. Flow (perm)	1874	0	0	1883	1763	0
Link Speed (k/h)	80			80	80	
Link Distance (m)	203.5			1404.0	441.0	
Travel Time (s)	9.2			63.2	19.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	26	1	0	254	4	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	27	0	0	254	5	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.7	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	22.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	24	1	0	234	4	1
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)	26	1	0	254	4	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			27		281	27
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			27		281	27
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
po queue free %			100		99	100
cM capacity (veh/h)			1587		709	1049

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	27	254	5
Volume Left	0	0	4
Volume Right	1	0	1
cSH	1700	1587	758
Volume to Capacity	0.02	0.00	0.01
Queue Length 95th (m)	0.0	0.0	0.2
Control Delay (s)	0.0	0.0	9.8
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.8
Approach LOS			A

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	22.3%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	1	22	240	1	1	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.932	
Flt Protected		0.998			0.976	
Satd. Flow (prot)	0	1880	1882	0	1713	0
Flt Permitted		0.998			0.976	
Satd. Flow (perm)	0	1880	1882	0	1713	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		1404.0	205.0		503.9	
Travel Time (s)		63.2	9.2		22.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	24	261	1	1	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	25	262	0	2	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	22.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	1	22	240	1	1	1
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)	1	24	261	1	1	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	262				288	261
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	262				288	261
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
po queue free %	100				100	100
cM capacity (veh/h)	1302				702	777

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	25	262	2
Volume Left	1	0	1
Volume Right	0	1	1
cSH	1302	1700	738
Volume to Capacity	0.00	0.15	0.00
Queue Length 95th (m)	0.0	0.0	0.1
Control Delay (s)	0.3	0.0	9.9
Lane LOS	A		A
Approach Delay (s)	0.3	0.0	9.9
Approach LOS			A

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



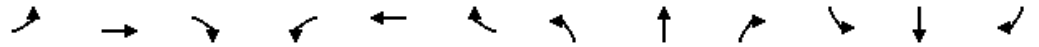
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	18	3	2	222	20	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.982				0.989	
Flt Protected					0.956	
Satd. Flow (prot)	1850	0	0	1883	1781	0
Flt Permitted					0.956	
Satd. Flow (perm)	1850	0	0	1883	1781	0
Link Speed (k/h)	80			80	80	
Link Distance (m)	205.0			1525.2	453.1	
Travel Time (s)	9.2			68.6	20.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	20	3	2	241	22	2
Shared Lane Traffic (%)						
Lane Group Flow (vph)	23	0	0	243	24	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.7	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 23.3%		ICU Level of Service A	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	18	3	2	222	20	2
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)	20	3	2	241	22	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			23		267	21
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			23		267	21
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
po queue free %			100		97	100
cM capacity (veh/h)			1592		721	1056

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	23	243	24
Volume Left	0	2	22
Volume Right	3	0	2
cSH	1700	1592	743
Volume to Capacity	0.01	0.00	0.03
Queue Length 95th (m)	0.0	0.0	0.8
Control Delay (s)	0.0	0.1	10.0
Lane LOS		A	B
Approach Delay (s)	0.0	0.1	10.0
Approach LOS			B

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	23.3%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	1	14	14	31	30	152	1111	43	13	534	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.916			0.946				0.850		0.965	
Flt Protected		0.984			0.991			0.994		0.950		
Satd. Flow (prot)	0	1698	0	0	1766	0	0	1872	1601	1789	1818	0
Flt Permitted		0.984			0.991			0.994		0.950		
Satd. Flow (perm)	0	1698	0	0	1766	0	0	1872	1601	1789	1818	0
Link Speed (k/h)		80			80			60			80	
Link Distance (m)		1525.2			538.8			477.9			466.2	
Travel Time (s)		68.6			24.2			28.7			21.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	1	15	15	34	33	165	1208	47	14	580	176
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	24	0	0	82	0	0	1373	47	14	756	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	119.7%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	7	1	14	14	31	30	152	1111	43	13	534	162
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	1	15	15	34	33	165	1208	47	14	580	176
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	2284	2282	668	2162	2323	1208	757			1254		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2284	2282	668	2162	2323	1208	757			1254		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
po queue free %	0	97	97	43	0	85	81			97		
cM capacity (veh/h)	0	31	458	27	29	223	854			555		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	24	82	1373	47	14	757
Volume Left	8	15	165	0	14	0
Volume Right	15	33	0	47	0	176
cSH	0	44	854	1700	555	1700
Volume to Capacity	Err	1.86	0.19	0.03	0.03	0.45
Queue Length 95th (m)	Err	63.6	5.4	0.0	0.6	0.0
Control Delay (s)	Err	605.9	7.2	0.0	11.7	0.0
Lane LOS	F	F	A		B	
Approach Delay (s)	Err	605.9	7.0		0.2	
Approach LOS	F	F				

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	119.7%	ICU Level of Service	H	
Analysis Period (min)	15			



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	160	121	24	80	81	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	5.0			5.0	0.0	5.0
Storage Lanes	0			0	1	0
Taper Length (m)	15.0			15.0	15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.896		0.967	
Flt Protected		0.972			0.963	
Satd. Flow (prot)	0	1831	1688	0	1754	0
Flt Permitted		0.972			0.963	
Satd. Flow (perm)	0	1831	1688	0	1754	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		1391.0	216.0		551.3	
Travel Time (s)		62.6	9.7		24.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	174	132	26	87	88	28
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	306	113	0	116	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	160	121	24	80	81	26
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)	174	132	26	87	88	28
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	113				549	70
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	113				549	70
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
po queue free %	88				80	97
cM capacity (veh/h)	1476				438	993

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	305	113	116
Volume Left	174	0	88
Volume Right	0	87	28
cSH	1476	1700	507
Volume to Capacity	0.12	0.07	0.23
Queue Length 95th (m)	3.0	0.0	6.7
Control Delay (s)	4.8	0.0	14.2
Lane LOS	A		B
Approach Delay (s)	4.8	0.0	14.2
Approach LOS			B

Intersection Summary			
Average Delay	5.9		
Intersection Capacity Utilization	34.6%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	273	44	8	42	60	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		5.0	5.0		0.0	5.0
Storage Lanes		0	0		1	0
Taper Length (m)		15.0	15.0		15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.981				0.920	
Flt Protected				0.992	0.980	
Satd. Flow (prot)	1848	0	0	1868	1698	0
Flt Permitted				0.992	0.980	
Satd. Flow (perm)	1848	0	0	1868	1698	0
Link Speed (k/h)	80			80	80	
Link Distance (m)	216.0			1409.5	498.9	
Travel Time (s)	9.7			63.4	22.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	297	48	9	46	65	95
Shared Lane Traffic (%)						
Lane Group Flow (vph)	345	0	0	55	160	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.7	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	32.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	273	44	8	42	60	87
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)	297	48	9	46	65	95
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			345		384	321
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			345		384	321
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
po queue free %			99		89	87
cM capacity (veh/h)			1214		615	720

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	345	54	160
Volume Left	0	9	65
Volume Right	48	0	95
cSH	1700	1214	673
Volume to Capacity	0.20	0.01	0.24
Queue Length 95th (m)	0.0	0.2	7.0
Control Delay (s)	0.0	1.3	12.0
Lane LOS		A	B
Approach Delay (s)	0.0	1.3	12.0
Approach LOS			B

Intersection Summary			
Average Delay	3.6		
Intersection Capacity Utilization	32.4%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	38	219	35	3	7	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	5.0			5.0	0.0	5.0
Storage Lanes	0			0	1	0
Taper Length (m)	15.0			15.0	15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.990		0.985	
Flt Protected		0.993			0.957	
Satd. Flow (prot)	0	1870	1865	0	1775	0
Flt Permitted		0.993			0.957	
Satd. Flow (perm)	0	1870	1865	0	1775	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		1409.5	203.5		521.2	
Travel Time (s)		63.4	9.2		23.5	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	41	238	38	3	8	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	279	41	0	9	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	30.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	38	219	35	3	7	1
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)	41	238	38	3	8	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	41				360	40
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	41				360	40
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
po queue free %	97				99	100
cM capacity (veh/h)	1568				622	1032

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	279	41	9
Volume Left	41	0	8
Volume Right	0	3	1
cSH	1568	1700	654
Volume to Capacity	0.03	0.02	0.01
Queue Length 95th (m)	0.6	0.0	0.3
Control Delay (s)	1.3	0.0	10.6
Lane LOS	A		B
Approach Delay (s)	1.3	0.0	10.6
Approach LOS			B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	30.3%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	218	6	4	35	3	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)		5.0	5.0		0.0	5.0
Storage Lanes		0	0		1	0
Taper Length (m)		15.0	15.0		15.0	15.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.996				0.966	
Flt Protected				0.995	0.964	
Satd. Flow (prot)	1876	0	0	1874	1754	0
Flt Permitted				0.995	0.964	
Satd. Flow (perm)	1876	0	0	1874	1754	0
Link Speed (k/h)	80			80	80	
Link Distance (m)	203.5			1404.0	441.0	
Travel Time (s)	9.2			63.2	19.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	237	7	4	38	3	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	244	0	0	42	4	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.7	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	218	6	4	35	3	1
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)	237	7	4	38	3	1
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume			243		287	240
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			243		287	240
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
po queue free %			100		100	100
cM capacity (veh/h)			1323		701	799

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	243	42	4
Volume Left	0	4	3
Volume Right	7	0	1
cSH	1700	1323	723
Volume to Capacity	0.14	0.00	0.01
Queue Length 95th (m)	0.0	0.1	0.1
Control Delay (s)	0.0	0.8	10.0
Lane LOS		A	B
Approach Delay (s)	0.0	0.8	10.0
Approach LOS			B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	2	221	40	2	1	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			
Flt Protected					0.950	
Satd. Flow (prot)	0	1883	1872	0	1789	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1883	1872	0	1789	0
Link Speed (k/h)		80	80		80	
Link Distance (m)		1404.0	205.0		503.9	
Travel Time (s)		63.2	9.2		22.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	240	43	2	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	242	45	0	1	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		0.0	0.0		3.7	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		1.6	1.6		1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24			14	24	14
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	23.2%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	2	221	40	2	1	0
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)	2	240	43	2	1	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	46				289	45
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	46				289	45
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
po queue free %	100				100	100
cM capacity (veh/h)	1562				700	1025

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	242	46	1
Volume Left	2	0	1
Volume Right	0	2	0
cSH	1562	1700	700
Volume to Capacity	0.00	0.03	0.00
Queue Length 95th (m)	0.0	0.0	0.0
Control Delay (s)	0.1	0.0	10.1
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay		0.1	
Intersection Capacity Utilization		23.2%	ICU Level of Service A
Analysis Period (min)		15	



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	197	30	4	31	5	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.982				0.917	
Flt Protected				0.995	0.981	
Satd. Flow (prot)	1850	0	0	1874	1694	0
Flt Permitted				0.995	0.981	
Satd. Flow (perm)	1850	0	0	1874	1694	0
Link Speed (k/h)	80			80	80	
Link Distance (m)	205.0			1525.2	453.1	
Travel Time (s)	9.2			68.6	20.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	214	33	4	34	5	8
Shared Lane Traffic (%)						
Lane Group Flow (vph)	247	0	0	38	13	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(m)	0.0			0.0	3.7	
Link Offset(m)	0.0			0.0	0.0	
Crosswalk Width(m)	1.6			1.6	1.6	
Two way Left Turn Lane						
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)		14	24		24	14
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.2%		ICU Level of Service A	
Analysis Period (min) 15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	197	30	4	31	5	7
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)	214	33	4	34	5	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			247		273	230
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			247		273	230
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
po queue free %			100		99	99
cM capacity (veh/h)			1319		714	809

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	247	38	13
Volume Left	0	4	5
Volume Right	33	0	8
cSH	1700	1319	767
Volume to Capacity	0.15	0.00	0.02
Queue Length 95th (m)	0.0	0.1	0.4
Control Delay (s)	0.0	0.9	9.8
Lane LOS		A	A
Approach Delay (s)	0.0	0.9	9.8
Approach LOS			A

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	22.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	22	103	30	4	23	17	558	27	41	1098	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.945			0.946				0.850		0.999	
Flt Protected		0.976			0.974			0.999		0.950		
Satd. Flow (prot)	0	1737	0	0	1735	0	0	1882	1601	1789	1882	0
Flt Permitted		0.976			0.974			0.999		0.950		
Satd. Flow (perm)	0	1737	0	0	1735	0	0	1882	1601	1789	1882	0
Link Speed (k/h)		80			80			60			80	
Link Distance (m)		1525.2			538.8			477.9			466.2	
Travel Time (s)		68.6			24.2			28.7			21.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	137	24	112	33	4	25	18	607	29	45	1193	12
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	273	0	0	62	0	0	625	29	45	1205	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Sign Control		Stop			Stop			Free			Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 86.2%		ICU Level of Service E	
Analysis Period (min) 15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	126	22	103	30	4	23	17	558	27	41	1098	11
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	137	24	112	33	4	25	18	607	29	45	1193	12
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	1959	1961	1199	2050	1938	607	1205			636		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1959	1961	1199	2050	1938	607	1205			636		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
po queue free %	0	59	50	0	93	95	97			95		
cM capacity (veh/h)	40	58	226	13	60	497	579			948		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	273	62	625	29	45	1205
Volume Left	137	33	18	0	45	0
Volume Right	112	25	0	29	0	12
cSH	63	24	579	1700	948	1700
Volume to Capacity	4.30	2.57	0.03	0.02	0.05	0.71
Queue Length 95th (m)	Err	58.8	0.8	0.0	1.1	0.0
Control Delay (s)	Err	1052.7	0.9	0.0	9.0	0.0
Lane LOS	F	F	A		A	
Approach Delay (s)	Err	1052.7	0.8		0.3	
Approach LOS	F	F				

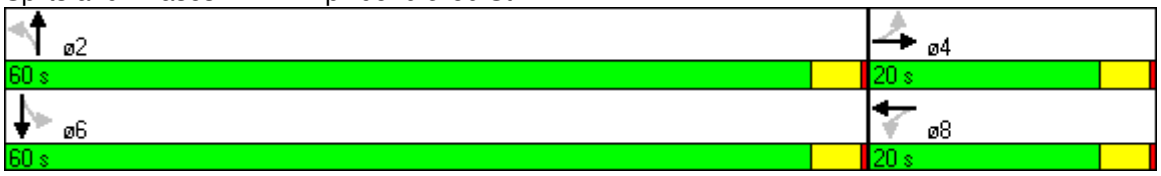
Intersection Summary				
Average Delay	1247.9			
Intersection Capacity Utilization	86.2%	ICU Level of Service	E	
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	1	14	14	31	30	152	1111	43	13	534	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.916			0.946			0.994			0.965	
Flt Protected		0.984			0.991		0.950			0.950		
Satd. Flow (prot)	0	1698	0	0	1766	0	1789	1872	0	1789	1818	0
Flt Permitted		0.928			0.958		0.288			0.071		
Satd. Flow (perm)	0	1601	0	0	1707	0	542	1872	0	134	1818	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			33			6			46	
Link Speed (k/h)		80			80			60			80	
Link Distance (m)		1525.2			538.8			477.9			466.2	
Travel Time (s)		68.6			24.2			28.7			21.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	1	15	15	34	33	165	1208	47	14	580	176
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	24	0	0	82	0	165	1255	0	14	756	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Minimum Split (s)	20.0	20.0		20.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	20.0	20.0	0.0	20.0	20.0	0.0	60.0	60.0	0.0	60.0	60.0	0.0
Total Split (%)	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%	75.0%	75.0%	0.0%	75.0%	75.0%	0.0%
Maximum Green (s)	16.0	16.0		16.0	16.0		56.0	56.0		56.0	56.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		16.0			16.0		56.0	56.0		56.0	56.0	
Actuated g/C Ratio		0.20			0.20		0.70	0.70		0.70	0.70	
v/c Ratio		0.07			0.22		0.44	0.96		0.15	0.59	
Control Delay		16.8			19.5		9.5	29.3		8.2	7.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		16.8			19.5		9.5	29.3		8.2	7.9	
LOS		B			B		A	C		A	A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		16.8			19.5			27.0			8.0	
Approach LOS		B			B			C			A	
Queue Length 50th (m)		1.1			6.2		9.0	144.0		0.6	45.3	
Queue Length 95th (m)		7.0			17.4		21.4	#266.0		3.0	71.4	
Internal Link Dist (m)		1501.2			514.8			453.9			442.2	
Turn Bay Length (m)												
Base Capacity (vph)		332			368		379	1312		94	1286	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.07			0.22		0.44	0.96		0.15	0.59	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Pretimed			
Maximum v/c Ratio: 0.96			
Intersection Signal Delay: 20.2		Intersection LOS: C	
Intersection Capacity Utilization 79.3%		ICU Level of Service D	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 7: TwpRd510 & 50 St

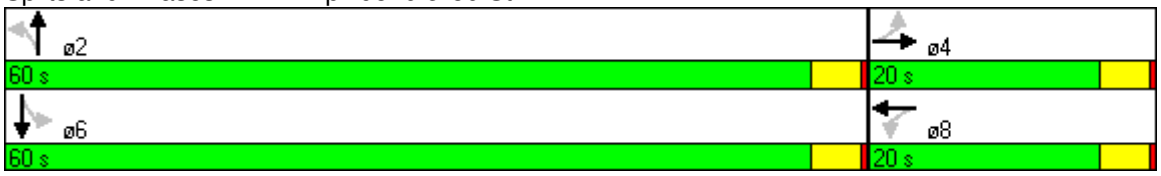


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	22	103	30	4	23	17	558	27	41	1098	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.945			0.946			0.993			0.999	
Flt Protected		0.976			0.974		0.950			0.950		
Satd. Flow (prot)	0	1737	0	0	1735	0	1789	1870	0	1789	1882	0
Flt Permitted		0.837			0.766		0.071			0.354		
Satd. Flow (perm)	0	1490	0	0	1365	0	134	1870	0	667	1882	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		39			25			7			2	
Link Speed (k/h)		80			80			60			80	
Link Distance (m)		1525.2			538.8			477.9			466.2	
Travel Time (s)		68.6			24.2			28.7			21.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	137	24	112	33	4	25	18	607	29	45	1193	12
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	273	0	0	62	0	18	636	0	45	1205	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(m)		0.0			0.0			3.7			3.7	
Link Offset(m)		0.0			0.0			0.0			0.0	
Crosswalk Width(m)		1.6			1.6			1.6			1.6	
Two way Left Turn Lane												
Headway Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Turning Speed (k/h)	24		14	24		14	24		14	24		14
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Minimum Split (s)	20.0	20.0		20.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	20.0	20.0	0.0	20.0	20.0	0.0	60.0	60.0	0.0	60.0	60.0	0.0
Total Split (%)	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%	75.0%	75.0%	0.0%	75.0%	75.0%	0.0%
Maximum Green (s)	16.0	16.0		16.0	16.0		56.0	56.0		56.0	56.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		16.0			16.0		56.0	56.0		56.0	56.0	
Actuated g/C Ratio		0.20			0.20		0.70	0.70		0.70	0.70	
v/c Ratio		0.83			0.21		0.19	0.49		0.10	0.91	
Control Delay		49.2			20.2		9.8	6.9		4.5	23.0	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		49.2			20.2		9.8	6.9		4.5	23.0	
LOS		D			C		A	A		A	C	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		49.2			20.2			7.0			22.3	
Approach LOS		D			C			A			C	
Queue Length 50th (m)		34.5			4.7		0.8	36.2		1.8	127.5	
Queue Length 95th (m)		#74.2			14.5		4.0	55.3		4.9	#248.1	
Internal Link Dist (m)		1501.2			514.8			453.9			442.2	
Turn Bay Length (m)												
Base Capacity (vph)		329			293		94	1311		467	1318	
Starvation Cap Reductn		0			0		0	0		0	0	
Spillback Cap Reductn		0			0		0	0		0	0	
Storage Cap Reductn		0			0		0	0		0	0	
Reduced v/c Ratio		0.83			0.21		0.19	0.49		0.10	0.91	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 80			
Control Type: Pretimed			
Maximum v/c Ratio: 0.91			
Intersection Signal Delay: 21.1		Intersection LOS: C	
Intersection Capacity Utilization 82.7%		ICU Level of Service E	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 7: TwpRd510 & 50 St



Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	50 Street	Direction (EW or NS)	NS	Road Authority:	
Side Street (name)	Twp Rd 510	Direction (EW or NS)	EW	City:	Beaumont
Quadrant / Int #		Comments	Based on 2007 Traffic Count	Analysis Date:	2009 Apr 06, Mon
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
50 Street	NB		1				1	6,500	1
50 Street	SB	1				1		425	1
Twp Rd 510	WB				1				
Twp Rd 510	EB				1				

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

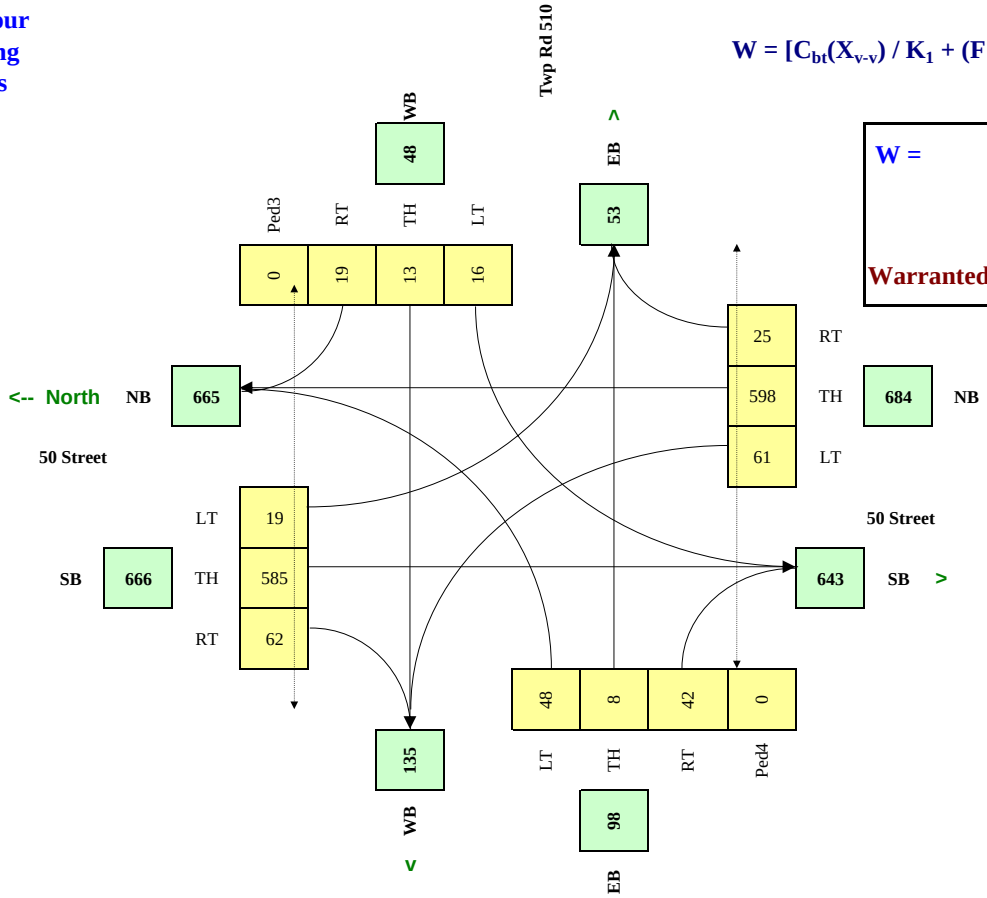
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
50 Street	NS	70	2.0%	N	2.0
Twp Rd 510	EW		2.0%	N	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
7:00 - 8:00	152	1111	43	13	534	162	14	31	30	7	1	14				
8:00 - 9:00	106	778	30	9	374	113	10	22	21	5	1	10				
11:30 - 12:30	38	376	16	12	367	39	10	8	12	30	5	26				
12:30 - 13:30	38	376	16	12	367	39	10	8	12	30	5	26				
16:45 - 17:45	17	558	27	41	1098	11	30	4	23	126	22	103				
17:45 - 18:45	12	391	19	29	769	8	21	3	16	88	15	72				
Total (6-hour peak)	**363**	**3,590**	**151**	**116**	**3,509**	**372**	**95**	**76**	**114**	**286**	**49**	**251**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**61**	**598**	**25**	**19**	**585**	**62**	**16**	**13**	**19**	**48**	**8**	**42**	**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 =	117	117	0
		Veh	*Ped*

Warranted

RESET SHEET

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	7	1	14	14	31	30	152	1111	43	13	534	162
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	1	15	15	34	33	165	1208	47	14	580	176
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	2284	2282	668	2162	2323	1208	757			1254		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2284	2282	668	2162	2323	1208	757			1254		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	97	97	43	0	85	81			97		
cM capacity (veh/h)	0	31	458	27	29	223	854			555		

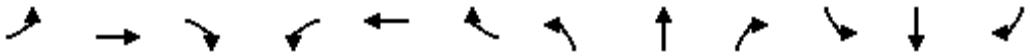
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	24	82	1373	47	14	757
Volume Left	8	15	165	0	14	0
Volume Right	15	33	0	47	0	176
cSH	0	44	854	1700	555	1700
Volume to Capacity	Err	1.86	0.19	0.03	0.03	0.45
Queue Length 95th (m)	Err	63.6	5.4	0.0	0.6	0.0
Control Delay (s)	Err	605.9	7.2	0.0	11.7	0.0
Lane LOS	F	F	A		B	
Approach Delay (s)	Err	605.9	7.0		0.2	
Approach LOS	F	F				

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	119.7%	ICU Level of Service	H	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	126	22	103	30	4	23	17	558	27	41	1098	11
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	137	24	112	33	4	25	18	607	29	45	1193	12
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	1959	1961	1199	2050	1938	607	1205			636		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1959	1961	1199	2050	1938	607	1205			636		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	59	50	0	93	95	97			95		
cM capacity (veh/h)	40	58	226	13	60	497	579			948		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	273	62	625	29	45	1205
Volume Left	137	33	18	0	45	0
Volume Right	112	25	0	29	0	12
cSH	63	24	579	1700	948	1700
Volume to Capacity	4.30	2.57	0.03	0.02	0.05	0.71
Queue Length 95th (m)	Err	58.8	0.8	0.0	1.1	0.0
Control Delay (s)	Err	1052.7	0.9	0.0	9.0	0.0
Lane LOS	F	F	A		A	
Approach Delay (s)	Err	1052.7	0.8		0.3	
Approach LOS	F	F				

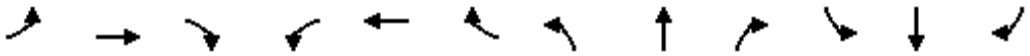
Intersection Summary			
Average Delay	1247.9		
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	1	14	14	31	30	152	1111	43	13	534	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Frt		0.92			0.95			1.00	0.85	1.00	0.97	
Flt Protected		0.98			0.99			0.99	1.00	0.95	1.00	
Satd. Flow (prot)		1696			1765			1872	1601	1789	1818	
Flt Permitted		0.93			0.95			0.75	1.00	0.09	1.00	
Satd. Flow (perm)		1609			1691			1408	1601	167	1818	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	1	15	15	34	33	165	1208	47	14	580	176
RTOR Reduction (vph)	0	13	0	0	16	0	0	0	8	0	7	0
Lane Group Flow (vph)	0	11	0	0	66	0	0	1373	39	14	749	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		16.0			16.0			126.0	126.0	126.0	126.0	
Effective Green, g (s)		16.0			16.0			126.0	126.0	126.0	126.0	
Actuated g/C Ratio		0.11			0.11			0.84	0.84	0.84	0.84	
Clearance Time (s)		4.0			4.0			4.0	4.0	4.0	4.0	
Lane Grp Cap (vph)		172			180			1183	1345	140	1527	
v/s Ratio Prot											0.41	
v/s Ratio Perm		0.01			c0.04			c0.98	0.02	0.08		
v/c Ratio		0.06			0.37			1.16	0.03	0.10	0.49	
Uniform Delay, d1		60.2			62.3			12.0	2.0	2.1	3.3	
Progression Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.7			5.7			82.0	0.0	1.4	1.1	
Delay (s)		60.9			68.0			94.0	2.0	3.5	4.4	
Level of Service		E			E			F	A	A	A	
Approach Delay (s)		60.9			68.0			90.9			4.4	
Approach LOS		E			E			F			A	

Intersection Summary			
HCM Average Control Delay	60.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	119.7%	ICU Level of Service	H
Analysis Period (min)	15		

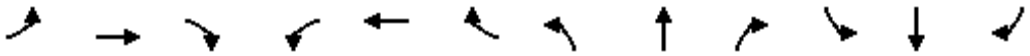
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	22	103	30	4	23	17	558	27	41	1098	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Frt		0.94			0.95			1.00	0.85	1.00	1.00	
Flt Protected		0.98			0.97			1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1736			1735			1881	1601	1789	1881	
Flt Permitted		0.83			0.75			0.79	1.00	0.37	1.00	
Satd. Flow (perm)		1486			1342			1486	1601	690	1881	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	137	24	112	33	4	25	18	607	29	45	1193	12
RTOR Reduction (vph)	0	28	0	0	20	0	0	0	8	0	0	0
Lane Group Flow (vph)	0	245	0	0	42	0	0	625	21	45	1205	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)		17.0			17.0			65.0	65.0	65.0	65.0	
Effective Green, g (s)		17.0			17.0			65.0	65.0	65.0	65.0	
Actuated g/C Ratio		0.19			0.19			0.72	0.72	0.72	0.72	
Clearance Time (s)		4.0			4.0			4.0	4.0	4.0	4.0	
Lane Grp Cap (vph)		281			253			1073	1156	498	1359	
v/s Ratio Prot											c0.64	
v/s Ratio Perm		c0.17			0.03			0.42	0.01	0.07		
v/c Ratio		0.87			0.16			0.58	0.02	0.09	0.89	
Uniform Delay, d1		35.5			30.6			6.0	3.5	3.7	9.7	
Progression Factor		1.00			1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2		29.2			1.4			2.3	0.0	0.4	8.8	
Delay (s)		64.7			32.0			8.3	3.5	4.1	18.5	
Level of Service		E			C			A	A	A	B	
Approach Delay (s)		64.7			32.0			8.1			18.0	
Approach LOS		E			C			A			B	

Intersection Summary			
HCM Average Control Delay	21.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	1	14	14	31	30	152	1111	43	13	534	162
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.92			0.95		1.00	0.99		1.00	0.97	
Flt Protected		0.98			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1696			1765		1789	1873		1789	1818	
Flt Permitted		0.93			0.96		0.29	1.00		0.07	1.00	
Satd. Flow (perm)		1601			1706		543	1873		135	1818	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	1	15	15	34	33	165	1208	47	14	580	176
RTOR Reduction (vph)	0	12	0	0	26	0	0	2	0	0	14	0
Lane Group Flow (vph)	0	12	0	0	56	0	165	1253	0	14	742	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		16.0			16.0		56.0	56.0		56.0	56.0	
Effective Green, g (s)		16.0			16.0		56.0	56.0		56.0	56.0	
Actuated g/C Ratio		0.20			0.20		0.70	0.70		0.70	0.70	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		320			341		380	1311		95	1273	
v/s Ratio Prot								c0.67			0.41	
v/s Ratio Perm		0.01			c0.03		0.30			0.10		
v/c Ratio		0.04			0.16		0.43	0.96		0.15	0.58	
Uniform Delay, d1		25.8			26.5		5.2	10.9		4.0	6.1	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.2			1.0		3.6	16.3		3.2	2.0	
Delay (s)		26.0			27.5		8.8	27.2		7.3	8.0	
Level of Service		C			C		A	C		A	A	
Approach Delay (s)		26.0			27.5			25.1			8.0	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	22	103	30	4	23	17	558	27	41	1098	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.94			0.95		1.00	0.99		1.00	1.00	
Flt Protected		0.98			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1736			1735		1789	1871		1789	1881	
Flt Permitted		0.84			0.77		0.07	1.00		0.35	1.00	
Satd. Flow (perm)		1489			1364		135	1871		668	1881	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	137	24	112	33	4	25	18	607	29	45	1193	12
RTOR Reduction (vph)	0	31	0	0	20	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	242	0	0	42	0	18	634	0	45	1204	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		16.0			16.0		56.0	56.0		56.0	56.0	
Effective Green, g (s)		16.0			16.0		56.0	56.0		56.0	56.0	
Actuated g/C Ratio		0.20			0.20		0.70	0.70		0.70	0.70	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)		298			273		95	1310		468	1317	
v/s Ratio Prot								0.34			c0.64	
v/s Ratio Perm		c0.16			0.03		0.13			0.07		
v/c Ratio		0.81			0.15		0.19	0.48		0.10	0.91	
Uniform Delay, d1		30.6			26.4		4.2	5.4		3.9	10.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		20.9			1.2		4.4	1.3		0.4	11.3	
Delay (s)		51.4			27.6		8.5	6.7		4.3	21.3	
Level of Service		D			C		A	A		A	C	
Approach Delay (s)		51.4			27.6			6.8			20.7	
Approach LOS		D			C			A			C	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

C Appendix C - Public Consultation





Welcome to the
Township Road 510 Functional Plan
Open House

June 25, 2008 3:00 to 7:00pm
at the Nisku Inn



Please sign in and take a comment sheet to fill out before you leave




LEDUC COUNTY

Associated Engineering





Township Road 510 Functional Plan

Study Purpose

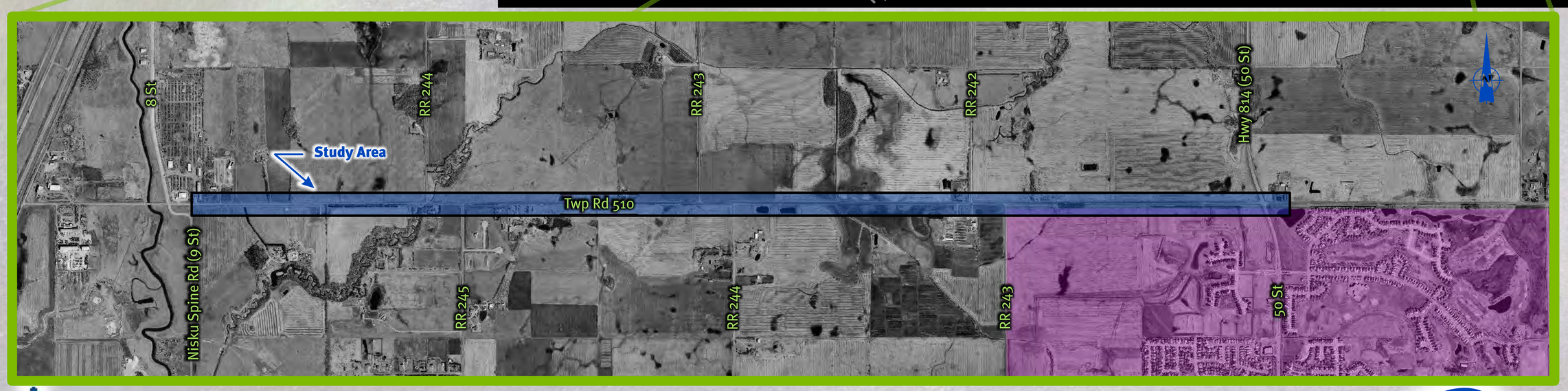
The Township Road 510 Functional Planning Study was initiated to clearly outline long-term requirements for the ultimate design of the roadway within the study area. The functional plan will recommend improvements to the existing roadway structure, design standards, horizontal and vertical alignment, right-of-way requirements, intersection requirements, and access control.

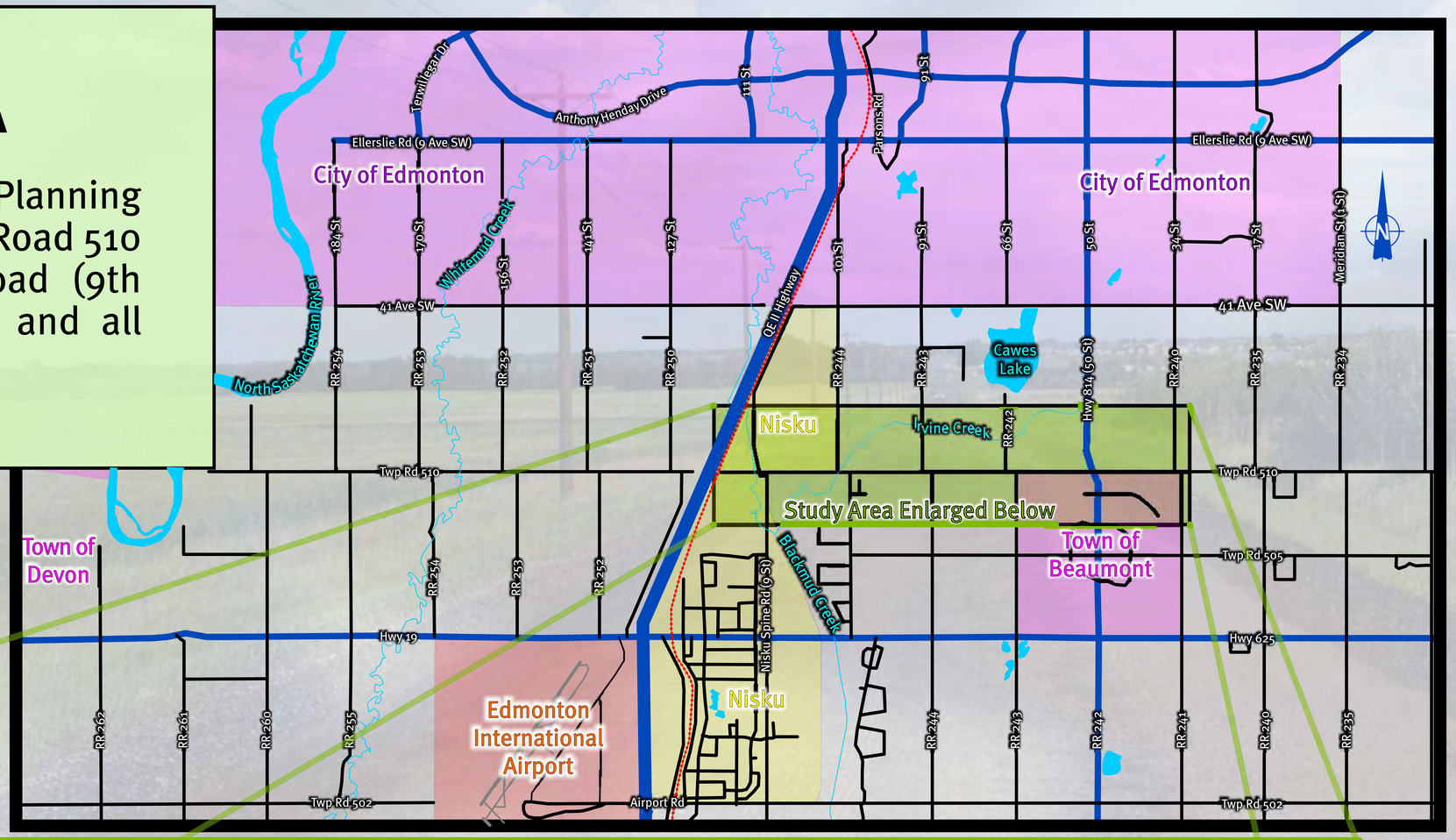
Residential growth in Leduc County, Beaumont, and southern Edmonton, as well as increased industrial development in Nisku, has contributed to the need for this study.

The overlying purpose of this study is to provide guidance for long range planning along Township Road 510 between Nisku and Beaumont.

Study Area

The Township Road 510 Functional Planning Study covers an area along Township Road 510 from the proposed Nisku Spine Road (9th Street) to Highway 814 (50 Street), and all connecting roadways.





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Township Road 510 Functional Plan

Public Communication Strategy

Key stakeholders in the study area include:

- Leduc County
- Town of Beaumont
- Adjacent landowners

The public consultation component consists of two stages. Through the first stage, landowners adjacent to the study area were interviewed to determine local issues and comments. Town of Beaumont administration were also consulted during the study.

As the second stage in public consultation, this open house is being held to present the recommended preliminary functional plans developed for the long-term configuration of Township Road 510 between the Nisku Spine Road and Highway 814 (50 Street), and to obtain the public's comments.

Comments received at this open house will be reviewed and addressed in the final recommended functional plan.

Please look at the presented concepts, **fill out a comment form,** and drop it off before you leave. You may also mail, fax, or e-mail to Associated Engineering by Friday July 4, 2008.

Relevant Studies and Plans

Major Studies and Plans relevant to the study area include:

- Greater Nisku Offsite Levy Bylaw (2008)
- Leduc County East Vistas Area Structure Plan (2008 – Under Development)
- Alberta Capital Region Integrated Growth Management Plan (2007)
- Town of Beaumont 50th Street Functional Planning Study (2007)
- Leduc County 9th Street (Nisku Spine Road) Functional Planning Study (2006)
- Leduc County North Major Area Structure Plan (2004)
- Town of Beaumont Municipal Development Plan (1998)
- Leduc County Nisku Area Structure Plan (1981)

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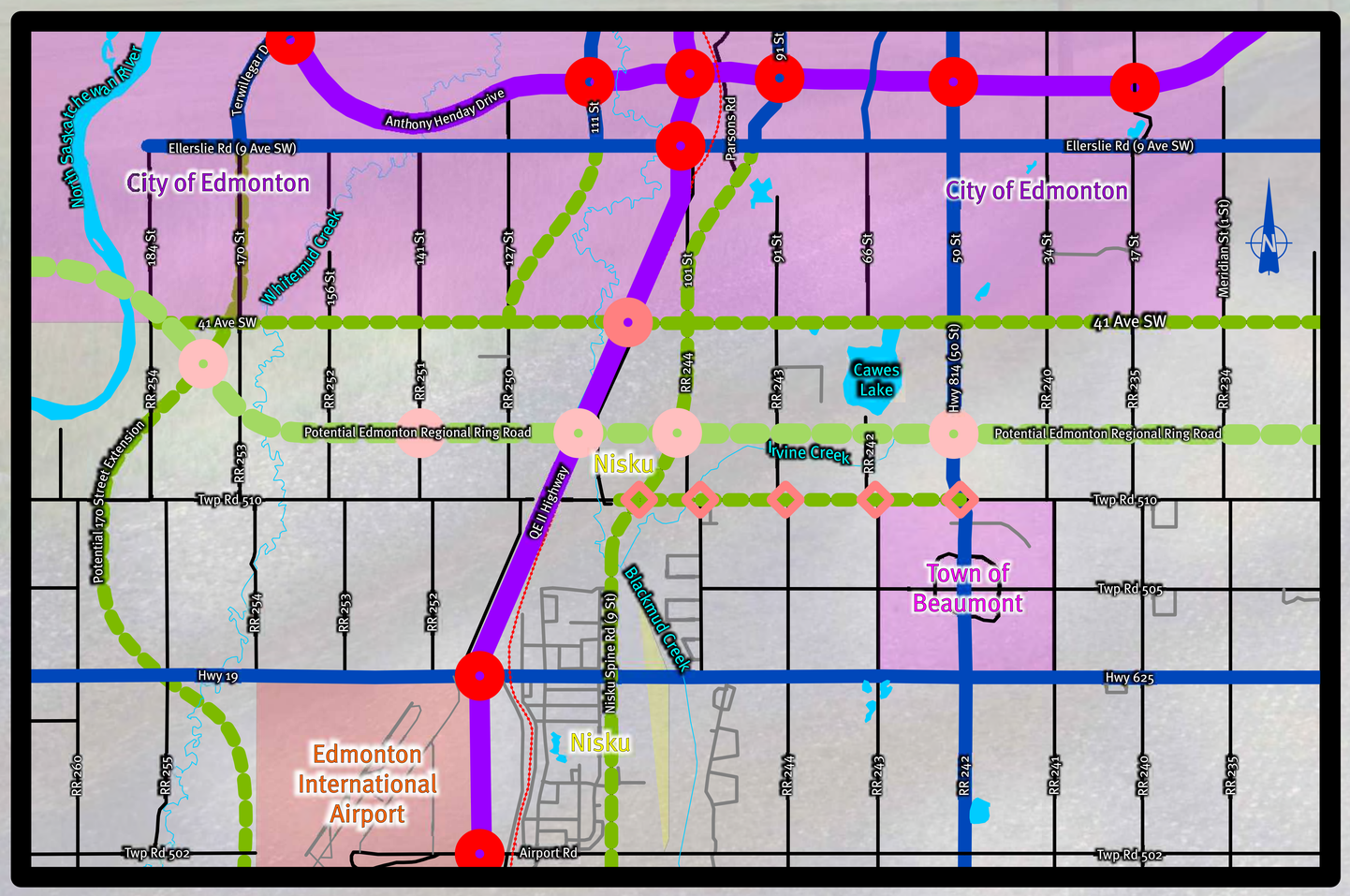
Township Road 510 Functional Plan

Roadway Functionality

Township Road 510 is planned to operate as a major arterial roadway in the future. Its function will be to collect traffic from the residential neighbourhoods adjacent to Township Road 510 and convey the traffic to the major north-south roads at the Nisku Spine Road and Highway 814 (50 Street).

The Capital Region Integrated Growth Management Plan indicates that the Edmonton Regional Ring Road will be developed just north of Township Road 510, and plans for interchanges at the Nisku Spine Road and Highway 814 (50 Street). The Edmonton Regional Ring Road (ERRR) will be a limited access freeway, similar to Anthony Henday Drive. As a result of the limited access to/from the ERRR, Township Road 510 will function to provide major access to the surrounding residential communities.

As a major arterial roadway, access to and from Township Road 510 will be through intersections with arterial or collector roads only; direct access may be allowed from private land in accordance with an access management policy. In order to maintain higher speeds (60 – 70 km/h), intersections will be spaced a desirable 800 metres apart or as outlined in the access management plan.



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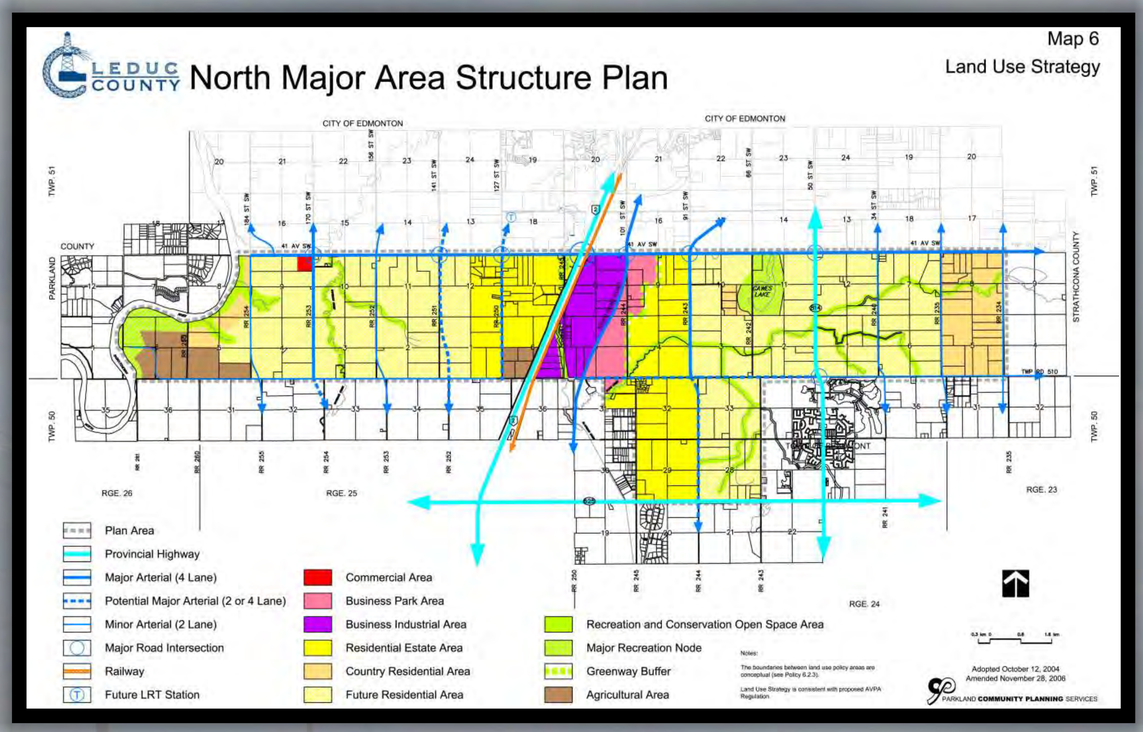


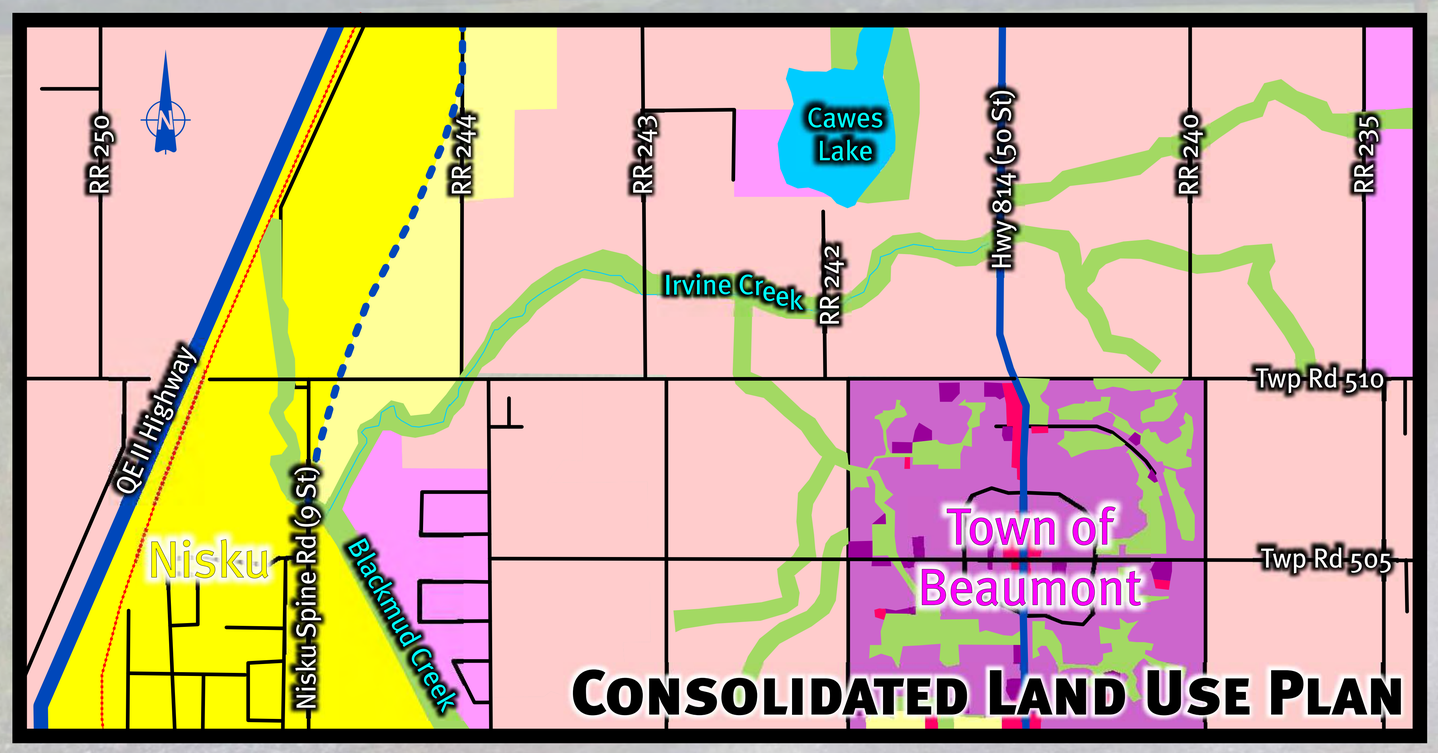


Township Road 510 Functional Plan

Future Land Use

The Leduc County North Major Area Structure Plan identifies future land use near Township Road 510 as generally residential lands. The Nisku business park is located at the west end of the study corridor; these lands will generally be developed into light industrial or business park uses. The Town of Beaumont also borders the study area; however, there is no direct access proposed from the town to Township Road 510.

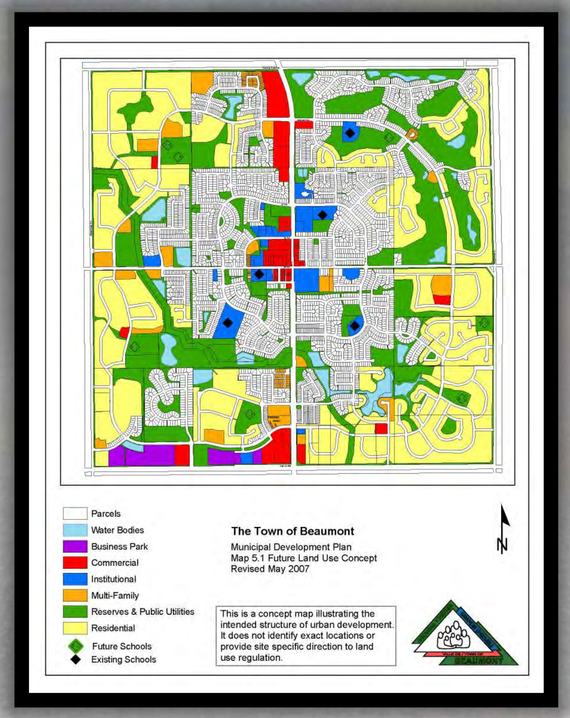




Country Residential
Low Density Residential
Medium Density Residential
Future Residential

Commercial
Parks & Green Space

Industrial Park
Business Park



LEDUC COUNTY

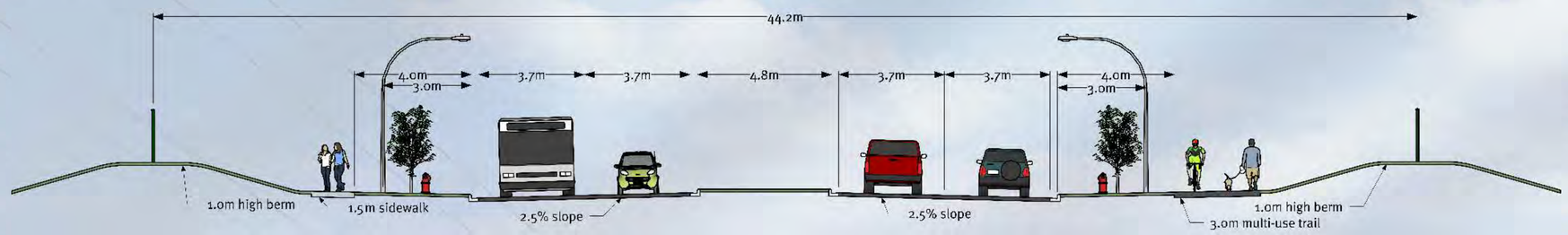
Associated Engineering





Township Road 510 Functional Plan

Roadway Cross Section



The proposed cross-section for Township Road 510 provides for four traffic lanes (two in each direction) with urban curb and gutter drainage. A raised median provides separation between traffic lanes and allows for left turn lanes at intersections.

A multi-use trail for non-motorized users is provided on the south side of the roadway, and a typical boulevard sidewalk is provided on the north side. Berms are proposed where the roadway is adjacent to residential development to help mitigate noise and light pollution into the neighbourhoods.

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Township Road 510 Functional Plan

Plan Drawing Four

Legend

- EXISTING PROPERTY LINE
- PROPOSED RIGHT OF WAY
- PROPOSED CENTRELINE
- PROPOSED FACE OF CURB
- PROPOSED LANE LINES
- 3.95 PROPOSED LANE CONFIGURATION AND WIDTHS
  note: curb lane width measurements include 0.25m gutter
- PROPOSED ASPHALT
- PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL

50 | 50 | 100 | 100 | 200

Scale in Metres

Tie-in to Proposed Upgraded Hwy 814

Potential Major Access

SERVICE ROAD

SW2_51-24-4

SE2_5

MATCHLINE TO PLAN DRAWING THREE

LEDUC COUNTY

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Township Road 510 Functional Plan

Plan Drawing One

Legend

- EXISTING PROPERTY LINE
- PROPOSED RIGHT OF WAY
- PROPOSED CENTRELINE
- PROPOSED FACE OF CURB
- PROPOSED LANE LINES
- 3.95 PROPOSED LANE CONFIGURATION AND WIDTHS
  note: curb lane width measurements include 0.25m gutter
- PROPOSED ASPHALT
- PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL

50 | 50 | 100 | 100 | 200

SCALE IN METRES

Tie-in to Proposed Nisku Spine Road

Potential Major Access

Tie-in to Proposed Nisku Spine Road

Potential Service Road Connection

Potential Service Road Connection

MATCHLINE TO PLAN DRAWING TWO

SW5 51-24-4

SE5 51-24-4

NW31 50-24-4

LOT 1

LEDUC COUNTY

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Township Road 510 Functional Plan

Plan Drawing Three

Legend

- EXISTING PROPERTY LINE
- PROPOSED RIGHT OF WAY
- PROPOSED CENTRELINE
- PROPOSED FACE OF CURB
- PROPOSED LANE LINES
- 3.95 PROPOSED LANE CONFIGURATION AND WIDTHS
  note: curb lane width measurements include 0.25m gutter
- PROPOSED ASPHALT
- PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL

50 | 50 | 100 | 100 | 200

SCALE IN METRES

Potential Road Realignment

Potential Major Access

Potential Major Access

MATCHLINE TO PLAN DRAWING TWO

MATCHLINE TO PLAN DRAWING FOUR

DRAINAGE DITCH ROW

NW33 50-24-4

NE33 50-24-4

SE3 51-24-4

SW2 51-24-4

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Township Road 510 Functional Plan

Plan Drawing Two

Legend

- EXISTING PROPERTY LINE
- PROPOSED RIGHT OF WAY
- PROPOSED CENTRELINE
- PROPOSED FACE OF CURB
- PROPOSED LANE LINES
- 3.95 PROPOSED LANE CONFIGURATION AND WIDTHS
  note: curb lane width measurements include 0.25m gutter
- PROPOSED ASPHALT
- PROPOSED MEDIAN
- PROPOSED SIDEWALK / MULTI-USE TRAIL

50 | 50 | 100 | 100 | 200

Scale in Metres

Potential Major Access

Potential Road Realignment

Potential Access

Approved Access

MATCHLINE TO PLAN DRAWING ONE

MATCHLINE TO PLAN DRAWING THREE

SW4 51–24–4

SE4 51–24–4

SW3 51–24–4

NW32 50–24–4

NE32 50–24–4

LOT 1

LOT 2

LOT 3

POWERLINE ROW

Leduc County

Associated Engineering





Township Road 510 Functional Plan

Next Steps

Comments gathered from this open house will be compiled, reviewed, and addressed in preparing the final plan for Leduc County.

The final recommendations report will be presented to Leduc County for approval in the summer of 2008.

The timing for construction of Township Road 510 is subject to development and funding approval.

Please remember to fill out a comment sheet before you leave

Thank-you for your participation!

LEDUC COUNTY

Associated Engineering

Open House Participant Survey

Please complete a feedback form and leave it in the box at the door, or send to:

Associated Engineering, Suite 1000, Associated Engineering Plaza
10909 Jasper Avenue, Edmonton, Alberta T5J 5B9

Fax: 780.454.7698
Email: benbows@ae.ca

Please send the feedback form by ***Friday, July 4, 2008***

If you require follow-up to this survey, please call Shawn Benbow at Associated Engineering at 780.451.7666 or email *benbows@ae.ca*

Open House Feedback

1. How did you hear about the open house?

---

2. Were the displays helpful in explaining the suggested concept for Township Road 510 and intersecting/adjacent roadways?

☐ Yes ☐ No

3. Were the project staff helpful in answering questions?

☐ Yes ☐ No

4. The information provided at the open house was:

☐ Adequate ☐ Too Much ☐ Too Little
☐ Too Technical ☐ Too Conceptual ☐ Just Right

Comments:

---

5. General comments about the information presented at this open house:

Your comments are being collected for possible summary reports to county council and administration regarding opinions expressed at this open house. The above information is being collected under the authority of Section 33(c) of the *Freedom of Information and Protection of Privacy Act (FOIP)*. It is protected by the privacy provisions of *FOIP.*

Functional Plan Feedback

6. What do you like about the recommended plan?

7. What do you dislike about the recommended plan?

8. What additional issues and ideas would you like the project team to consider as the study continues?

9. Do you have any other general comments about the plan?

Thank you for your responses.

The following personal information is optional:
Name:

Address:

Phone Number:

Your comments are being collected for possible summary reports to county council and administration regarding opinions expressed at this open house. The above information is being collected under the authority of Section 33(c) of the *Freedom of Information and Protection of Privacy Act (FOIP)*. It is protected by the privacy provisions of *FOIP.*

D Appendix D - Structural

ALBERTA TRANSPORTATION — BIM SYSTEM FORM - (Rev/92) — FORM ID: CUL1

Bridge File Number : 00537
Year Built : 78 / 79
Bridge or Town Name: EDMONTON
Stream Name : IRVINE CK
Legal Land Location: SSW04-051-24-4
Road Authority : C25
Highway #:Cntrl Sec: L : 0
Clear Roadway/ Skew: 7.3 m / -25. DEG
Structure Usage : RV
AADT / Year : .-..... / ..
Road Classification: ...-.....-...
Detour Length : ... km

LEGEND:

9	Very Good
8	
7	Good
6	
5	Adequate
4	
3	Poor
2	
1	Immediate Action
N	Not Accessible
X	Not Applicable

Last BIS Update: 1980-02

Last BIM Update: 1994-04-29

Culvert Information

Number of Culverts 1

Span / Rise (or Dia.)	Span Type	Length	Corr.Profile	Pl.Thickness
3700 X ..... mm	SP	39.6 m	...X.. mm	... ...mm
..... X ..... mm	...	..... m	...X.. mm	... ...mm
..... X ..... mm	...	..... m	...X.. mm	... ...mm

Special Features .....

Utilities (Located at):

AGT WEST & SOUTH DITCH
POWER 10 MN.E. U/S END
OTHERS
Remarks
GAS 15 M NORTH U/S END
MUNICPL
Problems Y/N NO

Approach Road / Embankment:

	Rating Last	Rating Now	Explanation of Condition
Horizontal Alignment	7	7 ✓	THIS IS A T INTERSECTION WITH THE EAST
Vertical Alignment	7	7 ✓	WEST ROAD RUNNING STRAIGHT THROUGH AND
Roadway Width (6.8 m)	****	****	THE NORTH SOUTH ROAD HAVING A STOP
Embankment	6	6 ✓	SIGN
(Sideslope 4 : 1)	****	****	
Height of Cover (1.0 m)	****	****	
Guardrail Installed	****	****	
(Y/N YES)	****	****	
App / Emb - Gen Rating	6	6	

Upstream End: Primary Span

Culvert Component	Rating Last	Rating Now	Explanation of Condition
End Treatment (Concrete,	****	****	
Steel, Others, None) C	****	****	
Headwall	X	X	SLOPE PROTECTION IS BAGGED RIP-RAP
Collar/Conc.Slope Prot.	6	6	IN A WINGWALL TYPE OF LAYOUT
Wingwalls	X	X	
(Flared Y/N ___)	****	****	
Cutoff Wall	X	X	
Bevel End	X	X	NO BEVEL
(Heaving 0 mm)	****	****	600 CMP FROM N/S ROAD FLOWS INTO
Invert Above/Below S.B.	****	****	CREEK 10 M FROM U/S END. SMALL GULLY
(0 mm)	****	****	SEEMS O.K. DITCH EROSION FROM E/W
Scour Protection	5	5	ROAD ALSO FLOWS INTO CREEK 15 M U/S
(Type ROCK RIP-RAP)	****	****	
(Avg. Rk. Size 150 mm)	****	****	
Scour / Erosion	5	5	
Beavers Y/N NO	****	****	
U / S End - Gen Rating	5	5	

Barrel: Primary Span

Barrel Accessible Y/N YES	****	****	
Special Features	****	****	
Type _____	X	X	CAN'T SEE THE FLOOR BUT IN AREA
Type _____	X	X	WHERE THE SIDEWALL IS DEFLECTING
Roof	7	7	THERE IS PIT RUN WHICH MAY BE COMING
(Sagging 0 mm)	****	****	FROM BELOW
Sidewall	4	4	1 POORLY NESTED SIDEWALL SEAM, 3 RINGS
(Deflecting 50 mm)	****	****	FROM D/S END. 4TH AND 5TH RINGS FROM
Floor	N	N	THE D/S END (NORTH SIDE) HAS CRACKED
(Bulging _____ mm)	****	****	SEAMS. AREA IS MARKED WITH PAINT.
(Abrasion Y/N ___)	****	****	
Circumferential Seams	5	5	Floor is covered with ice.
(Separation _____ mm,	****	****	
Longitudinal Seams	4	4	Ring No.9 measured at 4:oo, 50mm steel
(No of Cracked Rings ?)	****	****	between cracks(photo)
(Proper Lap Y/N NO)	****	****	
(Longt. Stagger Y/N YES)	****	****	
Coating	6	6	RUST STAINS COMING THROUGH BOLT HOLES
(Corr. by Soil/Water) S	****	****	
Camber POS/NONE/NEG N	****	****	
Ponding Y/N NO	****	****	
Fish Passage Adequacy	X	X	
Baffle Type _____	****	****	
Waterway Adequacy	6	6	
(Icing Y/N NO)	****	****	
(Silting Y/N NO)	****	****	
(Drift Y/N NO)	****	****	
Barrel - Gen Rating	5	5	

Downstream End: Primary Span

Culvert Component	Rating Last	Rating Now	Explanation of Condition
End Treatment (Concrete,	****	****	
Steel, Others, None) N	****	****	
Headwall	X	X ✓	
Collar/Conc.Slope Prot.	X	X ✓	
Wingwalls	X	X ✓	
(Flared Y/N ___)	****	****	
Cutoff Wall	X	X ✓	
Bevel End	6	6 ✓	
(Heaving _____ mm)	****	****	
Invert Above/Below S.B. B	****	****	
(1000 mm)	****	****	
Scour Protection	6	6 ✓	BAGGED CONCRETE RIP RAP ALONG SIDES
(Type CONCRETE)	****	****	AND TOP OF BEVEL
(Avg. Rk. Size _____ mm)	****	****	
Scour / Erosion	6	6 ✓	
Beavers Y/N NO	****	****	
D / S End - Gen Rating	6	6 ✓	

Channel:

Channel (U/S and D/S)	****	****	
Alignment	6	6 ✓	
Bank Stability	6	6 ✓	
HWM 1.5 m above S.B.	****	****	HWM TAKEN FROM STAINS ON BARREL
Drift Y/N NO	****	****	
Channel Bottom	****	****	
(Deg. Agg.) _	****	****	
Beavers Y/N NO	****	****	
Channel - Gen Rating	6	6 ✓	

Structural Condition Rating (Last) | 55.0 | % Last Sufficiency Rating | 50.8 | %

Expected remaining life of Structure ? ----> 10 Years

Maintenance Recommendations:

16. Shotcrete Repairs: 19__ ; Location _____
20. Place Additional Rip Rap: 19__ ; Quantity/Class _____
21. Remove Drift Accumulation: 19__
22. Install Cathodic Protection: 19__
23. Install Concrete/Steel Lining: 19__
24. Install Struts: 19__
25. Install Concrete Collar/Cutoff: 19__
26. Repair Seams: 19__
27. Obtain Corrosion Analysis Data: 19__
28. Other Repairs: 19__ ; Type _____
19__ ; Type _____
19__ ; Type _____
19__ ; Type _____

Special Comments For Next Inspection:
MONITOR SIDEWALL MOVEMENT (SOUTHSIDE, D/S END)
MONITOR CRACKS (NORTH SIDE)

Inspection Level: 1 | By:Dwayne Kwolick | Class:B | Date:940125

Authorized Maintenance by : Date:

Items	Target Date	Estimated Cost
NEXT INSPECTION - Date: 981025	- Level:	Total: 0.

PREVIOUS INSPECTION - Date:

ALBERTA TRANSPORTATION — BIM SYSTEM FORM - (Rev/92) — FORM ID: CUL1

Bridge File Number : 00537
Year Built : 78 / 79
Bridge or Town Name: EDMONTON
Stream Name : IRVINE CK
Legal Land Location: SSW04-051-24-4
Road Authority : C25
Highway #:Cntrl Sec: L : 0
Clear Roadway/ Skew: 7.3 m / -25. DEG
Structure Usage : RV
AADT / Year : .-..... / ..
Road Classification: ...-.....-...
Detour Length : ... km

LEGEND:

9	Very Good
8	
7	Good
6	
5	Adequate
4	
3	Poor
2	
1	Immediate Action
N	Not Accessible
X	Not Applicable

Last BIS Update: 1980-02

Last BIM Update: 2000-06-19

Culvert Information

Number of Culverts 1

Span / Rise (or Dia.)	Span Type	Length	Corr.Profile	Pl.Thickness
3700 X ..... mm	SP	39.6 m	...X.. mm	... ...mm
..... X ..... mm	...	..... m	...X.. mm	... ...mm
..... X ..... mm	...	..... m	...X.. mm	... ...mm

Special Features .....

Utilities (Located at):

AGT WEST & SOUTH DITCH
POWER 10 M N.E. U/S END
OTHERS _____
Remarks _____

GAS 15 M NORTH U/S END
MUNICPL _____
Problems Y/N NO

Approach Road / Embankment:

	Rating Last	Rating Now	Explanation of Condition
Horizontal Alignment	7	7	THIS IS A T INTERSECTION WITH THE EAST
Vertical Alignment	7	7	WEST ROAD RUNNING STRAIGHT THROUGH AND
Roadway Width (6.8 m)	****	****	THE NORTH SOUTH ROAD HAVING A STOP
Embankment	6	6	SIGN
(Sideslope 4 : 1)	****	****	
Height of Cover (1.0 m)	****	****	
Guardrail Installed	****	****	
(Y/N YES)	****	****	
App / Emb - Gen Rating	6	6	

Upstream End: Primary Span

Culvert Component	Rating Last	Rating Now	Explanation of Condition
End Treatment (Concrete,	****	****	NORTH.
Steel, Others, None) C	****	****	
Headwall	X	X	SLOPE PROTECTION IS BAGGED RIP-RAP
Collar/Conc.Slope Prot.	6	6	IN A WINGWALL TYPE OF LAYOUT
Wingwalls	X	X	
(Flared Y/N ___)	****	****	
Cutoff Wall	X	X	
Bevel End	X	X	NO BEVEL
(Heaving 0 mm)	****	****	600 CMP FROM N/S ROAD FLOWS INTO
Invert Above/Below S.B. _	****	****	CREEK 10 M FROM U/S END. SMALL GULLY
(0 mm)	****	****	SEEMS O.K. DITCH EROSION FROM E/W
Scour Protection	5	5	ROAD ALSO FLOWS INTO CREEK 15 M U/S
(Type ROCK RIP-RAP)	****	****	
(Avg. Rk. Size 150 mm)	****	****	
Scour / Erosion	5	5	
Beavers Y/N NO	****	****	
U / S End - Gen Rating	5	5	

Barrel: Primary Span

Barrel Accessible Y/N YES	****	****	
Special Features	****	****	
Type _____	X	X	CAN'T SEE THE FLOOR BUT IN AREA
Type _____	X	X	WHERE THE SIDEWALL IS DEFLECTING
Roof	7	6	THERE IS PIT RUN WHICH MAY BE COMING
(Sagging 0 mm)	****	****	FROM BELOW
Sidewall	4	4	1 POORLY NESTED SIDEWALL SEAM, 3 RINGS
(Deflecting 50 mm)	****	****	FROM D/S END. 4TH AND 5TH RINGS FROM
Floor	N	N	THE D/S END (NORTH SIDE) HAS CRACKED
(Bulging _____ mm)	****	****	SEAMS. AREA IS MARKED WITH PAINT.
(Abrasion Y/N ___)	****	****	
Circumferential Seams	5	5	Floor is covered with ice.
(Separation _____ mm)	****	****	
Longitudinal Seams	4	4	Ring No.9 measured at 4:oo, 50mm steel
(No of Cracked Rings 2)	****	****	between cracks.
(Proper Lap Y/N NO)	****	****	
(Longt. Stagger Y/N YES)	****	****	
Coating	6	5	RUST STAINS COMING THROUGH BOLT HOLES
(Corr. by Soil/Water) S	****	****	
Camber POS/NONE/NEG N	****	****	
Ponding Y/N NO	****	****	
Fish Passage Adequacy	X	X	
Baffle Type _____	****	****	
Waterway Adequacy	6	6	
(Icing Y/N NO)	****	****	
(Silting Y/N NO)	****	****	
(Drift Y/N NO)	****	****	
Barrel - Gen Rating	5	5	

Downstream End: Primary Span

Culvert Component	Rating Last	Rating Now	Explanation of Condition
End Treatment (Concrete,	****	****	SOUTH.
Steel, Others, None) N	****	****	
Headwall	X	X	
Collar/Conc.Slope Prot.	X	X	
Wingwalls	X	X	
(Flared Y/N ___)	****	****	
Cutoff Wall	X	X	
Bevel End	6	6	
(Heaving _____ mm)	****	****	
Invert Above/Below S.B. B	****	****	
(1000 mm)	****	****	
Scour Protection	6	6	BAGGED CONCRETE RIP RAP ALONG SIDES
(Type CONCRETE)	****	****	AND TOP OF BEVEL
(Avg. Rk. Size _____ mm)	****	****	
Scour / Erosion	6	6	
Beavers Y/N NO	****	****	
D / S End - Gen Rating	6	6	

Channel:

Channel (U/S and D/S)	****	****	
Alignment	6	6	
Bank Stability	6	6	
HWM 1.5 m above S.B.	****	****	HWM TAKEN FROM STAINS ON BARREL
Drift Y/N NO	****	****	
Channel Bottom	****	****	
(Deg. Agg.) D	****	****	
Beavers Y/N NO	****	****	
Channel - Gen Rating	6	6	

Structural Condition Rating (Last) | 55.0 | % Last Sufficiency Rating | 50.8 | %

Expected remaining life of Structure ? ----> 10 Years

Maintenance Recommendations:

16. Shotcrete Repairs: 19__; Location _____
20. Place Additional Rip Rap: 19__; Quantity/Class _____
21. Remove Drift Accumulation: 19__
22. Install Cathodic Protection: 19__
23. Install Concrete/Steel Lining: 19__
24. Install Struts: 19__
25. Install Concrete Collar/Cutoff: 19__
26. Repair Seams: 19__
27. Obtain Corrosion Analysis Data: 19__
28. Other Repairs: 19__; Type _____
19__; Type _____
19__; Type _____
19__; Type _____

Special Comments For Next Inspection:
MONITOR SIDEWALL MOVEMENT (SOUTHSIDE, D/S END)
MONITOR CRACKS (NORTH SIDE)
NO MAINTENACE AT THIS TIME - APRIL 18, 2000.

Inspection Level: 1 | By:AIME THEROUX | Class:A | Date:20000418

Authorized Maintenance by : Date:20

Items	Target Date	Estimated Cost
NEXT INSPECTION - Date: 20050118	- Level:	Total: 0.

PREVIOUS INSPECTION - Date:

EXH Engineering Services Ltd.

Bridge File 537
Culvert Inspection
Inspector: A. Theroux
April 18, 2000

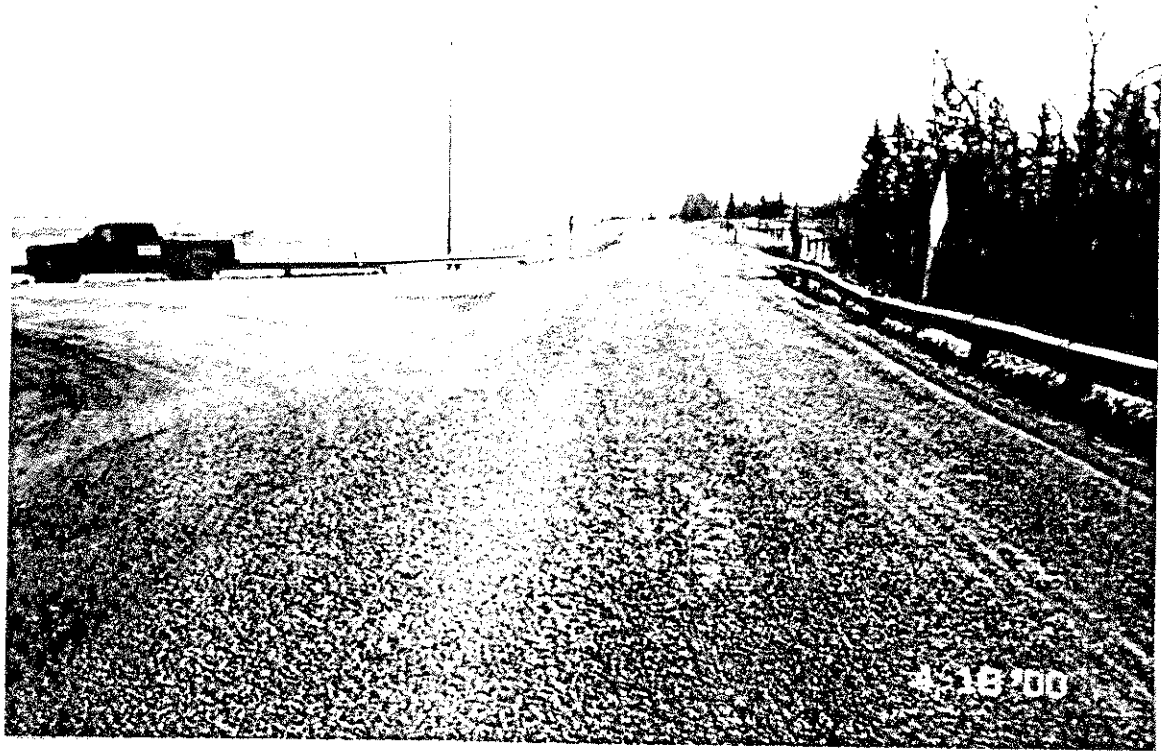


Photo No. 1
Overall view looking east.



Photo No. 2
Looking at north end of pipe, upstream side.

FXH Engineering Services Ltd.

Bridge File 537
Culvert Inspection
Inspector: A. Theroux
April 18, 2000

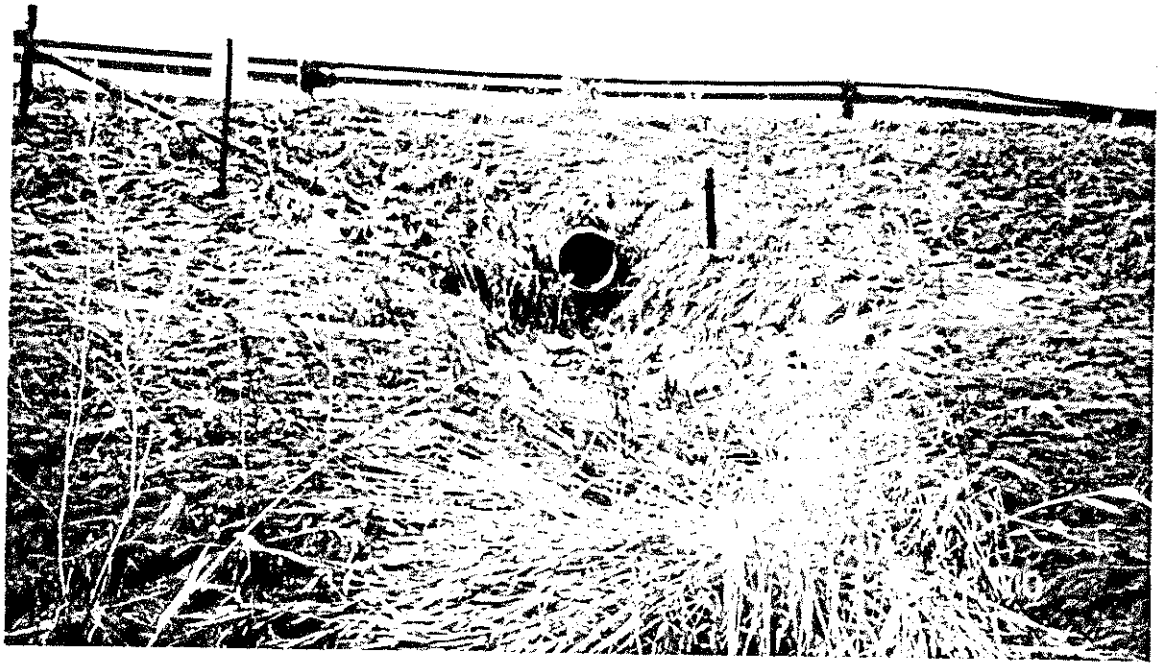


Photo No. 3
A 600 mm CSP 12 m north of main pipe flows into creek.

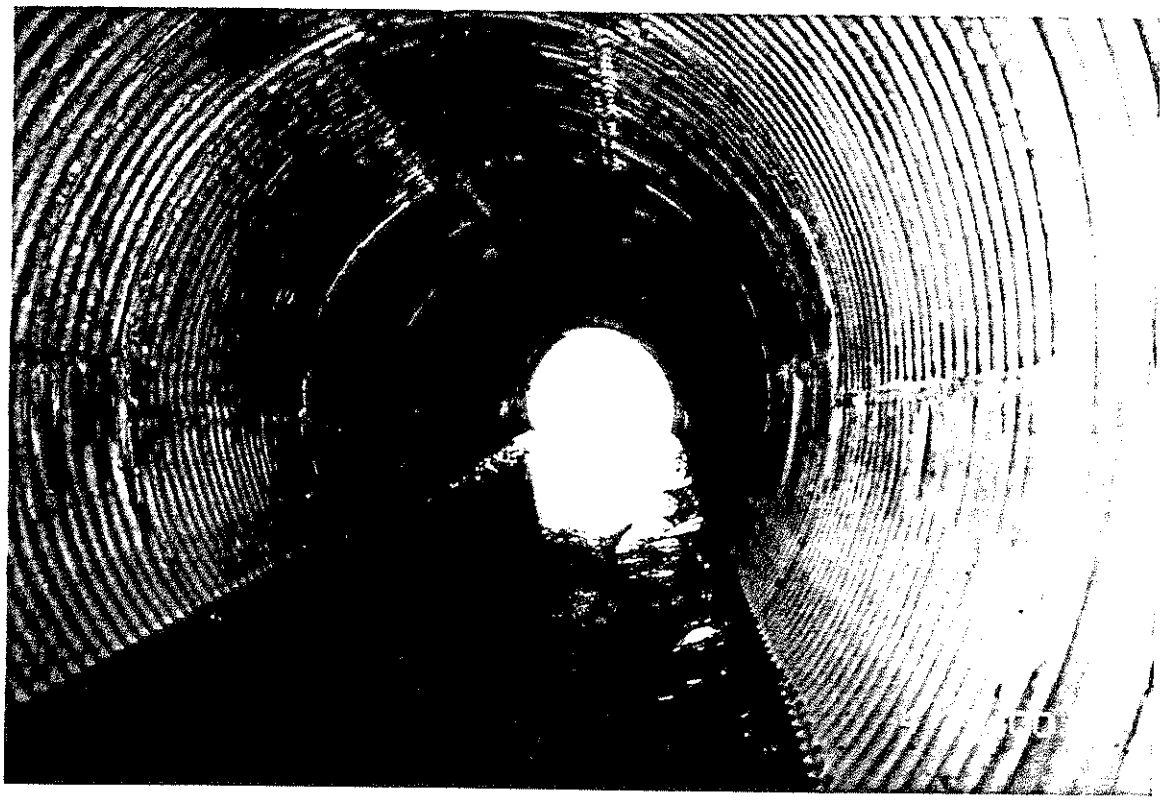


Photo No. 4
Looking south into pipe.

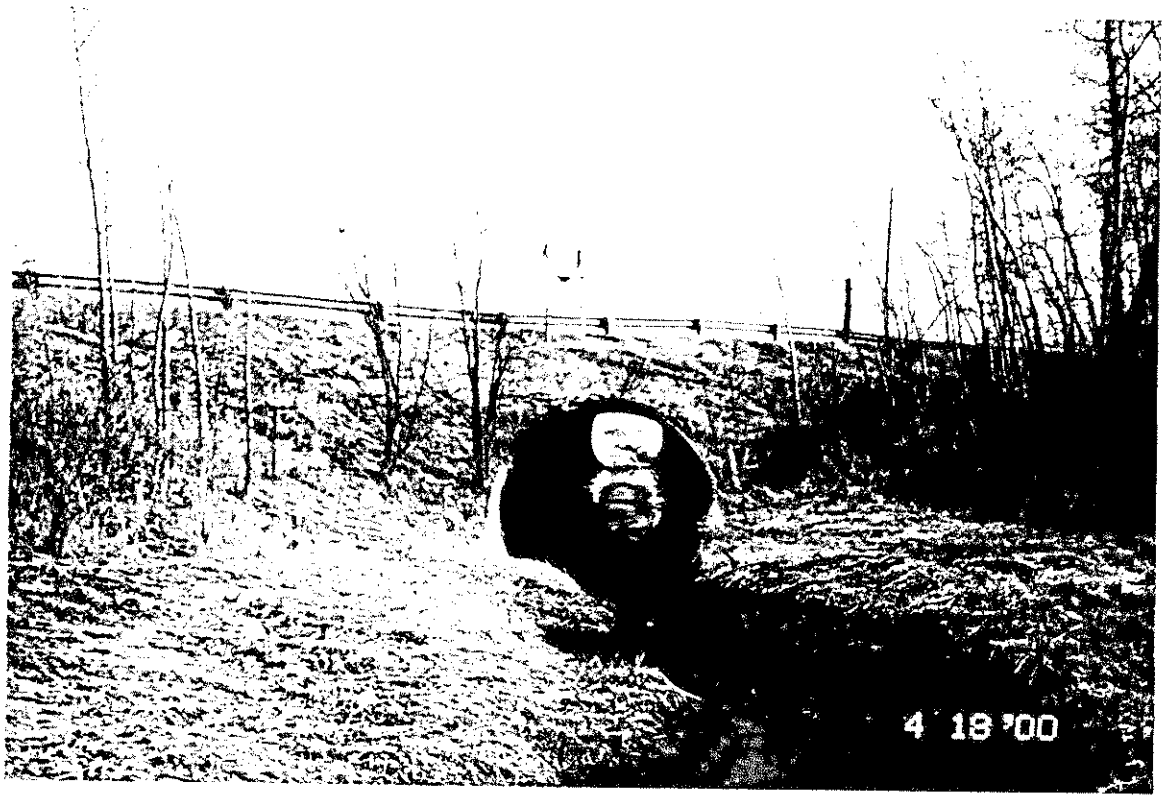


Photo No. 5
Looking north at south downstream side.

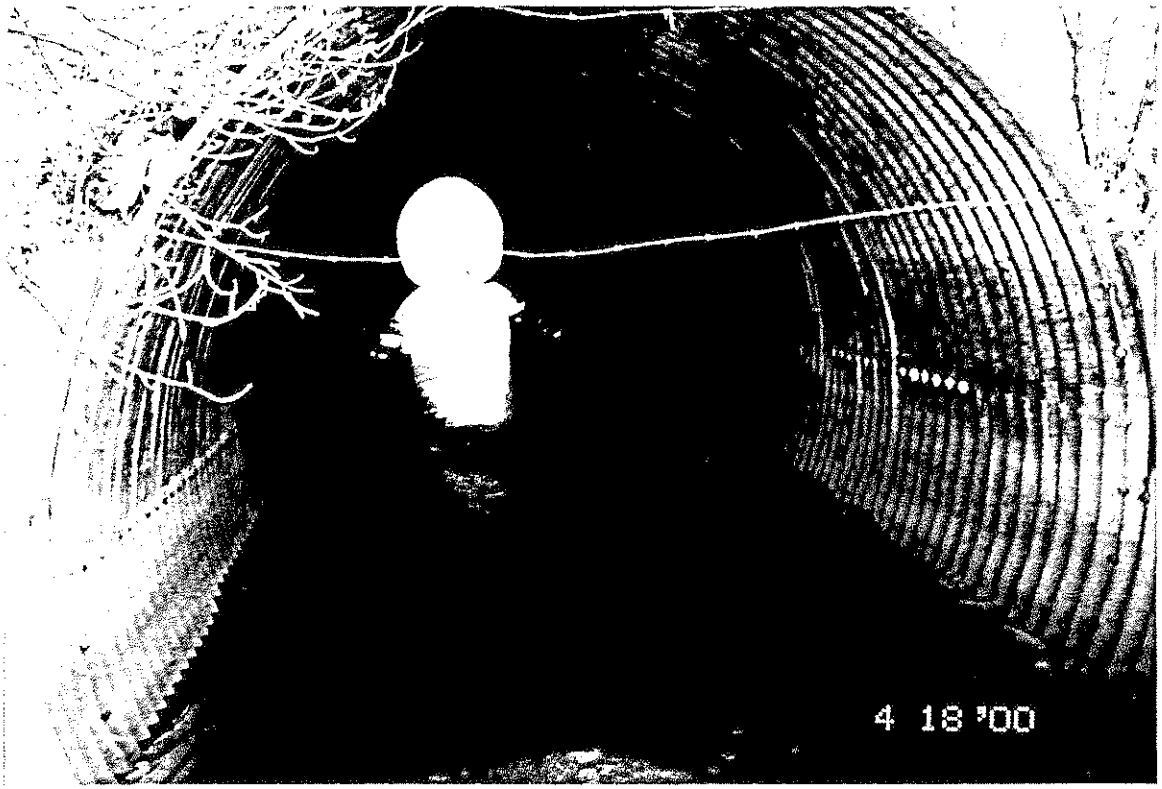


Photo No. 6
Looking north from downstream end.

Bridge Culvert Inspection

Bridge File Number	00537 -1 Bridge Culvert	Form Type	CUL1
Year B	1978	Lot No.	3
Bridge or Town Name	EDMONTON	Inspector Name	Aime Theroux
Located Over	IRVINE CREEK, 6.76.2.4, WATERCRS-ST	Inspector Class	BR CLS A
Located On	LOCAL ROAD	Assistant Name	
Water Body Cl./Year		Assistant Class	
Navigabil. Cl./Year		Inspection Date	10-Nov-2005
Legal Land Location	SW SEC 4 TWP 51 RGE 24 W4M	Data Entry By	Stephanie Parker
Longitude, Latitude	-113:29:30,53:22:01	Data Entry Date	01-Mar-2006
Road Authority	Leduc County	Reviewer Name	Arnold Assenheimer
Contract Main. Area		Review Date	23-Jan-2006
Clear Roadway/Skew	7.3 / -25 deg. (LHF)	Department Reviewer Name	
AADT/Year		Department Review Date	
Road Classification	RLU-207G-60	Follow-Up By	
Detour Length (km)	6		

Bridge Culvert Information

Number of Culverts		1						
Pipe #	Barrel	Span	Rise (or Dia.)	Type	Length	Corr. Profile	Pl. Thickness	Shape
1	MAIN	-	3700	SP	39.6	152X51	3.0	ROUND
Special Features								
Special Features Comment								

Utilities (Located at)

Telephone	WEST & SOUTH DITCH	Gas	15 M NORTH U/S END
Power	10 M N.E. U/S END 1 line.	Municipal	
Others		Problem (Y/N)	No
Remarks			

Approach Road / Embankment

		Last	Now	Explanation of Condition
Horizontal Alignment		7	7	THIS IS A T INTERSECTION WITH THE EAST WEST ROAD RUNNING STRAIGHT THROUGH AND THE NORTH SOUTH ROAD HAVING A STOP SIGN
Vertical Alignment		7	7	
Roadway Width (m)	6.800			
Embankment		6	6	
Sideslope (:1)	4.0			
(Height of Cover (m) : 1)				
Guardrail (Y/N)	Yes			
Approach Road / Embankment General Rating		6	7	

Upstream End

Culvert Component		Last	Now	Explanation of Condition
Direction		N		
End Treatment (Concrete, Steel, Others, None)	CONCRETE			
Headwall		X	X	SLOPE PROTECTION IS BAGGED RIP-RAP
Collar/Concrete Slope Protection		6	4	IN A WINGWALL TYPE OF LAYOUT
Wingwalls		X	X	Eroding at SE side Photo#1.
(Shape :)				
Cutoff Wall		X	X	

ALBERTA
AND TRANSP
TECHNICAL STANDARDS BRANCH
Rec'd
Rec

Upstream End				
Culvert Component		**Last**	**Now**	**Explanation of Condition**
Bevel End		X	X	NO BEVEL
Heaving (mm)	0			600 CMP FROM N/S ROAD FLOWS INTO
Invert Above/Below Stream Bed	BELOW			CREEK 10 M FROM U/S END. SMALL GULLY
Above/Below (mm)	300			SEEMS O.K. DITCH EROSION FROM E/W
Scour Protection		5	5	ROAD ALSO FLOWS INTO CREEK 15 M U/S
(Type : **RIP RAP**)				
(Avg. Rock Size (mm) : **150**)				
Scour/Erosion		5	5	
Beavers (Y/N)	No			
Upstream End General Rating		5	4	

Bridge Culvert Barrel				
Culvert Component		**Last**	**Now**	**Explanation of Condition**
(Pipe # : **1, Primary Span, Location Code: MAIN, Span (mm):** , **Rise (mm): 3700, Type: SP**)				
Barrel Last Accessible Date	18-Apr-2000			
Special Features				
Special Feature				CAN'T SEE THE FLOOR BUT IN AREA WHERE THE SIDEWALL IS DEFLECTING THERE IS PIT RUN WHICH MAY BE COMING FROM BELOW photo #8 ring 4-3865C4.490.
(Type :)				
Special Feature				
(Type :)				
Roof		6	6	
Measured Rise (mm)				
Measured At Ring No.				
Sag (mm)	0			
Percent Sag				
Sidewall		4	2	1 POORLY NESTED SIDEWALL SEAM, 3 RINGS photo #7 FROM D/S END. 4TH AND 5TH RINGS photo# 6.FROM THE D/S END (NORTH SIDE) HAS CRACKED SEAMS. AREA IS MARKED WITH PAINT.
Measured Span (mm)				
Measured At Ring No.				
Deflection (mm)	165			
Percent Deflection				
Floor		N	N	.
Bulge (mm)				
Measured At Ring No.				
Abrasion (Y/N)				
Circumferential Seams		5	5	Floor is covered with ice.
Separation (mm)				
Longitudinal Seams		4	2	Ring No.7 measured-photo #5 at 4:oo, 150mm steel left cracks.
Total No. of Cracked Rings	3			
Total No. of Rings with Two Cracked Seams				
Min. Remaining Steel Between Cracks (mm)				
Proper Lap (Y/N)	No			
Longitudinal Stagger (Y/N)	Yes			
Coating		5	4	RUST STAINS COMING THROUGH BOLT HOLES. Some pitting near d/s end pohto#3.
Corrosion By Soil (Y/N)	Yes			
Corrosion By Water (Y/N)				

Bridge Culvert Barrel				
Culvert Component		**Last**	**Now**	**Explanation of Condition**
(Pipe : **Primary Span, Location Code: MAIN, Span (mm): , Rise (mm): 3700, Type: SP**)				
Camber POS/ZERO/NEG	NEG			
Ponding (Y/N)	No			
Fish Passage Adequacy		X	5	
Baffle			X	
(Type :)				
Waterway Adequacy		6	6	
Icing (Y/N)	No			
Silting (Y/N)	Yes			
Drift (Y/N)	No			
Barrel General Rating		**5**	**2**	

Downstream End				
Culvert Component		**Last**	**Now**	**Explanation of Condition**
Direction		S		
End Treatment (Concrete, Steel, Others, None)	NONE			
Headwall		X	X	
Collar/Concrete Slope Protection		X	X	
Wingwalls		X	X	
(Shape :)				
Cutoff Wall		X	X	
Bevel End		6	4	Hole through side of bevel at north side-bottom Photo #9.
Heaving (mm)				
Invert Above/Below Stream Bed	BELOW			
Above/Below (mm)	1000			
Scour Protection		6	6	BAGGED CONCRETE RIP RAP ALONG SIDES AND TOP OF BEVEL
(Type : **CONCRETE**)				
(Avg. Rock Size (mm) :)				
Scour/Erosion		6	6	
Beavers (Y/N)	No			
Downstraam End General Rating		**6**	**4**	

Structure Usage				
		Last	**Now**	**Explanation of Condition**
Channel (U/S and D/S)				
Alignment		6	6	
Bank Stability		6	6	
HWM (m below Top of Culvert)	1.5			HWM TAKEN FROM STAINS ON BARREL
Drift (Y/N)	No			
Channel Bottom Degrading/Aggrading	DEGRADING			
Beavers (Y/N)	No			
(Fish Compensation Measure 1 : **NONE**)				
(Fish Compensation Measure 2 : **NONE**)				

Structure Usage			
	Last	Now	Explanation of Condition
Channel General Rating	6	6	

Inspector Recommendations	Year	Inspector Comments	Department Comments	Target Year	Est. Cost	Cat #
SHOTCRETE REPAIRS						
PLACE ADDITIONAL RIP RAP	2006	10m3-SE of u/s bevel.				
REMOVE DRIFT ACCUMULATION						
INSTALL CONCRETE/STEEL LINING						
INSTALL STRUTS						
INSTALL CONCRETE COLLAR/CUTOFF						
REPAIR SEAMS						
OTHER ACTION						
OTHER ACTION						
OTHER ACTION						
OTHER ACTION						

Structural Condition Rating (Last/Now) (%)	**55.0/22.2**	**Sufficiency Rating (Last/Now) (%)**	**50.8/43.7**	Est. Repl. Yr	2011	Maint. Reqd. (Y/N)	Yes

Special Comments for Next Inspection	~Monitor sidewall movement(southside, d/s end). ~Monitor cracks ring4,5,7. ~Monitor poor seam ring 3 south.	Department Comments	

Maintenance Reviewed By		Date		Estimated Total	0
Proposed Long-Term Strategy					
On 3-Year Program (Y/N)					
Proposed Action					
Previous Inspector's Name	Aime Theroux	Previous Assistant's Name			
Next Inspection Date		Previous Inspection Date	18-Apr-2000		
Inspection Cycle(Default) (months)	57				
Comment					

Material List for Routine Maintenance Items - Lot 3

File	Maintenance Item	Description of Materials	Quantity Required	Completed by	Priority
537	additional rip rap SE of U/S bevel		10 m^3		M

EXH Engineering Services Ltd.

Bridge File 537
Inspector: Aime Theroux
November 10, 2005

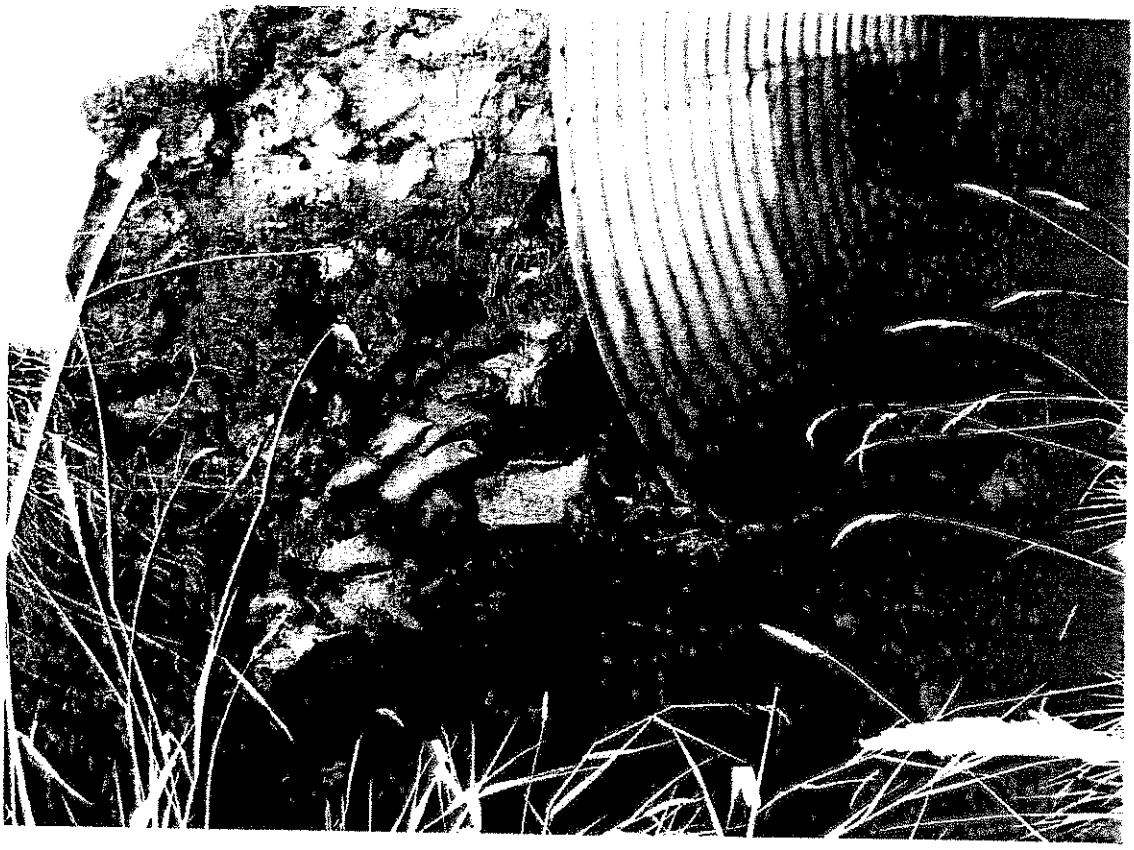


Photo 1 - Southeast corner upstream side. Bagged concrete eroding.



Photo 2 - Looking south from upstream end



Photo 3 - Pitting and rust at upstream end

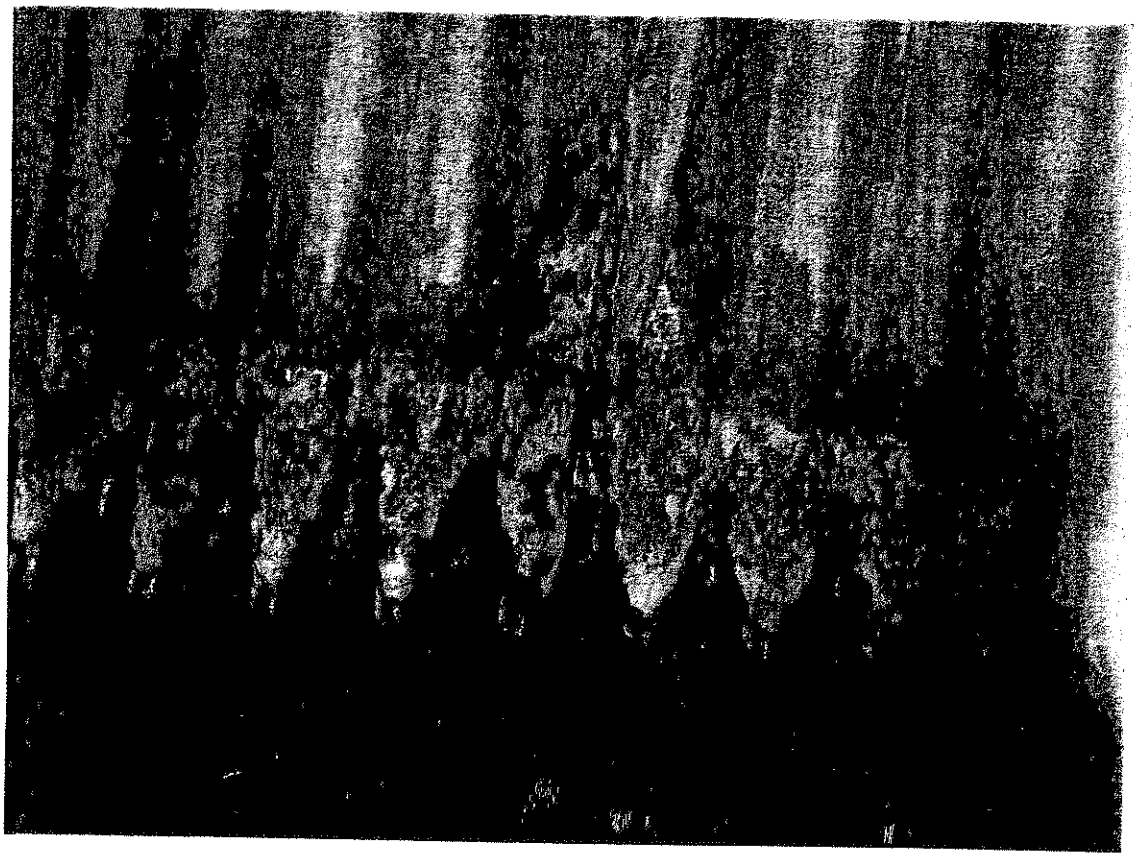


Photo 4

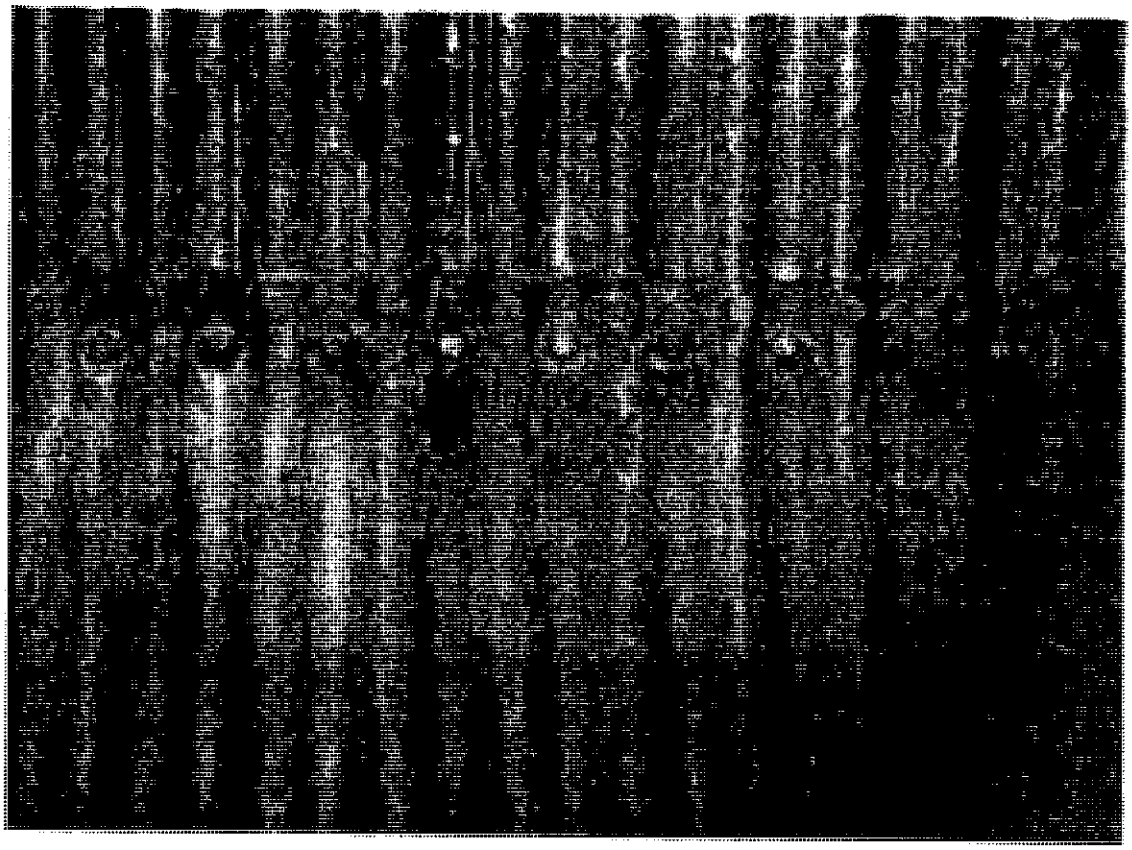


Photo 5 - Ring 7 from downstream north

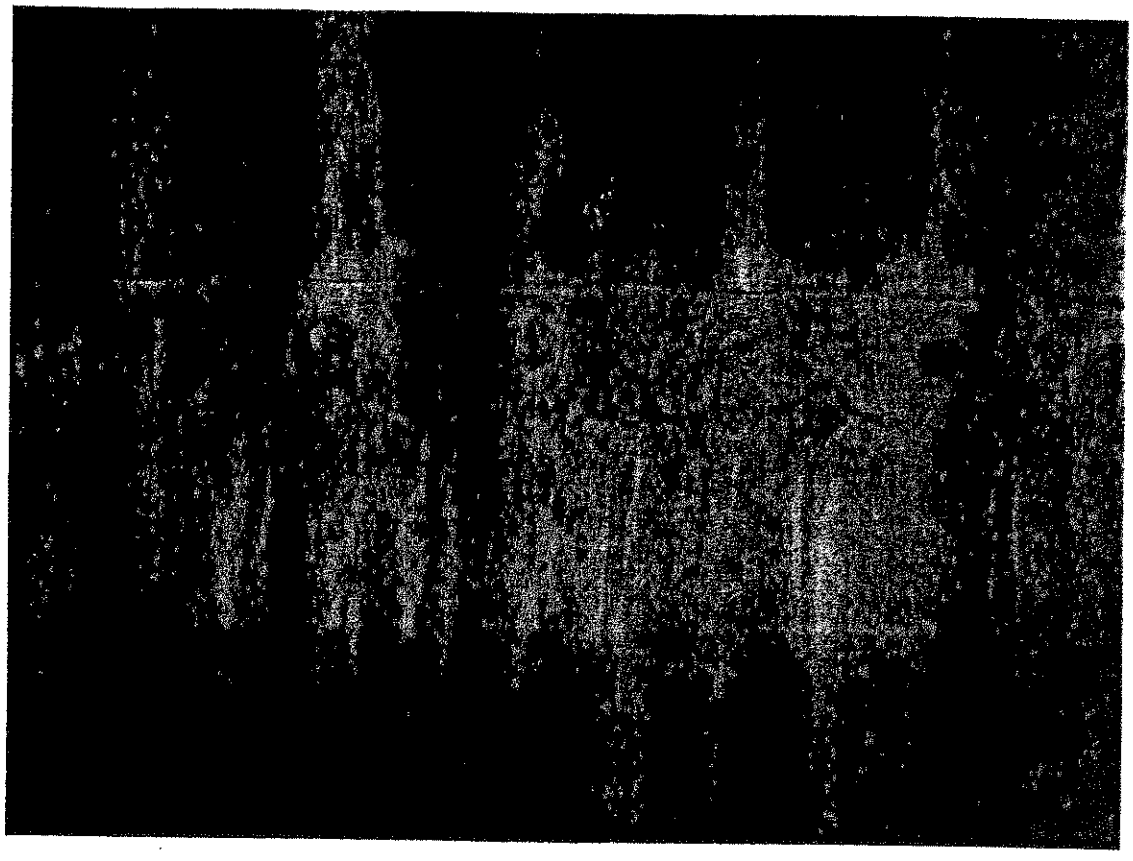


Photo 6 - Ring 5 - 48 mm north span 3810

EXH Engineering Services Ltd.

Bridge File 537
Inspector: Aime Theroux
November 10, 2005

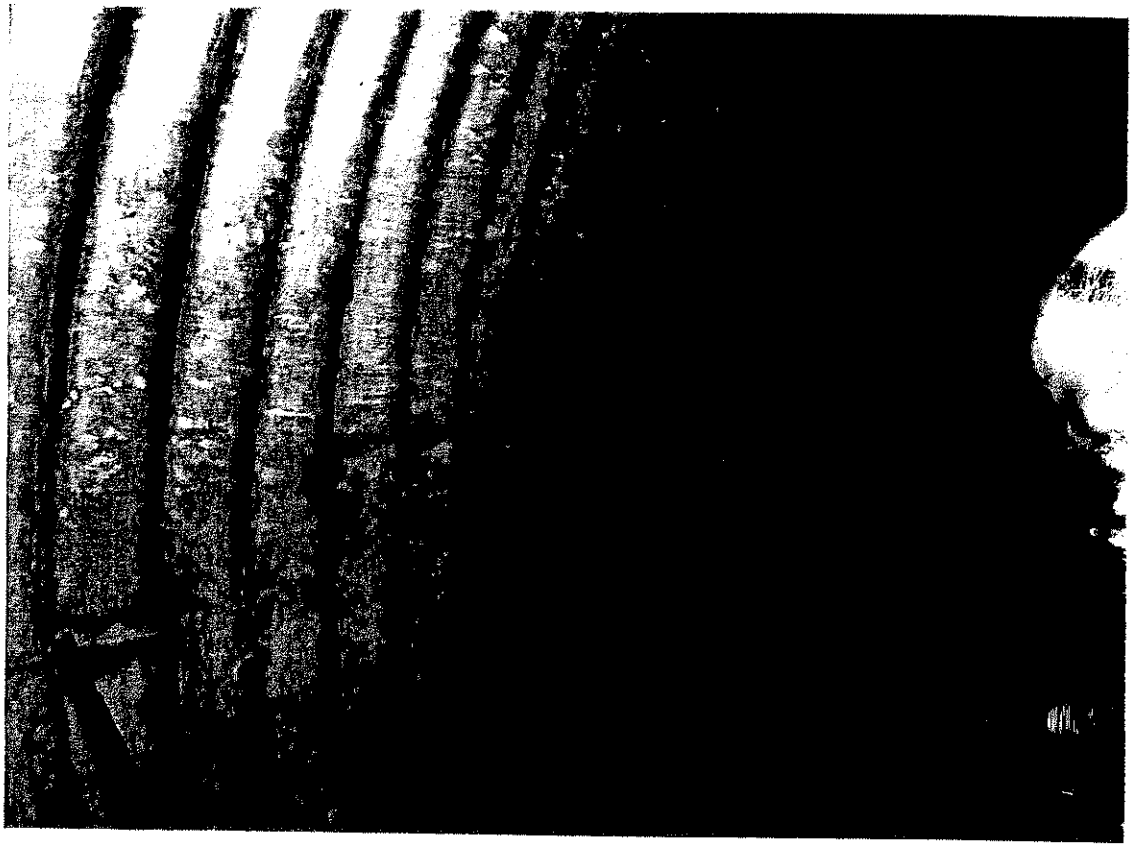


Photo 7 - Ring 3 from downstream - seam moving on south side

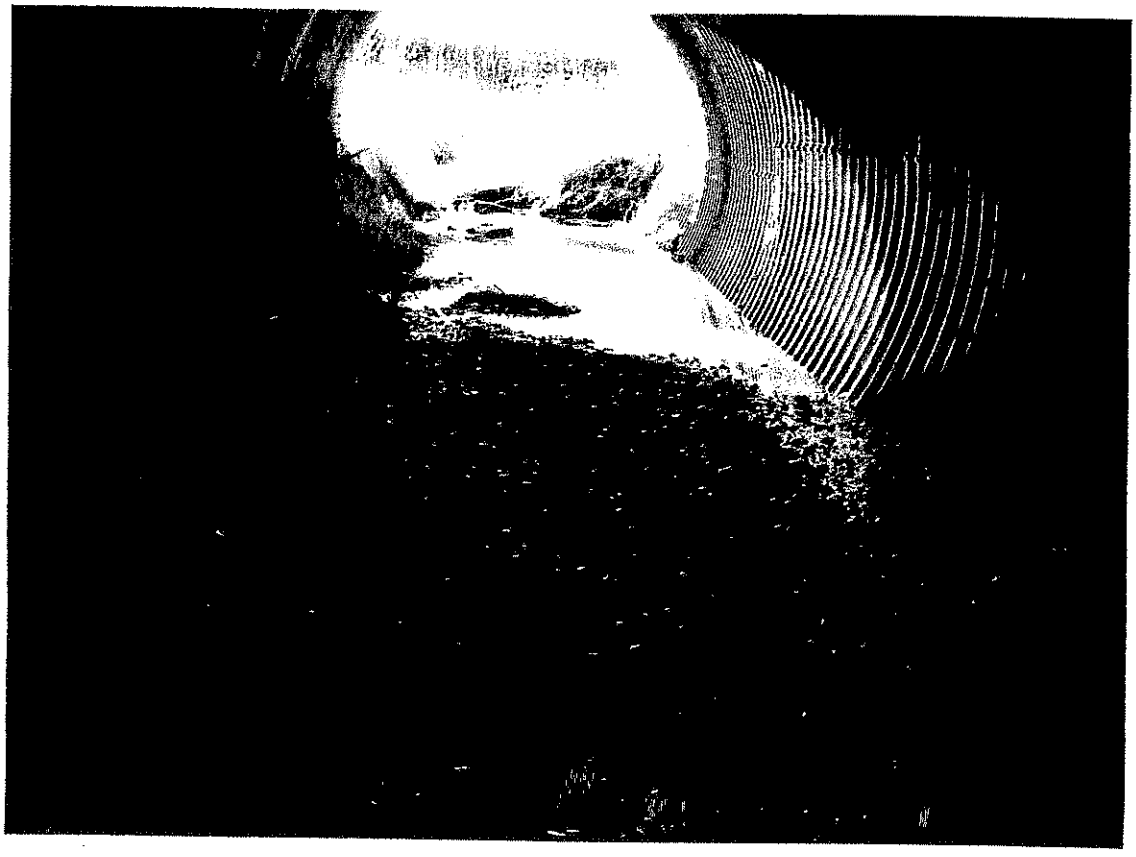


Photo 8 - Looking at silt at downstream end

EXH Engineering Services Ltd.

Bridge File 537
Inspector: Aime Theroux
November 10, 2005



Photo 9 - Hole rusted through downstream bevel

Culvert Inlet (North side of Twp Rd 510)
3.7 m Diamter, 39.6 m Long, Built in 1978
25° LHF Skew to Twp Rd 510

Intersection of Twp Rd 510 and Range Road 244 - Looking South. Culvert begins at North East corner of intersection and extends Southeast under the road.





Road Signage



Damaged guardrail on south side of T-Intersection



Culvert Inlet – Riprap slope protection to right, bagged concrete slope protection to left of barrel



Irvine Creek – Looking upstream from culvert inlet



Culvert Inlet



Culvert barrel looking north – Note pit run on floor (may be coming up from below)



Barrel – Showing sidewall deflection



Outlet



Leduc County

Assessment Options and Life Cycle Cost Summary

Escalation Rate : 4%

Analysis Period : 50 years

Starting Year : 2008

ASSOCIATED ENGINEERING

REVISION DATE: February 11, 2008

Note: Bridge Replacement costs based on ***Span length x Clear width x $4,000/m^2***
Culvert Replacement costs based on ***Invert length x Circumference x $2,000/m^2***
Cost estimates are ***Class 'A' accuracy [+/- 20%].***

		EXPENDITURE YEAR											EXPENDITURE	NET PRESENT
		2008	2011	2018	2022	2028	2033	2038	2043	2048	2053	2058	(current dollars)	VALUE
BF 00537	**Irvine Creek Culvert**													
	Option 3a - Replace with culvert in 2012													
	Removal and disposal of existing culvert		$11,500.00										$11,500.00	$10,223.46
	Construction of new culvert (75 m long x 3.7 m diameter)		$1,744,000.00										$1,744,000.00	$1,550,409.65
													$1,755,500.00	**$1,560,633.11**
	Option 3b - Replace with culvert in 2017													
	Repairs to existing culvert	$35,000.00											$35,000.00	$31,114.87
	Removal and disposal of existing culvert		$11,500.00										$11,500.00	$7,768.99
	Construction of new culvert (75 m long x 3.7 m diameter)		$1,744,000.00										$1,744,000.00	$1,178,183.91
			$1,755,500.00										**$1,790,500.00**	**$1,217,067.77**
	Option 3c - Replace with bridge in 2012													
	Removal and disposal of existing culvert	$11,500.00											$11,500.00	$10,223.46
	Construction of new bridge structure (21 m span x 26 m wide)	$1,893,000.00											$1,893,000.00	$1,682,870.11
													$1,904,500.00	**$1,693,093.57**
	Option 3d - Replace with bridge in 2017													
	Repairs to existing culvert	$35,000.00											$35,000.00	$31,114.87
	Removal and disposal of existing culvert		$11,500.00										$11,500.00	$7,768.99
	Construction of new bridge structure (21 m span x 26 m wide)		$1,893,000.00										$1,893,000.00	$1,278,842.97
													$1,939,500.00	**$1,317,726.83**

B-2A

C—Calgary Creosoting
E—Edmonton Creosoting
M—Manchester Yard
Mc—McLeod Yard
S—Scona Shops

BRIDGE AUTHORIZATION

File 537

Date July 11/57

Vote 2204, 3-2

To Mr. A. Hawkins, Secretary-Treasurer,

Address M.D. #3, Sherbrooke, 10126 - 81 Ave., EDMONTON.

You are hereby authorized to ~~Construct~~ ~~Reconstruct~~ ~~Repair~~ Install Pipe

Bridge File 537 located SW Sec 4 Tp 53 Rg 24 Mer 4

Location from nearest town 4 miles south of Kleraile

Stream Irvine Creek Highway District M.D./I.D. #3 District 5

Bridge Type Existing 1-20' treated timber

Spans and Lengths To be 96" 10 ga. SPCIP x 80' 82 Roadway 24'

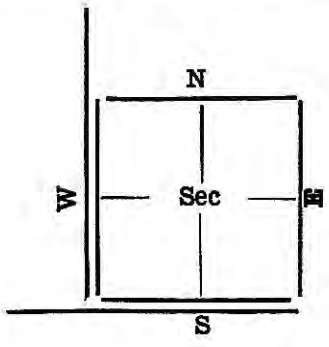
Material on Order § P-130 Date

To be shipped via Supplier's Truck Date

Delivery to Site

Instructions Install pipe on 25° skew LHF at existing bridge site. Make a small stream diversion just upstream from bridge to bring the water in to the pipe. Length of pipe based on a 15' fill with a 28' top and 2:1 slopes.

Mark location with X



HOA/JH

Signed

Date July 11th, 1957.

Bridge Completed

HRBF 11

DEPT. HIGHWAYS B ridge Branch

STOCK AT

TO Rosco Metal Products Ltd.,

11031 - 106 Avenue, EDMONTON.

ORDER NO. P-130

FILE NO. 537 A

CAR NO.

COMMITMENT NO. 2104 B-2

GOVERNMENT OF THE PROVINCE OF ALBERTA
DEPARTMENT OF HIGHWAYS

EDMONTON. July 11th, 1957.

PLEASE SHIP TO site c/o Secretary-Treasurer M.D. 83, SOUTH EDMONTON for bridge replacement SSW 4-51-24-4, 4 miles south of Ellerslie.

THE FOLLOWING BILL OF MATERIAL:

1 - only 96" 10 ga. 5% elongated SPCIP x 90' 22' invert length

Step bevel both ends at 2:1

P.A. 378503
Requisition B-07854

CONFIRMATION (PHONED)

HGA/JM

Rosco Invoice 1403.

MD83

537

96' pa

Note to File 537 SSW 4-51-24-4.

The installation of 1-96" SPCIP x 94' invert length was inspected September 17, 1957.

The pipe was placed in 15' fill, 28' top and on 35° LHF. The side slopes are steep - 1:1 or less.

Sand Cement rip-rap was well placed.

The struts are still in place and the compression caps are only of 2" material.

Channel well cleaned upstream but is full of drift downstream.

There is a 1' drop along pipe.

This is a good installation except for steep side slopes.

GRMc/JM

entered

~~DTH~~ 531

County of Strathcona No. 20

2001 - SHERWOOD DRIVE
SHERWOOD PARK, ALBERTA
T8A 3W7
TELEPHONE 464-~~3443~~
2111

Our File #PW 1030

February 24, 1978

Mr. F. C. Harvey, P. Eng.
Chief Bridge Engineer
Alberta Transportation
9630 - 106 Street
EDMONTON, Alberta

Dear Sir:

RE: Bridge File 537, S/SW 4-51-24-4

It has been brought to our attention that there is a steep embankment which is a hazard at the intersection at the southwest corner of SW 4-51-24-4. Several south bound cars have failed to stop at the "T" intersection and have slid over the bank on the south side of the correction line. The steep embankment in the northeast quadrant has also been a problem.

I would appreciate it very much if you would have someone look at this situation and advise if the cost is warranted to extending the culvert to the southwest and to the north east in order to provide flatter sideslopes.

Yours truly,

COUNTY OF STRATHCONA #20

Tom McGreer, P. Eng.
COUNTY ENGINEER

TM/ndd



Please acknowledge

537

Phone: 427-6911

May 10, 1978

Mr. J.C. Masson
Secretary Treasurer
County of Strathcona, No. 20
2001 Sherwood Drive
SHERWOOD PARK, Alberta
T8A 3W7

ATTENTION: MR. TOM MCGREER

Dear Sir:

Re: File 537, SSW 4-51-24-4
Local Road over Irvine Creek

The above mentioned location was inspected as per the request of the County. The existing 96" SPCMP is in good condition but is hydraulically inadequate and requires an extension.

As discussed with Tom McGreer, May 9, 1978 we propose to supply 1-144" SPCMP x 130' invert length. The 130' invert length is based on 24' roadway, 15' of fill, 4:1 3:1 sideslopes and 25° LHF skew.

Please advise this office of Council's comments and decisions regarding the above. It should be noted that upon approval culvert delivery will take 8 weeks.

Sincerely,

Randy Shalagan
Resident Bridge Engineer

for

F.C. Harvey, P. Eng.
CHIEF BRIDGE ENGINEER

RMPS:de

cc - Mr. B. Wells
District Transportation Engineer
- Mr. S.S. Takhar
District Bridge Engineer

Alberta
HIGHWAYS AND TRANSPORT
Office of the Chief Bridge Engineer

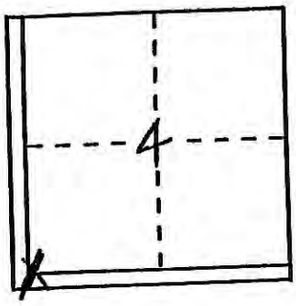
Form B-30

BRIDGE REPORT

Bridge File No. 537
MD. ID. County 20
District 7
Region 6
Date 18-4-78
Inspected by R Shalagan

Bridge known as _____ over IRVINE CREEK

Location SSW Sec. 4 Tp. 51 R. 24 W. 4 th M.



Location from nearest town or P.O. 4 Miles South of
0.1 Miles East of Ellerslie

Type of road and width oiled 24'

Density and type of traffic heavy local

Can bridge be eliminated by road diversion? no

by creek diversion no (sketch inside)

Note: overhead wires, pipelines, etc. POWER ON N side of R/W

EXISTING BRIDGE (Note timber treated or untreated)

Timber _____

Steel 96" SPCMP x 90', 10 gauge

Concrete _____

Number and lengths of spans _____ Clear Rdy. _____ Skewed _____

Panel lengths _____

Top of deck above stream bed _____ Depth of fill at abuts. _____

Substructure (piles, concrete, etc.) _____

Topdeck _____ Subdeck _____

Wheelguard _____ Handrail _____

Stringers _____

Caps and corbels _____

Sheathing _____

Floor beams _____

Nailing strips _____

Type of expansion joint and relative position _____

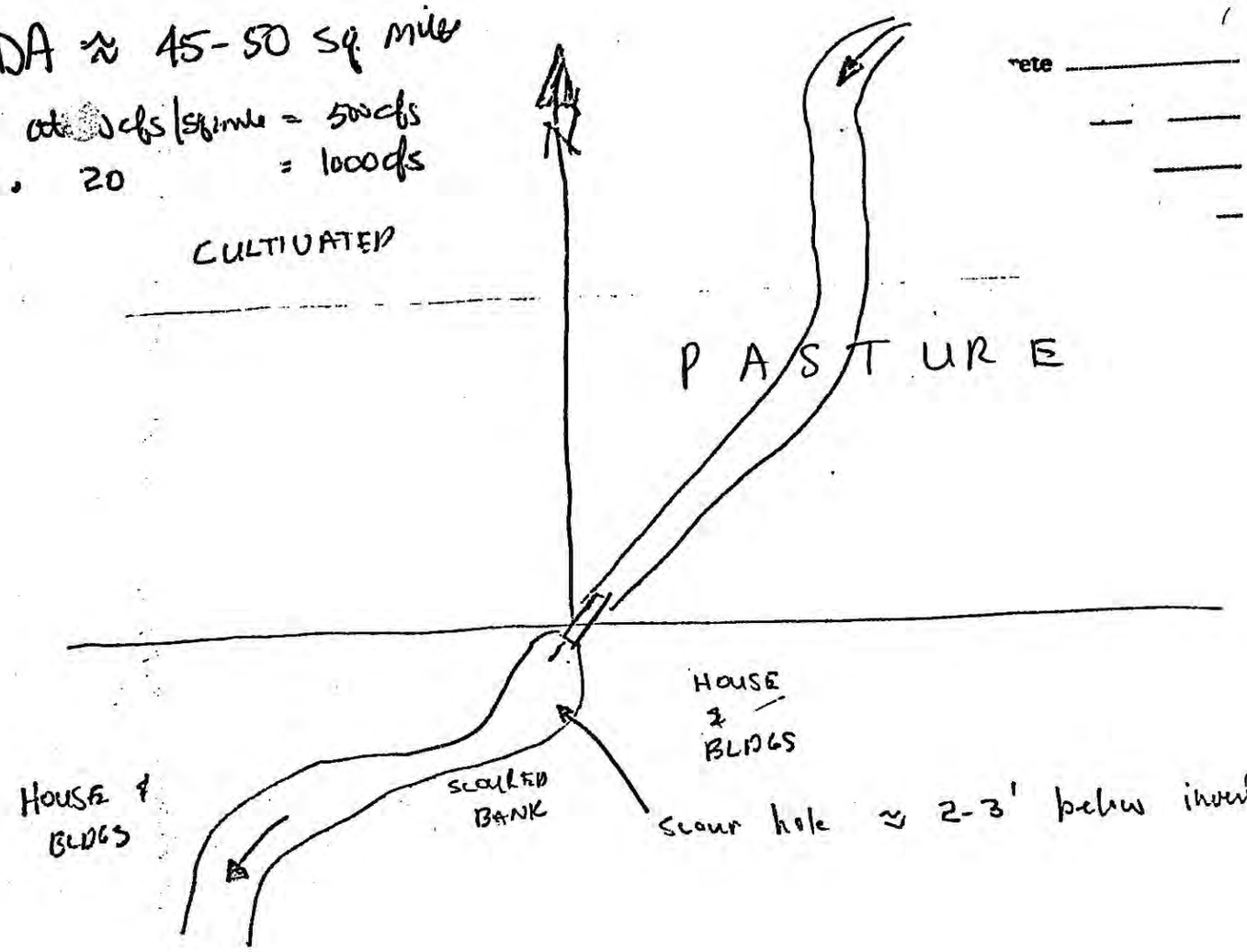
Condition of paint, color _____

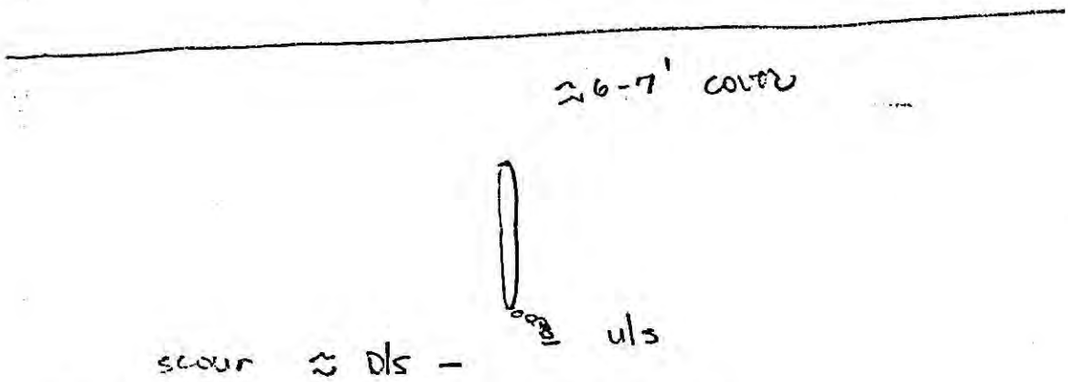
Overall condition Good

DA ≈ 45-50 sq mile

~~100~~ cfs/sq mile = 500 cfs

20 = 1000 cfs

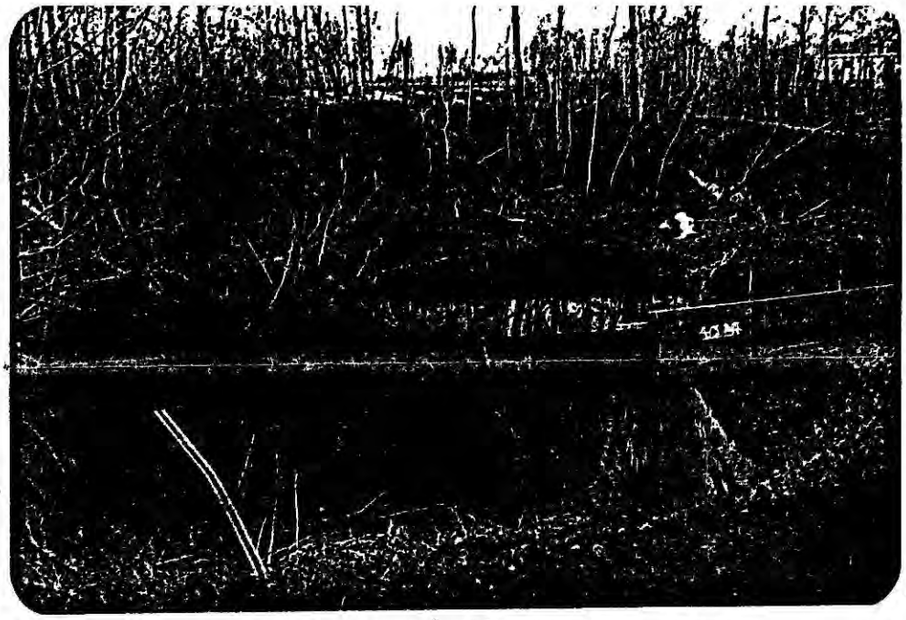




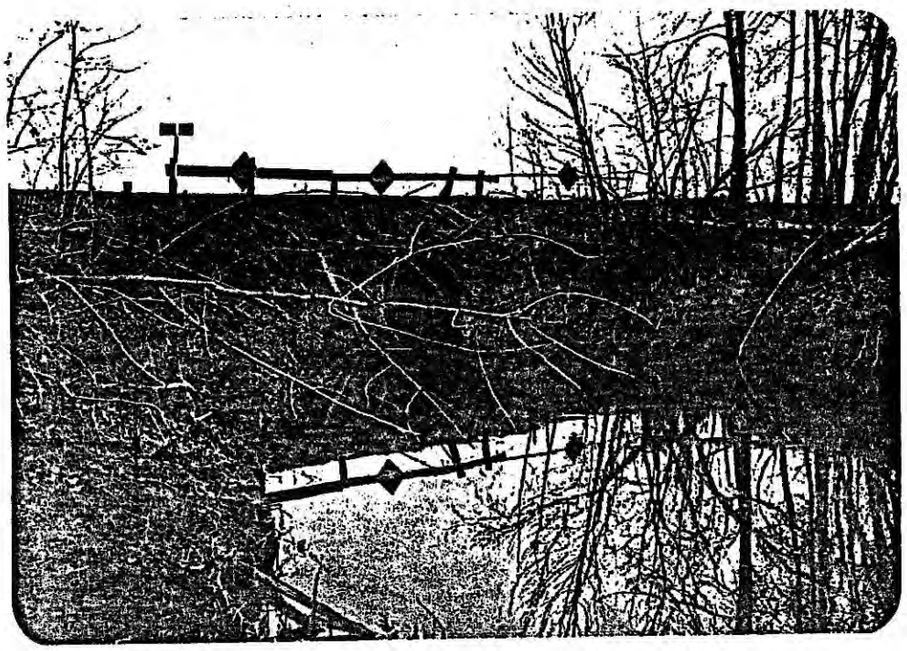
→ Installed 1957, 25° LHF skew

$\ell = 90'$ based on 15' fill, 25' top &
2:1 sideslopes

(for 3:1 sideslopes $\ell = 100'$ for 30° skew $\ell = 120$



LOOKING SOUTH AT D/S END



LOOKING NORTH AT D/S END

ALTERNATIVES

1. Extend existing culvert 16' each side
   COST $ 5,000 Q ≈ 340 cfs.; with 6' Head Q ≈ 1000 cfs
2. Ryran with 144" SAxx x 130' I.L.
   MAT ≈ $18,000, CMNT $11,700 ≈ $30,000 TOTAL
   Q ≈ 1000 cfs

- Recommend alt (2)
- Discussed with Tom PK office May 9/78, advised Council how to vote on proposal

CULVERTS

Timber _____ Steel _____ Concrete _____

Size _____ Length Top _____ Bottom _____

Condition _____

FLOW CONDITIONS

Does existing structure carry entire high water flow? _____

Indicate high water in feet above or below top deck at least 1' above pipe

Nature of stream channel: type of banks well defined

Stream bed at proposed site organic

Character of drainage area: (level), rolling, wooded, (cultivated)

Describe scour if any D/S banks

Advise if drift ice or drift will permit pile bent in stream channel. some drift but minor

Note if stream spring fed and height to which ice builds up no

Maximum c.f.s. and rate of flow _____

Pondage (up and downstream) U/S

Give location, size, type of any culverts, bridges, or other flow restrictions on this stream

1 mile U/S, Fill 1139 1-20' RC/TT

1 mile D/S, Fill 5472 1-20' RC/TT

1.5 miles D/S, Fill 300 3-28' RC/TT

3.6 miles U/S, Fill 329 1-30' RC/TT, SA 814; 32 sq miles; Q = 640 cfs

RECOMMENDATION based on 24' top, 3:1 slope & 8' of cover

Construct _____ Reconstruct 130' of Culvert 4 spans Repair _____

Size, type, wings _____ Skew _____

Height of top deck above stream bed _____

Depth of fills at abuts. _____

When required _____

Road or stream diversions _____

Details of repairs and material required _____

Preferred shipping point _____ R/R _____

Type and condition of haul roads _____

OFFICE USE ONLY

Date existing bridge built _____ By whom _____ Pile penetration _____

Recommended structure _____

Date _____ Engineer _____ Approved _____

Action taken _____

B-2A/77

File 637

Date June 26, 1978

Job U682T

Element A5300

Primary Code

Budget Code K

Elect. Code 22

Work Class R

Struct. Type 2

BRIDGE AUTHORIZATION

To Mr. J. C. Hasson, Secretary Treasurer

Address County of Strathcona, No. 20
2001 Sherwood Dr., SHERWOOD PARK, Alberta T8A 3W7

Region 5

Your are hereby authorized to: ~~Construct~~ ~~Reconstruct~~ ~~Repair~~ Install Culvert ~~Prel. Eng.~~

Bridge Located SSW Sec. 4 Tp. 51 Rg. 24 Mer. 4

Location from nearest town 1 mile east, 4 miles south, 1 mile west of Ellerslie

Stream Irvine Ck. Highway Local ~~Municipality~~/Cnty. 20 District 7

Existing Structure 1-96" SPCMP x 90'

Proposed Structure 1-144" SPCMP x 130', 25° LHF

Roadway height above streambed 15 Clear Roadway 24

Material on Order § (1) P-91 (2) JY 0440 (3) (4)

Trucking Orders (1) (2) (3) (4)

Instructions The existing culvert is in good condition but is hydraulically inadequate. Supervise the installation of 1-144" SPCMP x 130' as per Std. Drawing S-1086 and the following instructions. Remove and salvage the existing culvert. Place the 144" SPCMP at the site of the existing culvert on a compacted granular bed and provide clay seals and rock rip-rap end protection as provided in Std. Drawing S-1086. The upstream invert is to be placed 3' below streambed and the downstream invert 1' lower. Backfill around the culvert should be pit run gravel to be placed 9' on each side of the culvert and filled to a height 6' above the invert of the pipe to ensure a proper installation. The 130' invert length is based on 24' clear roadway, 15' of fill, 3:1 sideslopes and 25' LHF skew.

Installation Grant - $11,700

Authorized by

Section Head

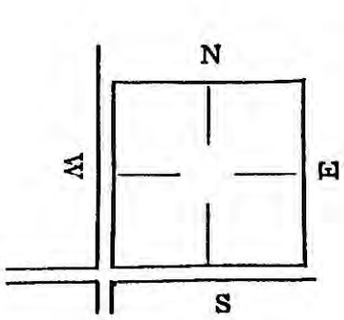
Telephone 427-6911

Chief Bridge Engineer

Est. Cost $30,000 Actual Cost

RMPS:lr
cc - Mr. R. Thornton
Eng. Department,
City of Strathcona

Mark location with X



Bridge Started

Bridge Completed

Foreman's Signature

SIGN AND RETURN THIS COPY
WHEN WORK COMPLETED

77-C-20 (537)

Phone: 427-6911

August 18, 1978

Mr. J.C. Masson
Secretary Treasurer
County of Strathcona, No. 20
2001 Sherwood Drive
SHERWOOD PARK, Alberta
T8A 3W7

ATTENTION: STAN TURNER

Dear Sir:

Re: Installation of 144" SPCMP
File 537, SSW 4-51-24-4

As requested please find enclosed one copy of Drawing S-1418, Culvert Installation Procedure for CMP and SPCMP and one copy of specifications for Rip-Rap and Installation of Large Metal Culverts.

Please note that for the above mentioned culvert installation at File 537 it is recommended that the quantity of rip-rap should be 75 cubic meters of Class I and 95 cubic meters of Class II.

Please contact the undersigned if there are any questions.

Sincerely,

Randy Shalagan
Resident Bridge Engineer

for

F.C. Harvey, P. Eng.
CHIEF BRIDGE ENGINEER

RMPS:de

cc - Mr. S.S. Takhar
District Bridge Engineer

Encl.

George Vincent
Bridge Services Engineer
Regional Transportation Services

537

Mr. Mr. Frank Kimura
Commodity Manager
Purchasing Branch
19th Floor, Park Square

November 28, 1978

427-6911

Extension to Culvert Order P-91
File 537, SSW 4-51-24-4
Requisition JY 0440
Job Number U682T

As discussed on November 28, 1978 the County of Strathcona requires an additional 12' of 144" diameter SPCMP, 5% ellipsed, 10 gauge with square ends as an extension to material ordered on culvert order number P-91.

Please consider this an extension to the previous order. The original supplier, Armco, has been contacted and is prepared to supply the additional culvert material at the same price as the culvert material previously ordered. We require this material as soon as possible to be delivered to the same site as indicated on the original culvert order No. P-91.

Your assistance in this matter is greatly appreciated.

Randy Shalagan
RESIDENT BRIDGE ENGINEER

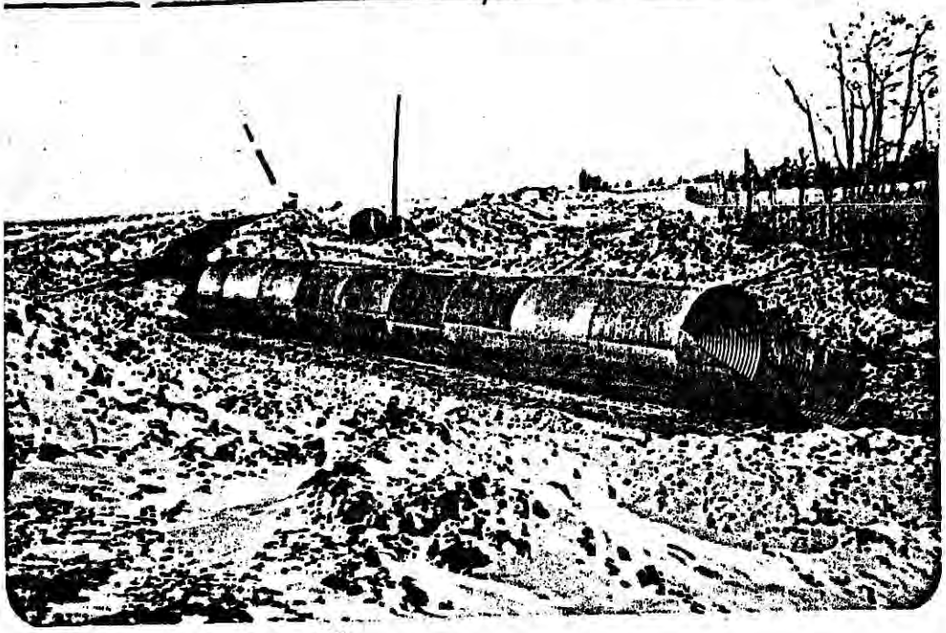
RMPS:de

cc - Mr. H.M. Alton
- Mr. W. Hamilton

3-3050

Alberta
TRANSPORTATION
Bridges

? Fle 537 , 144" SPCMP x 130' I.L.



LOOKING EAST
ALONG R/A

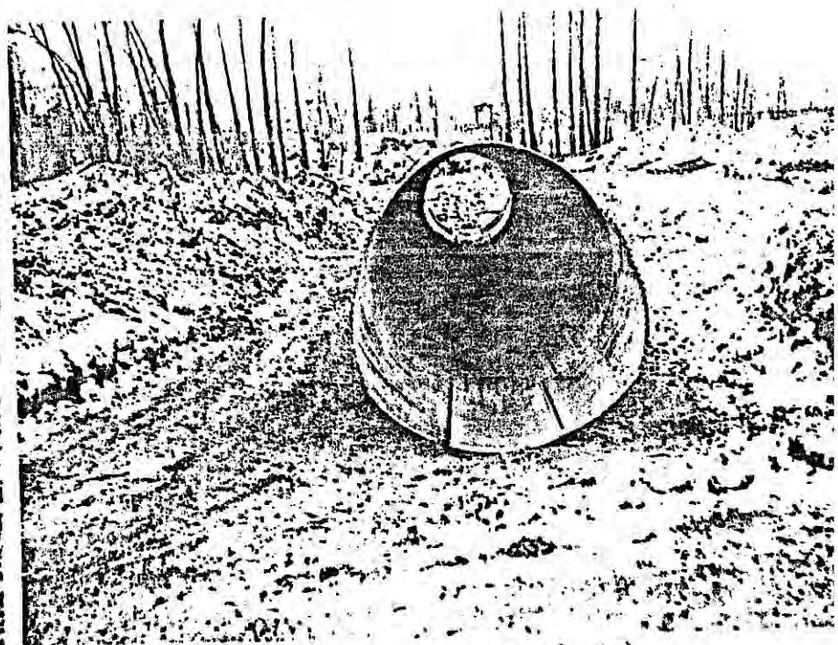
78-11-27
Advised P.U.S. RONALD THORNTON OF SITUATION
Randy Hodge

78-11-28
- discussed site with Cnty. engineer Stan Turner, decide best alternative would be to extend west 12' on D/S end. Contacted Alunco & Purchasing re-cost; same price, delivery 5 weeks
Rod.

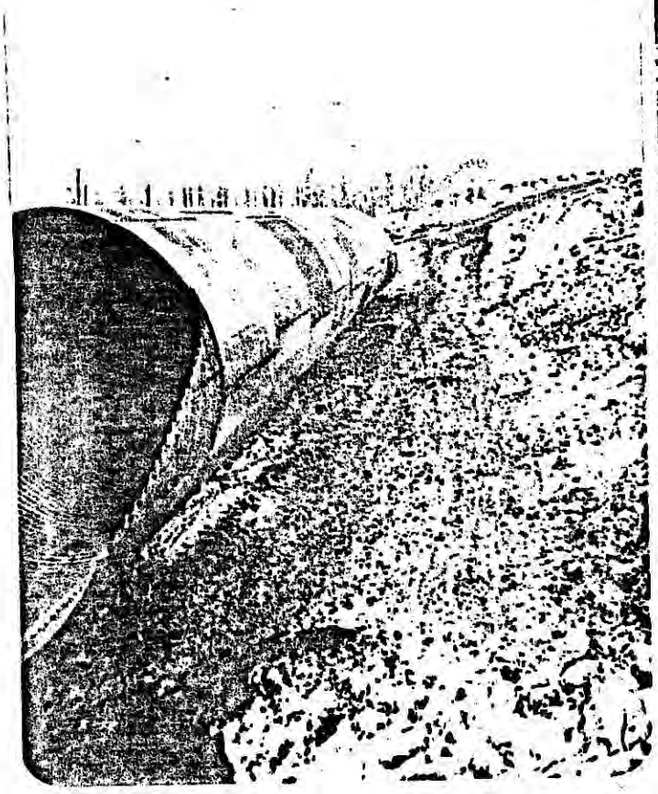
LOOKING WEST
ALONG R/A

NOTE - WEST BYPASS TO HAVE BEEN INSTALLED TO FAR NORTH





LOOKING SW (D/S)



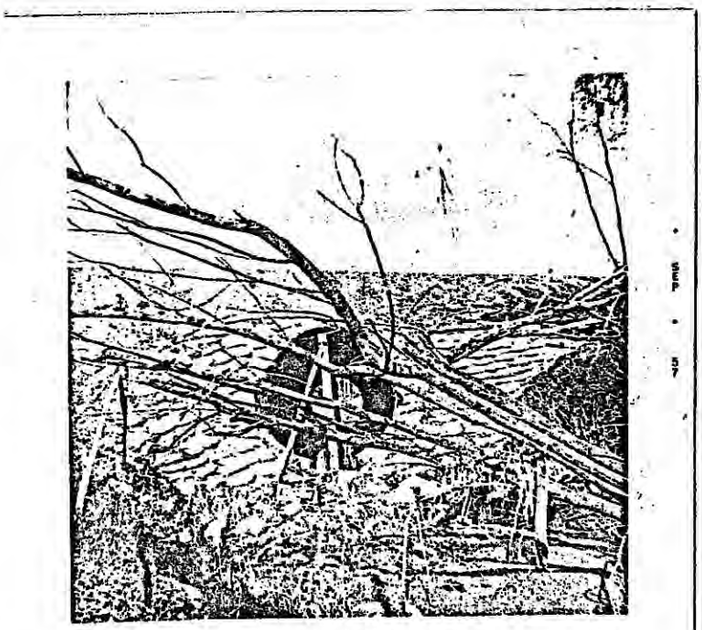
LOOKING NE (U/S)

By R Hodge
Date 78-11-21
File 537
Page 1

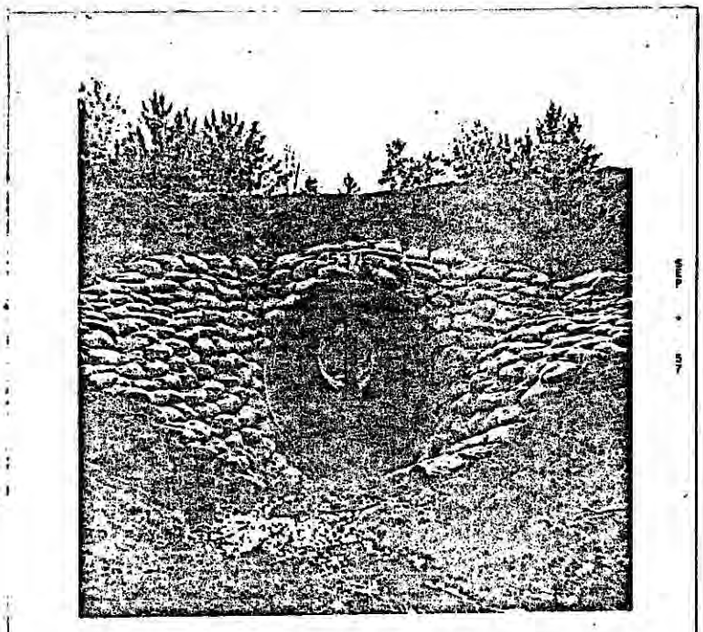
Sep 157.



Upstream End. North side of Road.



Downstream End



Upstream End.

Surveyors
Engineers
Planners
Consultants
Land Services

STEWART, WEIR & Co.

11405 - 163rd Street
Edmonton, Alberta T5M 3Y3
Tel. (403) 451-6465

A. G. STEWART, (1886-1976)
* C. H. WEIR, M.SC., C.L.S., A.L.S., S.L.S., P.ENG.
J. B. STEWART, B.SC. (RETIRED)
* R. J. WATSON, A.L.S., P.ENG.
* B. J. DIXON, A.L.S.
V. VOSS, A.L.S., S.L.S.
J. G. SUMYK, SUPERVISOR
A. RECZKA, SUPERVISOR
R. McGAFFIN, A.L.S.
R. F. ANDREWS, P.ENG.
C. W. YOUNGS, A.L.S., C.L.S.
A. C. HEINRICHS, A.L.S.
J. SHERRITT, M.PL., MCIP
W. A. THOM, P.ENG.
J. T. LEE, P.ENG.
E. J. CHRISTIANSEN, P.ENG.
R. A. GLIDDON, A.L.S., P.ENG.
T. G. JANZEN, P.AG.
D. R. HANSON, S.L.S.
S. L. FOURNIER, P.ENG.
J. ANDREW, M.E.S., MCIP
* - a representative of a corporate partner of Stewart, Weir & Co.

483
736
6949
70063
70064

Our file 6-83-12331

Your file _____

December 20, 1983

Alberta Transportation
P.O. Box 1810
Barrhead, Alberta
T0G 0E0

Attention: Mr. A.E. Assenheimer, P. Eng
Regional Bridge Engineer

Dear Sir:

Re: Blackmud & Irvine Creek Improvements
County of Leduc
Bridge Crossings

Further to our meetings of November 22 and December 16, 1983, we are submitting, for your approval, a complete set of drawings including all changes as discussed in the above mentioned meetings.

Yours truly,

STEWART, WEIR & CO.

J.T. Lee, P. Eng.

JTL:cy

cc: County of Leduc
Attn: Mr. F. Rolof

Alberta Transportation
Attn: Mr. J.G. Ramotar, P. Eng.

NOTE TO FILE

Files: 300, 483, 736, 8949,
70063, 70064, 537

November 22, 1983

Re: Proposed Drainage Improvement
Blackmud Creek, Saunders Lake to
North Boundary of the County of Leduc

A meeting was held this morning in Bridge Services Section to discuss the effects of the above noted proposal on the bridge structures within the reach. In attendance were:

J.T. Lee	-	Project Engineer, Stewart, Weir & Co.
A. Assenheimer	-	Regional Bridge Engineer
T. Belke	-	Bridge Engineering
J. Ramotar	-	Bridge Engineering

Mr. Lee provided the following information:

- The County of Leduc No. 25 engaged Stewart, Weir & Co. to undertake a design that will a) shorten the flood duration in the Blackmud Creek and b) to enable the reach of the creek to accommodate the 1:5 year flood within its banks.

- The project begins just downstream of Saunders Lake and ends at the north boundary of the County of Leduc (approx. 1 km downstream of Hwy. 2 structures). The total length of improvement is about 15 km.

- The project will be funded jointly by Alberta Environment and the County of Leduc, with the latter being the owner and thus responsible for future maintenance.

- The estimated cost of this project is $600,000 with no allowance made for contribution towards possible bridge reconstruction or modification. However, the cost of rock rip-rap at the bridge sites is included.

- Stewart, Weir & Co.'s general solution to the problem is to lower the existing streambed of the creek by up to 1.3 m. Construction of berms was not considered.

- Alberta Environment provided the hydrology and Stewart, Weir & Co. came up with the hydraulics. Apparently backwater due to the constrictions at the bridge crossings is not a problem. Also siltation should not be a problem if construction is as per design. (These are the opinions of Mr. Lee).

- Construction is expected to start soon with completion this winter.

Each bridge crossing was discussed with respect to Stewart, Weir & Co.'s proposal and the following pertinent points were made:

1. File 736 (Airport road)

- extend Class I heavy rock rip-rap 5 m upstream from the upstream side of bridge.
- show skew bridge on plan view.

.../2

2. File 8949 (Nisku Road)

- show skew bridge on plan view.

3. File 300 (9th Street Road)

- Owner (County) should be aware that any excavation to eliminate contraction at bridge crossing in the future is their responsibility.
- at time of bridge replacement, Alberta Transportation will determine most economical bridge length, i.e. if contraction operates well with rip-rap, channel widening may not be required.
- extend rip-rap minimum 7.5 m upstream from upstream side of bridge (10 m upstream and downstream desirable).
- show skew bridge on plan view.

4. File 483 (Boundary Road)

- Existing bridge was constructed in 1957. It is in good condition; one of the piers is heaving a little. Estimate 1/3 life is left.
- Proposal requires about 2 m excavation at the piers. This will likely leave the piers in a precarious state, i.e. no fixity and unsupported length exceeding our standard by about 1 m.
- Alternatives a) construct new bridge at an estimated cost of $150,000 with 1/3 (50,000) contribution from the County b) try to underpin and strengthen piers with total cost paid by County. Alternative #a is recommended for consideration at this time.
- Since backwater is not a problem, Alberta Transportation to determine most economical solution for bridge replacement, i.e. short bridge with rip-rap or long bridge without rip-rap.
- If new bridge, construction should be scheduled for winter 1984. Could leave channel under bridge unexcavated and don't rip-rap headslope until winter 1984.
- If bridge is retained, extend rip-rap upstream - same as File 300.

5. File 70063 & 70064 (N & S bound - Hwy. 2)

- In addition to these structures there are 2 pipeline crossings that indicate minimum excavation is desirable. It appears that excavation can be reduced significantly by modifying design. Mr. Lee will review this, and he will also check the discrepancy in the survey information.
- At File 70063 excavation should not exceed EL 687.0; entire streambed should be rip-rapped, flatten sideslopes from the proposed 1.3 to 1; ultimate waterway area after excavation and rip-rap should not exceed the area of the horizontal ellipse located downstream; excavation adjacent to and under structure may have to be in stages, depending on final design section.

.../3

5. File 70063 & 70064 (N & S bound - Hwy. 2) continued....

- At File 70064 (H.E. southbound) Mr. Lee to confirm streambed profile in vicinity of structure; if profile is as shown on plans, will require approximately 10 m rock rip-rap apron and bank protection on the upstream end of culvert.

6. File #537 (Irvine Creek Bridge)

- OK

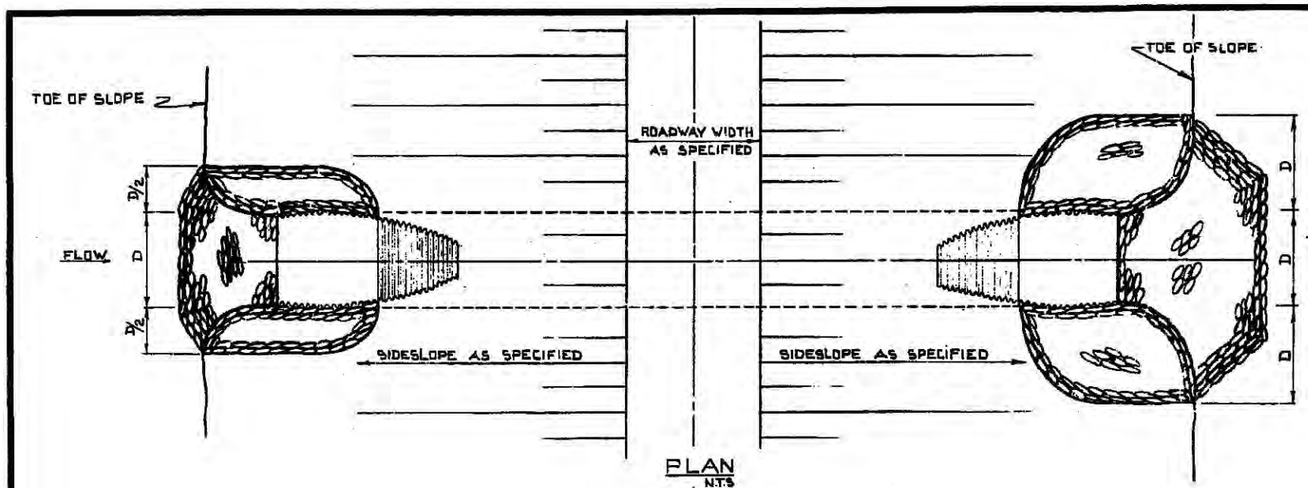
Conclusion

Mr. Lee will consider our comments and concerns, and obtain additional information as required. He will then set up another meeting with Alberta Transportation.

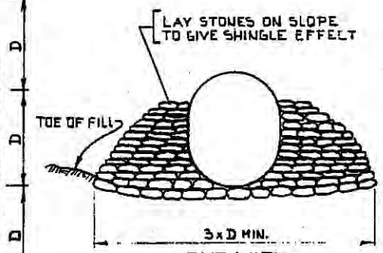
Jay G. Ramotar
Bridge Services Standards Engineer

JGR:don

cc - Arnold Assenheimer
- Ted Belke
- G.M. Mazurek (Attn. R. Walters)

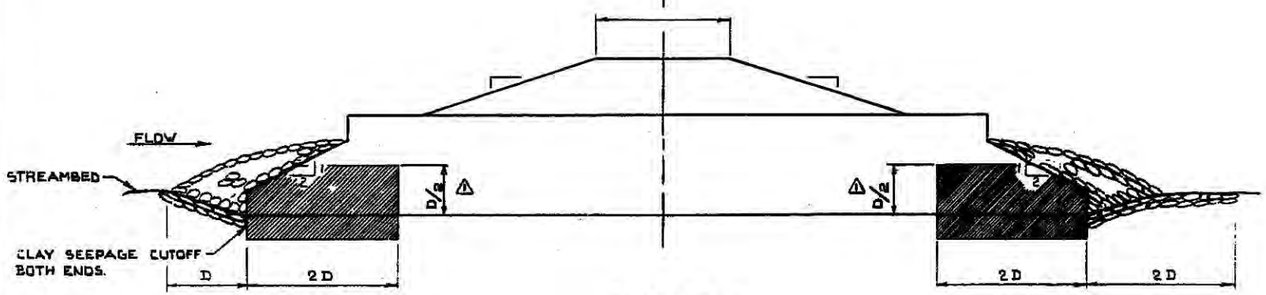


PLAN
N.T.S

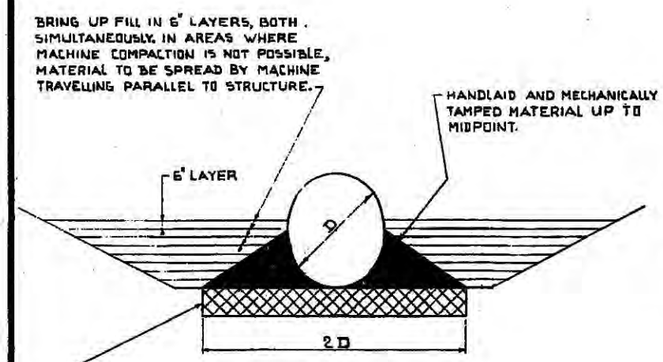


END VIEW
N.T.S.

GRADING OF ROCK SIZES
90% GREATER THAN 50 LBS.
50% GREATER THAN 75 LBS.
MAXIMUM SIZE 200 LBS.



ELEVATION
N.T.S.



BACK FILL DETAILS
N.T.S.

BACKFILL

1. BACKFILL MATERIAL TO BE AT OPTIMUM MOISTURE CONTENT. WET MATERIAL SHALL NOT BE USED.
2. BACKFILL MATERIAL SHALL BE READILY COMPACTIBLE SOIL OR GRANULAR MATERIAL. NO FROZEN SOIL, BOULDERS OR HIGHLY COMPRESSIBLE MATERIAL SHALL BE USED FOR BACKFILLING IN THE VICINITY OF THE STRUCTURE.
3. ALL MATERIAL GREATER THAN 2" SHALL BE REMOVED FROM ADJACENT TO CULVERT.
4. BACKFILL SHALL BE PLACED AND COMPACTED WITH CARE UNDER HAUNCHES OF THE PIPE TO ENSURE THAT IT IS IN FIRM AND INTIMATE CONTACT WITH THE ENTIRE BOTTOM SURFACE OF THE STRUCTURE. RAISE THE FILL EVENLY AND SIMULTANEOUSLY ON BOTH SIDES OF THE CULVERT TO THE MID HEIGHT OF THE CULVERT FOR ITS ENTIRE LENGTH. ROLLING OF THE STRUCTURE MUST BE AVOIDED.
5. MECHANICAL COMPACTION REQUIRED IN ALL AREAS WHERE NORMAL ROAD EQUIPMENT CANNOT WORK.
6. EMBANKMENT WITHIN 1 DIAMETER OF PIPE SHALL BE COMPACTED TO 100% PROCTOR DENSITY.
7. CLAY SEEPAGE CUTOFFS SHALL BE MAINTAINED UP TO MIDHEIGHT OF CULVERT, 2 DIAMETERS IN LENGTH.
8. BECAUSE METAL PIPES ARE FLEXIBLE, THEIR STRENGTH AGAINST SQUASHING DEPENDS ON CAREFUL BACKFILLING. AS THEY DEFLECT UNDER VERTICAL LOAD THEY MUST BUILD UP SIDE SUPPORT, THEREFORE, TO OBTAIN MAXIMUM LOAD BEARING CAPACITY, IT IS NECESSARY THAT THE BACKFILL UNDER AND BESIDE THE PIPE BE OF GOOD MATERIAL, CAREFULLY PLACED AND COMPACTED.
9. HEAVY CONSTRUCTION EQUIPMENT SHOULD NOT BE ALLOWED TO PASS OVER THE STRUCTURE UNTIL 2' OF COMPACTED COVER HAS BEEN PLACED.

ROCK RIP-RAP

VOLUME (CUBIC YARDS OF CLASS 1 MATERIAL)

PIPE DIAMETER (INCHES)	INLET	OUTLET
60	4 (cu. yds.)	10 (cu. yds.)
72	8	15
84	10	20
96	10	25
108	15	30

FOUNDATION PREPARATION

1. ESTABLISH LOCATION OF CULVERT AS PER INSTRUCTIONS OF BRIDGE AUTHORIZATION. LOCATE CULVERT SO THAT WATER HAS REASONABLY STRAIGHT ENTRANCE AND EXIT FROM CULVERT.
2. THE EXCAVATION FOR PLACING THE PIPE SHALL GENERALLY HAVE A WIDTH AT THE BOTTOM OF NOT LESS THAN ONE SCRAPER WIDTH CLEAR ON EACH SIDE OF THE PIPE. WHEN A FIRM FOUNDATION AT THE GRADE OF THE PIPE IS NOT ENCOUNTERED, THE EXCAVATION SHALL BE DEEPENED AND BACKFILLED WITH SUITABLE MATERIAL TO GIVE A FIRM FOUNDATION FOR THE BEDDING. IF EXCAVATION RESULTS IN A FIRM BED THEN ONLY A 6" LAYER OF FILL MATERIAL (CLAY OR SAND) SUFFICIENT TO UNIFORMLY BED THE CULVERT IS REQUIRED. A BED THAT CAN ADEQUATELY SUPPORT CONSTRUCTION EQUIPMENT IS CONSIDERED ADEQUATE TO MAINTAIN THE CULVERT. IF THE CULVERT FOUNDATION INCORPORATES THE STREAMBED, THEN ALL POOR MATERIAL FROM THE STREAMBED SHALL BE REMOVED AND GOOD BACKFILL IMPORTED.
3. WHATEVER THE PROCEDURE NECESSARY TO GIVE A FIRM FOUNDATION, THE COMPACTION OF THE ENTIRE BOTTOM OF THE EXCAVATION SHALL BE UNIFORM AND TO THE EXACT GRADE REQUIRED.
4. BOTTOM OF CULVERT TO BE PLACED $\frac{1}{8}$ DIAMETER BELOW MEAN STREAMBED ELEVATION, OR AS INSTRUCTED ON BRIDGE AUTHORIZATION.
5. IMPERVIOUS CLAY MATERIAL SHALL BE USED FOR FOUNDATION. GRANULAR MATERIAL MAY BE USED FOR FOUNDATION BENEATH CENTRE OF CULVERT IF CLAY IS UNWORKABLE. CLAY SEEPAGE CUT-OFFS AT ENDS MUST BE INSTALLED.
6. AFTER A FIRM FOUNDATION HAS BEEN OBTAINED, PLACE A MAXIMUM 6" LIFT OF LOOSE CUSHION CLAY (SAND IN CENTER ACCEPTABLE) ON BED. (THIS MATERIAL WILL BE FORCED INTO CORRUGATIONS.)

CULVERT ASSEMBLY

1. DETAILED CULVERT ASSEMBLY DRAWINGS SHOWING THE POSITION OF EACH PLATE AND METHOD OF LAP WILL BE SUPPLIED BY THE SUPPLIER WITH EACH STRUCTURAL PLATE CULVERT. NO DRAWING SUPPLIED FOR CMP CULVERTS.
2. STRUCTURAL PLATE PIPE AND PIPE ARCHES SHALL BE ASSEMBLED IN ACCORDANCE WITH THE PLANS AND DETAILED ASSEMBLY INSTRUCTIONS PROVIDED.
3. AFTER FOUR RINGS HAVE BEEN ASSEMBLED, TIGHTENING MAY PROCEED ON FIRST RING AFTER THE VERTICAL AND HORIZONTAL DIMENSIONS HAVE BEEN CHECKED AND ADJUSTED AS REQUIRED TO CONFORM TO DESIGN SHAPE. TEMPORARY PROPS MAY BE HELPFUL TO OBTAIN REQUIRED SHAPE IN FIRST FEW RINGS.
4. TIGHTENING MAY PROCEED ABOUT 3 RINGS BEHIND ASSEMBLY.
5. BOLTS TO BE TIGHTENED TO 150FB-LBS. TO 200 FT-LBS.
6. THE VERTICAL AND HORIZONTAL DIMENSIONS OF THE TIGHTENED SECTION OF CULVERT BARREL SHOULD BE CHECKED EVERY 20 FT. TO ENSURE THAT THE DESIGN SHAPE IS MAINTAINED.
7. IN NO INSTANCE SHALL TIGHTENING PROCEED IF LAPS ARE NOT FULLY NESTED. STRUTTING OR OTHER MEANS SHALL BE USED TO PRODUCE CORRECT DIMENSIONS SO THAT ALL LAPS NEST PROPERLY.
8. ALL BOLTS SHALL BE TIGHTENED AGAIN AFTER ASSEMBLY COMPLETED.
9. TIGHTENING TO START AT BOTTOM AND TO PROCEED UP ON BOTH SIDES SIMULTANEOUSLY.
10. METAL PIPE MATERIAL SHALL BE HANDLED SO AS NOT TO BRUISE OR DAMAGE THE SPELTER COATING. IT SHALL NOT BE DRAGGED ON THE GROUND OR MANIPULATED WITH HEAVY EQUIPMENT WITHOUT PROPER PRECAUTIONS TO PROTECT THE SURFACE.
11. GOOD TIGHTENING PRACTICE WOULD BE TO OPERATE POWER WRENCHES IN PAIRS, ONE ON EACH SIDE OF SEAM. LESS RE-TIGHTENING MAY BE REQUIRED IF BOTH SIDES OF SEAM WORKED SIMULTANEOUSLY.
12. IF STRUCTURE ASSEMBLED AWAY FROM SITE, TIGHTENING SHOULD BE CHECKED AFTER STRUCTURE IS IN FINAL POSITION.
13. IMPROPER NESTING OF PLATES MAY BE INDICATION OF:
    - A. WRONG PLATE AT A SPECIFIC LOCATION.
    - B. INCOMPLETE ASSEMBLY, OR CULVERT HAS NOT BEEN ASSEMBLED TO DESIGN SHAPE. (SEE ITEM #3).
    - C. IMPROPER CURVATURE OF PLATES. (CONTACT BRIDGE BRANCH OFFICE).

① ②

THIS DWG. SUPERSEDES DWG. S-772 & S-921

NO.	DATE	DESCRIPTION	BY
2	82 06 12	CLAY SEAL	T.B.
1			

REVISIONS

APPROVED
CHIEF BRIDGE ENGINEER
DATE July 5/84

PROVINCE OF ALBERTA
DEPARTMENT OF HIGHWAYS AND TRANSPORT
BRIDGE BRANCH

CULVERT INSTALLATION PROCEDURE

DESIGNED	DRAWN BY	DATE	CHECKED BY	DATE	STREAM	LOCATION	HWY. NO.	SCALE	FILE NO.	SHEET	DWG. NO.
E.W.M.	T.S.		G.E.V.	MAR/73						... OF	S-1086

E Appendix E - Cost Estimates

TOWNSHIP ROAD 510

FUNCTIONAL PLANNING STUDY

ROAD FULL DEVELOPMENT SUMMARY

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

Item	Description	Street Sections										Amount
		TWP RD 510 STA 0+000 to 6+646	RR 244 N	RR 245 S	COLLECTOR 1	COLLECTOR 2	RR 244 S	COLLECTOR 3	RR 243 S	COLLECTOR 4	50 STREET	
1	Roadwork	$19,857,150	$770,785	$843,200	$1,163,025	$1,055,875	$2,974,150	$1,163,175	$1,788,750	$668,220	$2,514,750	$32,799,080
2	Electrical	$3,325,000	$575,000	$625,000	$600,000	$625,000	$712,500	$600,000	$637,500	$600,000	$887,500	$9,187,500
3	Drainage	$7,969,280.00	-	-	-	-	-	-	-	-	-	$7,969,280
4	Bridge Structure	$1,790,500.00	-	-	-	-	-	-	-	-	-	$1,790,500
Sub-Total		**$32,941,930**	**$1,345,785**	**$1,468,200**	**$1,763,025**	**$1,680,875**	**$3,686,650**	**$1,763,175**	**$2,426,250**	**$1,268,220**	**$3,402,250**	**$51,746,360**
Contingencies (15%)		**$4,942,000**	**$202,000**	**$221,000**	**$265,000**	**$253,000**	**$553,000**	**$265,000**	**$364,000**	**$191,000**	**$511,000**	**$7,767,000**
Engineering and Administration (12.5%)		**$4,118,000**	**$169,000**	**$184,000**	**$221,000**	**$211,000**	**$461,000**	**$221,000**	**$304,000**	**$159,000**	**$426,000**	**$6,469,000**
Grand Total		**$42,001,930**	**$1,716,785**	**$1,873,200**	**$2,249,025**	**$2,144,875**	**$4,700,650**	**$2,249,175**	**$3,094,250**	**$1,618,220**	**$4,339,250**	**$65,982,360**

Note:

(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.

(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.

(3) Cost of water main, sanitary sewer and storm upgrades required in the study area
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

(4) The Drainage costs shown are the costs for the upgrades required to the storm sewer system within the road right-of-way.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT (4 LANE)
STATION: 0+000 TO 6+646

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	52000	t	$100.00 /t	5,200,000
1.02	300mm Gravel Base Course	93000	t	$26.00 /t	2,418,000
1.03	300mm Pit Run	86000	t	$28.00 /t	2,408,000
1.04	Concrete Sidewalk	6646	m	$250.00 /m	1,661,500
1.05	Sub-grade Preparation	120000	m^2	$3.00 /$m^2$	360,000
1.06	Width Concrete Curb and Gutter	26600	m	$140.00 /m	3,724,000
1.07	200mm Curb and Gutter Gravel Base	16000	t	$26.00 /t	416,000
1.08	Pavement Marking	13300	m	$1.00 /m	13,300
1.09	100mm Top Soil	165000	m^2	$5.25 /$m^2$	866,250
1.1	Hydroseeding	165000	m^2	$1.00 /$m^2$	165,000
1.11	Clearing R.O.W.	295000	m^2	$6.30 /$m^2$	1,858,500
1.12	Common Excavation	100000	m^3	$7.00 /$m^3$	700,000
1.13	Borrow Excavation	8500	m^3	$6.00 /$m^3$	51,000
1.14	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$19,857,150**
2.0 ELECTRICAL					
2.01	Illumination	266	lights	$12,500 /light	3,325,000
				Sub Total	**$3,325,000**
3.0 DRAINAGE					
3.01	450mm Pipe	960	m	$578 /m	554,880
3.02	600mm Pipe	1920	m	$885 /m	1,699,200
3.03	750mm Pipe	2400	m	$1,298 /m	3,115,200
3.04	900mm Pipe	360	m	$1,770 /m	637,200
3.05	900mm Culvert	50	m	$1,256 /m	62,800
3.06	Catchbasins	80	ea	$7,000 /ea	560,000
3.07	Stormwater Wetlands	12400	m^3	$100 /$m^3$	1,240,000
3.08	Hydrological Assessments	2	ea	$50,000 /ea	100,000
				Sub Total	**$7,969,280**
4.0 BRIDGE STRUCTURE					
4.01	Replace with Culvert in 2018	1	LS	$1,790,500	1,790,500
				Sub Total	**$1,790,500**

SUMMARY	
1.0 ROADWORK	$19,857,150
2.0 ELECTRICAL	$3,325,000
3.0 DRAINAGE	$7,969,280
4.0 BRIDGE STRUCTURE	$1,790,500
TOTAL	**$32,941,930**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required in the study area
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.
(4) The Drainage costs shown are the costs for the upgrades required to the storm sewer system within the road right-of-way.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FIRST STAGE (2 LANE)
STATION: 0+000 TO 6+646

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	1	LM	$450.00 /LM	450.00
1.02	300mm Gravel Base Course	1	LM	$210.00 /LM	210.00
1.03	300mm Pit Run	1	LM	$195.00 /LM	195.00
1.04	Sub-grade Preparation	1	LM	$32.00 /LM	32.00
1.05	Width Concrete Curb and Gutter	1	LM	$280.00 /LM	280.00
1.06	200mm Curb and Gutter Gravel Base	1	LM	$32.00 /LM	32.00
1.07	Pavement Marking	1	LM	$1.00 /LM	1.00
1.08	100mm Top Soil	1	LM	$165.00 /LM	165.00
1.09	Seeding	1	LM	$35.00 /LM	35.00
1.1	Clearing R.O.W.	1	LM	$280.00 /LM	280.00
1.11	Common Excavation	1	LM	$105.00 /LM	105.00
1.12	Borrow Excavation	1	LM	$8.00 /LM	8.00
1.13	Traffic Signs	1	LM	$2.50 /LM	2.50
				Sub Total	**1,795.50**
2.0 ELECTRICAL					
2.01	Illumination	1	LM	$250 /LM	250.00
				Sub Total	**250.00**

SUMMARY	
1.0 ROADWORK	$1,795.50
2.0 ELECTRICAL	$250.00
TOTAL	**$2,045.50**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required in the study area
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510

FUNCTIONAL PLANNING STUDY

FULL DEVELOPMENT (4 LANE)

STATION: 0+000 TO 6+646

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	1	LM	$785.00 /LM	$785.00
1.02	300mm Gravel Base Course	1	LM	$365.00 /LM	$365.00
1.03	300mm Pit Run	1	LM	$365.00 /LM	$365.00
1.04	Concrete Sidewalk	1	LM	$250.00 /LM	$250.00
1.05	Sub-grade Preparation	1	LM	$55.00 /LM	$55.00
1.06	Width Concrete Curb and Gutter	1	LM	$560.00 /LM	$560.00
1.07	200mm Curb and Gutter Gravel Base	1	LM	$65.00 /LM	$65.00
1.08	Pavement Marking	1	LM	$2.00 /LM	$2.00
1.09	100mm Top Soil	1	LM	$130.00 /LM	$130.00
1.1	Seeding	1	LM	$25.00 /LM	$25.00
1.11	Clearing R.O.W.	1	LM	$280.00 /LM	$280.00
1.12	Common Excavation	1	LM	$85.00 /LM	$85.00
1.13	Borrow Excavation	1	LM	$6.00 /LM	$6.00
1.14	Traffic Signs	1	LM	$2.50 /LM	$2.50
				Sub Total	**$2,975.50**
2.0 ELECTRICAL					
2.01	Illumination	1	LM	$500.00 /LM	$500.00
				Sub Total	**$500.00**
3.0 DELETABLES					
3.01	Berm			$135.00 /LM	
3.02	Multi-Use Trail			$250.00 /LM	
3.03	Sidewalk			$280.00 /LM	

SUMMARY	
1.0 ROADWORK	$2,975.50
2.0 ELECTRICAL	$500.00
TOTAL	**$3,475.50**

Note:

(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.

(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.

(3) Cost of water main, sanitary sewer and storm upgrades required in the study area
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
RR 244 NORTH

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	2000	t	$100.00 /t	200,000
1.02	300mm Gravel Base Course	3600	t	$26.00 /t	93,600
1.03	300mm Pit Run	3300	t	$28.00 /t	92,400
1.04	Concrete Sidewalk	350	m	$250.00 /m	87,500
1.05	Sub-grade Preparation	4500	m^2	$3.00 /$m^2$	13,500
1.06	Width Concrete Curb and Gutter	875	m	$140.00 /m	122,500
1.07	200mm Curb and Gutter Gravel Base	525	t	$26.00 /t	13,650
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	400	m	$1.00 /m	400
1.1	100mm Top Soil	1500	m^2	$5.25 /$m^2$	7,875
1.11	Seeding	1500	m^2	$1.00 /$m^2$	1,500
1.12	Clearing R.O.W.	6200	m^2	$6.30 /$m^2$	39,060
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$770,785**
2.0 ELECTRICAL					
2.01	Illumination	10	lights	$12,500 /light	125,000
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$575,000**

SUMMARY	
1.0 ROADWORK	$770,785
2.0 ELECTRICAL	$575,000
TOTAL	**$1,345,785**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
RR 245 SOUTH

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	1900	t	$100.00 /t	190,000
1.02	300mm Gravel Base Course	3300	t	$26.00 /t	85,800
1.03	300mm Pit Run	3100	t	$28.00 /t	86,800
1.04	Concrete Sidewalk	350	m	$250.00 /m	87,500
1.05	Sub-grade Preparation	5500	m^2	$3.00 /$m^2$	16,500
1.06	Width Concrete Curb and Gutter	1500	m	$140.00 /m	210,000
1.07	200mm Curb and Gutter Gravel Base	900	t	$26.00 /t	23,400
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	400	m	$1.00 /m	400
1.1	100mm Top Soil	2000	m^2	$5.25 /$m^2$	10,500
1.11	Seeding	2000	m^2	$1.00 /$m^2$	2,000
1.12	Clearing R.O.W.	5000	m^2	$6.30 /$m^2$	31,500
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$843,200**
2.0 ELECTRICAL					
2.01	Illumination	14	lights	$12,500 /light	175,000
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$625,000**

SUMMARY	
1.0 ROADWORK	$843,200
2.0 ELECTRICAL	$625,000
TOTAL	**$1,468,200**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
COLLECTOR 1

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	2900	t	$100.00 /t	290,000
1.02	300mm Gravel Base Course	5100	t	$26.00 /t	132,600
1.03	300mm Pit Run	4700	t	$28.00 /t	131,600
1.04	Concrete Sidewalk	310	m	$250.00 /m	77,500
1.05	Sub-grade Preparation	7500	m^2	$3.00 /$m^2$	22,500
1.06	Width Concrete Curb and Gutter	1750	m	$140.00 /m	245,000
1.07	200mm Curb and Gutter Gravel Base	1000	t	$26.00 /t	26,000
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	800	m	$1.00 /m	800
1.1	100mm Top Soil	7500	m^2	$5.25 /$m^2$	39,375
1.11	Seeding	7500	m^2	$1.00 /$m^2$	7,500
1.12	Clearing R.O.W.	14500	m^2	$6.30 /$m^2$	91,350
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$1,163,025**
2.0 ELECTRICAL					
2.01	Illumination	12	lights	$12,500 /light	150,000
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$600,000**

SUMMARY	
1.0 ROADWORK	$1,163,025
2.0 ELECTRICAL	$600,000
TOTAL	**$1,763,025**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
COLLECTOR 2

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	2200	t	$100.00 /t	220,000
1.02	300mm Gravel Base Course	4000	t	$26.00 /t	104,000
1.03	300mm Pit Run	3700	t	$28.00 /t	103,600
1.04	Concrete Sidewalk	310	m	$250.00 /m	77,500
1.05	Sub-grade Preparation	6500	m^2	$3.00 /$m^2$	19,500
1.06	Width Concrete Curb and Gutter	1800	m	$140.00 /m	252,000
1.07	200mm Curb and Gutter Gravel Base	1000	t	$26.00 /t	26,000
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	600	m	$1.00 /m	600
1.1	100mm Top Soil	9500	m^2	$5.25 /$m^2$	49,875
1.11	Seeding	9500	m^2	$1.00 /$m^2$	9,500
1.12	Clearing R.O.W.	15000	m^2	$6.30 /$m^2$	94,500
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$1,055,875**
2.0 ELECTRICAL					
2.01	Illumination	14	lights	$12,500 /light	175,000
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$625,000**

SUMMARY	
1.0 ROADWORK	$1,055,875
2.0 ELECTRICAL	$625,000
TOTAL	**$1,680,875**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
RR 244 SOUTH

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	9600	t	$100.00 /t	960,000
1.02	300mm Gravel Base Course	18000	t	$26.00 /t	468,000
1.03	300mm Pit Run	1600	t	$28.00 /t	44,800
1.04	Concrete Sidewalk	420	m	$250.00 /m	105,000
1.05	Sub-grade Preparation	29000	m^2	$3.00 /$m^2$	87,000
1.06	Width Concrete Curb and Gutter	4500	m	$140.00 /m	630,000
1.07	200mm Curb and Gutter Gravel Base	2700	t	$26.00 /t	70,200
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	1500	m	$1.00 /m	1,500
1.1	100mm Top Soil	29000	m^2	$5.25 /$m^2$	152,250
1.11	Seeding	29000	m^2	$1.00 /$m^2$	29,000
1.12	Clearing R.O.W.	52000	m^2	$6.30 /$m^2$	327,600
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$2,974,150**
2.0 ELECTRICAL					
2.01	Illumination	21	lights	$12,500 /light	262,500
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$712,500**

SUMMARY	
1.0 ROADWORK	$2,974,150
2.0 ELECTRICAL	$712,500
TOTAL	**$3,686,650**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
COLLECTOR 3

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	2800	t	$100.00 /t	280,000
1.02	300mm Gravel Base Course	5100	t	$26.00 /t	132,600
1.03	300mm Pit Run	4700	t	$28.00 /t	131,600
1.04	Concrete Sidewalk	310	m	$250.00 /m	77,500
1.05	Sub-grade Preparation	7500	m^2	$3.00 /$m^2$	22,500
1.06	Width Concrete Curb and Gutter	1800	m	$140.00 /m	252,000
1.07	200mm Curb and Gutter Gravel Base	1000	t	$26.00 /t	26,000
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	800	m	$1.00 /m	800
1.1	100mm Top Soil	7500	m^2	$5.25 /$m^2$	39,375
1.11	Seeding	7500	m^2	$1.00 /$m^2$	7,500
1.12	Clearing R.O.W.	15000	m^2	$6.30 /$m^2$	94,500
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$1,163,175**
2.0 ELECTRICAL					
2.01	Illumination	12	lights	$12,500 /light	150,000
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$600,000**

SUMMARY	
1.0 ROADWORK	$1,163,175
2.0 ELECTRICAL	$600,000
TOTAL	**$1,763,175**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
RR 243 SOUTH

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	5200	t	$100.00 /t	520,000
1.02	300mm Gravel Base Course	9400	t	$26.00 /t	244,400
1.03	300mm Pit Run	8600	t	$28.00 /t	240,800
1.04	Concrete Sidewalk	420	m	$250.00 /m	105,000
1.05	Sub-grade Preparation	14000	m^2	$3.00 /$m^2$	42,000
1.06	Width Concrete Curb and Gutter	2100	m	$140.00 /m	294,000
1.07	200mm Curb and Gutter Gravel Base	1300	t	$26.00 /t	33,800
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	1300	m	$1.00 /m	1,300
1.1	100mm Top Soil	10200	m^2	$5.25 /$m^2$	53,550
1.11	Seeding	10200	m^2	$1.00 /$m^2$	10,200
1.12	Clearing R.O.W.	23000	m^2	$6.30 /$m^2$	144,900
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$1,788,750**
2.0 ELECTRICAL					
2.01	Illumination	15	lights	$12,500 /light	187,500
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$637,500**

SUMMARY	
1.0 ROADWORK	$1,788,750
2.0 ELECTRICAL	$637,500
TOTAL	**$2,426,250**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
COLLECTOR 4

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	1400	t	$100.00 /t	140,000
1.02	300mm Gravel Base Course	2500	t	$26.00 /t	65,000
1.03	300mm Pit Run	2300	t	$28.00 /t	64,400
1.04	Concrete Sidewalk	310	m	$250.00 /m	77,500
1.05	Sub-grade Preparation	3800	m^2	$3.00 /$m^2$	11,400
1.06	Width Concrete Curb and Gutter	900	m	$140.00 /m	126,000
1.07	200mm Curb and Gutter Gravel Base	600	t	$26.00 /t	15,600
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	400	m	$1.00 /m	400
1.1	100mm Top Soil	3600	m^2	$5.25 /$m^2$	18,900
1.11	Seeding	3600	m^2	$1.00 /$m^2$	3,600
1.12	Clearing R.O.W.	7400	m^2	$6.30 /$m^2$	46,620
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$668,220**
2.0 ELECTRICAL					
2.01	Illumination	12	lights	$12,500 /light	150,000
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$600,000**

SUMMARY	
1.0 ROADWORK	$668,220
2.0 ELECTRICAL	$600,000
TOTAL	**$1,268,220**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

TOWNSHIP ROAD 510
FUNCTIONAL PLANNING STUDY
FULL DEVELOPMENT
50 STREET

Filename: P:\20073420\00_TownshipRoad510\Engineering\03.02_Conceptual_Feasibility_Report\rpt_estimate_073420.xls

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1.0 ROADWORK					
1.01	180mm ACP	8000	t	$100.00 /t	800,000
1.02	300mm Gravel Base Course	14200	t	$26.00 /t	369,200
1.03	300mm Pit Run	13100	t	$28.00 /t	366,800
1.04	Concrete Sidewalk	310	m	$250.00 /m	77,500
1.05	Sub-grade Preparation	21000	m^2	$3.00 /$m^2$	63,000
1.06	Width Concrete Curb and Gutter	3100	m	$140.00 /m	434,000
1.07	200mm Curb and Gutter Gravel Base	2000	t	$26.00 /t	52,000
1.08	Median Strip	320	m^2	$260.00 /$m^2$	83,200
1.09	Pavement Marking	2000	m	$1.00 /m	2,000
1.1	100mm Top Soil	11000	m^2	$5.25 /$m^2$	57,750
1.11	Seeding	11000	m^2	$1.00 /$m^2$	11,000
1.12	Clearing R.O.W.	29000	m^2	$6.30 /$m^2$	182,700
1.13	Traffic Signs	1	LS	$15,600	15,600
				Sub Total	**$2,514,750**
2.0 ELECTRICAL					
2.01	Illumination	35	lights	$12,500 /light	437,500
2.02	Traffic Signals	1	LS	$450,000	450,000
				Sub Total	**$887,500**

SUMMARY	
1.0 ROADWORK	$2,514,750
2.0 ELECTRICAL	$887,500
TOTAL	**$3,402,250**

Note:
(1) All unit prices are based on 2009 Alberta Transportation Unit Price Averages.
(2) Costs for the removal and relocation power lines to be determined by others during detailed design phase of this project.
(3) Cost of water main, sanitary sewer and storm upgrades required
due to Township Road 510 Reconstruction is to be determined by others during detailed design phase of this project.

LEDUC COUNTY





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