HIGHWAY 947 EXTENSION PROJECT

PROJECT DESCRIPTION

Proposed
Environmental Impact Statement

29 January 2014
(Amended 14 April 2014)

Submitted To:

ALBERTA TRANSPORTATION
North Central Region

Prepared For

ARA Engineering Ltd
Suite 101, 110 Country Hills Landing NW
Calgary, Alberta
T3K 5P3

Prepared By

Ecofor Consulting Ltd
9940 – 104th Ave
Fort St. John, BC
V1J 2K3
(250) 787-6009

EPN: 2011-2136-155

ECOFOR
natural and cultural resource consultants

This page has been purposely left blank for double-sided printing.

Table of Contents

1 General Information and Contacts 1
1.1 Project Nature 1
1.2 Proponent Contact Information 4
1.2.1 Name of the Designated Project 4
1.2.2 Name of the Proponent 4
1.2.3 Address of the Proponent 4
1.2.4 Chief Executive Officer or Equivalent 4
1.2.5 Principle Contact Person for Purposes of the Project Description 4
1.3 Jurisdictions and Parties Consulted for the Project Description 4
1.4 Other Relevant Information 5
1.4.1 Environmental Assessment and Regulatory Requirements of Other Jurisdictions 5
1.4.2 Regional Environmental Studies 7
2 Project Information 7
2.1 General Description of Project 7
2.2 Provisions of the *Regulations Designating Physical Activities* 8
2.3 Components and Activities 9
2.3.1 Physical Works Associated with the Designated Project 9
2.3.2 Anticipated Size and Capacity of the Designated Project 9
2.3.3 Project Components that are Expansions 9
2.3.4 Activities to be Performed in Relation to the Designated Project 9
2.4 Emissions, Discharges, and Waste 11
2.4.1 Sources of Atmospheric Contaminant Emissions 11
2.4.2 Sources and Location of Liquid Discharges 12
2.4.3 Types of Wastes and Plans for Disposal 12
2.5 Construction, Operation, Decommissioning and Abandonment 12
2.5.1 Anticipated Scheduling 12
2.5.2 Main Activities in Each Phase 13
3 Project Location 14
3.1 Project Location 14

3.1.1 Coordinates 14
3.1.2 Overview Site Map 14
3.1.3 Detailed Site Maps 14
3.1.4 Photographs of Representative Work Sites 15
3.1.5 Legal Descriptions of Land to be used for the Designated Project 15
3.1.6 Proximity to Residences, Aboriginal Lands, and Federal Lands 15
3.2 Land and Water Use 17
3.2.1 Zoning Designations 17
3.2.2 Current Land Ownership, including Subsurface Rights 17
3.2.3 Land Use, Water Use, and Resource Management / Conservation Plans 17
3.2.4 Marine Terminal 18
3.2.5 Canada Marine Act 18
3.2.6 Land Used for Traditional Purposes by Aboriginal Peoples 18
4 Federal Involvement - Financial Support, Lands and Legislative Requirements 20
4.1 Federal Financial Support 20
4.2 Federal Lands 20
4.3 Federal Legislative or Regulatory Requirements that may be Applicable 20
4.3.1 Canadian Environmental Assessment Act (Canada) 20
4.3.2 Fisheries Act 20
4.3.3 Navigable Waters 21
4.3.4 Migratory Birds Convention Act 21
5 Environmental Effects 21
5.1 Physical and Biological Setting 21
5.1.1 Air 21
5.1.2 Water 21
5.1.3 Terrain and Vegetation 40
5.1.4 Wetlands 53
5.1.5 Fish and Fish Habitat 57
5.1.6 Birds 66
5.1.7 Amphibians 70
5.1.8 Mammals 72

5.1.9 Species at Risk 73
5.2 Impacts 76
5.2.1 Air Impacts 77
5.2.2 Water Impacts 78
5.2.3 Terrain and Vegetation Impacts 78
5.2.4 Wetland Impacts 78
5.2.5 Fish and Fish Habitat Impacts 80
5.2.6 Bird Impacts 80
5.2.7 Amphibian Impacts 81
5.2.8 Mammal Impacts 82
5.2.9 Species at Risk Impacts 83
5.3 Potential Changes to the Physical and Biological Setting 83
5.3.1 Fish and fish habitat, as defined in the Fisheries Act 83
5.3.2 Aquatic species, as defined in the Species at Risk Act 84
5.3.3 Migratory birds, as defined in the Migratory Birds Convention Act, 1994. 84
5.4 Extra-territorial Changes to the Environment 84
5.5 Effects on Aboriginal Peoples of Changes to the Environment 84
6 ENGAGEMENT AND CONSULTATION WITH ABORIGINAL GROUPS 85
6.1 Aboriginal Groups Interested in, or Affected by, the Designated Project 85
6.2 Engagement and Consultation Activities with Aboriginal Groups 85
6.3 Key Comments and Concerns Expressed by Aboriginal Groups 85
6.4 Traditional Use of Lands and Resources by Aboriginal Groups 85
6.5 Consultation Plan for Aboriginal Engagement 85
7 CONSULTATION WITH THE PUBLIC AND OTHER PARTIES 89
7.1 Stakeholders and Consultation to Date 89
7.2 Key Comments and Concerns Expressed by Stakeholders 89
7.3 On-going and Proposed Stakeholder Consultations 89
7.4 Consultations with Other Jurisdictions 89
8 EXECUTIVE SUMMARY 90
1.0 Project's Name, Nature and Proposed Location 92
2.0 Proponent's Name and Contact Information 92

3.0 Consultations with Aboriginal Peoples and the Public 94
4.0 Other Relevant Information 94
5.0 Context and Objectives 94
6.0 Regulations Designating Physical Activities 95
7.0 Physical Works 96
8.0 Capacity of the Project 96
9.0 Activities to be Performed in Relation to the Project 96
10.0 Wastes to be Generated During the Project 98
11.0 Phases and Schedule of the Project 99
12.0 Project Location 100
13.0 Federal Financial Support 101
14.0 Federal Lands 101
15.0 Federal Legislation or Regulatory Requirements 101
16.0 Physical and Biological Setting 102
16.1 Air 102
16.2 Water 102
16.3 Terrain and Vegetation 103
16.3.1 Terrain 103
16.3.2 Vegetation 105
16.4 Wetlands 106
16.5 Fish 108
16.6 Birds 108
16.7 Amphibians 109
16.8 Mammals 109
16.9 Species at Risk 110
17.0 Fisheries Act, Species at Risk Act, and Migratory Birds Convention Act 111
18.0 Extra-territorial Changes to the Environment 111
19.0 Effects on Aboriginal Peoples 111
9 REFERENCES 112
Appendixes A-1
Appendix 1. Highway 947 Proposed Alignment A-2

Appendix 2. Photographs of Representative Areas of the Project A-21
Appendix 3. Land Dispositions affected by the Project A-34
Appendix 4. Correspondance associated with the 2001 Alignment Update A-42
Appendix 5. Project area vegetation types A-56
Appendix 6. Plant Species Recorded from the Project Area A-77
Appendix 7. Field verified wetlands within 150m of centreline A-86
Appendix 8. Wetlands - Canadian Wetland Classification System A-96
Appendix 9. Stream Crossing Locations A-98
Appendix 10. Birds Observed within the Project Area A-100
Appendix 10.1 Nesting Bird Surveys 2012 ..... A-100
Appendix 10.2 Owl Surveys February and April 2013 ..... A-104
Appendix 11. Amphibians within Project area. A-108
Appendix 12. Mammals within the Project area A-111
Appendix 13. Species at Risk Potentially within Highway 947 Study Area A-113
Appendix 14. Watersheds with Stream Crossings A-120
Appendix 15. Heritage Assessment A-122

List of Figures

Figure 1. Highway 947 Proposed Location 2
Figure 2. Highway 947 Proposed Alignment 3
Figure 3. Indian Reserves near the Proposed Highway 947 Alignment 16
Figure 4. Compilation of water well yields in Alberta, with Highway 947 Alignment 25
Figure 5. Location of Water Survey of Canada Hydrometric Stations 27
Figure 6. Alberta Water Yield per Square Kilometer (Kienzle, no date) 28
Figure 7. Seasonal Variation in Streamflow at Water Survey of Canada Stream Gauging Stations 29
Figure 8. Athabasca River Maximum Daily Discharge 34
Figure 9. Sundance Creek Maximum Daily Discharge 35
Figure 10. Precipitation Map for June 19-22, 2013 Storm Event 36
Figure 11. Design Flood Runoff Depth Map 37
Figure 12. Physiography of the Highway 947 Area 43
Figure 13. Representative Fish Present in the Project Area 65
Figure 14. Representative Amphibians in the Project Area. 71

List of Tables

Table 1. Summary of Information Available at Regional Water Survey of Canada Hydrometric Stations . 30
Table 2. Distribution of Basin Areas 38
Table 3: Summary of existing data sources on geology and soils 40
Table 4: Types of soils inventoried in the study area 46
Table 5. Rare Plant Observations 2012 - 2013 51
Table 6. Noxious Weed Plant Observations 2012 - 2013 52
Table 7: Wetland areas within 150 m of the proposed centerline 56
Table 8: Fish species historically present within the study area 60
Table 9: Fish species known from each stream crossing site of proposed alignment 62
Table 10. Bird Inventory Dates 66
Table 11. Bird species recorded within 150m of centreline 68
Table 12. Aboriginal Interaction Summary 86

1 General Information and Contacts

1.1 Project Nature

The Alberta Transportation Highway 947 Project is an extension of the existing Highway 47 north from the intersection of Highway 16, about 10 km west of Edson, Alberta. From Hwy 16 it runs north along a proposed alignment to tie into a bridge crossing over the Athabasca River, at the south end of an existing section of Highway 947, between Fox Creek and Whitecourt (Figure 1, 2). Highway 947 will be constructed with a gravel roadway surface, with provision to pave at a later date.

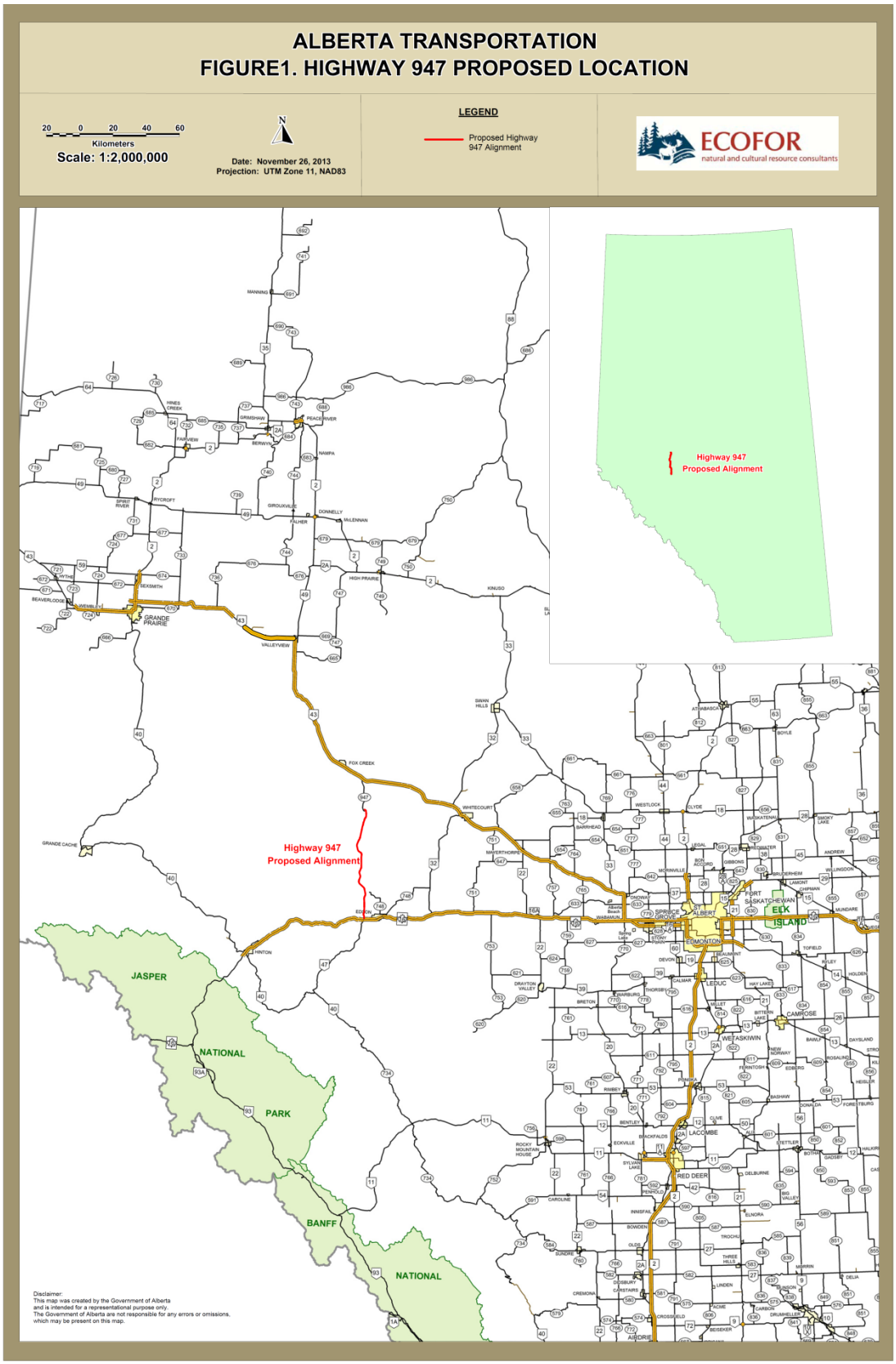
The total length of the project is 69.2 km, with the following sections.

Hwy 947:08 C1 – Hwy 16 to Hwy 748 (km 0.000 to km 16.600)
Hwy 947:08 C1 – Hwy 748 to Wildwood LOC Road (km 16.600 to km 25.000)
Hwy 947:08 C1 – Wildwood LOC Road Silver Summit Access (km 25.000 to km 37.711)
Hwy 947:10 C1 – Silver Summit Road – Twp Road 583 (km 0.000 to km 16.150)
Hwy 947:10 C1 – Twp Road 583 to Athabasca River (km 16.150 to km 31.511)

The Project consists of construction of highway sections that replace and/or realign and upgrade existing road sections, follow on and parallel to existing power transmission corridors, and pass through undeveloped Crown forest land. In addition to the highway construction there will be works connecting to local roads to maintain existing access. Alberta Transportation has retained ARA Engineering Ltd (ARA) as Prime Consultant, and Ecofor Consulting BC Ltd (Ecofor) as a sub-consultant to ARA, to complete the design phases, including an Environmental Impact Statement (EIS) that meets the requirements of the Canadian Environmental Assessment Act (CEAA).

The alignment runs through a generally forested setting that has been developed by the forest and oil and gas industries. There are two major watersheds, the Edson River watershed to the south, and the Pine Creek watershed to the north. Both the Edson River and Pine Creek are tributaries of the Athabasca River.

Figure 1. Highway 947 Proposed Location



ALBERTA TRANSPORTATION
FIGURE1. HIGHWAY 947 PROPOSED LOCATION

20 0 20 40 60
Kilometers
Scale: 1:2,000,000

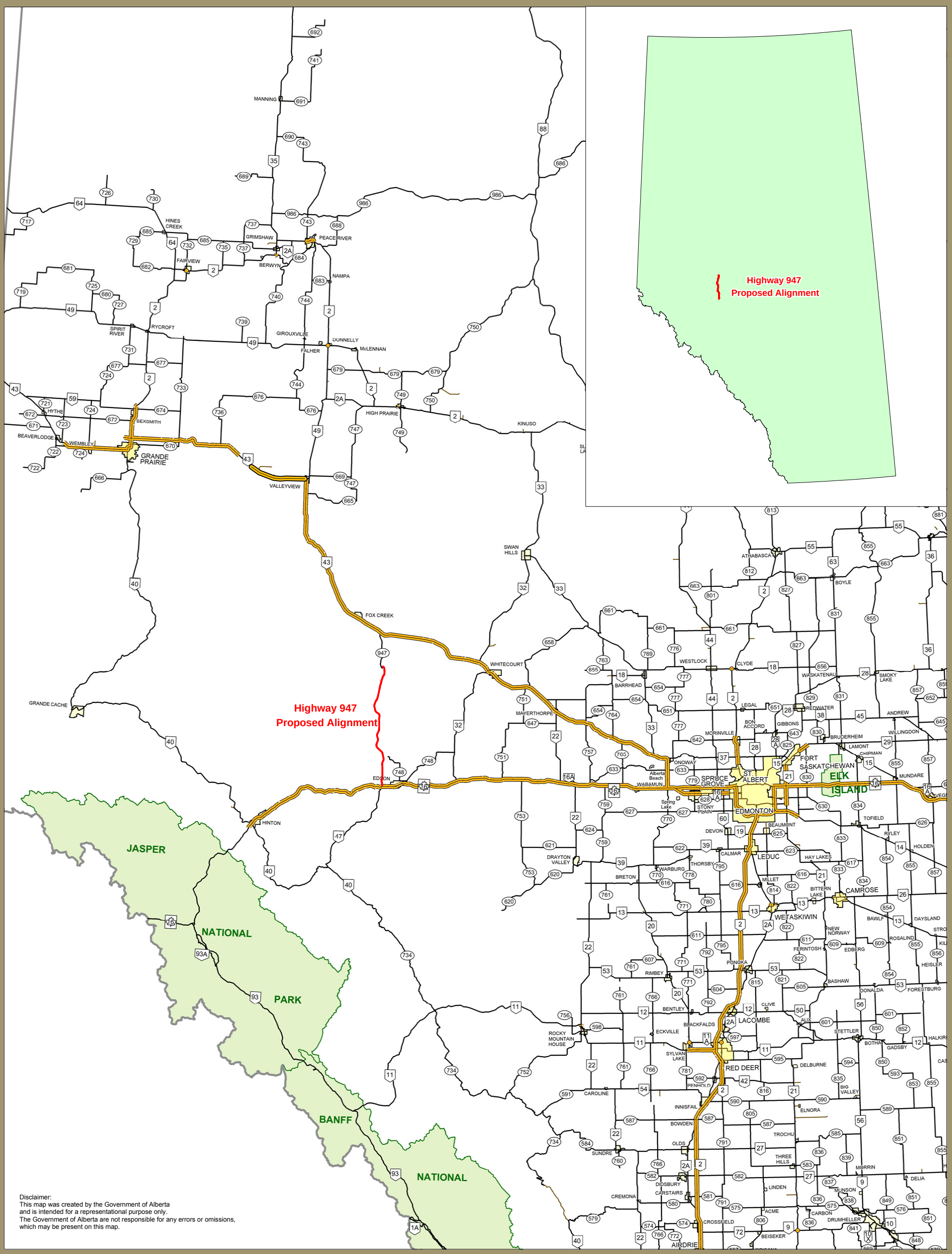
N

Date: November 26, 2013
Projection: UTM Zone 11, NAD83

LEGEND

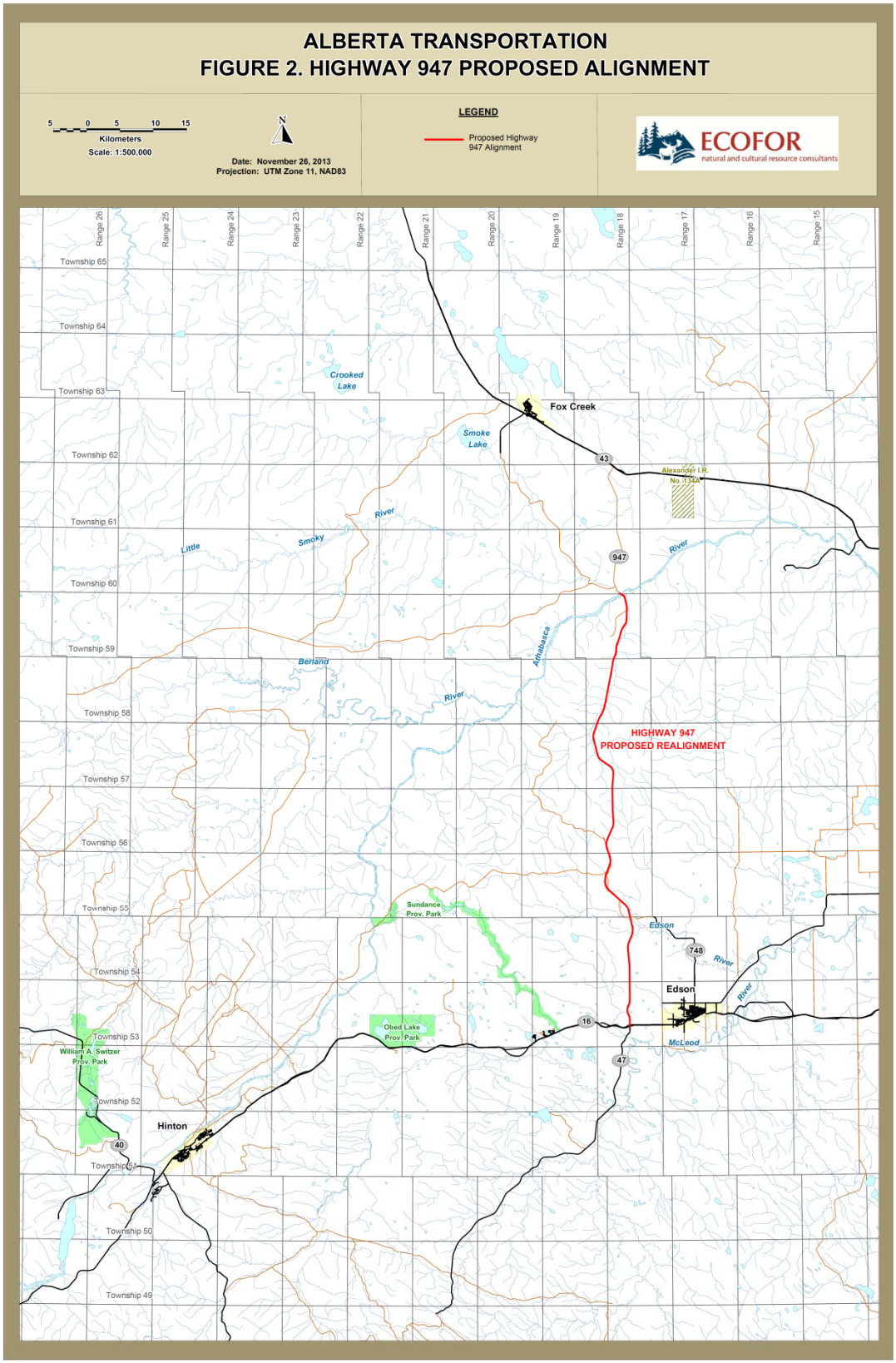
Proposed Highway 947 Alignment

ECOFOR
natural and cultural resource consultants



Disclaimer:
This map was created by the Government of Alberta
and is intended for a representational purpose only.
The Government of Alberta are not responsible for any errors or omissions,
which may be present on this map.

Figure 2. Highway 947 Proposed Alignment



ALBERTA TRANSPORTATION
FIGURE 2. HIGHWAY 947 PROPOSED ALIGNMENT

5 0 5 10 15
Kilometers
Scale: 1:500,000

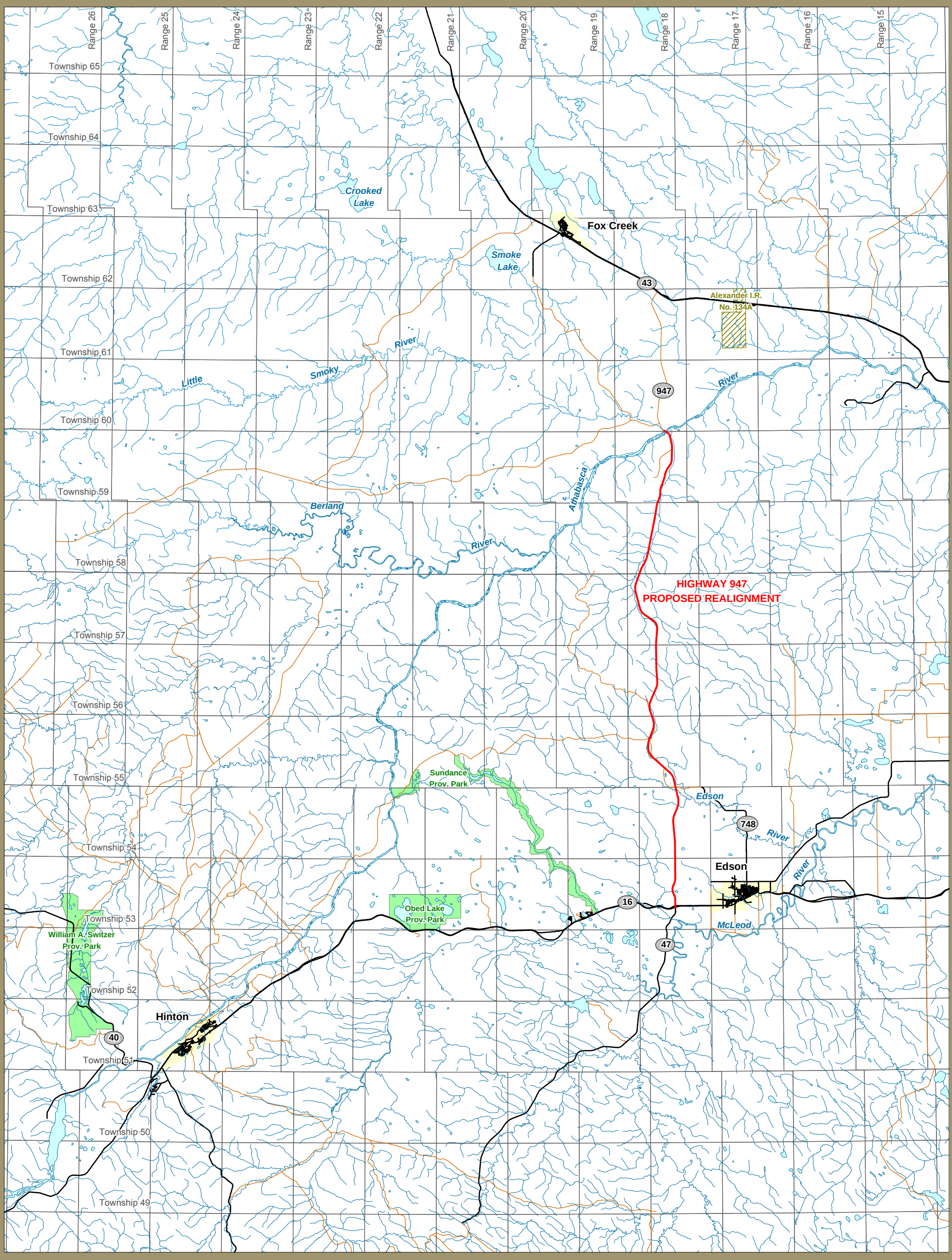
N

Date: November 26, 2013
Projection: UTM Zone 11, NAD83

LEGEND

Proposed Highway 947 Alignment

ECOFOR
natural and cultural resource consultants



1.2 Proponent Contact Information

1.2.1 Name of the Designated Project

The name of the Project is *Alberta Highway 947 from Highway 16 to the Athabasca River Bridge*.

1.2.2 Name of the Proponent

The Proponent is *Alberta Transportation*, formerly *Alberta Infrastruture and Transportation*.

1.2.3 Address of the Proponent

The address of the Proponent is:

Alberta Transportation
4999 - 98th Ave, 3rd Floor
Edmonton, AB T6B 2X3
Canada
Phone: 780-643-1525
Fax: 780-415-0475

1.2.4 Chief Executive Officer or Equivalent

The Deputy Minister of Alberta Transportation is Rob Penny.

1.2.5 Principle Contact Person for Purposes of the Project Description

Stephen Legaree, PBiol
Environmental Coordinator, North Central Region
Alberta Transportation
Suite 310, 4999 - 98th Ave, 3rd Floor
Edmonton, AB T6B 2X3
Canada
Phone: 780-643-1525
Fax: 780-415-0475
Email: stephen.legaree@gov.ab.ca

1.3 Jurisdictions and Parties Consulted for the Project Description

- Canadian Environmental Assessment Agency (Tracy Utting / Lorie Crosier / Sean Carriere)
- Alberta Environment and Sustainable Resource Development

1.4 Other Relevant Information

1.4.1 Environmental Assessment and Regulatory Requirements of Other Jurisdictions

Canadian Environmental Assessment Act (Canada)

Highway 947 may need to meet the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in the *Regulations Designating Physical Activities* (see Section 2.2 below).

Fisheries Act (Canada)

Highway 947 will cross many streams tributary to the Edson River and Pine Creek, as well as the main channels of those streams. One small tributary of Little Sundance Creek is also crossed. Therefore there may be impacts to fish and fish habitat as defined by the *Fisheries Act*. The streams range in importance from small drainages without a defined channel and clearly lacking in fish, to large streams that are known to support fish populations. Documentation of the fish and fish habitat present, as well as proposals for mitigation of impacts, will be part of the Environmental Impact Statement. Where required by Fisheries and Oceans Canada, fisheries assessments will be completed and submitted for their review in order to obtain a *Letter of Advice* or an *Authorization*.

Navigable Waters Protection Act (Canada)

Highway 947 will cross a number of watercourses, which will be assessed under the criteria of the federal *Navigable Waters Protection Act* to determine if they are navigable. If they are deemed navigable, Transport Canada approval may be required. An assessment of the affected streams under the *Navigable Waters Protection Act*, and proposals for mitigation of impacts (if required), will be part of the Environmental Impact Statement.

This Act is currently under review by the Federal Government and is subject to change. The title of the Act is proposed to be changed to the *Navigation Protection Act*, with the new Act planned to be brought into force in 2014.

Migratory Birds Convention Act (Canada)

Highway 947 will pass through habitat used by birds that are protected under the *Migratory Birds Convention Act*. The most obvious potential impacts of the highway on migratory birds is the direct destruction of nesting habitat through clearance of the right-of-way and construction of the highway. This work will need to be done so as to avoid harm to any active bird nests, to be consistent with the *Migratory Birds Convention Act*. Surveys for migratory birds and their habitats, as well as proposals for mitigation of impacts, will be part of the Environmental Impact Statement.

Species at Risk Act (Canada)

Highway 947 will pass through habitat for some species that are listed on Schedule 1 of the *Species at Risk Act*. The potential impacts of the highway, such as from noise disturbance and habitat alterations, on species at risk extend out from the right-of-way, with the potential impacts diminishing with

distance. Surveys for species at risk and their habitat, as well as proposals for mitigation of impacts, will be part of the Environmental Impact Statement.

Water Act (Alberta)

Watercourse crossings will fall under the Alberta *Code of Practice for Watercourse Crossings*. Stream, wetland and pond impacts are anticipated, and *Water Act* approvals may be required. Surveys, assessments, and classification of streams, wetlands, and lakes, as well as proposals for mitigation of impacts, will be part of the Environmental Impact Statement.

Alberta Environment's *Provincial Wetland Restoration / Compensation Guide* (Alberta Environment 2007) provides guidance for addressing the potential impacts of human activities on wetlands. The Restoration / Compensation Guide outlines Alberta's priority avoiding impacts to wetland whenever possible, and requires proponents to reduce and compensate for other impacts. This can be summarized as:

- avoiding impacts to wetlands;
- minimizing impacts and requiring applicable compensation; and
- compensating for impacts that cannot be avoided or minimized.

Wildlife Act (Alberta)

Highway 947 may result in impacts to prescribed wildlife or prescribed wildlife habitat protected under the *Wildlife Act*. The potential impacts of the highway on prescribed wildlife and prescribed wildlife habitat extend out from the right-of-way, with the potential impacts diminishing with distance. Surveys for prescribed wildlife and their habitat that may occur in the area, as well as proposals for mitigation of impacts, will be part of the Environmental Impact Statement.

Historical Resources Act (Alberta)

Highway 947 may result in impacts to historical resources protected under the *Historical Resources Act*. Details of the project, as known at this time, have been submitted to Government of Alberta – Alberta Culture, for determination under the Historical Resources Act. A Historical Resources Impact Assessment (Archaeological and Palaeotological) has been triggered. The office and field assessments have been completed, have been reviewed by Alberta Culture, and the reports will be re-submitted after minor revisions. Additional field assessments will be completed in response to changes in highway design and addition of structures such as borrow pits, laydown areas, and intersections, and will be part of the Environmental Impact Statement. Mitigation or avoidance of heritage resource sites will be completed where required by Alberta Culture.

Environmental Protection and Enhancement Act (Alberta)

Highway 947 may need to meet the requirements of the Alberta Environmental Protection and Enhancement Act (EPEA). HIghway facilities fall into the discretionary category, with discretionary decisions made by Alberta Environment and Sustainable Resource Development on a case-by-case basis.

1.4.2 Regional Environmental Studies

The *Canadian Environmental Assessment Archives*[1] were searched without finding any relevant assessments. Alberta Environment and Sustainable Resource Development[2] provides links to many of the most recent environmental impact assessments that have been completed in the province. None of the environmental assessments available through the internet are within or near the study area. The Alberta Government Library will be searched for additional environmental assessments overlapping the study area. If any are found, they will be reviewed and relevant information incorporated in the Environmental Impact Statement. The data from existing fish and wildlife inventories and studies is available through the Alberta Fish and Wildlife Management Information System[3] and the Alberta Conservation Information Management System (ACIMS)[4] and will be included in the Environmental Impact Statement.

2 Project Information

2.1 General Description of Project

The location of Highway 947 is an important north-south corridor from west of Edson on Hwy 16 to an existing bridge across Athabasca River. Currently the general area of Highway 947 is served by a series of existing resource roads. The most northern section of Highway 947, from the Athabasca River north to Highway 43 was constructed in 1970-73. This section of the highway was constructed to service the Kaybob gas field and the resulting sulphur extraction plant just south of the Athabasca River.

The first report proposing Highway 947 south of the Athabasca River was produced in 1975; hence the proposed route has a history of over 40 years. Yellowhead County would like to see this project completed as it would support and facilitate the economic activity (oil and gas, and increased log hauling due to MPB, etc.) in the region, and will contribute some of the required funding and manage some of the construction. Local industry (oil/gas/forestry) are very supportive of this project as they see the benefits in terms of efficient transportation of people and products in the area, as well as increased safety for industry and the public by reducing heavy traffic on Hwy 32. It will be a forestry log haul route for logs moving from Edson/Hinton area to Whitecourt, avoiding the need to utilize local roads and

[1] http://www.ceaa.gc.ca/052/index-eng.cfm
[2] http://environment.alberta.ca/01495.html
[3] http://xnet.env.gov.ab.ca/imf/imfAlbertaUserAgreeSubmit.jsp?site=fw_mis_pub
[4] **ACIMS** (Alberta Conservation Information Management System):- is the database of Alberta's biodiversity data centre that provides accurate and accessible biodiversity information necessary for making informed decisions concerning conservation, natural resource management and development planning / - collects, continually updates, analyzes and disseminates information about the location, condition, status and trends of selected elements, including species and ecological communities, using NatureServe methodology http://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-(acims).aspx

causing conflict with residences/school buses, etc. Recreational traffic mostly travels to the Silver Summit ski resort.

Some potential benefits of this initiative may include:

- create employment/economic spin-off;
- create a transportation corridor from Edson to Fox Creek area on a provincial highway;
- and reduce industrial traffic volumes that currently use Hwy 32 going to Fox Creek area via Whitecourt.

The objective of the Project is to build and operate a modern roadway to connect Highway 16, about 10 km west of Edson, to an existing bridge across the Athabasca River (Figure 2). Highway 947 will provide a safe, rapid travel route from Highway 16 near Edson to Highway 43 between Fox Creek and Whitecourt. The new highway will be 69.2 km long, and will be designed as a 2-lane paved highway with a 10 m top width and a design speed of 110 km/hr. Stage 1 will be a gravel road with a posted speed of 80 km/hr, with paving (Stage 2) planned to occur at a later time.

Design and construction of the alignment will require a number of watercourse crossings (see Section 5.1.4), including two major bridges at Edson River and Pine Creek, standard bridges, and culverts. The project will also involve works at local roads to maintain existing road configurations. The Environmental Impact Statement will provide details on the alignment, stream crossing structures and proposed mitigation measures.

2.2 Provisions of the *Regulations Designating Physical Activities*

The new highway is 69.2 km long and will be predominantly located on a new right-of-way. Therefore the Canadian Environmental Assessment Act (CEAA) Regulations (2012) may apply under the *Regulations Designating Physical Activities*:

> 28. The construction, operation, decommissioning and abandonment of
>
> (b) an all-season public highway that will be more than 50 km in length and either will be located on a new right-of-way or will lead to a community that lacks all-season public highway access /

The capacity of the borrow pits, quarries and gravel pits required for the highway have not yet been determined. Therefore the following section of the *Regulations* may apply:

> 17. The construction, operation, decommissioning and abandonment, or an expansion that would result in an increase in production capacity of more than 35%, of
>
> (i) a stone quarry or gravel or sand pit with a production capacity of 1 000 000 t/a or more

2.3 Components and Activities

2.3.1 Physical Works Associated with the Designated Project

Highway construction will involve a survey for the clearance width, vegetation and surface soil clearance, bridge and culvert installation, constuction of the roadbed, borrow development, and gravel development. The details of these works have not yet been determined; they will be part of the Environmental Impact Statement.

2.3.2 Anticipated Size and Capacity of the Designated Project

Highway 947 will be 69.2 km of new highway, which may cause the Project to fall under the Canadian Environmental Assessment Act (see Section 2.2). There will be a number of sites developed for excavation of borrow materials, gravel and rock for use in construction of the highway. These sites have not yet been designed, but none are not anticipated to individually reach 1,000,000 tons per annum production (see Section 2.2). However, the total capacity of all the sites may exceed that level. The Environmental Impact Statement will include the details of the borrow material, gravel and rock extraction sites, including their anticipated production, required for the highway.

The traffic capacity of the new highway has not been calculated. However it is anticipated to exceed the capacity of the existing network of industrial roads that presently carry traffic in the area. Highway 947 will carry all types of motor vehicle traffic, from passenger cars to heavy industrial trucks.

2.3.3 Project Components that are Expansions

The project and all its components are not expansions; it is an entirely new project.

2.3.4 Activities to be Performed in Relation to the Designated Project

The Project consists of several phases with various components, starting with the work required to develop the Environmental Impact Statement, followed by highway construction, and finally its operation. The Highway is anticipated to continue to exist, operate, and be maintained indefinitely into the future. Many of the activities will be performed simultaneously or during overlapping time frames.

Highway Design

The route of the proposed highway was first determined in 1975, and minor revisions were done in 2001. The Environmental Impact Statement will include a proposed area to be surveyed and marked for clearance. The final area to be surveyed and cleared will depend on the results of the Environmental Impact Statement and the resulting Environmental Assessment; hence the not all the design field work will be done until completion of those processes. The proposed survey and clearance locations that will be included in the Environmental Impact Statement are anticipated to be a close approximation of the final locations, subject only to changes resulting from the Environmental Assessment.

Environmental Values Assessment

Field environmental assessment work will be done to provide information for the Environmental Impact Statement. The "environmental" work broadly includes studies of all *valued ecosystem components* (VECs). The VECs that have been identified to date include:

Biophysical Environment VECs

- fish
- wildlife
- species at risk
- plants
- amphibians
- migratory birds
- weeds
- wetlands
- streams
- ecosystems
- landforms
- soils
- surface hydrology
- groundwater
- noise
- air quality

Historical, Archaeological, Aboriginal and Socio-economic VECs

- historical resources
- archaeological resources
- palaeontological resources
- aboriginal and community values
- socio-economic values

All the VECs will be addressed in the Environmental Impact Statement. Additional VECs may be identified through aboriginal and community consultation and socio-economic review, in which case they will also be addressed in the Environmental Impact Statement. Some of this work requires permits from the provincial and federal governments, and it may also require the involvement of local aboriginal and other communities, organizations and individuals.

Construction

Field construction activities will commence with clearing the width of the right-of-way of vegetation. Top soils will be stripped and stockpiled for later use in reclamation of disturbed areas not used for roadbed or road surface. Borrow pits, gravel pits and rock quarries will be developed, and the materials used in the construction of the highway. The right-of-way will be levelled and graded, the roadbed constructed, and the highway will initially be surfaced with gravel and asphalt will be applied in the future. Bridges and culverts will be installed at stream crossings and other locations where drainage is required to carry fish and/or water from one side of the highway to the other. The right-of-way will be shaped to provide drainage away from the roadbed, while not significantly affecting the direction and flow of water within and across the project area. Areas not to be used by traffic will be revegetated. A more detailed description of the construction process will be included in the Environmental Impact Statement.

Operation

During the operational phase there will be a wide range of vehicles using the highway, primarily motorized (cars, trucks) but with some unmotorized (bicycles, primarily after paving). Foot traffic may occasionally use the sides of the highway, although this is anticipated to be rare because of the general lack of settlement along the route. A more detailed description of the operational phase will be included in the Environmental Impact Statement.

Maintenance

Maintenance activities include ditch maintenance; snow clearing; general road maintenance such as grader work, sign maintenance, weed mowing, and, after paving, line painting and pavement patching; bridge maintenance; and culvert maintenance. A more detailed description of maintenance will be included in the Environmental Impact Statement.

Decommissioning and Closure

The highway will be operational indefinitely into the future; therefore no decommissioning or closure activities are planned for the highway itself. Borrow pits, gravel pits, rock quarries, and laydown areas that are closed after the completion of construction will be compliant with regulatory requirements and activities will be specified in the Environmental Impact Statement. The reclamation of such areas may be designed to be part of fish and wildlife habitat mitigation and compensation measures.

2.4 Emissions, Discharges, and Waste

2.4.1 Sources of Atmospheric Contaminant Emissions

The existing air quality in the vicinity of the Project is influenced by traffic and nearby industrial activities. Local road traffic and oil/gas industry are the predominant existing sources of air emissions in the Project area, with forest harvesting also sporadically producing emissions. In the vicinity of the Project area, existing contributors to air emissions include combustion emissions from vehicle traffic and machinery; forest harvest waste burning; generation of airborne dust by traffic; natural gas wells; gas flaring; gas processing plants; and other oil/gas industry plants. These emissions are anticipated to remain unchanged as a result of the construction of Highway 947.

The new highway length will be 69.2 km. This is shorter than the existing winding route using existing resource roads. However, traffic volumes can be expected to increase, due to the higher quality and traffic speed of the new highway. Driving conditions on the new highway will be easier than the existing roads, and hence less fuel will be burned to travel each kilometer. It is unclear at this time whether there will be an increase or decrease in emissions, including greenhouse gasses, from motorized traffic in the local area. There is unlikely to be a net change in total automobile traffic in this region of Alberta; hence here is unlikely to be a net increase in gas emissions.

Greenhouse gas production is anticipated to temporarily increase during the construction phase, because the machinery will produce greenhouse gasses in addition to those produced by the existing traffic on the existing roads.

2.4.2 Sources and Location of Liquid Discharges

Liquid discharges from the highway will primarily be water. There will likely be small discharges of petroleum products due to spills and machinery malfunction during construction; these will be addressed as described in the Environmental Construction Operations Plan (ECOPlan) prepared by the construction contractor prior to construction. Measures to guide the contractor's ECOPlan will be included in the Environmental Impact Statement. There will be minor discharges of petroleum products such as oils from leaks from vehicle engines during the long term operation of the highway, and occasional larger spills due to accidents. Mitigation measures to minimize the environmental impact of such spills, such as highway design measures, will be included in the Environmental Impact Statement.

2.4.3 Types of Wastes and Plans for Disposal

Waste disposal is a component of the Environmental Construction Operations Plan (ECOPlan), which will be prepared by the construction contractor prior to construction. The ECOPlan will detail the specific waste stream and hazardous management procedures applicable to the contractor's scope of work and work plan. Anticipated wastes include cement, concrete, wood products, oils, fluids, and asphalt. All waste materials will be retained in appropriate containment onsite and then transferred to appropriate recycling or disposal facilities at appropriate times during the project.

Maintenance work during the operational phase will also produce wastes. Road works and resurfacing will be conducted in accordance with Alberta Transportation standards and the contractor will be required to dispose of waste asphalt or other materials in appropriate locations, similarly to what was prescribed for the construction phases. Spills and other wastes associated with the road users will be handled according to applicable provincial and federal regulations.

2.5 Construction, Operation, Decommissioning and Abandonment

2.5.1 Anticipated Scheduling

The environmental assessment work and historical resources assessment and mitigation work is expected to be completed by December 31, 2014. The highway right-of-way and clearance area will be surveyed and marked in 2015, with concurrent clearance of the alignment right-of-way followed by grade construction and watercourse crossings. Completion of Phase 1 of the highway construction (gravel surfaced roadway) is anticipated for 2016, at which time the operational phase will commence. Phase 2 construction (asphalt paving) has not been scheduled, and will depend on traffic use and

funding availability. Staging areas for construction materials and equipment will be specified in the Environmental Impact Statement, and will be within the assessment area. Additional details of the scheduling and staging will depend on the outcomes of information resulting from aboriginal and community consultation, environmental assessments, and budget planning, and will be provided in the Environmental Impact Statement.

Road building and infrastructure construction works are not seasonally constrained, and may occur in any season. Timing constraints may be placed on select aspects of the project and will be stipulated by the environmental assessment and the associated authorizations or approvals. Proposed timing constraints will be stated in the Environmental Impact Statement.

The operation of the highway is anticipated to start in late 2016, and is intended to continue indefinitely. There will be no decommissioning and abandonment phases.

2.5.2 Main Activities in Each Phase

Construction activities will include vegetation clearance (trees, shrubs, herbs); excavating; grading; de-watering of wetlands, streams, ponds and saturated soils; drilling at bridge sites; piling installation; infilling of depressions and stream crossing structure approaches; and installing stream crossing and other structures. This work will utilize earthen materials from borrow excavations and quarries near the site. Gravel and riprap materials if required will come from an aggregate source; the locations have not yet been determined. Materials such as geotextile and geo-products, culverts, bridge and overpass components, cement, precast concrete products, asphalt, and fuel will come from suppliers selected by the contractor.

Reclamation works, where required, will occur in accordance with all applicable legislation.

Operation of the completed highway will include maintenance activities. Roadway runoff and ditch maintenance will involve use of labour and machinery. Snow clearing will involve use of snowplows, with sand and/or road salts applied in accordance with Alberta Transportation standards and specifications. Road maintenance activities will be scheduled as required throughout the operational stage of the project. Road maintenance could involve use of machinery and any of the associated materials identified for use in the construction phase.

The requirement for illumination will be determined through the detailed design process. If illumination is required for the project then there will be some energy needs, resulting in a requirement for construction of electrical infrastructure.

Toxic or hazardous materials may be used during the construction and would include the fuel and associated fluids to operate the construction and maintenance machinery, cement used for the construction, asphalt for the paving, and road de-icing chemicals used during the operation. All of these materials would be used in accordance with federal and provincial regulatory requirements.

Toxic, hazardous, or otherwise dangerous materials may also come into play since the roadway is a transportation corridor intended to transport goods. It is possible that vehicles using the highway could be hauling toxic substances. In Canada the transport of toxic substances is controlled by the Transportation of Dangerous Goods regulations. Transporters are in many cases required to have protection measures, including response plans and spill containment plans in place.

3 Project Location

3.1 Project Location

The south end of the Project is located at the existing junction of Highway 16 and Highway 47, about 10 km west of Edson, Alberta. The north end of the Project is at an existing bridge across the Athabasca River, west of Whitecourt, Alberta. The proposed alignment is shown in Figure 2, with more detailed maps in Appendix 1.

3.1.1 Coordinates

The south end of the Project is at the edge of Highway 16, at 53° 34' 06" N 116° 34' 52.53" W; also UTM Zone 11u.527732.5935568. It is at the corners of SE 16 53 18 W5M, SW 15 53 18 W5M, NE 9 53 18 W5M, and NW 10 53 18 W5M.

The north end of the Project is at the north end of an existing bridge across the Athabasca River, at 54° 09' 12" N, 116° 35' 56" W; also UTM Zone 11u.526205.6000657. It is in NW 35 59 18 W5M.

3.1.2 Overview Site Map

Figure 1 shows an overview of the proposed alignment of Highway 947, with more detailed maps in Appendix 1.

3.1.3 Detailed Site Maps

Maps showing details of the proposed alignment are provided in Appendix 1. These maps include, where applicable and known:

- watercourses and waterbodies, with their names;
- linear and other transportation components (e.g., airports, ports, railways, roads, electrical power transmission lines and pipelines);
- other features of existing or past land use (e.g. commercial development, houses, industrial facilities, residential areas and any waterborne structures; confidential archaeological sites are not shown);

- location of Aboriginal groups, settlement land (under a land claim agreement) and, if available, traditional territory;
- federal land including, but not limited to National parks, National historic sites, and reserve lands;
- nearby communities;
- permanent, seasonal or temporary residences;
- fisheries and fishing areas (i.e., Aboriginal, commercial and recreational);
- environmentally sensitive areas (e.g., wetlands, and protected areas, including migratory bird sanctuary reserves, marine protected areas, National Wildlife areas, and priority ecosystems as defined by Environment Canada); and,
- provincial and international boundaries.

3.1.4 Photographs of Representative Work Sites

Photographs of representative areas along the highway are provided in Appendix 2.

3.1.5 Legal Descriptions of Land to be used for the Designated Project

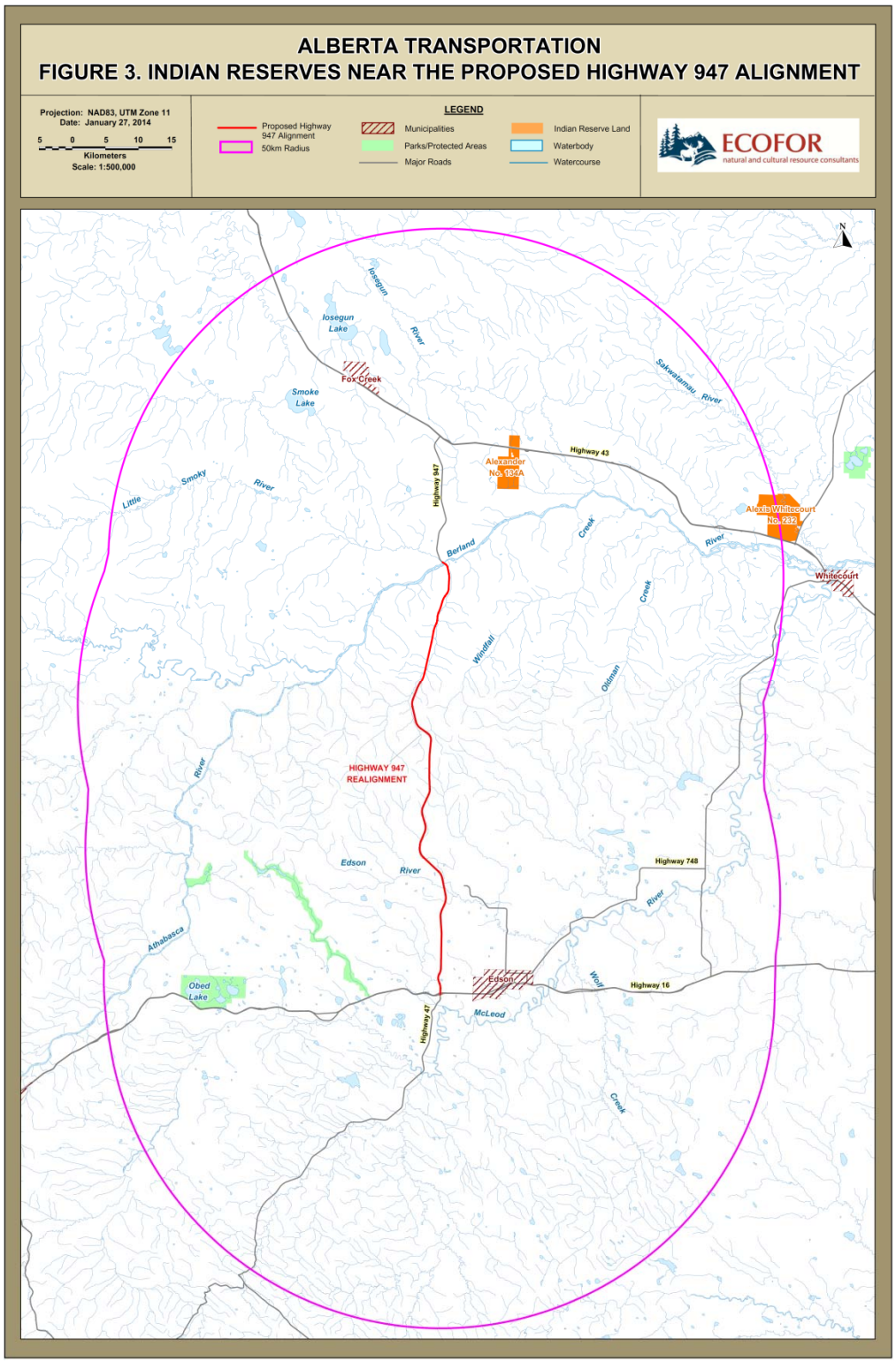
The land to be used for the Project is mostly Crown land, with various rights confirmed to others through permits and licences. The maps in Appendix 3 show the land dispositions.

3.1.6 Proximity to Residences, Aboriginal Lands, and Federal Lands

The Project is not in close proximity to any Federal Lands or Aboriginal Lands (Figure 3). The closest reserve is approximately 19 km to the northeast of the north end of the project, with another approximately 49 km to the east. The aboriginal groups with asserted traditional territories in the area are listed in Section 6.

The nearest urban area is the community of Edson, 10 km east of the south end of the project. The community of Fox Creek is about 30 km northwest of the north end of the Project, and Whitecourt is about 55 km east of the north end. One residence is directly impacted. The highway is generally located distant from residential and urban areas.

Figure 3. Indian Reserves near the Proposed Highway 947 Alignment



ALBERTA TRANSPORTATION
FIGURE 3. INDIAN RESERVES NEAR THE PROPOSED HIGHWAY 947 ALIGNMENT

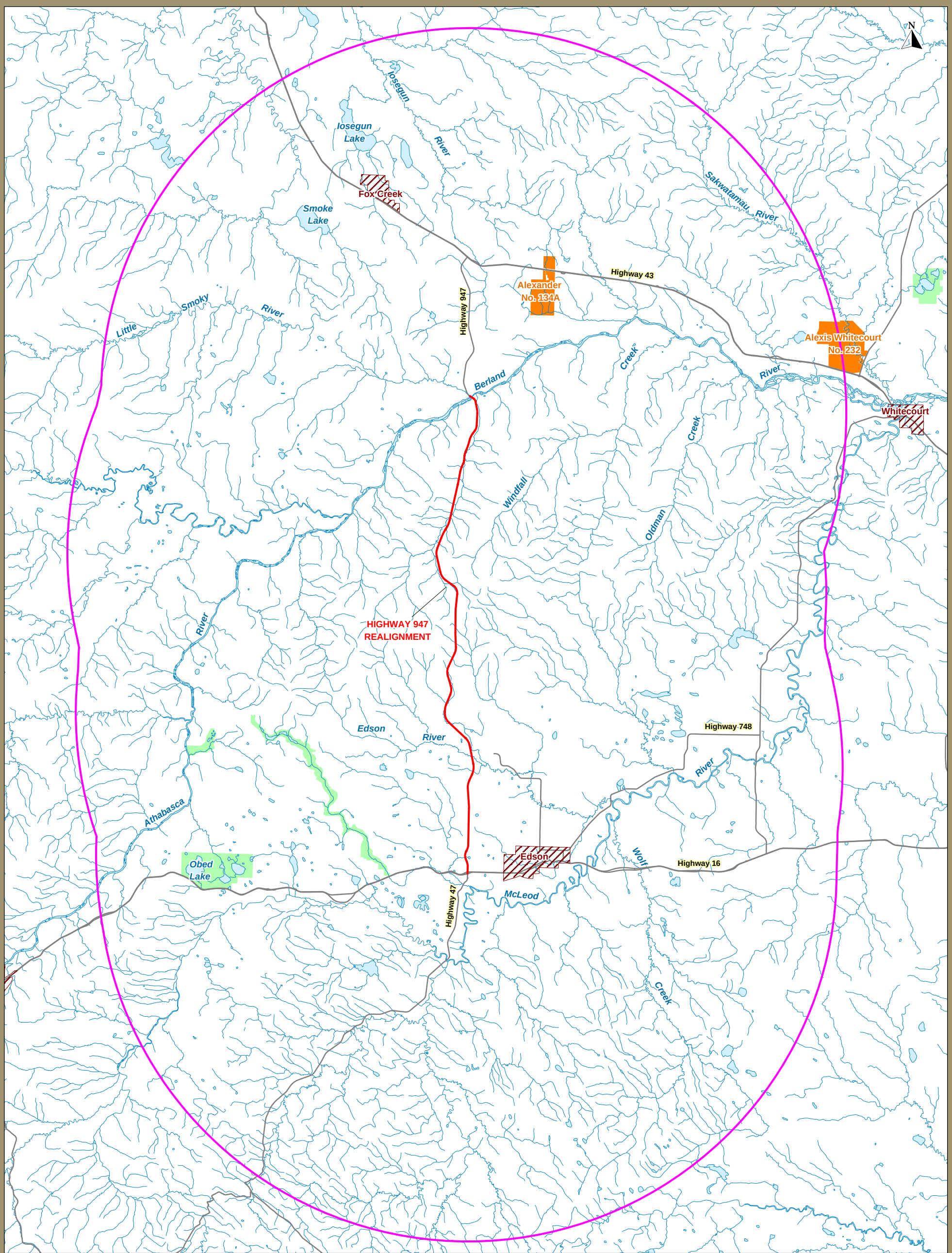
Projection: NAD83, UTM Zone 11
Date: January 27, 2014

5 0 5 10 15
Kilometers
Scale: 1:500,000

LEGEND

- Proposed Highway 947 Alignment
- 50km Radius
- Municipalities
- Parks/Protected Areas
- Major Roads
- Indian Reserve Land
- Waterbody
- Watercourse

ECOFOR
natural and cultural resource consultants



3.2 Land and Water Use

The study area encompasses land located from Highway 16, 10 km west of the community of Edson, north to an existing bridge across the Athabasca River, south of the community of Fox Creek. The majority of the land is Crown forest land, with significant disturbance from corridors for power transmission lines, oil and gas access roads, and pipelines. There are minor components of industrial, agricultural, and residential development.

The majority of the land is undeveloped. There is one residence directly along the route alignment. The house itself will not be directly impacted, but the associated fields and a small chicken coop/horse barn will be affected. A small A-frame cabin will be right along the edge of the development. There is a network of oil, gas and forestry roads that will be impacted throughout the Project area, as well as oil and gas pipelines. No oil and gas wells are directly impacted, and no other forestry infrastructure.

3.2.1 Zoning Designations

There are no Zoning Designations for the Project area.

3.2.2 Current Land Ownership, including Subsurface Rights

A Provisional Roadway Reservation (RDS11935) to protect the alignment from development was approved on April 15, 1999. A Ministerial Order was signed on April 21, 1999 which places SH947 under the Direct Control and Management of the Minister of Alberta Infrastructure (Appendix 4).

3.2.3 Land Use, Water Use, and Resource Management / Conservation Plans

The maps in Appendix 3 show the land dispositions.

There are no national, provincial, or other designated parks within the project area.

The area adjacent to the Athabasca River is a designated wildlife key area for biodiversity values. The bridge and its approaches are already in place; hence very little or no new impact on the biodiversity values is anticipated to occur as a result of this project. Another designated wildlife key area for biodiversity values is just to the east of the study area, north of the Edson River crossing. The highway construction will not affect this area.

A provincial special access zone is a short distance west of the study area, over Little Sundance Creek near the south end of the Project area. The reason for the special access zone is unknown at this time; the information appears to be confidential. The highway is not expected to affect this zone.

3.2.4 Marine Terminal

This project does not involve a marine terminal.

3.2.5 Canada Marine Act

This project does not take place within the water or lands administered by a Canada Port Authority under the Canada Marine Act and its regulations.

3.2.6 Land Used for Traditional Purposes by Aboriginal Peoples

The proposed alignment of Highway 947 falls within the asserted traditional territories of the Alexander First Nation, Alexis Nakota Sioux Nation, Enoch Cree Nation, Louis Bull Tribe, Montana First Nation, Paul First Nation, Saddle Lake First Nation, Samson Cree Nation, and Sunchild First Nation; all of which are signatory members of Treaty 6, which was signed in 1876.

Treaty 6, one of sixty-eight (68) major historical treaty agreements signed between First Nations and the Government of Canada, was signed in two separate ceremonies in Forts Carlton and Pitt, Saskatchewan in 1876. The treaty pertains to signatory First Nations in central Saskatchewan and central Alberta. Signing the treaty meant a surrender of title in exchange for reserve lands. Treaty 6 also featured the "medicine chest clause" which was interpreted by the First Nations to mean that the Canadian Government was obligated to and intended on providing ongoing healthcare to the Nations (Dickason 1992; Indian Claims Commission 2005).

The Alexander and Enoch Cree Nations are affiliated with the Woodland Cree group of First Nations, while the Louis Bull Tribe, Montana, Saddle Lake, Samson Cree, and Sunchild First Nations are part of the Plains Cree. All of the above Nations are part of the linguistic group called the Algonquian Cree (Government of Alberta 2014).

The Algonquian Cree language is spoken from as far west as the coast of James Bay and east to the foot of the Rocky Mountains. The linguistic area covers the northern boreal forests of Ontario and Manitoba, as well as the prairies of Alberta and Saskatchewan. Cree speakers are found throughout the central Western Subarctic cultural area and in the Plains to the south. Nearly half of its speakers communicate in the Plains Cree dialect, while other variations in the language are generally referred to as: Swampy Cree, Woods Cree (or Woodland Cree), and Moose Cree (Wolfart 1996).

The Paul First Nation and Alexis Nakota Sioux Nation, on the other hand, belong to the Stoney, or more formally “Dakota”, group of Nations and the linguistic group Siouan Dakota. The Siouan Dakota linguistic group is found in small pockets throughout southern central Canada and south

into the United States, particularly Minnesota, eastern Nebraska, and North and South Dakota (Lewis et al. 2013). The Alexis Nakota Sioux Nation is the most northern representative of the Souian language family, while the Paul First Nation has links to the Algonquian Cree linguistic group (Alexis 2012; Government of Alberta 2014).

Subsistence practices relied heavily on hunting of large game, particularly buffalo which were abundant in the area. The dependence on buffalo required a mobile lifestyle as people had to follow the food source seasonally. Buffalo meat was typically dried, pounded, and mixed with fat to make pemmican. Dried berries were often added for taste. Hunting of other game animals and gathering of berries and vegetables were other means of acquiring food. Men were responsible for hunting whereas women would do the gathering and cooking, sew clothing, make tools, and mind the children (Findlay 2007; Ridington 2013).

In winter and summer, people resided in conical shaped structures called tipis, which were constructed out of poles covered in rawhide, typically buffalo skin. Since people were semi-nomadic, these housing structures were ideal in that they could be easily assembled, disassembled, and relocated when necessary (Findlay 2007).

With the arrival of Europeans on the east coast in the 17th century, aboriginal peoples were indirectly affected by the newcomers through the migration of other groups westward and the transfer of new trade items. By the 19th century, people were fully engaged in the fur trade, which led to hunting of specific animals for trade and dependence on certain trade goods, such as weaponry (e.g. guns, knives), clothing, and eventually food. Other impacts of contact include the spread of European diseases such as smallpox and influenza, the adoption of Christianity, and the formation of alliances with the Europeans or in some cases, warfare (Ridington 2013). An early explorer and partner in the North West Company, Alexander Henry the Younger, kept ethnographic accounts of his experiences with the First Nations in Alberta in the early 1800s. These journals are available through the National Archives of Canada.

The Enoch Cree Nation, Alexander First Nation, Louis Bull Tribe, Saddle Lake First Nation, Montana First Nation, Alexis Nakota Sioux Nation, Samson Cree Nation and Sunchild First Nation are being involved in discussions regarding Highway 947.

The historic resources background research revealed one previously recorded archaeological site (FjQd-13) located approximately 3.5 km from the proposed alignment. One historic structure was said to be near the southern terminus of the project (Royal Northwest Mounted Police Post from 1911 was recorded to be within LSD 2 and 3, 9-53-18-W5M). However, no existing structure was previously recorded in the area and no archaeological sites were previously recorded within the planned alignment.

The historic resources background review and Statement of Justification presented to Alberta Culture (Appendix 15) identified approximately twenty-four stream crossings and areas of heritage interest to be investigated during field survey efforts along with pedestrian transects in other areas of lower disturbance and increased potential. Alberta Culture concurred with the Statement of Justification, and recommended a Historical Resources Impact Assessment for archaeological resources at the noted areas of interest as well as pedestrian transects in areas of least prior disturbance to survey for other areas of potential. Alberta Culture also directed Alberta Transportation to include a Historical Resources Impact Assessment for paleontological resources.

4 Federal Involvement - Financial Support, Lands and Legislative Requirements

4.1 Federal Financial Support

There is no proposed or anticipated federal financial support that federal authorities are, or may be, providing to the designated project.

4.2 Federal Lands

There is no federal lands that may be used for the purpose of carrying out the designated project, including no granting of interest in federal land (i.e., easement, right of way, or transfer of ownership).

4.3 Federal Legislative or Regulatory Requirements that may be Applicable

4.3.1 Canadian Environmental Assessment Act (Canada)

Highway 947 may be required to meet the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in the *Regulations Designating Physical Activities*.

4.3.2 Fisheries Act

Fish and fish habitat, as defined under the Fisheries Act, will be impacted during construction of stream crossings. For some of the streams a *Notification* will be all that is required; for other streams an *Authorization* may be required.

4.3.3 Navigable Waters

Watercourses will be assessed under the criteria of the Navigable Waters Protection Act to determine if they may be deemed navigable. If they are deemed navigable, Transport Canada approval may be required for stream crossing structures.

4.3.4 Migratory Birds Convention Act

Highway 947 will pass through habitat used by birds that are protected under the *Migratory Birds Convention Act*. A permit authorizing destruction of nests of birds may be required, should any active nests of migratory birds be impacted. Mitigation measures will be undertaken to avoid any disruption or destruction.

5 Environmental Effects

5.1 Physical and Biological Setting

5.1.1 Air

Air quality data has not been collected for this Project. A cursory office assessment of likely sources of air pollution was completed. Field work conducted in 2012 and 2013 did not note any major sources of air pollution. Data from existing industrial site air quality monitoring has not been compiled for this Project Description.

The air quality is apparently generally good, with the predominant air flow moving eastward from the Rocky Mountains towards the prairies. There are no large urban areas or industrial centers to the west, from which large-scale pollution can be carried. The nearest large urban center is Edmonton, AB, about 200 km to the east; little influence on air quality in the Project area can be expected on the rare occasions when the winds are from the east. Gas production flaring likely produces some air pollution. Dust is currently generated by traffic on local unpaved resource roads; the traffic includes a high proportion of heavy truck traffic. The Environmental Impact Statement will provide further details regarding air quality impacts and proposed mitigation measures.

5.1.2 Water

5.1.2.1 HYDROGEOLOGY

A literature review of publications and mapping relevant to the hydrogeology of the Project area was conducted. Sources of information included the Alberta Geological Survey, Alberta Agriculture and Rural Development, Alberta WaterPortal, Alberta Environment and Sustainable Resource Development, Environment Canada and numerous papers and reports.

Groundwater results from precipitation and surface water percolating into the ground where it occupies interstitial spaces between sand and gravel and collects in crevices and cracks in rocks and typically occurs within 100 meters of the earth's surface (Environment Canada, 2011). The water table is defined as the level below which all pore spaces or fractures are filled with water. The area above the water table is the unsaturated zone which contains air and water and the area below is the saturated zone. Water cannot be pumped from wells in the unsaturated zone as it is held too tightly by capillary forces. Groundwater flows slowly through the saturated zone where it can reach the surface as springs and seeps. Wetlands are created when groundwater interacts with a depression in the land surface that cannot be quickly drained. Wetlands interact with groundwater where they can serve as receptors for discharge or act as important recharge areas.

The largest stores of groundwater are found in aquifers which are underground formations of permeable rock or loose material which contain significant quantities of water in the saturated zone. Aquifers located close to the land surface tend to yield greater quantities of water than those at greater depths, because the cracks or voids tend to be much smaller due to the weight of the overlying rock and therefore yield smaller amounts of water. Aquifers are tapped by wells and provide an important source of fresh water for domestic, agricultural and industrial use in Alberta. Alberta Environment and Sustainable Resource Development has published an interactive map of water well locations, drilling reports and baseline water well test results for the province and these can be viewed online at: http://groundwater.alberta.ca/WaterWells/.

Physiography and topography

The proposed Highway 947 alignment is located in west central Alberta within three physiographic regions. The Western Alberta Plains, Southern Alberta Uplands and Eastern Alberta Plains (Pettapiece, 1986). The southern and northern portions of the alignment are located within the bedrock plains near Edson and Athabasca Rivers, respectively. These plains are characterized by an undulating, gently sloping bedrock surface. The central section of the alignment is located in the moderately sloping bedrock uplands. The Alberta landscape in the area of the Highway 947 alignment is strongly influenced by the topography of the bedrock plains and uplands areas (Atkinson and Lyster, 2010).

Bedrock geology

Mapping by Prior et al. (2013) indicates that the project lies within the Paleogene Paskapoo Formation of the Central Plains. This formation is composed of nonmarine mudstone and siltstone with lesser amounts of thick to thinly bedded sandstone, conglomerate, mollusc coquina and coal. The Paskapoo Formation is a significant bedrock aquifer system which covers approximately 10% of Alberta and tapers from the east (zero thickness) into a wedge more than 800 m thick along the edge of the Rocky Mountains (Lyster and Adnriashek, 2010). The formation is made up of three members. The upper coal bearing Dalehurst Member, middle fine grained, mudstone Lacombe Member and lower coarse grained Haynes Member. The coarse grained nature of the Haynes member facilitates fluid passage into the Paskapoo aquifer system.

Surficial geology

The proposed Highway 947 is principally located in glacially derived materials. Mapping by Roed (1970) indicates that the southern portion of the project is located in Edson Till, Mayberne Till and lacustrine deposits. Both till deposits are from continental sources containing granite and high grade metamorphic rocks from the Canadian Shield. The Edson Till also includes quartzite and small amounts of limestone in a silty clay matrix. Metaquartzite is found in the silty, sandy clay matrix of the Mayberne Till. Lacustrine materials include clay, silt and sands which may be laminated in some areas. Smaller amounts of crossbedded sand, pebbly sand with clay and silts are found in deltaic deposits. Surficial geology mapping by Utting (2013) indicates that the northern portion of the alignment is located in morainal, glaciofluvial, colluvial and eolian deposits with small bedrock outcrops. The morainal material is composed of diamicton containing a mixture of clay, silt, sand and minor pebbles, cobbles and boulders. Glaciofluvial deposits contain sand and gravel with minor amounts of silt. A small deposit of eolian derived medium to fine grained sand with minor amounts of silt exists at the most northerly point of the proposed alignment. Slope or slump deposits of pre-existing bedrock, till, glaciolacustrine, glaciofluvial and eolian sediment comprise the colluvial sediments.

Aquifers

There are three main types of aquifers. Alluvial aquifers consist of unconsolidated near surface sand and gravel deposits which commonly exist along river beds. These deposits tend to be highly permeable due to the large void spaces between the sand and gravel and are therefore able to hold large amounts of water. Alluvial aquifers tend to yield significant quantities of fresh water because they are located close to the surface.

A network of buried channels formed in western Alberta prior to and during the last glaciation (Late Wisconsin) from glacial meltwater erosion during periods of warming (WorleyParsons, 2011). Deposits of sand and gravel from outwash plains and fluvial channels were laid down during several episodes of glacial advance and retreat of the Laurentide Ice Sheet. Deposits of less permeable till were deposited over these sands and gravels during deglaciation creating confined aquifers. These buried channel aquifers are present in the Athabasca River Basin in the vicinity of the Highway 947 alignment.

The bedrock aquifers in the study area are typically comprised of thick alternating sequences of sandstone, siltstone and shale deposited in the foreland basin of the Western Canadian Sedimentary Basin (WorleyParsons, 2011). Water in these aquifers is located in the spaces between the grains or in bedrock fractures. The Highway 947 alignment passes over the extensive Paskapoo bedrock aquifer system. The Paskapoo Formation has transmissivity values of 1.5 m^2/d to 15 m^2/d and safe yields of 0.4 L/s to 2 L/s (Vogwill, 1983) and is one of the most important aquifers in Alberta.

Groundwater flow direction

Groundwater flow is driven by the difference in energy between two points. Regional geology and topography of an area will generally dictate the flow direction. The general direction of flow in the

study area is from southwest to northeast, however, a more detailed analysis of topographic and piezometric data would better define local flow patterns.

Regional groundwater supply

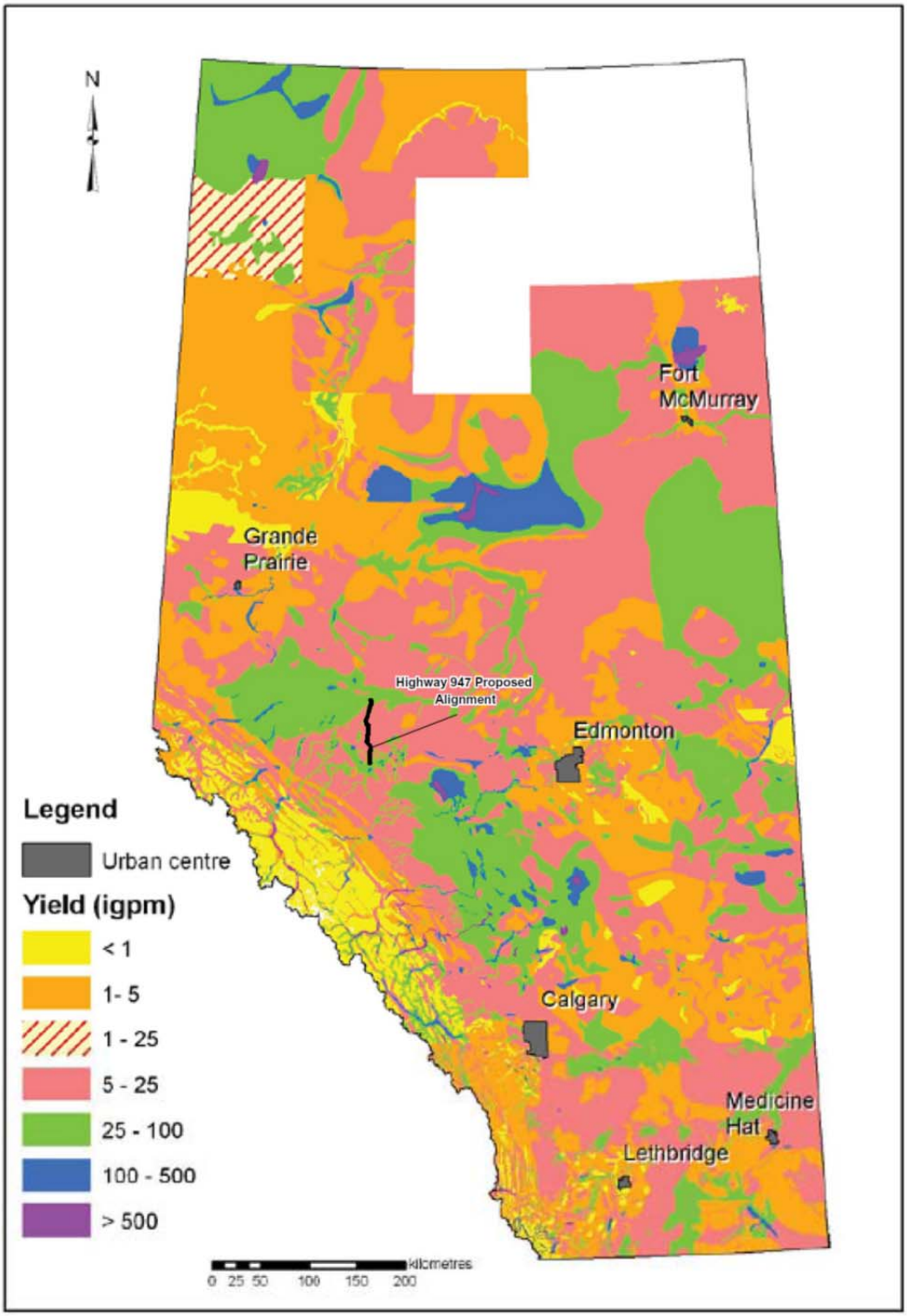
It is estimated that 21.1% of Albertans are reliant on groundwater as a fresh water source (Environment Canada, 2013). The Alberta Government launched the Provincial Groundwater Inventory Program in 2008 to help better understand the groundwater systems in the province. In addition, the Energy Resources Conservation Board compiled all existing groundwater data and maps into one document (Lemay and Guha, 2009). A map illustrating the compilation of water-well yields in Alberta is shown on Figure 3. Maps illustrating the distribution of alluvial sand and gravel deposits, buried channel deposits and major bedrock aquifers are available in WorleyParsons (2011).

Groundwater quality

Groundwater quality is affected by the depth from ground surface, permeability and chemical makeup of the sediments it travels through and climatic variability. Groundwater becomes more mineralized the longer it is in contact with sediments therefore shallower aquifers will typically have lower amounts of total dissolved solids (TDS) than those at a greater depth. Similarly, water moving through sediments with a low permeability also results in greater TDS than highly permeable sediments due to the amount of time water is in contact with the sediment. The chemical makeup of the minerals also affects the amount and rate of mineralization that will occur. Sodium, sulfate and chloride increase the rate of mineralization and thus aquifers with high concentrations of these elements will result in water with higher TDS (Alberta Agriculture and Rural Development, 2013). Groundwater quality is affected by variability in annual rainfall and evaporation rates. In arid or semi-arid regions groundwater is evaporated at the surface resulting in higher concentrations of minerals being deposited in the surficial materials or soils. Precipitation dissolves these minerals and transports them to the saturated zone thus increasing the mineral concentration in the groundwater. Generally speaking, groundwater in areas where precipitation is greater than evaporation has lower mineral concentrations than those in drier regions. Additional information regarding groundwater quality is published on the Alberta Agriculture and Rural Development website (http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wwg406#movement).

Alberta Environment and Sustainable Resource Development maintains a database of all water wells drilled in the province through the Alberta Water Well Information Database (http://groundwater.alberta.ca/WaterWells/). Active and inactive water well drilling reports, chemical analysis reports up to the end of 1986, springs, flowing shot holes, test holes and pump test records can be downloaded using the interactive map. The Groundwater Observations Well Network is an Alberta Government owned network of groundwater monitoring wells. Regional technologists maintain the wells, collect and summarize the data. Groundwater levels and water quality data is available online for active and inactive wells in this network (http://environment.alberta.ca/apps/GOWN/). Data for the wells in the vicinity of the Highway 947 project was not downloaded, analyzed and summarized for the Project Description.

Figure 4. Compilation of water well yields in Alberta, with Highway 947 Alignment (modified from Lemay and Guha 2009)



5.1.2.2 HYDROLOGY

The initial description of the hydrological setting has been based on an office analysis of existing discharge data and regional analyses. The drainage areas of watersheds upslope of the highway were calculated from digital 1:20,000 scale topographic mapping provided for this project by ARA Engineering Ltd.

Regional drainage setting

The Water Survey of Canada (WSC) operates or has compiled data from a network of hydrometric stations in the vicinity of the study area (Figure 4). The available information at these sites is summarized in Table 1. The four discontinued stations located immediately west of the proposed Highway 947 alignment were operated by the Canadian Forestry Service and some additional data, not contained in the WSC database, is available in the report by Hillman *et al*. (1978). Selected streamflow characteristics for Alberta were compiled by Neill *et al.* (1970) and provide a useful template for future analyses (as the data used in this document have now been superceded). Hudson and Trevor (1984) investigated peak flows in small drainages in north-central Alberta based on high water marks at culverts. Their study area includes the proposed highway alignment, but collected information is from the surrounding area. A variety of regional studies have used the available precipitation and runoff data to estimate streamflows in ungauged basins. The Alberta Water Portal (http://www.albertawater.com) provides links to a variety of these reports and related mapping. Relevant documents include reports by Kienzle (no date); Lapp and Kienzle (no date) and Abbaspour *et al.* (2010).

Average Annual Runoff

The spatial variation in average annual runoff (expressed as $m^3/km^2/yr$) is illustrated on Figure 5 along with the approximate location of the proposed highway alignment. This map is based on analysis of WSC streamflow data and naturalized streamflow data presented in Seneka (2004). The analysis indicates that the mean annual runoff increases from 117,000 $m^3/km^2/yr$ in the south to 152,000 $m^3/km^2/yr$ in the northern section of the alignment. These values correspond to average annual runoff depths of 117 to 152 mm which is approximately 20 to 30% of the average annual precipitation[5].

Seasonal Variation in Discharge

The seasonal variation in discharge observed at selected WSC hydrometric stations is illustrated in Figure 6. This analysis indicates that the snowmelt freshet dominates the annual hydrograph in larger streams such as Sundance Creek or Athabasca River. Streamflow begins to increase in March or April, typically peaks in June or July and reaches winter base flow conditions by November or December. Precipitation events augment streamflow throughout the open water periods and can result in substantial flood flows during the height of the snowmelt in May, June or July.

[5] National Climate Data and Information Archive. accessed February 2013. Canadian Climate Normals or Averages 1971-2000. http://climate.weatheroffice.gc.ca/climate_normals/index_e.html.

Figure 5. Location of Water Survey of Canada Hydrometric Stations

(data from http://www.ec.gc.ca/rhc-wsc/default.asp?lang=En&n=894E91BE-1)

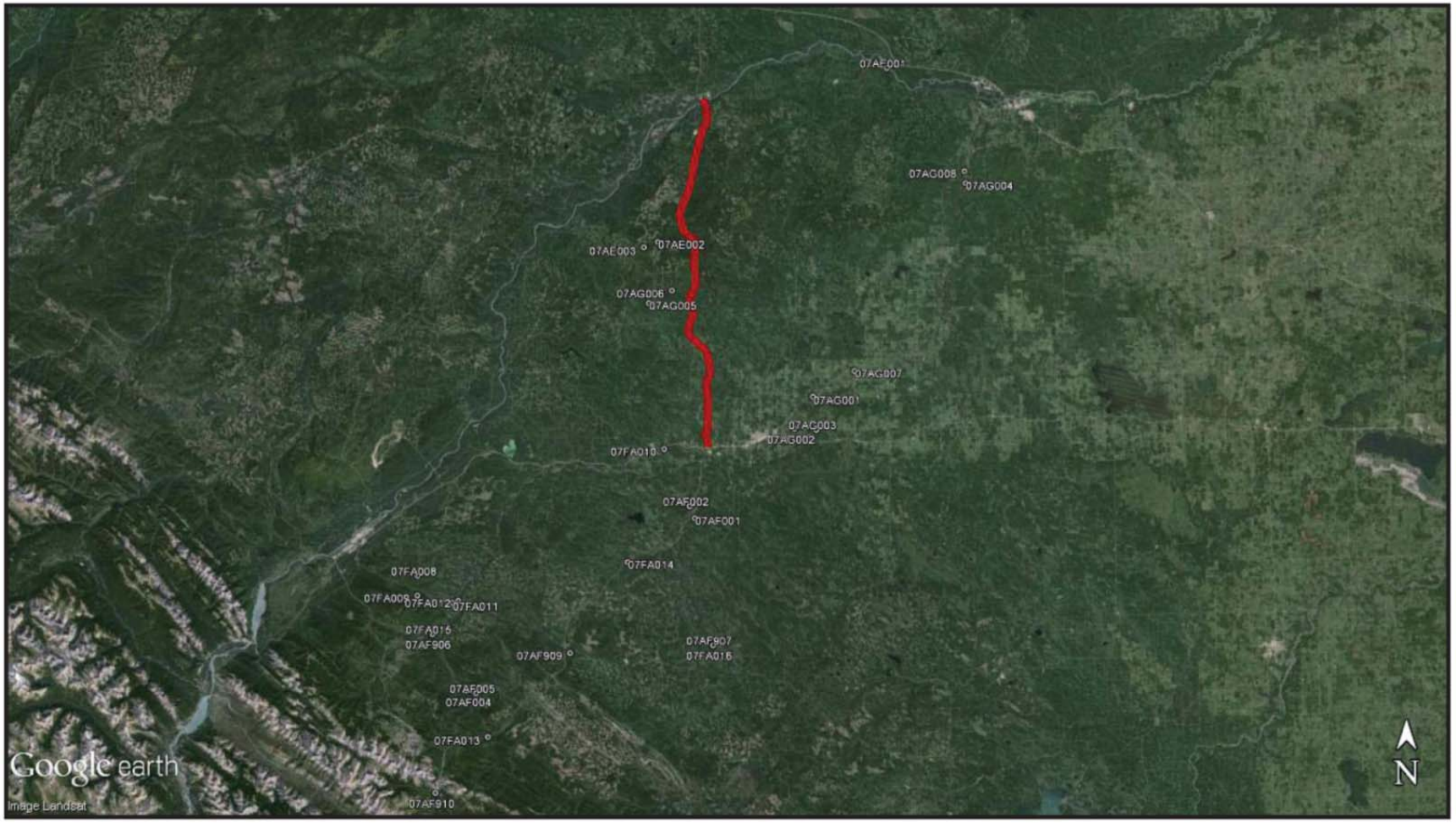


Figure 6. Alberta Water Yield per Square Kilometer (Kienzle, no date)

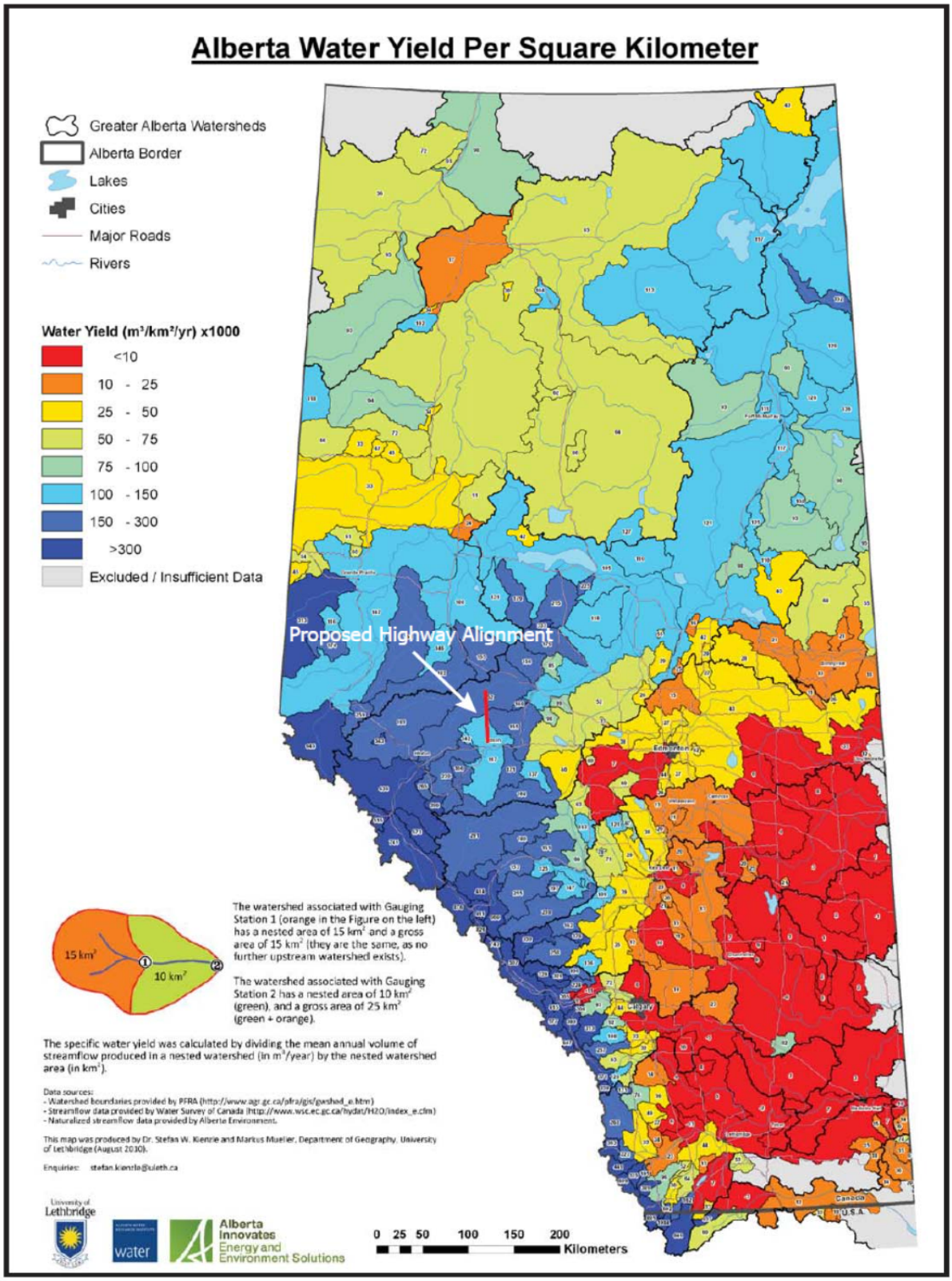
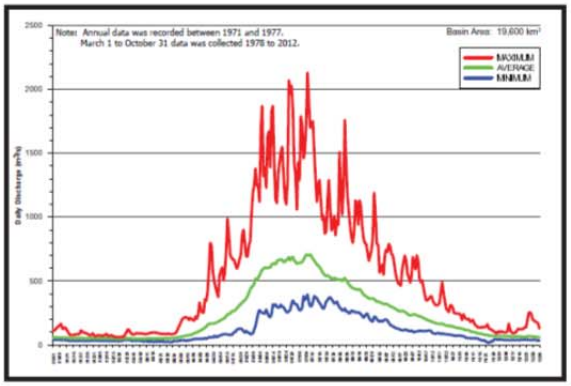
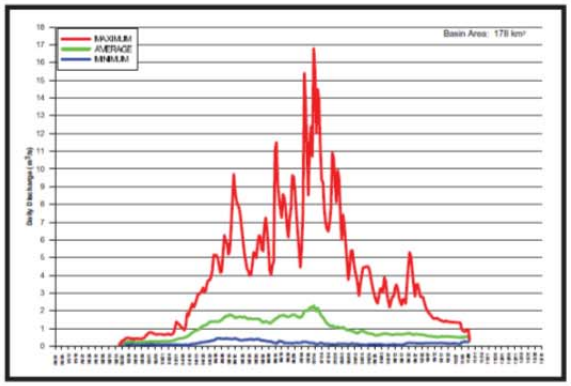


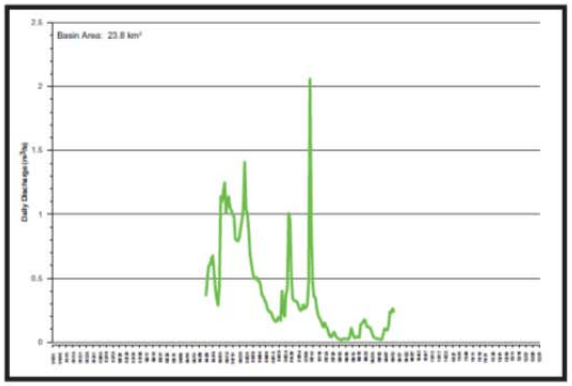
Figure 7. Seasonal Variation in Streamflow at Water Survey of Canada Stream Gauging Stations



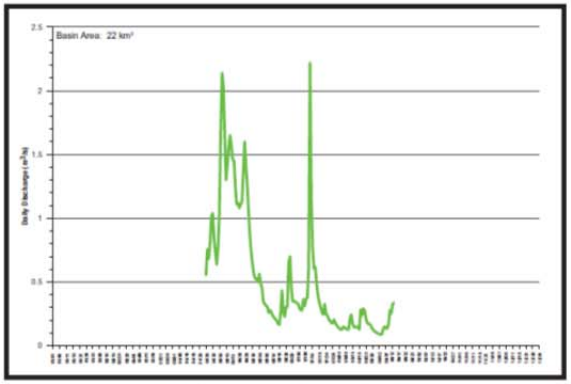
Athabasca River near Windfall (07AE001), 1960 to 2011



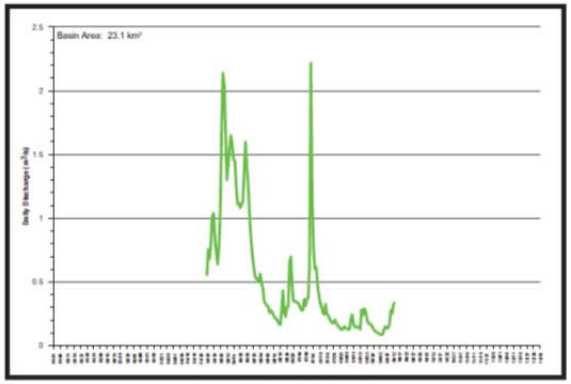
Sundance Creek near Bickerdike (07Af010), 1972 to 2011



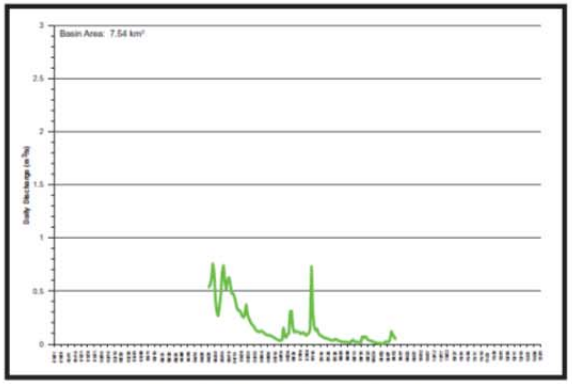
Hinton Study Basin No: 6 (07AE002), 1974



Hinton Study Basin No: 7 (07AE003), 1974



Hinton Study Basin No: 8 (07AG005), 1974



Hinton Study Basin No: 9 (07AG006), 1974

Table 1. Summary of Information Available at Regional Water Survey of Canada Hydrometric Stations

Station number	Station name	Active or discontinued	Gross drainage area (km.sq.)	Regulation type	Period of record (Regulation)	Real-time data available	Sediment data available	Record length	Period of record (attributes)	Operational schedule	Gauge type
07AE001	ATHABASCA RIVER NEAR WINDFALL	Active	19,600.00	Natural	1960 - 2013	Yes	Yes	8 years 10 years 36 years	1960 - 1967 1968 - 1977 1978 - 2013	Continuous Continuous Seasonal	Manual Recorder Recorder
07AE002	HINTON STUDY BASIN NO.6	Discontinued	23.80	Natural	1974 - 1974	No	No	1 years	1974 - 1974	Seasonal	Recorder
07AE003	HINTON STUDY BASIN NO.7	Discontinued	22.00	Natural	1974 - 1974	No	No	1 years	1974 - 1974	Seasonal	Recorder
07AF001	EMBARRAS RIVER NEAR MCLEOD RIVER	Discontinued	1,860.00	Natural	1913 - 1919	No	No	7 years	1913 - 1919	Miscellaneous	Manual
07AF002	MCLEOD RIVER ABOVE EMBARRAS RIVER	Active	2,560.00	Natural	1954 - 2013	Yes	Yes	1 years 18 years 41 years	1954 - 1954 1955 - 1972 1973 - 2013	Seasonal Continuous Continuous	Manual Manual Recorder
07AF003	WAMPUS CREEK NEAR HINTON	Active	25.90	Natural	1966 - 2013	No	Yes	48 years	1966 - 2013	Seasonal	Recorder
07AF004	DEERLICK CREEK NEAR HINTON	Discontinued	14.00	Natural	1966 - 1991	No	Yes	26 years	1966 - 1991	Seasonal	Recorder
07AF005	EUNICE CREEK NEAR HINTON	Discontinued	17.10	Natural	1967 - 1993	No	Yes	27 years	1967 - 1993	Seasonal	Recorder
07AF008	QUIGLEY CREEK NEAR HINTON	Discontinued	15.30	Natural	1972 - 1974	No	No	3 years	1972 - 1974	Seasonal	Recorder
07AF009	NORTH ANDERSON CREEK NEAR HINTON	Discontinued	10.60	Natural	1972 - 1974	No	No	3 years	1972 - 1974	Seasonal	Recorder
07AF010	SUNDANCE CREEK NEAR BICKERDIKE	Active	178.00	Natural	1972 - 2013	No	No	42 years	1972 - 2013	Seasonal	Recorder
07AF011	HINTON STUDY BASIN NO.15	Discontinued	19.70	Natural	1974 - 1974	No	No	1 years	1974 - 1974	Seasonal	Recorder
07AF012	HINTON STUDY BASIN NO.16	Discontinued	8.05	Natural	1974 - 1974	No	No	1 years	1974 - 1974	Seasonal	Recorder
07AF013	MCLEOD RIVER NEAR CADOMIN	Active	330.00	Natural	1984 - 2013	No	No	30 years	1984 - 2013	Seasonal	Recorder
07AF014	EMBARRAS RIVER NEAR WEALD	Active	640.00	Natural	1984 - 2013	No	No	30 years	1984 - 2013	Seasonal	Recorder
07AF015	GREGG RIVER NEAR THE MOUTH	Active	384.00	Natural	1986 - 2013	No	No	28 years	1986 - 2013	Seasonal	Recorder
07AF016	ERITH RIVER BELOW HANLAN CREEK	Discontinued		Natural	1986 - 2013	No	No	5 years	1991 - 1995	Seasonal	Recorder
07AF906	GREGG RIVER NEAR HINTON	Discontinued	364.00	Natural	1986 - 2013	No	No	2 years	1984 - 1985	Seasonal	Recorder
07AF907	ERITH RIVER BELOW HANLAN CREEK	Discontinued	595.00	Natural	1984 - 1990	No	No	7 years	1984 - 1990	Seasonal	Recorder

07AF909	EMBARRAS RIVER AT ROBB	Discontinued	123.00	Natural	1984 - 1988	No	No	5 years	1984 - 1988	Seasonal	Recorder
07AF910	WHITEHORSE CREEK NEAR CADOMIN	Discontinued	115.00	Natural	1985 - 1987	No	No	3 years	1985 - 1987	Seasonal	Recorder
07AG001	MCLEOD RIVER NEAR WOLF CREEK	Discontinued	6,310.00	Natural	1913 - 1983	No	Yes	1 years 1 years 9 years 8 years 1 years 11 years 1 years 14 years	1913 - 1913 1914 - 1914 1915 - 1923 1924 - 1931 1957 - 1957 1958 - 1968 1969 - 1969 1970 - 1983	Miscellaneous Seasonal Continuous Seasonal Seasonal Continuous Seasonal Continuous	 Manual Manual Manual Recorder Recorder Recorder Recorder
07AG002	MCLEOD RIVER NEAR EDSON	Discontinued	5,450.00	Natural	1954 - 1957	No	No	4 years	1954 - 1957	Continuous	Manual
07AG003	WOLF CREEK AT HIGHWAY NO. 16A	Active	826.00	Natural	1955 - 2013	Yes	No	32 years 25 years 1 years	1955 - 1986 1987 - 2011 2013 - 2013	Continuous Continuous Continuous	Manual Recorder Recorder
07AG004	MCLEOD RIVER NEAR WHITECOURT	Active	9,110.00	Natural	1968 - 2013	No	Yes	46 years	1968 - 2013	Seasonal	Recorder
07AG005	HINTON STUDY BASIN NO.8	Discontinued	23.10	Natural	1974 - 1974	No	No	1 years	1974 - 1974	Seasonal	Recorder
07AG006	HINTON STUDY BASIN NO.9	Discontinued	7.54	Natural	1974 - 1974	No	No	1 years	1974 - 1974	Seasonal	Recorder
07AG007	MCLEOD RIVER NEAR ROSEVEAR	Active	7,140.00	Natural	1984 - 2013	Yes	No	30 years	1984 - 2013	Continuous	Recorder
07AG008	GROAT CREEK NEAR WHITECOURT	Active	133.00	Natural	1984 - 2013	No	No	30 years	1984 - 2013	Seasonal	Recorder

The short term seasonal data from the four small (<24 km2) gauged watersheds in the vicinity of the proposed highway alignment suggest that the snowmelt freshet begins in late-March or early-April, peaks in mid-May and is more or less completed by mid-June. Subsequent open water flows are strongly influenced by rainfall activity with convective processes resulting in short-duration events which can exceed the snowmelt peak. Streamflows are substantially reduced by late-September.

Flood Chronology

It is useful to understand the chronology and magnitude of flood events when interpreting field data related to channel processes. The record of annual maximum daily and instantaneous data collected at the long term stations Athabasca River near Windfall (Figure 7) and Sundance Creek (Figure 8) indicate the timing of regional floods in these larger watersheds. These data suggest that sizeable flows occurred in 1965, 1972, 1980, 1982, 1997 and 2011. Return periods for these events have not been calculated, however, Alberta Transportation (2001, 2004) provides guidance on how these analyses should be undertaken. This can be a challenging task given the mixed population of events (snowmelt, large cyclonic storms and convective events) which can cause floods in this area of Alberta (see Nemanishen, 1977; Neill and Watt, 2001).

Data compiled by Alberta Environment and Sustainable Resource Development indicate that heavy precipitation associated with the June 2013 flood did not extend north into the study area (see Figure 9).

Flood Magnitude

Alberta Transportation has provided advice on how to determine hydrotechnical design criteria, including high water elevations, mean channel velocities and design discharge, for highway stream crossings. As discussed in Alberta Transportation (2006a):

> *"The design hydrotechnical parameters should be representative of the response to … a large flood event at the design site. This requires consideration of historic highwater observations in the hydrologic region and assessment of the site-specific response based on the nature of the basin and the nature of the channel supplying the flows to the site. The following techniques can be used to determine hydrotechnical design parameters for stream crossings:*
>
> - *Channel Capacity*
> - *Historic Highwater Observations*
> - *Basin Runoff Potential*
>
> *All three techniques provide a different way of estimating the nature of the largest historic response at a site. The channel capacity technique considers the physical capacity of the channel being crossed, which is a result of the flow history over an extended period of time. The historic highwater observations technique directly considers historic data. The basin runoff potential technique applies to the largest historic runoff data collected at gauge sites in the hydrologic region as an upper bound to the supply of runoff to a site. Therefore the resulting design parameters can be considered 'equivalent to the largest historic event'. A return period (or probability of exceedance) is not required."* (AT, 2006a, page 1)

Discharge estimates based on channel capacity and historic high water observations require field work which should be undertaken in the next phase of this project. However, in situations where *"the runoff response may not reach the channel capacity estimate under design conditions" (AT, 2006a, page 6)* unit discharges can be estimated based on a Runoff Depth Map prepared by Alberta Transportation (2006b). This map, which reflects the maximum expected runoff from snowmelt or precipitation, is presented as Figure 10.

As discussed in Alberta Transportion (2006b):

"Unit discharges can be estimated for each area on the runoff depth map as follows:

$q\ (cms/km^2) = d/(3.6*T_p)$

where 'd' is the design runoff depth (mm) and 'T_p' is the associated time to peak (hours). For example:

$d = 35\ mm,\ T_p = 40\ hrs,\ q = 0.25\ cms/km^2$

$d = 40\ mm,\ T_p = 20\ hrs,\ q = 0.55\ cms/km^2$

$d = 60\ mm,\ T_p = 20\ hrs,\ q = 0.83\ cms/km^2$

$d = 80\ mm,\ T_p = 20\ hrs,\ q = 1.1\ cms/km^2$

The upper bound to peak flow based on runoff supply, assuming no significant routing in the basin, can then be estimated by:

$Q_p = q * DA$

where DA is the gross drainage area for the basin (km^2)." (AT, 2006b, page 6)

The study area has a predicted flood runoff depth of 60 mm and the minimum design unit discharge using the AT procedure would therefore be 0.83 m^3/km^2, assuming the time to peak was 20 hours. However, this time of concentration will vary with basin area and site specific analyses will be required.

Alberta Transportation (2004) provides guidance on culvert sizing considerations once the design flow is known and this information will be used to assist in the design of highway crossing structures.

Stationarity

Keinzle (no date) reviewed how runoff values in the 30-years between 1971 and 2000 have compared to those recorded in the preceding time periods. This analysis indicates that the mean annual discharge has been increasing in west-central Alberta.

Barrow and Yu (2005) have examined the effect of various climate change scenarios on Alberta. This information, along with projections available from Climate WNA, (www.genetics.forestry.ubc.ca/cfcg/ClimateWNA/ClimateWNA.html) should be used in the subsequent phase of this project to evaluate how climate change or variability could affect hydrological conditions in the study area. Recommendations prepared in response to the June 2013 flood for enhanced considerations of the effects of natural disasters should also be undertaken, as appropriate (see Alberta WaterSmart, 2013).

Figure 8. Athabasca River Maximum Daily Discharge

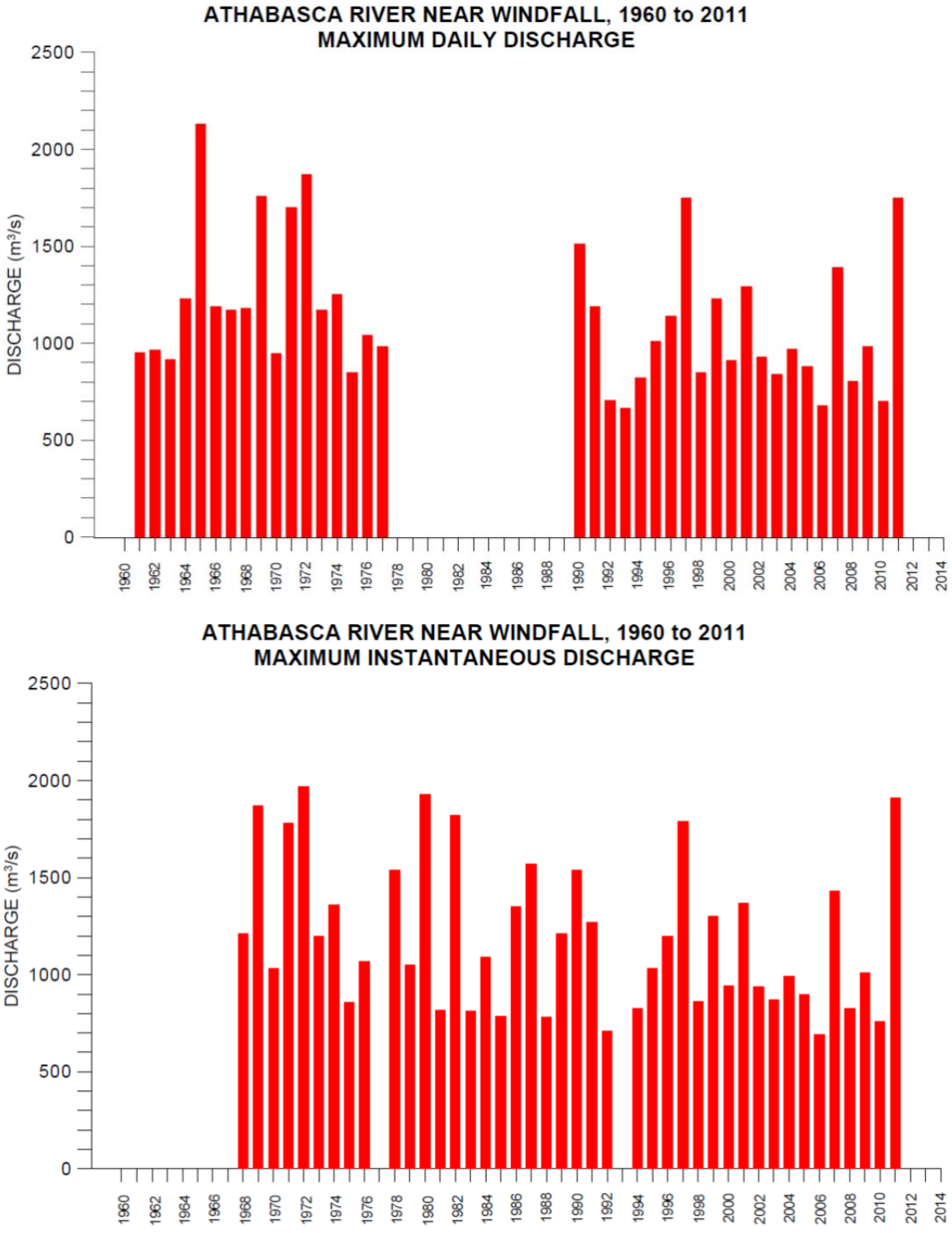


Figure 9. Sundance Creek Maximum Daily Discharge

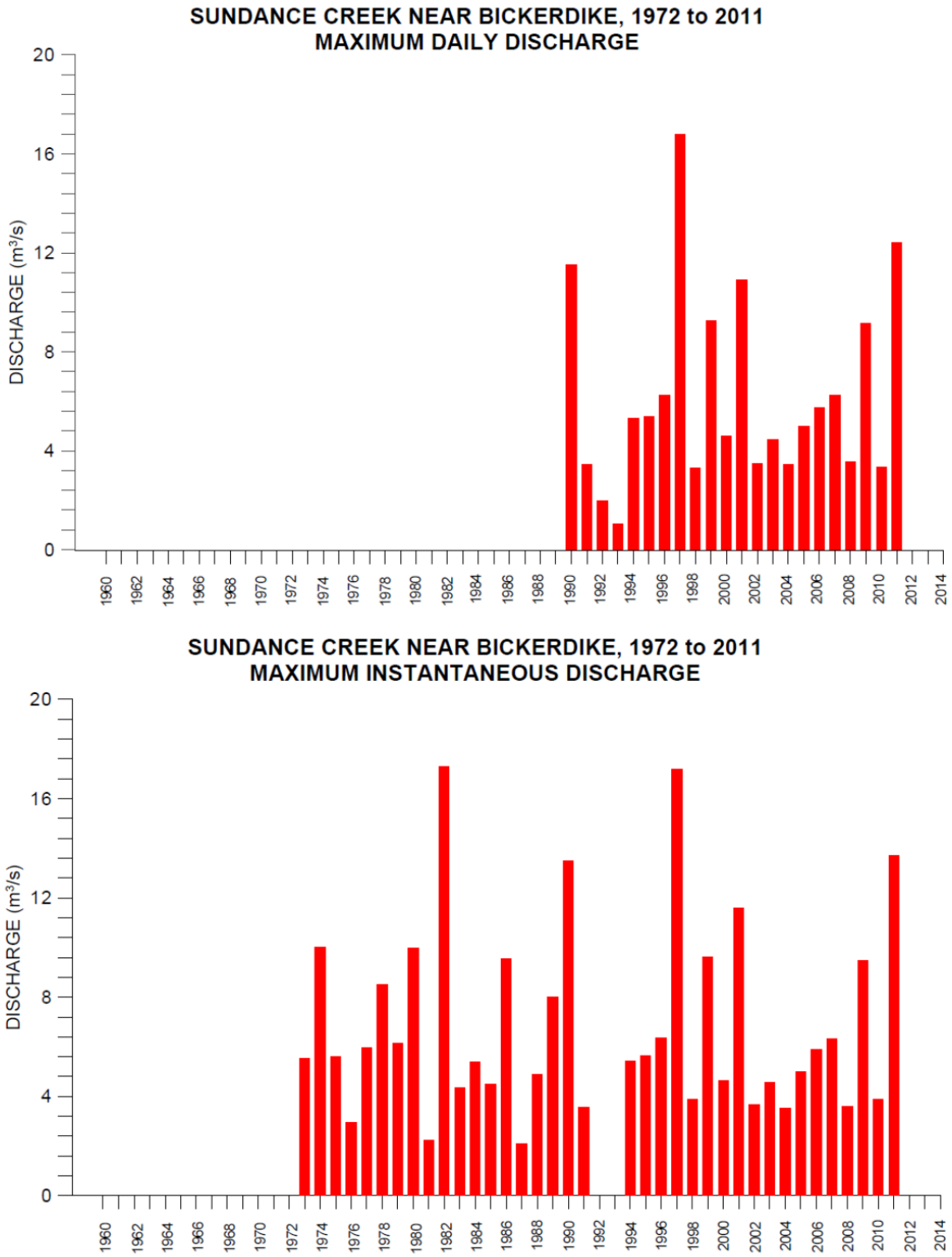


Figure 10. Precipitation Map for June 19-22, 2013 Storm Event
(from Alberta Environment and Sustainable Resource Development 2013)

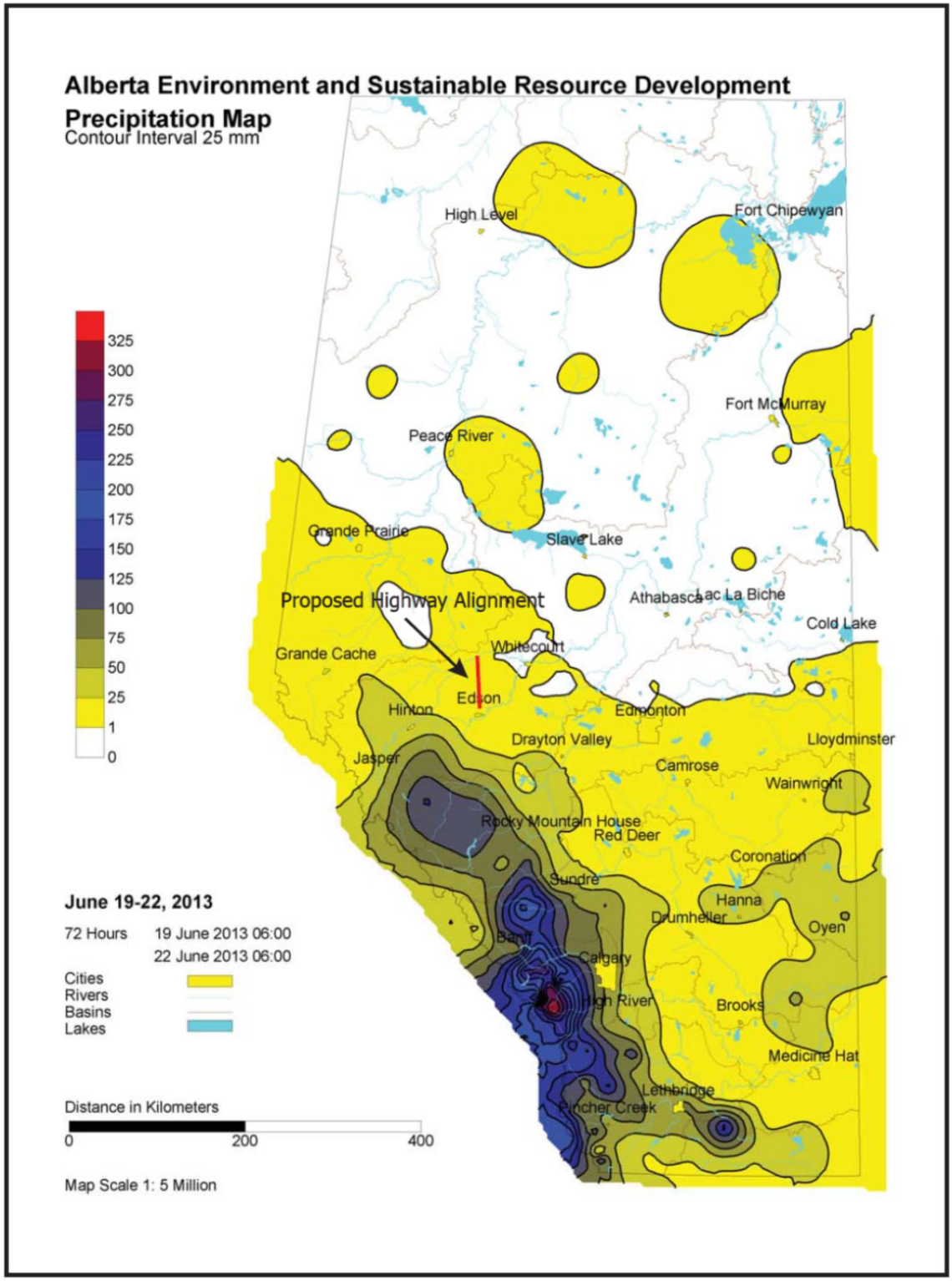
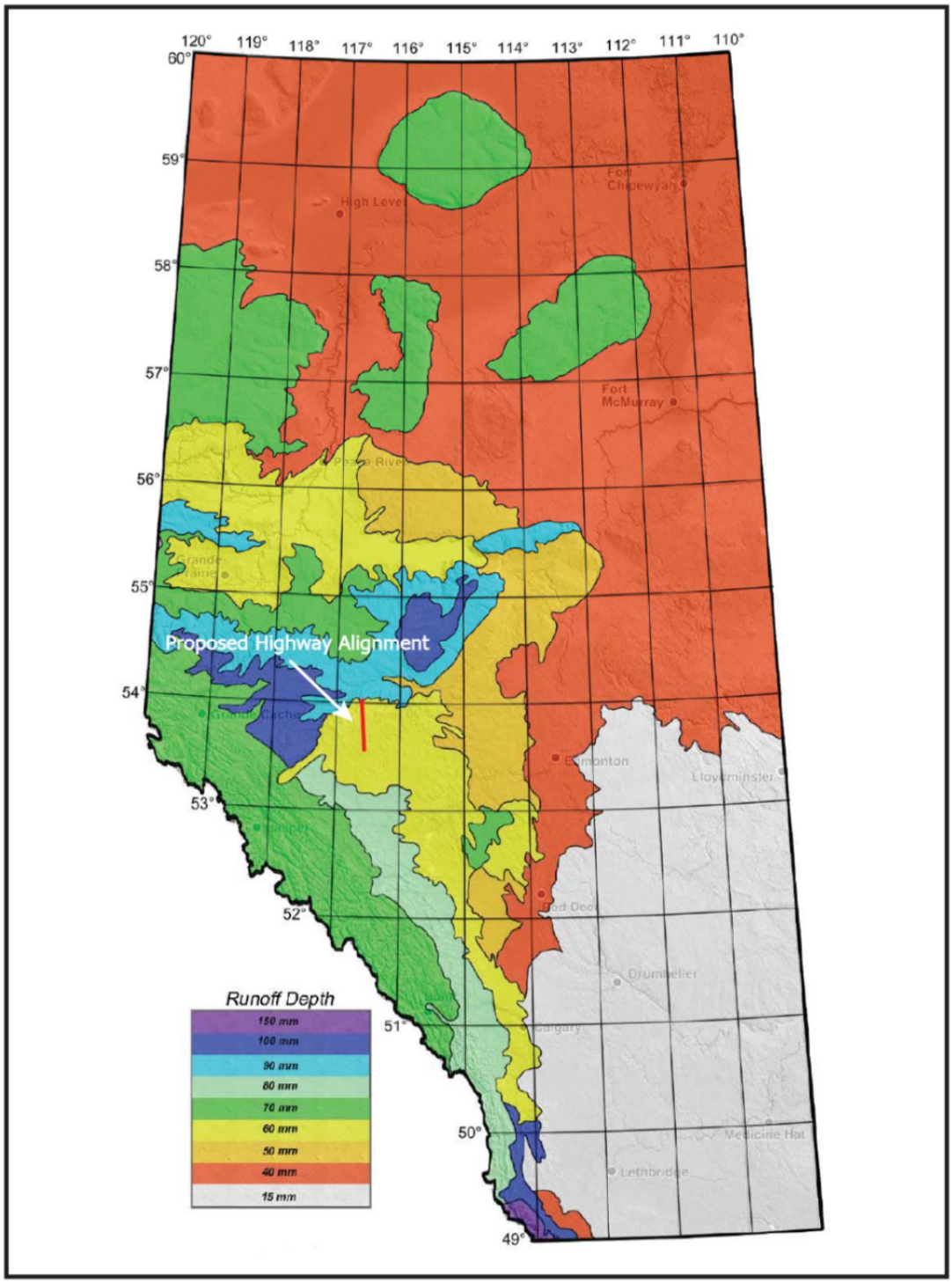


Figure 11. Design Flood Runoff Depth Map
(from Alberta Transportation 2006b)



Stream Crossings

Analysis of digital 1:20,000 scale topographic mapping, combined with field review during initial fisheries studies, indicates that the proposed highway alignment will cross 32 mapped watercourses (see Appendix 14). Five small mapped streams at the northern end of the alignment could not be located in the field. There are other sites where streams closely parallel the route of the highway.

The digital topographic data indicate that the basin areas upstream of the highway crossings range from <0.3 km^2 to 218 km^2. The distribution of basin areas is given in Table 2.

Table 2. Distribution of Basin Areas

Upstream Basin Area km^2	# Streams	% of Total Crossings
0 to 1	12	38
>1 to 5	12	38
>5 to 10	4	13
>10 to 25	1	3
>15 to 20	1	3
>20 to 60	0	0
>60 to 70	1	3
>70 to 175	0	0
>175 to 200	1	3
>200 to 220	1	3
Total Crossings	32	

This analysis indicates that the majority of the stream crossings have upstream basin areas of <5 km^2 and, with the exception of four crossings, all the crossings have upstream catchments of <15 km^2. The three larger streams include the Edson River's mainstem crossing (basin area 218 km^2), crossing of two unnamed tributaries to Edson River (basin areas 20 and 61.68 km^2) and a crossing of Pine Creek (basin area 176.1 km^2).

Discharge data are not available from any of the stream crossings and the determination of streamflow characteristics at the crossing sites would require additional field and office analyses.

ARA Engineering (2012) has undertaken an initial assessment and calculated preliminary design flows for 15 of the larger crossings. Flood discharge estimates were typically in the range of 2 to 5 m^3/s which could be accommodated by a single round culvert of ≥1.5 m diameter. Four of the investigated crossings had estimated peak discharges of >15 m^3/s and warrant ≥3.5 m diameter bridge sized culverts. The Pine Creek Crossing has a preliminary design flow of 150 m^3s and likely justifies construction of a bridge. These initial analyses should be updated and expanded during the next phase of the project, with consideration of fish passage where appropriate.

5.1.2.3 FLUVIAL GEOMORPHOLOGY

The initial fluvial geomorphology studies consisted of a review of the April 4, 2013 Google Earth imagery of the study area. Small streams cannot be reliably identified on this low resolution imagery and the fluvial characteristics of even the larger streams are difficult to interpret reliably. Further office and field studies should therefore be undertaken in the next phase of this project.

Channel characteristics

The majority of the small stream crossings on the alignment consist of narrow, single thread channels and appear laterally stable in areas where the bank vegetation has not been disturbed. These channels are unlikely to pose significant or unusual design challenges.

The largest watershed with a stream crossing is Edson River (Stream s0501, see Appendix 14). This consists of an irregular, single thread and likely incised channel. The proposed alignment crosses at the apex of a wide radius and apparently laterally stable meander bend. The southern tributary channels (Stream s04S01) consists of a narrow irregular to tortuous channel. A portion of the channel runs parallel to the preliminary highway alignment and could result in a river encroachment. The northern Edson River tributary crossing (Stream s0601) is located near an existing road. The channel consists of a small irregular channel which has formed a narrow discontinuous valley flat incised within a higher plain. The channel appears to be laterally stable. None of these three streams appear to be carrying sizeable quantities of coarse material (as indicated by the lack of unvegetated sediment accumulations within the channel). None of these crossings appear to have unusual hydrotechnical issues.

The second largest watershed with a stream crossing is Pine Creek (s1307). This irregularly meandering channel is flowing within a moderately wide valley flat. The channel contains unvegetated gravel bars indicating that the channel is laterally mobile and is periodically transporting a coarse-textured bed load. The proposed highway crossing is located within or near a previously cleared power transmission right-of-way. The crossing design will need to consider future channel instability and provide passage for water, coarse sediment and, potentially, debris.

Additional office and field studies would be needed to confirm the initial results presented above, evaluate conditions on small streams and determine if other engineering constraints, such as winter icings, need to be considered in the highway design.

5.1.3 Terrain and Vegetation

5.1.3.1 TERRAIN

Geomorphologist Pierre-Luc Fortin, Geogr., M.Sc. conducted a desktop review of the Project area. He gathered and synthesized existing information for the physiography, geology, and soils of the Project area, within 150 m on either side of the proposed centreline of the highway. Primary data sources are listed in Table 3, which was supplemented with available scientific literature.

Table 3: Summary of existing data sources on geology and soils

Reference	Topic
Alberta Soil Information Centre (2001)	AGRASID 3.0 (Agricultural Region of Alberta Soil Inventory Database) Soil Correlation Area (SCA) 13-14
Dumanski et al. (1972)	Soil survey map (83F, E-1/2) of the Hinton-Edson area and report
Knapik and Lindsay (1983)	Soil survey map (83K-NE) of the Iosegun Lake area and report
Roed (1970)	Surficial geology of the Edson area (NTS 83F)
Utting (2013)	Surficial geology of the Fox Creek area (NTS 83K/SE)
Hamilton et al. (1999)	Bedrock geology (Alberta Province)
Edwards et al. (1986)	Physiographic Regions of Alberta

Physiographic and geological maps (bedrock and surficial geology) and various related reports were reviewed to extract relevant information. The digital (vector) version of the surficial geology maps of Roed (1975) and Utting (2013) were processed using GIS. The units falling within a 300 m buffer centered in the highway corridor were extracted for area calculations (ha and %).

The study area for the terrain review was limited to about 150m on each side of the proposed centreline, which constrained the interpretations. The Pine Creek valley has not been field reviewed and described regarding its surficial geology, landforms and fluvial geomorphology, or the risk of landslides along the highway route. The surficial geology of the area, landforms mapping, and stratigraphy of a buried valley are too poorly know to fully understand ground water movement in the area. An assessment of the river bank sensitivity to erosion may be adviseable where the highway is close to the river bank, to allow the planning and the design of protection works. Geotechnical investigations will occur at all major bridges.

The soil information available in the Project area consisted mainly of two soil survey maps produced in the 1970s (Dumanski et al., 1972) and the 1980s (Knapik and Lindsay, 1983). These documents were acquired as scanned paper maps and came with their associated report. To extract the soil information, the maps were imported and georeferenced in a GIS. The soil polygons (map delineations) were digitized for a 300 m buffer centred in the high corridor and the areas (ha and %) of each soil polygon were calculated.

Soil data available from Agricultural Region of Alberta Soil Inventory Database (AGRASID) 3.0, covered only a limited area in the southern section on the study site, which overlapped Dumanski et al. (1983) maps on about a tenth of the study area. The AGRASID 3.0 database covers typically the agricultural "white" areas, but since 90% of the Project area is in forested "green" areas, very few AGRASID data were available. As the information contained in AGRASID 3.0 database differed significantly from the information presented of the soil inventory maps named above, the two maps mentioned above were usedto provide a uniform data source.

Due to the age of those maps, the inventory soil names may not fit the latest soil names classification of the Soil Correlation Areas (SCA) (Bock et al., 2006), which should normally fall under SCA 13 and 14. Nevertheless, where available, the soil series names were extracted and are presented in this text. The existing soils mapping for the Project area do not use modern soil terminology; hence soils could not be classified down to the subgroup and series levels. Soil types in the Project area have not been field tested through surveys (soil pits and soil profiles) or laboratory analysis for trace metals.

Structure and the content of the maps

The semantic used to describe the soil information varied between the two maps. It was decided to use the most recent one, therefore the terms are from Knapik and Lindsay (1983). The soil information contained in those maps is structured according to various levels: Soil Association, Map Delineation, Soil Units, Soil Groups, Soil Series, Variant and Phase, Topography and Parent material. Those are explained below and are followed by examples.

Each feature (distinct soil area) on a map is called a Map Delineation and comes with a label. The label describes the Soil Association to which the Map Delineation belongs, and the Soil Unit that forms it. A Soil Unit is a sub-level of a Soil Association, which is a group of closely interrelated soil series developed on similar parent materials, landforms and climates (Dumanski et al., 1972; Mose, 1965). A Soil Unit can involve more than one Soil Units (up to three) when contrasting materials occur in the Map Delineation (see example below). The Soil Unit leads to the Soil Group level (Great Groups and Sub-Groups). Those are describes in terms of “Dominant Soils”, “Significant Soils” and “Minor Soil Inclusions”. The Dominant Soils cover > 40% of the Map Delineation, the Significant Soils 15 to 40 % and the Minor Soil Inclusions < 15%. The first two usually lead to the Soil Series name, which is the highest level of soil classification. Note that, because the Minor Soil Inclusions were not taken into account by Knapik and Lindsay (1983) and also did not lead to relevant descriptive information, it was decided to use only the Dominant Soils and Significant Soils for the purpose of this work.

The label contains topography information and variant information. The former consist of a letter added at the end of the label string and ranks between “a” and “h”; “a” for a level topography (0-2 %) and “h” for a very hilly topography (>60 %). The Variant and Phase refers to additional information indicating abnormal observations regarding the ph (ph variant, “Z”), the soil thickness (Thin phase, “T”), high stone content (Stony phase, “S”) and the partially gleyed soil (Gleyed phase, “G”). Those are matched to the Soil Units using slashes (/) (See example below). Finally, the soil Parent material is the surficial material on which the soil had developed.

To illustrate this system, here is an example: A Map Delineation was labelled “JRV4 c”. This label indicates that the Map Delineation is part on the Jarvis Soil Association and the soil falls under the JRV4 Soil Unit. The “c” indicated an undulating topography ranging for 2 to 5 %. Its parent material is glaciofluvial deposits and the dominant and significant soils are respectively Eluviated Dystric Brunisol (Jarvis) and Podzolic Gray Luvisol (Hightower, Nosehill). The names in brackets refer to soil series names. If the label was “JRV4+MBN5 c”, this would indicate the presence of contrasting soil content with additional Orthic Gray Luvisols (Tom Hill) (dominant) and Gleysolic soils (significant). The JRV4 would however remain the most important soil proportion in the Soil Unit. Finally if JRV4 Soil Unit had developed on an abnormally stony material the label would become “JRV4/S+MBN5 c”. It is important to understand that all the terms contained in the label constitute the Soil Unit.

Process used to extract soil information

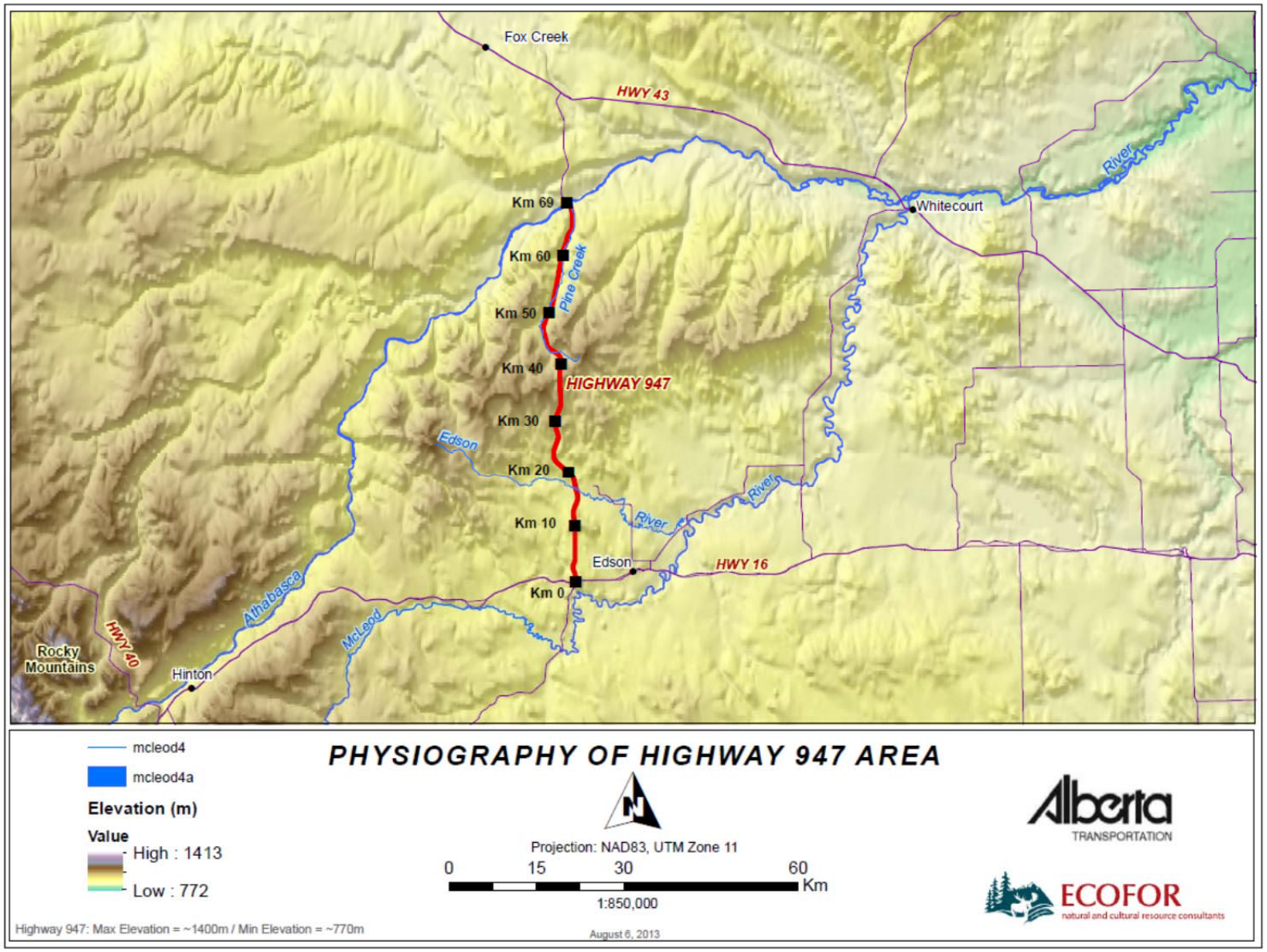
As mentioned above, all the terms contained in the label describing a Map Delineation constitute the Soil Unit. The area is calculated (ha or %) for the whole Map Delineation; therefore it is not possible to precisely calculate the proportion associated with every soil group and/or soil series, because those are not specified in the label. In addition to that, the precise proportion of Dominant soils and Significant Soils in each Map Delineation are not specified and their respective >40% and 15-40% class does not allow precise calculation either. Therefore, the only reasonably accurate proportion (%) that could be calculated was for the Soil Order level. However a complete inventory of the soil sub-groups and series was developed, even though their proportion is unknown. The result is provided using the Canadian Soil Classification System (Soil Orders, Great Groups, Sub-Groups, Series).

5.1.3.1.1 PHYSIOGRAPHY

The physiography of the Project area (Figure 11) places it as part of the Southern Western Alberta Plains and the Alberta Uplands (Edwards 1986). Within that classification, the highway falls within the Edson Lowland, Edson Benchland, Mayberne Tableland and Athabasca Benchland physiographic subdivisions as defined by Roed (1975). Those are described as follows:

- The Edson lowland corresponds to an undulating to gently rolling topography smoothed out by glaciolacustrine sediments from the last glaciation. Its altitude varies from 900 à 1000 m and its upper limit occurs around Km 15.
- The Edson Benchland lies between the Edson Lowland and the toe of the Mayberne Tableland. The topography forms a plateau-benchland landscape varying from 1000 to 1100 meters of elevation. It is comprised between Km 15 and 30.
- The Mayberne Tableland lies between km 30 and 55. It consists of high plateaus of 1100 to 1250m overhung by flat top parallel ridges isolated by mostly steep-side valleys. Those summits reach an elevation of 1450 m.
- The Athabasca Benchland is the uppermost physiographic division and lies from km 55 to 69. As for the Edson Benchland, the topography forms a plateau-benchland landscape, generally

Figure 12. Physiography of the Highway 947 Area



ending at the foot of the Mayberne Tableland, but in addition steep-sided valleys are cut through the plateaus. The elevation varies from 800 m to 1100m.

The Mayberne Tableland draws the waterline between the Pine Creek watershed facing north and the Edson River area and other unnamed creeks watersheds flowing south-easterly. Pine creek connects directly to the Athabasca river while the Edson drainage area drains through the McLoad river, which also connects with the Athasbasca further down. Except on the Mayberne Tableland and active alluvial plains, the area is covered by a dense forest boreal forest (NRC, 2006; Roed, 1975).

5.1.3.1.2 GEOLOGY

This section describes the bedrock geology and the surficial geology, including an explanation of the origin of the different features composing the study area.

Bedrock Geology

The study area is underlain by rocks belonging to the Paskapoo Formation of Pleistocene age. This formation is composed of weakly consolidated beds of sandstone, silt-stone, mudstone and shale with interbedded strata of shale, coal, chert and conglomerates consisting predominantly of metaquartzite, sandstone and chert (Roed, 1975; McCrossan and Glaister, 1964; Hamilton, 1999).

Surficial Geology

The surficial geology of the area is a direct legacy of the last glaciation. The Edson area has a complex glacial history; it would have been over- ridden by as many as five different glaciers. More specifically, the area has the particularity to be located at a contact zone between the two main glaciers in action during the Wisconsinian glaciation (Roed, 1975), namely the Cordilleran glacier and the Laurentide glacier. The former originated in the Rocky Mountains and spread easterly through the Rocky Mountain Foothills and the latter originated from the Canadian Shield and spread south-westerly across Canada including Alberta (Roed, 1975).

Those glaciers left three different tills in the study area: Mayberne, Edson and Marlboro. The first two originated from the last Laurentide glacial advance and were synchronous with the third one associated with the Cordilleran glacier. The Marlboro glacier ice prevented the Laurentide ice from flowing further west or southwest and forced it to flow southeast, nearly parallel to the Rocky Mountain foothills (Roed, 1975).

The retreat of those glaciers of the study area occurred about 12k-13.5k BP (Dyke, 2004; Prest, 1969; Roed, 1975; St-Onge, 1972) and generated a glacial lake (Edson Lake) receiving the meltwater and sediments mostly from Marlboro glacier (Dumanski at al., 1972; Roed, 1975). The lake took place on the deglaciated lowlands (Edson Lowland and lower part of the Edson Benchland). The lake remained in the area for an undefined time and covered and smoothed the existing topography with a layer of clay/silt (varves) resulting of the deposition of fine suspended material.

Surficial Material

This sedimentological sequence and the subsequent natural processes left four main types of surficial material in the area: glacial (62.6%), alluvial (12.1%) glaciolacustrine (11.2%), colluvial (8.3%),

glaciofluvial (5.6%) and a tiny area of Eolian (0.2%). Those units are described below according their distribution across the highway corridor and their sedimentological and morphological settings; and finally a brief summary was achieved.

The glacial material found in the study area is of two types: till and stagnant moraine. The till is by far the dominant material of the glacial category with 61.3%. It consists of Mayberne (33.9%), Edson (24.3%), Marloboro (3.1%) till units. A till deposit, also called morainal deposit, corresponds to a diamicton deposited directly by ice and composed of a mixture of clay, silt, sand and minor pebbles, cobbles and boulders. It may locally contain blocks, pre-existing stratified sediment and till or lenses of glaciolacustrine and/or glaciofluvial sediments (Utting, 2013). The Mayberne till average thickness is 6 m and tends to be thinner on the Mayberne Tableland (1.5 m), where pre-glacial gravel can also be found. The average thicknesses of the Marlboro and Edson tills are 6 m and 3 m respectively, but can reach more than 30 m in pre-glacial buried valleys (Roed, 1975). Four of those ancient valleys will be overlaid by the highway corridor, notably Pine Creek and the Edson River. This suggests that those filled bedrock channels could locally influence the flow pattern of ground water. Till is less common in the Pine Creek valley, where it was mainly reworked by postglacial processes. The stagnant ice moraine deposits are located around km 56, in the Pine Creek valley feature and cover 1.3% of the study area. A stagnant ice moraine is formed of material resulting from the melt of the stagnant ice margins of a glacier. The sediments are mainly diamicton (till), but could locally include glaciolacustrine (clay and silt) and glaciofluvial sediments (gravel). It is characterized by a low to high relief hummocky (holes and hills) sediments (Utting, 2013).

The alluvial material, also called fluvial deposit, is composed of sediments transported and deposited by streams and rivers. It includes sand, gravel, silt and clay often stratified and some organic sediments (Utting, 2013). The bottom part of Pine Creek valley (km 50 to 69) is essentially overlaid by alluvial material.

The melt water from the last glaciation generated a postglacial lake (Edson Lake), which left glaciolacustrine sediments in the lower section of the Edson Benchland and in the Edson Lowland (Roed, 1975; Roed, 1970; St-Onge, 1972). Along the highway corridor the glaciolacustrine material forms flat varved silt and clay patches seperated by hills (km 0 to 20). The hills did not get overflowed by the glacial lake, and that is where the Edson and Marlboro tills are found. The contact area between the Marlboro and Edson tills, mentioned above, can be found in this environment at km 4. As the lake smoothed the original topography the thickness of the this glaciolacustrine unit varies significantly, but averages about 6 m (Roed, 1975).

Colluvial material is very common in the of the steep side slopes of Pine Creek valley (km 56 to 67). This material consists of pre-existing material (till, glaciofluvial, glaciolacustrine, etc.) reworked by gravity-induced movements (slumps) confined to valley side slopes (Utting, 2013).

In similar morphological settings and locations can be found glaciofluvial material (km 58 to 60). This unit consists of sediments deposited by glacial meltwater streams and subaerial and subaqueous outwash. This includes sand and gravel often stratified and a limited fraction of silt. Those deposits are

accompagned by morphological features such as meltwater channels, kettle holes and terraces (Utting, 2013).

A minor area of eolian deposits can be found at the mouth of Pine Creek (km 68). This material consists of wind deposited sediments with well-sorted sands and minor silt content. Cross-bedded ripples structures are often observed in the sediment (Utting, 2013).

In summary, till is the most widespread material in the study area. It is overlaid by glaciolacustrine sediments in the Edson Lowland and Benchland, and is mainly reworked as alluvial and colluvial material in the Pine creek valley. Glaciofluvial, eolian and stagnant ice moraine deposits can also be found locally in this valley. Finally, pre-glacial valleys filled with glacial sediments would locally underlay the highway corridor (Roed, 1975).

5.1.3.1.3 SOILS

Soil types

The study area is composed of a majority of Luvisolic soils (56.6%). In order of importance the rest of the area is covered by Regosolic soils (15.5%), Brunisolic soils (8.7%), Organic soils (8.0%), Gleysolic soils (7,7%) and Nonsoils (3.5%). The Great Groups, Sub-Group and Soil Series associated to each Soil Order are presented at the Table 4. The statistics were obtained by generalizing the information extracted from the soils maps of Dumanski et al. (1972) and Knapik and Lindsay (1983). The generalisation was done using the Dominant Soils.

Table 4: Types of soils inventoried in the study area

Order	Great Group / Sub-Group	Soil Serie*
Luvisolic	Orthic Gray Luvisol	Hubalta, Ansell, Tom Hill, Hanlan, Culp, McPherson, Modeste, Rosevear, Pepper, NL
	Bisequa Gray Luvisol	Nosehill, Judy
	Pozolic Gray Luvisol	Nosehill, Hightower
	Brunisol Gray Luvisol	NL
Regosolic	Orthic Regosol	NL
	Degraded Eutric Regosol	NL
	Orthic Eutric Regosol	NL
	Cumulic Regosol	NL
Brunisolic	Eluviated Dystric Brunisol	Jarvis
	Eluviated Eutric Brunisol	Deep Valley
	Degraded Eutric Brunisol	Bickerdike, Levi
Organic	Mesisol	NL
	Humisol	NL
Gleysolic	Low Humic Eluviated Gleysol	NL
	Orthic Gleysol	NL
	Gleysolics soils	NL
	Rego Gleysol	NL
Nonsoil	NA	NA

* NL = No link with a Soil Series.

Spatial Distribution of Soils

As the structure of the base information (maps) did not allow the calculation of the proportions of each soil Sub-Group within each Map Delineation (soil Polygon), the spatial distribution of the soils was performed using the Soil Order level. This information was extracted from Soil Associations, which had been developed using specifically those soil characteristics (Dumanski et al., 1972; Mose, 1965). A general description of the soils parent material and topography accompanies the explanation of the soil distribution. Note that in the follow descriptions the “Soil Association” expression is contracted to "SA" for brevity.

The Luvisolics soils are mainly found on the lower half of the highway corridor (< km 35) and in the Pine creek valley (km 55). In the lowest section of highway (< km 25), the Luvisolic soils have developed essentially on yellowish brown till from the Edson and Marlboro SA. The topography of this area is generally undulating to gently rolling which includes depressions containing rare Luvisolic soils from the Lendrum SA, whom with gleyed soils are likely to be found. On higher and steeper lands (km 25 to 35), the Luvisolics Soils have developed on Mayberne till and pre-glacial gravels, from the Mayberne, Maskuta and Summit SA. The soils are generally medium textured with coarse material inclusion such as gravel and stones and their color vary from dark yellowish brown to olive brown. Luvisolics Soils found in Pine creek valley are affiliated to Lodge and Mayberne SA respectively for gently undulating and strongly rolling topography. Because of less efficient drainage the Luvisolic soils of Lodge SA can be found in association gleyed soils.

The Regosolic soils found in the highway environment are located in the Pine Creek valley between km 42 and 61. Those are linked with the Alluvium and the Iosegun SA and refer to typical alluvial settings. The texture varies from sand, silt, gravel; nonstony to very stony and local morphology is undulating.

Brunisolic Soils are located on the last ten kilometers of Pine Creek valley (Km 60 to 69). They involve mainly Jarvis SA but there also small areas of the Deep Valley SA. The Jarvis SA is formed of glaciofluvial material upholstering the bottom flat part of the valley. They are coarse textured soils with yellowish brown to olive gravel and generally exceedingly cobbly. Its topography varies from undulating to strongly rolling. The Brunisolic soils of Deep Valley are developed on much steeper slopes (hilly to very hilly) and correspond to escarpments adjacent to Pine creek riverbed. They are likely to mass wasting and gullying processes. Therefore those are considered as colluvium deposits developed on till material reworked by gravity and runoff processes. Their composition varies from sandy loam to clay loam

Organic soils found in the study area are strictly from Fickle SA. They form isolated patches overlaying glaciolacustrine surrounded by Edson and Marlboro tills sitting slightly higher. They are found between km 0 and 25. The typical topography of the Fickle organic soils is undulating to rolling with concave depressions. Their thickness is > 60 cm.

Gleysolic soils are found in similar environments as the Regosolic soils, except they are not directly in contact with stream water. They are located on the high plateau of Mayberne Tableland and in the upper section of the Pine creek valley (km 35 to km 52). Those soils are associated with the Erith and

Smoky SA and poor drainage. They are generally found on the gently rolling lower side slope and depressional areas collecting runoff and ground water. Typically they take place between well drained upland and organic soils. Their texture varies from clay loam sandy loam with stony phases. They are overlaid by a peat layer of less than 60 cm.

The Nonsoil category corresponds most of the time to very steep slope topography with heterometric coarse material highly disturbed by river erosion and mass wasting processes. They are distinguished from the Brunisolic soils of Deep Valley SA as they are currently affected by active processes. They are found mainly on the steep sides of lower Pine Creek valley (km 58 to 68) and in contact with the Edson River (km 6).

It appears that the soil orders distribution matches quite well the physiographic regions described above. The Edson Lowland and Benchland are characterized by Luvisolic and Organic soils. The former corresponds to well drained and tilted topography and the latter involves poor drainage and flatter lands. On the Mayberne Tableland Luvisols are found again in well drained and rolling relief, while Regosolic soils occur on lower side slope with imperfect drainage conditions. Finally the Athabasca Benchland, more precisely the Pine Creek valley environment, leads to Regosolics soils, in similar conditions of those mentioned above, while Brunisolic soils and Nonsoils are found on sleep side slopes with coarse material generating well drained areas.

During the design phase the erodability of soil materials will be assessed to determine temporary and permanent erosion and sediment control measures. Temporary measures will be determined by the construction contractor through the ECO Plan program.

5.1.3.1.4 GEOMORPHOLOGICAL SETTING OF PINE CREEK VALLEY

This section presents of a brief overview of the geormorphological conditions that may represent natural hazards for the highway in Pine Creek valley. Note that the results presented here are preliminary thus should be interpreted with caution.

Valley Side Slopes

The lower section of Pine Creek valley (km 55 to 69) is characterized by U shape profile typical of glaciated valleys. Those valleys are likely due to mass wasting processes mainly because of their high gradient, but also because streams may have modified or are still modifying the toe slope profile and initiating instabilities. Based on the available information, the west side of Pine Creek valley between km 58 and 66 may have signs of instability and possible predispositions for landsliding. Knapik and Lindsay (1983) mapped slope gradients varying from 30 to over 60% in colluvium soil types and classified an important section of this valley side as RB (Rough Broken), which would indicate very steep slopes with possible slumped features (p. 57, Knapik and Lindsay 1983). In addition the Utting (2013) surficial geology map indicates landslide scars in the same area. This information should be taken into account during highway design and construction.

River Banks

On its last 20 km Pine Creek shows a channel pattern varying from braided to anastomosed with some meandering sections with an estimated 0.0088 slope gradient. The 130 km^2 watershed is 35 km long by 2 to 18 km wide. Its upper half drains steep sided slopes surrounded by a flat summit of an average elevation of 1250 m. At its mid-point the river bed lies at an altitude of 1000 m, and at its mouth it sits at 800 m. This watershed morphology results in a highly reactive watershed likely to generate flash floods and thus river bank erosion. This, in fact, happened in summer 2012 and led to the washout of existing road sections in the lower section of the river.

5.1.3.2 VEGETATION

General Vegetation Types

The Project area is within the Foothills Natural Region, which includes the Lower and Upper Foothills Natural Subregions. The topography is highly variable, ranging from sharp, bedrock-controlled ridges near the mountains to rolling and undulating terrain in the north and east. Mixed forests of aspen, lodgepole pine, white spruce and balsam poplar with variable understories on Gray Luvisolic soils are dominant on average sites at lower elevations. Mixed forests of aspen, lodgepole pine, white spruce and balsam poplar with variable understories on Gray Luvisolic soils are dominant on average sites at lower elevations. Lodgepole pine forests with less diverse understories and well developed feathermoss layers on Brunisolic Gray Luvisols are typical of higher elevations (Natural Regions Committee 2006).

The Project area is mostly within the Lower Foothills Subregion, with the central, higher elevation part of the Project in the Upper Foothills Subregion. Within the Lower Foothills Subregion, forests on upland sites are typically deciduous or mixedwood with aspen, balsam poplar, white birch, lodgepole pine, white spruce and black spruce as common associates. Wetlands are mainly vegetated by stunted black spruce and tamarack or shrub-graminoid communities. The Upper Foothills Natural Subregion is dominated by forests that are typically even-aged fire origin lodgepole pine stands, often with an understory of black spruce. White spruce stands occur along river valleys and on lower slopes. Deciduous and mixedwood stands occur on warmer southerly and westerly slopes. Shrubby grasslands occur on the driest sites, and poor to rich fens dominated by black spruce, tamarack, shrubs and herbs occur on low, wet sites (Natural Regions Committee 2006).

The general vegetation types have been mapped from air photographs, for a distance of about 500 m on each side of the proposed centerline of the highway. Stereoscopic imaging was not used, because only generalized vegetation types were desired for habitat interpretations. Land cover and vegetation types that were mapped were:

- Lake
- Stream
- Man-made Pond
- Wetland - Forest Dominated
- Wetland - Sedge Dominated
- Potential Wetland / Meadow
- Mixed Conifer / Deciduous Forest
- Conifer Dominated Forest

- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Sand / gravel bar
- Pipeline / Powerline Right of Way
- Agricultural Fields
- Buildings

The minimum polygon size was the smallest that could be distinguished on the orthophotos, which varied depending on land cover / vegetation type. The land cover / vegetation mapping has not been ground truthed.

The study area is dominated by natural and semi-natural ecosystems, with frequent gravel and dirt roads and trails. Clearings for power transmission lines and pipelines are the dominant land use within and adjacent to the study area. The maps of the vegetation types are for a distance of 500 m on each side of the proposed centreline of the highway (Appendix 5).

Plant Species

All vascular and some non-vascular plant species present in the project area were recorded for at least one site within the Project area. The Project area within 150 m of the centreline was searched on foot for rare plants in 2012 and 2013. Voucher specimens were collected for identification as required, and a database of all records was compiled. There were 302 species of plants recorded from the Project area in 2012 - 2013 (Appendix 6). Of these, a total of 5 (possibly 6) species are *at risk* (Table 5). Potential impacts to plant species will be assessed in the Environmental Impact Statement.

Exotic Plants and Weeds

Exotic plants and weeds were identified, recorded, and databased when encountered during the rare plant species inventory. Weed records for the 2013 field work are only partially compiled to be available for this Project Description.

The relatively undisturbed nature of the Project area results in a limited distribution and relatively low abundance of noxious weeds. Three noxious weeds have been recorded from the Project area - Canada thistle, common tansy, and oxeye daisy (Table 6). Roadsides, drill pads, powerline and pipeline right-of-ways, and other disturbed areas typically have these species throughout the study area. Some were also found in naturally disturbed areas such as beaver dams.

Table 5. Rare Plant Observations 2012 - 2013

Location and additional details will be provided separately with the Environmental Impact Statement, and to the Alberta Conservation Information Management System.

Plant Species	Rarity	Date	Comments (area size, # of individuals, habitat, etc)
Botrychium lanceolatum	S2 - tracked	2012-08-25	1 individual in poor condition on seldom used ATV trail on west edge of ROW. Growing with many *B. multifidum*
		2012-08-25	6 individuals on west edge of ROW along ATV trail, sparse vegetation area. Growing with many *B. multifidum*
		2012-08-27	12+ individuals on edge of seldom used ATV trail along west edge of ROW. Growing with many *B. multifidum*
Botrychium pinnatum	S3 - tracked	2012-08-22	40 individuals in dryish exposed riparian area (approx 20 m x 15 m) in powerline ROW. Growing with *B. virginianum* (many), B. multifidum (x1), B. lunaria (x 3)
		2012-08-25	6 individuals on west edge of ROW along ATV trail, sparse vegetation area. Growing with many *B. multifidum*
		2012-08-25	7 individuals on edge of grassy ATV trail along west edge of ROW. Growing with many *B. multifidum*
		2012-08-27	12+ individuals on edge of seldom used ATV trail along west edge of ROW. Growing with many *B. multifidum*
Botrychium sp.	unknown	2012-08-21	unknown *Botrychium* sp. ID pending-- may be a rare species, but only one specimen so ID difficult
Chrysosplenium iowense	S3 - tracked	2013-06-08	10 individuals in boggy area. Quite yellow, 5-6 stamens, small patch.
		2013-06-08	25 individuals in larch area. 2 x 4 m area
		2013-06-10	7 stamens. Several individuals in wet open forest area
		2013-06-11	25+ individuals in wet woods with Sb, in open canopy patch. 5m x 5m area; some additional plants along stream.
		2013-06-12	2 individuals in grassy wet trail area.
		2013-06-13	20+ individuals in wet grassy area of old ROW
Lactuca biennis	S2 - tracked	2012-07-21	1 individual in grassy open canopy area of mature poplar forest
		2012-08-29	8 individuals found on grassy south-facing slope along small stream in powerline ROW
		2012-08-29	25 individuals found in fairly dry area in middle of ROW
		2012-08-29	4 individuals found in fairly dry area in north-facing slope in ROW
		2012-08-29	100+ individuals found on grassy east-facing slope in ROW (area approximately 100 m long along ROW)
		2012-08-29	150+ individuals found on grassy south-facing slope in ROW (through about next 100 m of ROW north of waypoint)
		2012-08-29	8 individuals in grassy riparian area along small stream in 20m x 20 m area within ROW
		2012-08-29	1 individual in grassy riparian area--alder thickets common along Pine Creek
		2012-08-29	10 individuals in slight open area in alder-dominated riparian area along Pine Creek
		2012-08-29	300+ individuals in 4 m x 20 m patch on fairly dry south-east facing slope in ROW.
		2012-08-29	6 individuals scattered in 20 m x 40m patch of grown in shrubby and grassy ROW area.
		2013-06-06	26 individuals in wet forest area beside road
Pinguicula villosa	S2 - tracked	2013-06-09	On sphagnum hummocks in treed fen area. 50 individuals in small area, with possible lady slippers

Table 6. Noxious Weed Plant Observations 2012 - 2013

Plant Species		UTM Zone 11		Weed	Comments (area size, # of individuals, habitat, etc)
Common Name	Scientific Name	Easting	Northing	Classification	
Canada Thistle	*Cirsium arvense*	524317	5958560	Noxious	Old grassy road ROW with many disturbed area plant species
Canada Thistle	*Cirsium arvense*	525142	5989605	Noxious	Old beaver pond and pond. Covered in Canada thistle (noxious weed) and Canada bluejoint.
Canada Thistle	*Cirsium arvense*	526546	6000364	Noxious	throughout open area
Canada Thistle	*Cirsium arvense*	526816	6000341	Noxious	throughout sandy shore area
Canada Thistle	*Cirsium arvense*	526967	5999750	Noxious	throughout ROW of road
Canada Thistle	*Cirsium arvense*	527317	5937851	Noxious	Thistle along dam of beaver pond
Canada Thistle	*Cirsium arvense*	527694	5944766	Noxious	along cut trail
Canada Thistle	*Cirsium arvense*	528022	5949493	Noxious	on old beaverdam
Common Tansy	*Tanacetum vulgare*	525006	5990024	Noxious	Common tansy (noxious weed) in gas well site
Common Tansy	*Tanacetum vulgare*	526488	6000381	Noxious	One small patch in disturbed area near Athabasca River
Oxeye Daisy	*Leucanthemum vulgare*	524317	5958560	Noxious	Old grassy road ROW with many disturbed area plant species
Oxeye Daisy	*Leucanthemum vulgare*	524351	5958595	Noxious	along old road
Oxeye Daisy	*Leucanthemum vulgare*	525040	5970505	Noxious	throughout powerline ROW

5.1.4 Wetlands

Orthophotograph imagery supplied by Alberta Transportation was initially utilized to delineate existing wetland areas within 150 m of the centerline, based on visible vegetation and drainage features. The preliminary mapping was refined through field visits. Alberta provincial data catalogues were queried to determine the ecological land classification (ELC) data that exists for the Project area.[6]

Historical aerial photographs were acquired from Government of Alberta's Aerial Photographic Record System for all identified wetland areas. Photographs from approximately 30 years ago (1981, 1983) were reviewed; they were examined to determine the origin of the wetland features identified within the current Project area (i.e. whether they are naturally occurring, or result from recent beaver or human activity), and whether the extents of the wetlands varied between wet and dry years. Photographs for 1981 and 1983 were reviewed to examine the conditions and land uses of wetlands and surrounding areas 30 years ago. No major differences were observed at any of the wetlands in the historical photos.[7]

Wetland Classification Systems

Wetlands were classified according to *The Canadian Wetland Classification System* (CWCS) (National Wetlands Working Group 1997), which classifies wetlands on the basis of both hydrological origin and vegetation present. To enable simplified reference to the *Provincial Wetland Restoration/Compensation Guide* (Alberta Environment 2007), a second classification system, *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin *et al.* 1979), was also utilized.

Canadian Wetland Classification System

Wetlands are defined by CWCS as "land saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment"(National Wetlands Working Group 1988).

The CWCS divides wetlands broadly into two types defined by the underlying soil conditions: Organic wetlands, comprised of wetlands with organic soils (e.g. peatlands) and mineral wetlands which are found mainly on mineral soils. Bogs and fens are the two classes of organic wetlands. Marshes, swamps, and shallow water are the three classes of mineral wetlands; though swamps may sometimes be classified as peatlands depending on the soils and vegetation present. Water in wetlands is less than 2 m deep; when water is deeper than 2 m it is a pond, lake, or stream.

Classification of wetlands depends largely on the hydrology of the area, which leads to the formation of the wetland processes and also the vegetation that is found within the wetland. Each of the wetland classes in the CWCS is further divided in form, subforms, and vegetation types. Numerous forms and subforms have been described for each class have been described; largely dependent on the drainage and physical characteristics found at each wetland area. Vegetation type is strictly a reflection of the most dominant portion of the plant community found during the field assessment. Subdominant vegetation types have also been included in our assessments to provide additional information.

[6] Spatial data for "Green" (low settlement density) and "White" (high settlement density) areas of Alberta need to be reviewed and incorporated.
[7] Air photos for additional years are currently on order to compare years of high and low precipitation amounts.

Although each of the wetland classes is defined within CWCS, it should be noted that many wetland areas may exhibit characteristics of several classes, and in some cases form mosaics of several wetland types; especially in large wetland areas. Wetlands have many variable characteristics, and their combinations form gradients among which wetlands (or parts of wetlands) may not always be easily pinpointed.

Bogs: Bogs are wetlands that develop in areas where drainage is restricted and there is very little or no water flow. The water that saturates the soil originates mainly from rainfall, resulting in low nutrient availability and acidity. *Sphagnum* sp. mosses (i.e. peat mosses) are always present and are often dominant, though shrubs (dwarf to tall), and trees may be abundant. Over time dead moss and other vegetation forms a layer of semi-decayed peat below the living top layer of the bog; this layer often reaches several metres thick. This accumulation of peat often results in the surface of the bog being raised above the surrounding landscape; the presence of S*phagnum* results in the water table rising in conjunction with the bog surface.

Fens: The fen class of wetlands develops in areas with greater water flow and/or fluctuating water levels. The flowing/fluctuating water brings more nutrients into the wetland, resulting in different vegetation communities; depending on the nutrients and levels. Fens vary widely in terms of nutrient levels and water table depth. Fens very rich in nutrients are often dominated by graminoid plant species (e.g. grasses and sedges), while those more nutrient poor are often moss-dominated. Larch and black spruce are common trees of fens; larch occurring in richer and drier fens. Peat in fens is comprised of partially decayed sedges or mosses, depending on the dominant vegetation.

Swamps: Swamps are defined as tree or tall shrub dominated wetlands that are influenced by mineral rich groundwater, and may occur on mineral or organic soils (National Wetland Working Group 1997). Swamps may be dominated by tall shrubs (often willows), needle-leaved trees, broad-leaved trees or a mixture of needle-leaved and broad-leaved trees. Nutrient conditions are variable, ranging from poor to rich; depending on the water characteristics. Swamps can grade into other wetland classes: Poor to moderately-rich fens where both are treed or have tall shrub coverage, treed bogs where nutrient levels are low, and marshes where trees are absent, but tall shrubs and moderate nutrient levels are present. Swamps tend to be drier than other wetland classes.

Marshes: Marshes are a wetland areas with shallow water, which often fluctuates (from annually to daily) for a variety of reasons (e..g tides, flooding). Portions of marshes may become dry at certain times of year (or years at a time in semi-arid regions). Marshes do not accumulate peat, although small amounts of organic substrates may present. Vegetation is usually comprised of emergent herbs, including sedges, grasses, rushes, cattails etc, but low to tall shrubs are often present, especially at wetland margins.

Shallow Water: Shallow water wetlands are areas that combine the characteristics of permanent deep (>2 m deep) waterbodies (e.g. lakes, rivers) and other wetlands. These wetlands have standing or flowing water less than 2 m deep (excluding floods) that occupies at least 75% of the wetland surface area. Water may be stable or fluctuate intermittently. Shallow water wetlands can be located along the

margins of lakes and rivers. In some cases, shallow water wetlands can be classified separately from adjoining wetlands, if the two areas have separate hydrological processes. Man-made impoundments (e.g. dugouts) are not included as shallow water wetlands, but beaver ponds, where the water level is unregulated, may be considered shallow water if the other characteristics are consistent. Vegetation is usually comprised of emergent and submerged macrophytes, shrubs and trees (covering less than 25% of the wetland area).

Classification of Wetlands and Deepwater Habitats of the United States

The Cowardin classification system, last updated in 1979, is a frequently used for wetland classification in Alberta. The *Provincial Wetland Restoration/Compensation Guide* (Alberta Environment 2007), recommends the use of this system (or Stewart and Kantrud 1971) for QWAES assessments and determining wetland compensation requirements for projects in which wetland impacts cannot be avoided.

The Cowardin system identifies wetlands in a different manner than CWCS. Under Cowardin, wetlands are classified according to the larger overall system to which they belong (Marine, Estuarine, Riverine, Lacustrine, and Palustrine). All of the wetlands within the Project area are considered Palustrine, because Riverine systems are restricted to wetland areas found only within watercourse channels and Lacustrine wetlands are associated with lakes and have a minimum size of 8 ha.

Cowardin wetland classes are determined based on the tallest vegetation type that covers 30% or greater of the surface area of the wetland. Compared to the CWCS, the Cowardin system does not differentiate between peatlands and other wetland types. For example, graminoid-dominated fens (under CWCS) would be considered *emergent wetland* under Cowardin. Similarly, treed bogs, treed fens and swamps would all be considered *forested wetland* under Cowardin. CWCS provides a more in-depth description of wetland ecosystems than the Cowardin system, because it is based to a larger degree on hydrological characteristics.

Field Surveys

Wetland areas were assessed in the field by qualified wetland aquatic environment specialists (QWAES) during vegetation surveys conducted in August through October 2012. Wetlands were classified according to both *The Canadian Wetland Classification System* and the *Classification of Wetlands and Deepwater Habitats of the United States*. Notes were taken regarding the hydrological, physical and vegetation characteristics of each wetland, and incidental wildlife observations recorded. Representative photographs were taken.

There are 38 wetlands within 150 m of the proposed centreline of the highway, which have been field verified and classified (Appendx 8). Forested bogs and fens predominate, with a small amount of marsh, swamp, and shallow water pond areas (Table 7).

Table 7: Wetland areas within 150 m of the proposed centerline

Wetland Classes	Area within 150 m of centerline (ha)	% of Area within 150 m of centerline
Bog	34.5	1.65%
Fen	48.8	2.33%
Marsh	18.2	0.87%
Shallow Water	1.0	0.05%
Swamp	7.5	0.36%
TOTAL	**110.0**	**5.26%**

Peatlands, comprised of bogs and fens, made up 15 of the wetland areas and cover an area of 83.3 ha within the Project area (4.0 %). In some cases it can be difficult to distinguish between bogs and fens; vegetation cover provides some indication, but the underlying hydrology can be difficult to detect. Fens typically originate in areas with mineral rich water—the water contains minerals because it is constantly (if slowly) moving overland or subsurface. Water in bogs is mineral poor and generally acidic; it originates mainly from rainfall. Fens can also be nutrient poor, resulting in a gradient of nutrient richness from bog to fen, for which it is sometimes difficult to delineate individual peatland areas. Nonetheless, many peatlands exhibit similar vegetation communities, and mitigation recommendations for peatlands are based not on the specific wetland class, but on the vegetation and wildlife resources identified within. Some peatlands are commonly referred to as "muskeg".

Non-peatland wetlands (marshes, swamps, and shallow water) comprise 26.7 ha within the Project area (1.3%). These wetlands tended to be small and isolated when compared to the some of the extensive peatland areas; excluding several wetland complexes associated with stream areas altered by beavers.

Marshes and swamps were primarily distinguished by the abundance of trees over 6 m tall. Marshes and swamps can be quite similar in vegetation and other characteristics when tall shrubs are present. Shallow water wetlands require open water to cover greater than 75% of the wetland area. Most open water within the Project area is within streams or beaver ponds—which are also associated with the surrounding wet areas, and tended to be classified as marshes or swamps. Shallow water wetlands are rare in the Project area.

Bogs: Six wetlands within the Project area are classified as bogs. Most of the bogs are forested to some degree and have areas within the Project area that range from 0.3 ha to 17.1 ha. The larger bog areas tend to extend far beyond the boundaries of the Project area. Three CWCS bog subforms were identified: Flat Bog, Blanket Bog, and Basin Bog. Flat bogs are not confined within a well-defined basin and tend to cover extensive, flat, lowland areas. Blanket bogs also commonly cover extensive areas, however, they are found on gentle slopes. Basin bogs are confined to relatively discrete basins with no feeder streams and have a generally flat surface that is not raised above the surrounding area.

Fens: Ten wetlands were identified as fens within the Project area. Fens, also being peatlands, bear a strong resemblance to many of the described bogs. Fens differ in terms of vegetation, often with a large

component of sedge in non-treed fens, or larch in treed fens. The dominance of these vegetation types is indicative of more nutrient rich water, which is a defining characteristic of fens. Because fens also tend to have moving water (overland or subsurface), the characteristics of local geography / hydrology also play a role in determining whether wetlands were fens or bogs (i.e. in areas where direction drainage was evident, especially in conjunction with identified drainages, a wetland is more likely a fen).

Three CWCS fen subforms were identified in the Project area: Horizontal fen, basin fen, and spring fen. Horizontal fens (similar to Flat Bogs) tend to occur in large poorly defined depressions, usually on gently sloped surfaces. Basin Fens are confined within basins in the local geography, but often have out-flowing streams. Spring fens occur in locations that have mineral rich springs providing the ground water.

Swamps: Within the Project area, four wetlands were classified as swamps. Two subforms of swamp were identified: Basin Swamp and Riverine Swamp. Basin Swamps usually occur in well-defined basins and may develop a layer of peat. Riverine Swamps occur along watercourses (permanent and intermittent).

Marshes: Fifteen wetlands were classified as marshes within the Project area. Four marsh subforms were identified, based largely on drainage characteristics: Linked Basin Marsh (n=2), Isolated Basin Marsh (n=5), Discharge Basin Marsh (n=1) and Riparian Stream Marsh (n=7). Basin Marshes are found within well-defined basins or depressions, and receive water from precipitation, surface runoff, groundwater discharge, and stream inflows. Discharge Basin Marshes receive most of their water from groundwater discharge, and are found in low lying areas. Isolated Basin Marshes are usually in shallow depressions and lack surface inlets or outlets. Linked Basin Marshes have inlets and outlets but may only have water during times of high runoff. Riparian Stream Marshes are located along stream channels, embankments and riparian zones.

Shallow Water: Only one shallow water wetland was found within the Project area. The subform was identified as Linked Basin Water, which is defined as occupying a well-defined basin with in- and out-flowing streams.

5.1.5 Fish and Fish Habitat

5.1.5.1 FISH

The Project is located within the Edson River drainage to the south and the Pine Creek drainage to the north; both drainages are part of the Athabasca River watershed. A map of the watersheds showing the stream crossing locations is in Appendix 14. Current proposed watercourse structures are under review (Appendix 9). In the central-north part of the Project a major bridge is proposed across Pine Creek; another major bridge is proposed for the Edson River in the southern part of the Project. Water velocity matching will be met at all bridge-file sized structures, to allow for upstream fish passage. Bridge structures typically do not impede fish passage.The Project area has a high fisheries values, especially for native mountain whitefish, burbot and Athabasca rainbow trout (Table 8). The Project area is within Fish Management Zone ES3.

Historical fish inventory data for the streams in the Project area, and close enough to crossing sites to indicate fish species that may be present, was acquired from the on-line Alberta Environment and Sustainable Resource Development Fish and Wildlife Information Management System. The historical inventory data is summarized in Table 9 for as "upstream" and "downstream" historical fish inventory. Fish species recorded upstream of a crossing site will probably also occur at the crossing site, at least to the extent of migrating through the site even if they do not use it as living habitat. Fish species recorded downstream of the crossing site may or may not occur as far upstream as the crossing site. Fish and fish habitat inventory at and near the crossing site will be combined with the historical upstream and downstream inventory in standard Qualified Aquatic Environmental Specialist (QAES) reports to determine the fish species likely using the stream at the crossing site. Scientific literature was reviewed for basic biological information for each species (Table 8).

Permits for fish collection were acquired from Alberta Environment and Sustainable Resource Development, and fish inventories and fish habitat assessments specific to the proposed highway alignment were conducted in 2012 and 2013. Fish inventory methods used were electrofishing, minnow trapping, and dip netting. Fish and fish habitat assessments were completed consistent with the *Guide to the Code of Practice for watercourse crossings, Alberta Envrionment, 2001* and the *Code of Practice for Watercourse crossings, Alberta Environment, 2005*. Biologists leading the fish inventories were experienced fish biologists. All inventories were designed to determine fish species presence / absence.

The fish species found during inventories in 2012 and 2013 are illustrated in Figure 12 and the results summarized in Table 9, together with the historical upstream and downstream fish inventory records. The crossing site locations are shown in Appendix 14. The proposed highway will cross 21 streams that are at this time known to support fish at the crossing site (Table 9). A few (< 5) additional streams may also be fish bearing, even though no fish have been recorded; they will be fully assessed in individual QAES reports. There are also locations where the highway is closely parallel to a fish stream, and therefore there may be impacts.

Edson River

The Edson River drainage has historical capture records of *at-risk* and *sensitive* species that include Athabasca rainbow trout (at-risk), Arctic grayling (sensitive), northern redbelly dace (sensitive), and spoonhead sculpin (sensitive). Records of secure species include brook stickleback, burbot, finescale dace, lake chub, longnose dace, longnose sucker, mountain whitefish, trout perch and white sucker. The exotic species brook trout has also been historically found within this drainage (Tables 8, 9).

New fish inventory data (2012 and 2013) for the Edson River drainage included all historically documented fish species, except for white sucker (secure) and brook trout (exotic). Athabasca rainbow trout were captured in the main stem of the Edson river as well as in the headwater tributaries. Arctic grayling (sensitive) and spoonhead scuplin (sensitive) were captured only within the main stem of the Edson river. Northern redbelly dace (sensitive) were captured in the main stem of the Edson River, as well as in the lower sections of an unnamed primary tributary of the Edson River (Table 9).

Pine Creek

The Pine Creek drainage has historical capture records of *at-risk* and *sensitive* species that include Athabasca rainbow trout (at-risk), Arctic grayling (sensitive), bull trout (sensitive) and spoonhead sculpin (sensitive). Historical records of secure species include burbot, lake chub, longnose dace, longnose sucker, mountain whitefish and white sucker (Tables 8, 9).

New fish inventory data (2012 and 2013) for the Pine Creek drainage included Athabasca rainbow trout (at-risk), spoonhead sculpin (sensitive) and the secure species of mountain whitefish, burbot and longnose dace. Athabasca rainbow trout (at-risk) were captured throughout the main stem of Pine Creek as well as in its upper tributary streams (Table 9).

It is presently unknown which streams are used for upstream spring migration by Athabasca rainbow trout and/or arctic grayling. There are historical records of bull trout in Pine Creek, but it is unknown whether Pine Creek is used by bull trout as a migration route (upstream or downstream) in the fall. The amount of fish habitat that will be impacted by construction of the highway will be addressed in the Environmental Impact Statement.

Table 8: Fish species historically present within the study area

Common/Scientific Name (Acronym)	Conservation Status	Spawning Season	Migrate to Spawn	Spawning Temperature (°C)	Spawning Habitat	General Habitat	Migration study candidate
Arctic Grayling (ARGR) *Thymallus arcticus*	Sensitive	Spring (April - June)	Yes (Lakes - Rivers)	7-10	Small gravel creeks and rocky bottom tributaries. No redds	Clear, large cold rivers, rocky creeks, lakes	Yes - spring
Brook Stickleback (BRST) *Culaea inconstans*	Secure	Spring (April - July)	No	8	Shallow water with reeds, grass and algae. Nests	Clear, cold densely vegetated small streams, margins of ponds.	No
Brook Trout (BKTR) *Salvelinus fontinalis*	Exotic	Fall (Sept - Nov)	Yes		Gravel beds in headwater streams or gravel lake shallows with springwater flow. Redds	Clear, cool oxygenated streams	No
Bull Trout (BLTR) *Salvelinus confluentus*	Sensitive	Fall (Sept - Nov)	Yes (tributaries)	7-8	Moderate to large gravel streams with moderate current. Redds	Cold lakes, rivers. Young stay in spawning streams	Yes - fall (Pine Cr. only)
Burbot (BURB) *Lota lota*	Secure	Winter (Nov - May)	No		Small gravel beds in lakes and rivers, under ice. No nests	Lakes, tributary streams in spring	No
Finescale Dace (FNDC) *Phoxinus neogaeus*	Secure	Spring (June - July)	No		Cool Bogs and streams, beaver pnds. No nests	Cool bogs and streams, beaver pnds.	No
Lake Chub (LKCH) *Couesius plumbeus*	Secure	Spring (April - Aug)	Yes	10	Tributaries with large rocks in shallows. No nests	Highly adaptable habitat preference	No
Longnose Dace (LNDC) *Rhinichthys cataractae*	Secure	Spring (May - Aug)	No		Riffles over gravel bottom	Clean, swift flowing gravel, boulders in streams	No
Longnose Sucker (LNSC) *Catostomus catostomus*	Secure	Spring (May - July)	Yes (tributaries)	5	Streams or shallow lake ares with deep current. No nests	Gravel substrate within lakes and rives	No
Mountain Whitefish (MNWH) *Prosopium williamsoni*	Secure	Late Fall - Winter	Yes (Main stem rivers)		Gravel, cobble main stem rivers. No redds	Lakes and large rivers/streams, with high yearly migration	No
Northern Redbelly Dace (NRDC) *Phoxinus eos*	Sensitive	Summer (July - Aug)	No		Slow water with algae mass	Slow water, beaver ponds, fine detritous silt bottom	No
Rainbow Trout (RNTR) *Oncorhynchus mykiss*	At-Risk	Spring (April - June)	Yes (tributaries)	10-15	Fine gravels, above pools. Redds	Large, shallow rivers with gravel substrate, pool-riffle combinations. Young live in spawning streams.	Yes - spring
Slimy Sculpin (SLSC) *Cottus cognatus*	Secure	Spring (May - June)	No		Rocky territory	Varied. Rocky and gravel streams, small rivers, lakes.	No

Common/Scientific Name (Acronym)	Conser-vation Status	Spawning Season	Migrate to Spawn	Spawning Temper-ature (°C)	Spawning Habitat	General Habitat	Migration study candidate
Spoonhead Sculpin (SPSC) *Cottus ricei*	Sensitive	Late Summer - Fall	No		Rocky areas	Large rivers and streams. Wide distribution, rocky and boulders	No
Trout-perch (TRPR) *Percopsis omiscomaycus*	Secure	Spring (May - Aug)	No		Rocky streams, above gravel substrate	Small turbid streams	No
White Sucker (WHSC) *Catostomus commersoni*	Secure	Spring (May - June)	Yes	10	Migrate to gravel streams and lake margins. No Nests	Warm, shallow lakes and tributary rivers	No

Table 9: Fish species known from each stream crossing site of proposed alignment

See Appendix 14 for "Inventory Site" Locations

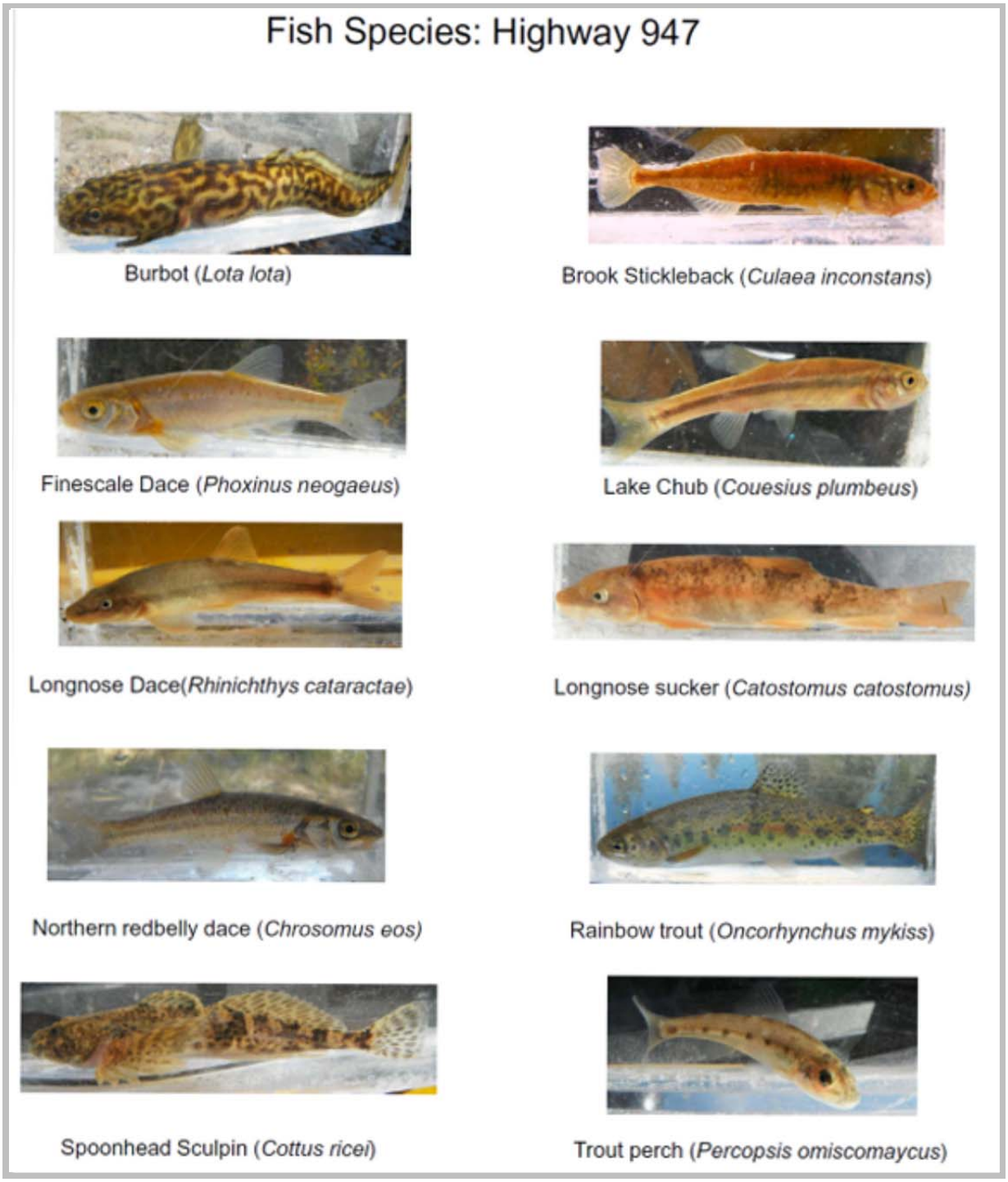
ARGR = arctic grayling; BRST = brook stickleback; BURB = burbot; FNDC = finescale dace; LKCH = lake chub; LNDC = longnose dace; MNWH = mountain whitefish; NRDC = northern redbelly dace; RNTR = rainbow trout; SLSC = slimy sculpin; SPSC = spoonhead sculpin; TRPR = trout-perch; WHSC = white sucker.

Inventory Site	Bridge File Number	Stream Name	Watershed	Crossing Location	Fish Records		
					Historical (FWMIS)	2012 Inventory	2013 Inventory
Little Sundance Creek Watershed							
0101	85229	Unnamed	LS01a, LS01b	SE 21-53-18-W5M	Downstream: RNTR, BKTR, WHSC, SPSC	BRST	BRST
Edson River Watershed							
0201		Unnamed	ER15a, ER15b		Downstream: BRST, LKCH		FNDC
0401	85230	Unnamed	ER03a, ER03b	SW 27-54-18-W5M	Upstream: BRST, NRDC, FNDC, WHSC	BRST, LKCH	FNDC, BRST, NRDC
0501	85217	Edson River	ER01a, ER01b	NW 34-54-18-W5M	Upstream: BRST, WHSC, LKCH, LNSC, RNTR, LNDC, TRPR At location: RNTR, SPSC, LKCH, WHSC, MNWH, TRPR, LNSC Downstream: ARGR, RNTR, BRST, LKCH, WHSC, TRPR, MNWH, LNSC	FNDC, LNDC, LNSC, SPSC, TRPR	RNTR, FNDC, BRST, NRDC
0502		Unnamed	ER04a		Downstream: ARGR, RNTR, BRST, LKCH, WHSC, TRPR, MNWH, LNSC	FNDC, LNSC	LKCH, LNSC, NRDC
0601	85231	Unnamed	ER04a, ER04b	NW 16-55-18-W5M	At location: SPSC, BURB, LNSC, RNTR, MNWH	FNDC, LNSC, NRDC	LNSC, FNDC, NRDC, BURB, SLSC
0701		Unnamed	ER04b, ER04c		Upstream: RNTR, BURB	BURB, LNSC, RNTR	LNSC, FNDC, BURB
0702	85232	Unnamed	ER06a	SE 29-55-18-W5M	Upstream: RNTR, BURB	FNDC, LNSC, RNTR	BURB, RNTR, FNSC, LNSC
0802	85233	Unnamed	ER06a, ER06b	NE 5-56-18-W5M	no records		
0803	85234	Unnamed	ER09a, ER09b	NW 9-56-18-W5M	Downstream: BURB		
0901	85235	Unnamed	ER16a, ER16b	SW 21-56-18-W5M	Downstream: RNTR	BURB, RNTR	RNTR
0902	85236	Unnamed	ER02a	NW 28-56-18-W5M	no records	RNTR	
Pine Creek Watershed							

Inventory Site	Bridge File Number	Stream Name	Watershed	Crossing Location	Fish Records		
					Historical (FWMIS)	2012 Inventory	2013 Inventory
1101	85237	Unnamed	PC18a, PC18b	SE 17-57-18-W5M	At location: RNTR	RNTR	
1102		Unnamed	PC18a		no records		
1103		Unnamed	PC18a		no records		
1104		Unnamed	PC18a		no records		
1105		Unnamed	PC18c		no records		
1106	85238	Unnamed	PC17a, PC17d	NE 19-57-18-W5M	no records		RNTR
1201		Unnamed	PC17a		no records		
1203		Unnamed	PC17a, PC17b		no records		RNTR
1301		Unnamed	PC01b, PC01j		Upstream: RNTR, SPSC, MNWH (in Pine Creek)		
1304	85239	Unnamed	PC15a, PC15b	NW 5-58-18-W5M	no records	RNTR	
1305		Unnamed	PC10b		no records		
1306/1307	77858	Pine Creek	PC01a, PC01b, PC13, PC12	NE 8-58-18-W5M	Upstream: RNTR, BURB, MNWH, SPSC		MNWH, RNTR, SPSC
1401		Unnamed	PC01a, PC01g		no records		
1402	85240	Unnamed	PC09a, PC09b	SE 17-58-18-W5M	no records	RNTR	MNWH
1403		Unnamed	PC01a, Pc01h		no records	RNTR	
1501		Unnamed	PC01e, PC06a		no records		
1502	85241	Unnamed	PC06a, PC06b	SW 33-58-18-W5M	no records	BURB, RNTR	RNTR
1503		Unnamed	PC01a, PC01f		no records		
1504	85242	Unnamed	PC05a, PC05b	SE 3-59-18-W5M	no records	BURB, RNTR	BURB, MNWH
1603		Unnamed	PC01a		no records		
1605		Unnamed	PC01a		no records		
1607		Unnamed	PC01a		no records		
1610		Unnamed	PC01a		no records		
1702		Unnamed	PC01a		no records		

Inventory Site	Bridge File Number	Stream Name	Watershed	Crossing Location	Fish Records		
					Historical (FWMIS)	2012 Inventory	2013 Inventory
1505/1701/ 1802/1803		Pine Creek	PC01a		At Location 1505: BURB, LNDC, LNSC Upstream: BURB, ARGR, LKCH, LNDC, RNTR, MNWH, SLDC, BLTR, WHSC		

Figure 13. Representative Fish Present in the Project Area



5.1.6 Birds

Nesting bird surveys were completed during the breeding season (May – June) of 2012 and 2013 (Table 10). Surveys began shortly after sunrise and were conducted for eight hours per day. The entire distance of the highway alignement was not inventoried; instead representative samples of the major habitat types were surveyed within 150 m of the proposed highway centreline. All birds seen or heard were recorded, and extra time was spent looking for nests when birds exhibited nesting behaviours (female birds giving repeated alarm calls; birds not flying away until the surveyor was in very close proximity; raptors calling from the top of trees).

Nesting bird surveys were not conducted during periods of moderate to high winds (> Beaufort Scale 2) or during precipitation heavier than a drizzle, because these types of weather adversely affect bird singing behaviour and decrease human hearing capabilities (RIC 1999). An iPod with various bird recordings was used in the field to help with identification. The *Sibley Field Guide to Birds of Western North America* (Sibley 2003) was used to assist with visual identification.

Surveys for nesting owls were conducted during the breeding season in February and April 2013 (Table 10).

Table 10. Bird Inventory Dates

Highway Section (distance north of Hwy 16)	Date and Time of Day	Type of Survey
0 - 28.000 km	17 - 18 June 2012 / 09:00 - 17:00	Nesting Bird
28.000 - 64.500 km	22-30 May 2013	Nesting Bird
64.500 - 69.200 km	19 - 21 June 2012 / 07:00 - 15:00	Nesting Bird
various	24 - 25 February 2013; 4 - 9 April 2013	Owls

Three survey methods were used to collect data on birds in the Project area.

Point-count surveys: The surveyors walked through the study area and stopped about every 200m, for five minutes at each station, and recorded all birds seen or heard during that time (RIC 1999a). All point-count locations were marked with a Garmin GPS 62s unit.

Encounter transects: The surveyors walked continuously through the study area, recording all birds seen or heard within the study area (RIC 1999a).

Nocturnal Owl Call Playback Surveys: Nesting owl call playback surveys are used to determine presence/not detected of owl species. All protocols used for these surveys followed the Alberta Wildlife Animal Care Committee Class Protocol #006 (Alberta Government 2005) and the Alberta Nocturnal Owl Survey Instruction Booklet (Takats 2003). In February 2013, owl call playback surveys consisted of playing pre-recorded calls of species potentially present, using an iPod and a game caller to amplify the call. The audio track began with 5 minutes of silent listening followed by the call of each species and a final 5 minute silent listening phase. Each species was broadcast twice for twenty seconds with a 30 second break in between calls. While the call was played the speaker was rotated so the call was

broadcast in all directions. Between each species there was a silent listening period of one minute (Takats 2003). The species calls used for this survey were boreal owl, great grey owl and barred owl (Takats 2003). If any owls respond to the played calls, the species, direction, distance and which call it responded to was recorded (RISC 2006a). Two fifteen minute stand watches were also performed for short-eared owls in suitable habitat. In April 2013, the survey track was modified to match the more commonly used methodology from the Alberta Nocturnal Owl Survey Instruction Booklet (Takats 2003 / Lisa Takats pers. comm. March 2013). Surveys began with a 2 minute silent listening period followed by each species' call broadcast for 20 seconds (Takats 2003). A one minute silent listening period followed each species' call. A silent listening period of 3 minutes followed the last species call. The species calls used for this survey were also boreal owl, great grey owl and barred owl, and two new species were added for this survey period (northern saw-whet owl and long-eared owl) to increase the potential number of species that could be detected (Lisa Takats pers. comm. March 2013). The surveys began half an hour after sunset and ran until midnight (February survey) or until about 04:00 am (April survey). Survey stations were placed as near as possible to optimal owl habitat, usually in or near mature coniferous forests. Surveys were not conducted during periods of moderate to high winds (Beaufort scale >3) or during precipitation heavier than a light drizzle/snow, as these types of weather adversely affect bird singing behaviour and decrease hearing capabilities (Takats 2003). Environmental data collected at each site included temperature, percent cloud cover, and precipitation. When an owl call was heard, the direction and approximate distance to the animal were recorded.

There is a wide diversity of birds using the Project area, including many species of migratory birds. Waterfowl are uncommon, because there are few open-water ponds and lakes. Several species of raptors use the area, but the largest species (eagles) may be absent or rare (osprey) because of the lack of large fish-bearing waterbodies. Migratory birds are managed under the federal *Migratory Birds Convention Act*, bird species at risk are managed under the federal *Species at Risk Act*, and provincially significant birds are managed under the Alberta *Wildlife Act*. In this section all birds are addressed, so that all species that are of management concern under all legislation are included.

A total of 40 hours were spent in the field conducting nesting bird surveys in 2012, and 64 hours in 2013. There were 69 different bird species or groups of species recorded -- 52 in 2012 and 44 in 2013 (Table 11; details in Appendix 10). Some birds were not able to be identified to species due to similarities in appearance and song to a closely related species (blackbirds) or because scat was used to identify species presence (grouse). One bird species (three-toed woodpecker) was recorded as an incidental observation during other work in February 2013, and then was recorded during the surveys in 2013. The nests of 4 species were found in the survey area. In 2012, two song sparrow nests were found (one had eggs and the other had chicks); cliff swallows were nesting under the bridge over the Athabasca River; and one American robin nest with chicks was found. In 2013 a grey jay nest was found and cliff swallow nests were again observed in a second location. Most of the other birds were likely breeding in the area (Table 11).

There were 23 species recorded in 2012 but not 2013, and 13 species recorded in 2013 but not 2012. This reflects a combination of habitat differences (especially elevation) and normal year-to-year variation in brid presence and abundance.

Table 11. Bird species recorded within 150m of centreline

BIRD SPECIES	2012		2013	
	BREEDING[1]	ABUNDANCE[2]	BREEDING[1]	ABUNDANCE[2]
Canada Goose			P	S
Mallard	P	UC	P	UC
Common Goldeneye	L	S		
Common Merganser	L	UC		
Hooded Merganser	L	S		
Osprey			P	S
Sharp-shinned Hawk	L	S		
Red-tailed Hawk	P	S	L	FC
American Kestrel			P	S
Merlin	P	S		
Northern Saw-whet Owl	P	S		
Boreal Owl	P	S		
Long-eared Owl	P	S	P	S
Great Horned Owl	P	S		
Great Grey Owl	P	S	P	S
Ruffed Grouse			L	FC
Grouse species	L	FC		
Sandhill Crane	P	UC		
Spotted Sandpiper			L	S
Lesser Yellowlegs	L	S		
Wilson's Snipe	L	FC	L	FC
Belted Kingfisher	P	UC	L	S
Northern Flicker	L	FC		
Pileated Woodpecker			P	S
Downy Woodpecker	L	S	L	S
Yellow-bellied Sapsucker	L	S	L	UC
American Three-toed Woodpecker	P	S	L	S
Alder Flycatcher	L	C		
Least Flycatcher	L	UC	L	UC
Blue-headed Vireo	L	UC		
Warbling Vireo	L	S	L	FC
Red-eyed Vireo	L	UC		
Gray Jay	L	FC	O	C
American Crow	P	UC		
Common Raven			P	UC
Cliff Swallow	O	C	O	C
Black-capped Chickadee	P	UC	L	UC
Boreal Chickadee	L	FC	L	FC
White-breasted Nuthatch	L	S		

Bird Species	2012		2013	
	Breeding[1]	Abundance[2]	Breeding[1]	Abundance[2]
Red-breasted Nuthatch	L	C	L	UC
Golden-crowned Kinglet	L	UC	L	UC
Ruby-crowned Kinglet	L	FC	L	C
Varied Thrush	L	UC	L	FC
American Robin	O	C	L	C
Swainson's Thrush	L	C	L	C
Hermit Thrush	L	FC	L	FC
Townsend's Solitaire			P	S
Grey Catbird	P	S		
Waxwing species	P	UC		
Tennessee Warbler	L	C	L	UC
Orange-crowned Warbler	L	S		
Yellow Warbler	L	C		
Yellow-rumped Warbler	L	C	L	C
Townsend's Warbler			L	S
Northern Waterthrush	L	S		
Common Yellowthroat	L	S		
Wilson's Warbler	L	UC		
Western Tanager	L	S	L	S
Rose-breasted Grosbeak			L	UC
Chipping Sparrow	L	C	L	C
Savannah Sparrow	L	S	L	UC
Song Sparrow	O	FC	L	UC
Le Conte's Sparrow			L	UC
Lincoln's Sparrow	L	UC		
Dark-eyed Junco	L	C	L	C
White-throated Sparrow	L	C	P	S
Blackbird species	P	FC		
Red Crossbill			P	UC
Pine Siskin			P	UC

[1]**Breeding:** P = Possible -- bird was seen either as single or flock but no singing was observed / no obvious reason to be believe nesting; L = Likely -- male heard singing, adults acting territorially, females giving alarm calls; O = Observed -- nest or chicks were found.
[2]**Abundance:** C = Common -- greater than 10 birds seen or heard; FC = Fairly Common -- between 5 and 10 birds seen or heard; UC = Uncommon -- between 2 and 4 birds seen or heard; S = Singleton -- only 1 bird seen or heard.

Thirteen species were common throughout the study area in one or both years (Table 11): alder flycatcher, cliff swallow, gray jay, red-breasted nuthatch, American robin, ruby-crowned kinglet, Swainson's thrush, Tennessee warbler, yellow warbler, yellow-rumped warbler, chipping sparrow, dark-eyed junco and white-throated sparrow. Twelve species are fairly common in one or both years: ruffed grouse, grouse species, Wilson's snipe, northern flicker, gray jay, boreal chickadee, ruby-crowned kinglet, hermit thrush, warbling vireo, song sparrow, and brewers and/or rusty blackbirds (could not be distinguished).

No owls were seen or heard during the February 2013 survey. This may have been due to the marginal weather encountered during the survey, and/or it may have been too early in the season for owls to be calling. The April 2013 survey detected six owls of four different species: northern saw-whet owl, boreal owl, long-eared owl, and great horned owl. A great gray owl was observed hunting prior to the commencement of the survey. Single individuals of long-eared and great gray owls were seen during the May 2013 nesting bird survey.

Eight species are bird *species at risk* (see that section). They are all listed as sensitive by Alberta ESRD, and are on the ACIMS watch list: osprey, American kestrel, sandhill crane, pileated woodpecker, least flycatcher, common yellowthroat, western tanager, and great gray owl. No rusty blackbirds were confirmed, because their song could not be distinguished from Brewer's blackbird, but they are likely present. A notable observation during the 2012 survey includes a gray catbird in the riparian area adjacent to the Athabasca River bridge at the north end of the proposed highway. Although gray catbirds are common in Alberta, they are generally found in the southwestern part of Alberta in the Prairie Region (Sibley 2003). The Edson area is at the northern limit of the gray catbird's usual breeding range; however, they have been documented breeding as far north as Grande Prairie and Fairview. Presently, there is no documentation of nesting for this species in the Highway 947 region. Given the time of year and habitat the bird was found in, it is possible that nesting was taking place.

5.1.7 Amphibians

Adult and juvenile amphibian data were collected in 2012 in conjunction with stream, wetland, habitat and breeding bird surveys. All visual and audible call observations were recorded. Amphibian surveys are conducted in the spring during June and July of 2012 and May 2013. The spring time is when breeding is occurring and calling is most frequent. Ideal conditions for amphibian breeding and monitoring are when air temperature is between 5 and 10^{o}C and water temperature is at least 10^{o}C. Surveys are focused on breeding habitat, which typically includes areas of shallow water such as marshes, sloughs, ponds, flooded ditches, margins of lakes and backwaters of streams and rivers. Preferred breeding habitat is gradually sloping shorelines that support abundant emergent vegetation and receive direct sunlight early in the morning or afternoon (ACA and ASRD 2006).

Once survey sites are chosen, surveys are conducted at dusk until four hours after dark. Upon arrival onsite there is a two minute waiting period before monitoring begins. This allows for any amphibians disturbed by the surveyor's arrival to resume calling. The surveyor then listens for 10 minutes, during which time calls are recorded and identified to species. General weather observations are also recorded. Surveys were conducted at the same location on subsequent nights in conjunction with yellow rail

surveys. The sequence of sites visited was reversed on the second night to reduce any effect that the time the survey was conducted might have.

Daytime surveys were conducted at each of the same locations. During these surveys, wetlands were circumnavigated on foot searching the water and shoreline for egg masses, amphibian larvae and adults. Dip nets were utilized to make periodic sweeps of any standing water to search for and capture hidden amphibian larvae. Species and life stage of amphibians encountered were recorded, and photographs were taken to aid in identification of larvae.

Additional surveys for adults were conducted In June through September 2012 (generally after eggs and larvae were no longer present) by walking all stream, pond and wetland areas throughout the study area and recording any adults or juveniles observed. Additional observations of adults were noted in June 2013 while conducting fish and fish habitat surveys.

Amphibians breed in open-water such as ditches, ponds, lakes, ponded streams, and shallow-water wetlands. They migrate to the breeding sites in the spring, and migrate to upland living areas for the summer. Three species of amphibians are known to occur within the study area:

- Wood Frog, *Rana sylvatica*
- Boreal Chorus Frog, *Pseudacris maculata*
- Western Toad, *Anaxyrus boreas*

It is unlikely that any other amphibian species occur within the Project area.

Amphibians recorded in 2012 and 2013 included 2 sites with Western Toads, 45 sites with Wood Frogs, and 20 sites with Boreal Chorus Frogs (Appendix 11; Figure 13). Fourteen sites had tadpoles that were too young to reliably identify. Additonal details regarding habitats and number of individuals at each site will be included in the Environmental Impact Statement. In the Project area, Western Toads are rare, Boreal Chorus Frogs are uncommon, and Wood Frogs are widespread and common. See the "Species at Risk" section for a note on the taxonomy of the Western Toads.

Amphibian habitats have been surveyed within 150 m from the centreline of the highway for presence / absence of amphibian species. No amphibian migration routes between upland and aquatic habitats have been documented.

Figure 14. Representative Amphibians in the Project Area.

Boreal Chorus Frog

Western Toad

Wood Frog

5.1.8 Mammals

Winter track count surveys were conducted February 21-27, 2013. During these surveys a total of 45 km of transects were covered. Twenty-five transects were performed with an average transect length of 1783 m. Environmental conditions were recorded at the beginning of each transect, including temperature, precipitation, cloud cover, total snow depth, new snow depth, and time since last snowfall. Tracks were counted starting at the point of commencement (POC). Tracks of all species encountered were recorded and the locations were marked with a waypoint. The last snowfall before surveys commenced was February 17th with only a small amount of snow having fallen (<1cm). Surveys were done each day February 21-24. Track age during this period was up to 7 days old. On February 25th tracking was not done due to heavy snowfall; 5-10 cm of snow fell within the survey area. Tracking recommenced on February 26th after snowfall had stopped and tracks had once more accumulated. Track age on Feb 26-27 ranged from 12-36 hours. The time between snowfalls can influence the number of tracks observed and bias density results; hence track densities were standardized by dividing the number of tracks found by the number of days since the last snowfall (RISC 2006).

The primary objective of the winter track surveys was to determine the presence of mammal species using various habitats during the winter. The conditions during the survey period were generally good for track identification and most tracks could be identified with a high level of confidence, except for very similar species-groups. A secondary objective of this study was to obtain an indication of relative population densities. This study was a one-time event conducted over a period of six days and in only one sampling year, and at the beginning of the survey period (Feb 21st to 24th) tracks of certain species were sometimes difficult to count due to the large number of tracks that had accumulated since the last snowfall. This only affected certain areas and included species with very high abundances, such as snowshoe hare, red squirrel, moose and deer. Transects where track densities for certain species were too high to count reliably were omitted from the track density data. The length of the affected transect was also omitted. In most cases track density was sufficient to determine habitat preferences as shown in Appendix 12. The relative populations density information must be interpreted with caution.

Most mammals living in the Project area are of commercial and cultural importance for hunters and trappers. The surveys confirm the presence of 18 species or groups of species of mammals:

- American badger
- black bear
- moose
- red squirrel
- white-tail deer, mule deer
- snowshoe hare
- weasel species
- American marten
- fisher*
- Canada lynx
- coyote
- shrew species
- vole species
- mouse species
- grey wolf
- wolverine
- northern river otter
- red fox

In the summer of 2013, one American badger was observed crossing a resource road west of the middle of the Project area. This is apparently the most northern record for this species in Alberta, but it is not unexpected because the range of badgers is expanding northward in this area. A fisher was seen the same day crossing the same road near where the badger was seen, confirming the presence of that species (winter tracks of fisher and marten could not be reliably separated).

Appendix 12 includes summaries of the winter track survey data -- track density based on habitat types; a comparison of mature habitats to immature habitats; and a comparison of deciduous, coniferous, mixed, and riparian habitats. The greatest numbers of species were found in the coniferous and mixed habitat types, with 14 species being found in each. The riparian habitat type had the next most at 13 species, while the deciduous habitat type had the least species with only 8 species found in total.

The long-tailed weasel and wolverine are ranked 'may be at risk' by Alberta ESRD. As discussed above, the tracks of different weasel species could not be distinguished; hence it is unknown whether the tracks were made by a long-tailed weasel or another weasel species. Wolverine tracks were found in several places along the study area. American badger, fisher and Canada lynx are ranked as 'sensitive' by Alberta ESRD. Fisher and marten tracks could not be distinguished, but Canada lynx tracks were common throughout the study area.

Grizzly bears in Alberta are classified as 'at risk' by Alberta ESRD and as 'special concern' by COSEWIC. Secondary grizzly bear habitat exists in the northern sections of the Highway 947 corridor (FWMIS). Secondary ranges consist of good habitat but have low bear densities because they are generally closer to areas of high density human disturbance (ESRD 2010). Areas with high levels of human activity have reduced use of high quality habitat by grizzly bears. Greater road access leads to a higher frequency of bear/human encounters resulting in higher bear mortality. Bears are killed due to collisions with vehicles, illegal hunting, self defence or defence of property and relocation or euthanization due to bears becoming habituated to the presence of humans (ESRD 2010). Roads also attract bears because they are often associated with good habitat such as valley bottoms and cut blocks that provide increased foraging opportunities. As traffic volume increases, the negative impact of roads on grizzly bears also increases. Areas with high levels of human access may convert good quality grizzly bear habitat into "population sinks" (ESRD, 2010), in which mortality is greater than reproduction, and bear populations decline. The primary limiting factor of grizzly bears in Alberta is human caused mortality associated with expanding road access, habitat loss and alteration.

5.1.9 Species at Risk

Wildlife rankings, in terms of population status, (i.e. threatened, endangered, etc) are governed by several bodies in Canada. Nationally the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) produces a list, with most (but not all) of the species at risk identified by COSEWIC later being listed on Schedule 1 of the federal Species at Risk Act (SARA). Provincially the Alberta Wildlife Act provides legal protection to a small list of species, and Alberta Environment and Sustainable Resource Development maintains a non-legisltated list of species at risk known as "The General Status of Alberta Wild Species". Details of the conservation ranking methods are provided in Appendix 13.

A list of species at risk that are *potentially* present in the Project area, based on the Project area being within the Lower Foothills Subregion and the Upper Foothills Subregion, is provided in Appendix 13. This list is generally summarized from data available on the Alberta ESRD website. The ESRD website data appears to be incomplete, and Athabasca rainbow trout and American badger have been added to Appendix 13. Species at Risk that are known to be within or adjacent to the Project area are discussed here.

Athabasca rainbow trout are a genetically distinct population of rainbow trout that is unique to the Athabasca River watershed, and is presently ranked as *at risk* in Alberta. Athabasca rainbow trout are being considered by the Alberta government to be legally designated a "Threatened" species under the *Wildlife Act* (no desision by December 2013), and the species is scheduled for assessment by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2014 for potential listing under the *Species at Risk Act* (George Sterling, Alberta Government, pers.comm. April 2013). The trout occur throughout the Pine Creek watershed, including in many of the small headwaters tributaries, and locally in the Edson River watershed.

Northern redbelly dace occur in some tributaries of the Edson River, but do not appear to occur in the Pine Creek watershed. They are ranked as 'sensitive' by Alberta ESRD. In contrast, Bull trout occur in the main channel of Pine Creek, but do not appear to occur in the Edson River watershed. They are also ranked as 'sensitive' by Alberta ESRD.

Western Toads are listed as Sensitive by Alberta SRD and Special Concern under Schedule 1 of the federal Species at Risk Act. Western Toads are now considered to belong to two populations - "calling" and "non-calling", which are recognized as distinct conservation units by COSEWIC (2012d). They may actually comprise two separate species, with almost the entire world range of the "calling" population occurring in Alberta (Pauly 2008). Both types have Special Concern national conservation rank under the Species at Risk Act, and are considered Sensitive by Alberta SRD. The "calling" population-type is present in the Highway 947 study area, based on the ranges given by COSEWIC (2012d). Western Toads breed in wetland habitats, but are adaptable and can even breed in ditches. Adults tend to live in dense shrub areas but are also found in varying habitats, even cleared forests. The primary concerns are the loss of wetland habitats and mortality resulting from habitat fragmentation by roads. COSEWIC (2012d) states that both population types are relatively intolerant of urban expansion, conversion of habitat for agricultural use, and habitat fragmentation resulting from resource extraction and road networks. Fair to good habitat for Western Toads exists within the study area, with breeding and overwintering habitat present in small wetlands and ponded water along streams. Highway mortality in areas where the highway runs adjacent existing ponded streams or wetlands may be an issue that needs to be addressed; significant toad mortality can occur from traffic (Kobylarz 2003).

Trumpeter swans are listed as ‘at risk’ by Alberta ESRD and designated as “Threatened” under the Alberta Wildlife Act. An estimated 166 breeding pairs occur in Alberta and breeding habitat is relatively secure. Population growth in Alberta is limited by a shortage of overwintering habitat (Government of Alberta 2012). The greatest impacts to trumpeter swans from this project are likely to be incurred if the

highway passes too close to breeding habitat. In Alberta, trumpeter swans breed on undisturbed shallow lakes, with stable water levels and unpolluted water (James, 2000). Trumpeters are very sensitive to loud traffic, boat, floatplanes and human disturbance near their nesting site (James 2000). If the project passes too closely to nesting areas, vehicle traffic and human intrusion could disrupt feeding and incubation resulting in nest failure or cygnet loss. There is one identified Trumpeter Swan lake just to the east of the Project area, near the south end, which has the ungazetted name of "Lacy's Lake". The highway itself may be just outside the 300 m buffer zone, but the study area overlaps the buffer. In the winter of 2012/13 a right-of-way was cleared (mulched) that is closely adjacent to this lake, and road construction proceeded in the summer 0f 2013. Trumpeter swans have not been observed to use the lake since 1998, and ESRD is considering removing it from the list of lakes to be managed as trumpeter swan habitat.

The osprey is classified as ‘sensitive’ by Alberta ESRD. The species is uncommon but widespread, and is vulnerable to loss of nest sites. Large stick nests are built at high points such as the tops of tall dead trees, telephone poles, and rock pinnacles overlooking water. The osprey returns to the same nest year after year.

The great grey owl is classified as ‘sensitive’ by Alberta ESRD. This is due to this species being present in low densities across the landscape, and requiring stands of mature forest for nesting. As a result this species is sensitive to forest harvesting.One individual was observed hunting within the study area in April 2013. The great grey owl is present throughout Alberta in low densities (Government of Alberta 2012). It is dependent on mature forests for nesting and as a result is vulnerable to forest harvesting (Government of Alberta 2012). Both observations of the owl were of it hunting along the current power transmission line right-of-way that parallels the proposed highway right-of-way. Edge species such as the great gray owl take advantage of the edge-effect created by the clearing of right-of-ways.

The pileated woodpecker is classified as ‘sensitive’ by Alberta ESRD. The species is uncommon but widespread, and is vulnerable to loss of large diameter trees used for nesting.

The rusty blackbird was classified as ‘Special Concern’ by COSEWIC in April of 2006 and is classified as ‘Sensitive’ by Alberta ESRD. The Alberta designation is a result of a dramatic decline in the population across its range since 1966 (Government of Alberta, 2012). This species also occupies a threatened habitat (Government of Alberta 2012). The COSEWIC designation is due to habitat loss resulting from the loss of wetlands in its wintering grounds on the floodplains of the Mississippi valley (COSEWIC 2006). Breeding habitat consists of forest wetlands, such as slow moving streams, peat bogs, sedge meadows, marshes, swamps, beaver ponds and pasture edges (COSEWIC 2006). The rusty blackbird could not be distinguished from the brewer’s blackbird during the 2012 survey, but both these species may be nesting within the study area.

American badger is ranked as sensitive by Alberta ESRD and one was seen crossing a resource road near the Project area. The species can be assumed to at least occasionally enter the Project area. They are a carnivore that excavates burrows to live in, and road mortality can be significant.

Canada lynx are ranked as 'sensitive' by Alberta ESRD. This is due to population declines in recent years and concern over habitat loss and fragmentation (Government of Alberta 2012). Canada lynx were found throughout the study area during the winter track surveys in 2013. This project may impact lynx through fragmentation of habitat, collisions with vehicles and increased human access into lynx habitat.

Fisher are ranked as 'sensitive' by Alberta ESRD because the population status is unknown and trends in population and distribution are uncertain. Current forestry practices may reduce availability of preferred habitat (Government of Alberta 2012). Many tracks classified as marten/fisher were found within the study area. Since fisher and marten tracks could not be reliably distinguished due to the similarities of the tracks it is not possible to tell conclusively if fisher exist within the study area from the track surveys. However, one fisher was seen crossing a road just outside the Project area, so it is reasonable to assume they are present within the Project area. Deciduous stands are an important component of fisher habitat as this is where reproductive den habitat is most likely to be found. For reproduction, fisher require large standing trees with heart rot cavities and access holes that are just large enough for the female fisher to fit through but no larger so as to exclude predators (Fisher habitat and forest management web module http://fisher.forrex.org/). These are often large, standing dead or dying black cottonwood. Within the study area this type of habitat is most likely to be found in riparian areas near Pine Creek and the Athabasca River. The highway corridor follows Pine Creek for about 30 km.

Wolverine are classified as 'may be at risk' by Alberta ESRD and as 'special concern' by COSEWIC. The Alberta ranking is due to a lack of information on population trends and because wolverine populations are known to be negatively affected by human disturbance and habitat fragmentation (Government of Alberta 2012). The COSEWIC ranking is due to habitat loss, degradation, and fragmentation from oil, gas and mineral exploration and extraction, forestry, roads, agriculture and urban development (COSEWIC 2012). Wolverines are susceptible to population declines due to human activities. Wolverines have low populations densities, low reproductive rates, large home ranges, and usually try to avoid humans (Petersen 1997). These characteristics of the wolverine's life history make it susceptible to activities that fragment the landscape and cause a loss of habitat. Wolverine tracks were found in the study area during the winter track surveys.

5.2 Impacts

There are many different habitat types within the clearance width of the highway, including streams, ponds, wetlands, mature coniferous, mixed and deciduous forests, immature forest, cut blocks and agricultural fields. Each of these areas serves as habitat for various wildlife species and their disturbance will inevitably lead to displacement of some wildlife species. Highway development may affect air, water, fish, wildlife, and other environmental values in various ways including:

- Changes in air quality
- Changes in water quantity, quality, and hydrology
- Alteration of terrain characteristics and changes to vegetation

- Changes to wetland habitats
- Changes to fish and fish habitat
- Changes to bird habitat
- Changes to mammal habitat
- Changes to species at risk habitat

The environmental changes are usually negative for highway construction, but can be positive, especially with implementation of good mitigation and compensation measures. The proposed highway 947 clearance width will be approximately 69.2 km long and 60 m wide, for a total land area impact of about 420 ha. There will some additional, as yet unknown, area lost to junctions with existing roads. There will also be partial loss of habitat for various species, due to a reduction in suitability of habitat for a variable distance away from the highway, due to factors such as noise disturbance, dust, pollutants, and increased mortality. Impacts to wildlife depend on the importance of the habitat to each species. This is a function of both the suitability of the habitat and the time of year. As there is a large range of habitat types present within the Project area, impacts to some wildlife will occur throughout the year.

Parts of the proposed Highway 947 corridor follow existing roadways of various sizes, from busy haul roads to small low traffic resource access roads. In the areas where busy roads already exist, additional impacts due to operation of the new highway are likely to be relatively low, but increased traffic volumes and speed may increase mortalities. In areas where no roads currently exist or only an infrequently used access road exists, new barriers to wildlife movement and increased mortalities may be created.

Road widths and traffic density are factors that determine how effective a barrier a road may be (Forman and Alexander 1998). Road barriers can create 'meta-populations', when roads divide a large continuous population into smaller isolated populations (Forman and Alexander 1998 / Alexander and Waters 2000). The effects of this are that genetics are often altered and recolonization is usually inhibited. The resulting smaller individual populations have a higher probability of extinction than the original larger population, especially when a barrier persists over many generations. Road widening and increased traffic exacerbates these effects.

5.2.1 Air Impacts

Impacts to local air quality will primarily from dust, until the road surface is paved. Vehicle emissions, including greenhouse gas emissions, may increase within the Project area. However, on a regional basis the Project is unlikely to increase the total vehicle traffic volumes, and therefore overall gas emissions are unlikely to increase.

5.2.2 Water Impacts

Impacts to water quantity and quality are expected to be limited to a risk of sedimentation during construction and operation.

Impacts to surface water and ground water hydrology are expected to be minor, given installation of appropriate drainage structures.

5.2.3 Terrain and Vegetation Impacts

The primary terrain potential impacts are the potential for landslides along Pine Creek, and the potential for soil erosion in areas of high erodibility. There will be a loss of natural soils and terrain features within the clearance width.

Vegetation impacts will include the complete loss of natural vegetation within the 60 m clearance width, and likely the loss of some individuals and populations of the five provincial plant species at risk that are present.

5.2.4 Wetland Impacts

Wetland area will be lost where they are filled, drained or otherwise disturbed during construction activities. This will include wetland areas within the road corridor that require grading or other alterations in the course of road construction, areas that are impacted during other construction activities (e.g. staging, etc.), and potentially areas outside the construction area due to changes in local surface or subsurface hydrology. Loss of wetland area will result in the loss of wetland values provided by the wetland, such as waterfowl and songbird habitat, amphibian breeding habitat, and ungulate feeding and security habitat.

Peatlands (bogs and fens), have the largest footprint within the Project area, and will be the most impacted wetland type. Peatlands, which are usually forested, are the most difficult wetland type to create new area in compensation for lost area. Swamp and marsh type wetlands are cover a smaller area in the Project area, and creation of new compensation area is more easily done. Shallow water wetlands are rare in the Project area, but are the most easily created wetland type. Topsoil salvaged from wetlands in the clearance area can be used in re-vegetation or creation of new wetlands for compensation projects. Some vegetation, particularly grasses, sedges, and shrubs, are well-suited for salvage, provided sufficient care is taken, and can be stored and maintained alive until use in re-vegetation.

The construction of the highway has the potential to result in changes to local hydrology, but appropriate design will mitigate that potential. Roads (and the fill required to construct them) can alter both surface and sub-surface water flow, leading to changes in water levels within wetlands (i.e. having more or less water). As wetlands are largely defined by the amount of water present, this can result in changes to wetland type and wetland function. The linear nature of the Project will result in some of the

larger wetlands being bisected. If natural drainage patterns are not maintained, water levels could increase on the upstream side of the road, while decreasing on the downstream side of the road. Wetlands not directly impacted by construction, including those a considerable distance from the highway, may be affected by changes to water table levels and surface flows originating within the Project area. These changes could lead to changes in plant species composition (even changing the wetland class or changing to upland vegetation) and impairment or loss of wetland function. Measures to mitigate these potential impacts will be included in the Environmental Impact Statement.

Deleterious substances such as petroleum products or other contaminants (as liquids, particles, or gases) may be released into wetlands during the construction or operation of the highway. These primarily include accidental release of hydrocarbons (such as those used within construction equipment; e.g. fuel, oil), sediments mobilized as a result of construction or maintenance activities, and dust (including toxins carried by the dust). Hydrocarbons can be acutely toxic to a wide variety of organisms, and can easily spread to contaminate large areas due to their hydrophilic properties. Vehicle and machinery use inevitably results in accidental releases of hydrocarbons into the environment. These can have various causes (e.g. single and multi-vehicle accidents, wildlife collisions, mechanical failure). These occurrences are expected to be uncommon, and most will involve small amounts of hydrocarbon (other than fuel truck accidents). Measures to mitigate these potential impacts will be included in the Environmental Impact Statement.

Sedimentation results from water flowing over disturbed ground, or soils being deposited into water. Disturbed soils may be easily mobilized (mainly by runoff), and carried into watercourse and wetlands. Deposition of sediments within wetlands results in the reduction or loss of wetland function. Sedimentation of wetlands is most likely during the construction phase, but may occur in the operational phase if disturbed areas have not been fully revegetated, if ditch cleaning and other maintenance results in bare ground, and from the road surface through dust and grader work. Measures to mitigate these potential impacts will be included in the Environmental Impact Statement.

Application of road salt (sodium chloride, NaCl) to increase driving safety during winter months can result in road salt entering the surrounding wetland environments through runoff and airborne deposition. Road salt can be toxic to plants and impact aquatic environments (Environment Canada. 2002). The *Code of Practice for the Environmental Management of Road Salts* (Environment Canada 2004) provides guidance for minimizing impacts of road salt use.

Dust settling on the leaves of plants reduces light reaching the chlorophyll in the leaves, and can significantly reduce photosynthesis and therefore the health and growth rate of the plants. Dust can also reduce the palatability and food value of leaves to herbivores. Dust can also carry contaminants with it, including petroleum products, metal dust, calcium chloride, and lead dust.

5.2.5 Fish and Fish Habitat Impacts

The proposed highway will cross 20 streams that are at this time known to support fish at or upstream of the crossing site. The Environmental Impact Statement may recommend that a few (< 5) additional streams should be treated as fish bearing, even though no fish have been recorded. There are also locations where the highway is closely parallel to a fish stream, and fish habitat may be impacted. There is the potential for loss, or reduction in quality, of fish habitat at each of these sites where the highway interacts with fish habitat. Types of habitats that may be lost or degraded include summer rearing habitat, winter habitat, spawning habitat, and opportunities for upstream migration to spawn or rear. The potential direct impacts to rearing, winter, and spawning habitat of highway crossings will generally be at or near the crossing site.

The potential for fish habitat fragmentation occurs primarily through stream crossing structures that impede or prevent upstream fish migration.The use of the crossing site for migration to upstream rearing, winter or spawning habitat may determine the type of crossing structure that is installed. Rearing habitat, winter habitat, and spawning habitat may be impacted for considerable distances downstream if sediment is carried downstream from a crossing site or associated ditches and is deposited in those areas. The highest risk of this occurring is during the construction phase, but it may also occur during the operational phase.

The right-of-way clearance removes the riparian vegetation adjacent to a fish stream; this vegetation is an integral part of fish habitat by providing shade, food, large woody debris and nutrients to the stream. If a crossing site is poorly located or the crossing structure poorly designed, the dynamics of the stream may be changed to result in bank erosion or channel scouring. This may result in long-term downstream sedimentation, loss of riparian vegetation and other changes to fish habitat.Mitigation measures for these impacts will be included in the Environmental Impact Statement.

5.2.6 Bird Impacts

Highways cause direct mortality to birds through direct impacts by vehicles. Highway 947 will have short-term noise associated with construction and long-term noise associated with ongoing operation of the highway. The noise resulting from highway construction and use can lower the value of nearby habitat for many bird species. Roadside habitats may constitute a population "sink" due to degradation and loss of natural habitat features. A population sink requires a constant input of new individuals from an outside population to maintain the populations in that area, due to mortality being greater than reproduction (Trombulak and Frissel 2000).

The impacts to owl species will occur in various habitats depending on the species, from mature forests (barred owl and great grey owl) to forest edges (northern pygmy owl) to open habitats such as fields and wetlands (short-eared owl). Of these species only the great grey owl has been found within the study area. The primary impacts to great grey owls from this project will likely result from loss of mature forest habitat from highway construction. Highway noise resulting from heavy traffic use has also been

known to disrupt bird breeding and nesting behaviour (Forman and Deblinger 2000). It is likely that if suitable nesting habitat is located adjacent to the highway corridor its suitability will be reduced as a result of high traffic noise levels.

Habitat loss affects migratory birds by removing habitat that they would use for a variety of purposes including breeding, migration, foraging and overwintering. Habitat loss is one of the most important factors influencing the population size of birds (Riejnen and Foppen, 1997). A variety of different habitat types likely to be utilized by birds will be completely lost within the clearance width of Highway 947 in the areas that are presently undeveloped.

Highway development also results in the fragmentation of habitat, by making it difficult for certain bird species to migrate across the roadway. For example, reclusive forest dwelling birds may be unwilling to cross gaps in forest cover >50m (Kociolek et al. 2011) will be hindered by new road development. Habitat fragmentation may decrease the nesting success in some species, while increasing the abundance, activity or species richness of nest predators (Stephens et al. 2003 / Chalfoun et al. 2002). It should be noted that these effects of the new highway will vary along its entire length, because parts of the roadway already exist. and existing linear clearances for powerlines and pipelines will be widened.

Studies have shown that road noise is the primary cause of changes to the avian community along roads (Forman and Deblinger 2000), including younger age structures and reduced population densities in some species (Kociolek et al. 2011 / Forman and Alexander 1998). For example sandhill cranes avoid nesting near busy paved and gravel roads, but will nest near infrequently travelled roads (Trombulak and Frissel 2000). Birds may be adversely affected by noise due to their reliance on acoustic communication (Kociolek et al. 2011). Road noise is likely to affect bird populations up to approximately 1km from the highway (Benitez-Lopez et al. 2010), with the greatest effects occurring within 500m (Riejnen and Foppen 2006).

One of the most direct effects of highways/roads is road kill, but vehicle caused mortality does not result in population decline for most species (Kociolek et al. 2011). Some species are more susceptible to road mortality than others. A study of road killed barn owls in Idaho showed that barn owls had a road mortality rate four times high than for other species, and that juveniles and females were most affected due to their larger dispersal distances (Boves and Belthoff 2012).

5.2.7 Amphibian Impacts

Amphibian reproductive habitat, including that for Western Toads, may be directly destroyed by highway construction, or may be degraded through changes in hydrology, contamination with oils and other pollutants, and noise pollution. High road mortality of migrating amphibians can also occur, when the amphibians are migrating between wetland patches or between wetland and upland patches.

The removal of vegetation from the Project footprint may alter migration patterns of Western Toads, and the migrations may be limited by the highway. Amphibians are most likely to be impacted by highway mortality during migration between breeding and overwintering areas. Migration usually

occurs at night, especially at times of high humidity such as during summer rains. This mortality has been found to affect population densities along higher traffic roads (Mazzerolle 2004), and is considered a threat to Western Toad populations (COSEWIC 2002, 2012d).

Most amphibians, like birds, rely on sound for attracting mates and defining territories. Minimal noise impacts to amphibians will occur for construction and operational use occurring outside the spring amphibian breeding season. However, noise may disrupt breeding behaviour during breeding season.

5.2.8 Mammal Impacts

The proposed highway has the potential to impact wildlife movements, whether seasonal migrations or random daily movements. Many small slow moving small mammals may be unable to cross the highway due to exposure to the elements, predators and highway traffic. Larger animals such as ungulates, furbearers and bears will face increased road mortality as they cross the highway. This reduction of movement across the barrier, and associated increased mortality, can result in the division and isolation of populations which can cause lowered genetic diversity in a population and may inhibit recolonization of areas that lose a species.

Increased human access to an area resulting from a new road can result in both direct and indirect mortality through increased contact with humans. This can result in an overall reduction in population densities. Roads can modify an animal's behaviour either negatively or positively. For example bears will shift home ranges away from areas with high road densities, while vultures will preferentially use areas with high densities due to the increase in carrion in these areas (Trombulak and Frissel 2000).

The impact of road avoidance on mammal populations may be much greater than the impact of road kill, with traffic noise being the major cause of road avoidance for most wildlife. Road noise can affect mammal populations for up to 5 km from the highway (Benitez-Lopez, 2010). Some species are more sensitive to road effects than others. The species most at risk of road impacts are those that tend to be specialists requiring interior forest conditions; especially those species with long life spans and low reproductive rates (eg. fisher, wolverine) (Robinson et al. 2010).

The main cause of direct mortality to mammals as a result of highway operation is likely to be road kill. Road width, traffic levels and speed affect road kill rates (Forman and Alexander, 1998); hence mortality rates are likely to increase once the highway is paved and the speed limit increases. In general road kill rates are not high enough to affect populations on a large scale for most species; although some species are much more susceptible to road kill than others and may suffer population decline as a result (eg. grizzly bear) (Forman and Alexander 1998). The primary factor in grizzly bear decline in Alberta is human caused mortality as a result of expanding road systems (Government of Alberta 2012).

Since this project involves the construction of a new highway through an area that has been previously disturbed by humans to varying extents, the impacts to grizzly bears are also expected to be variable depending on the habitat quality and level of disturbance. Secondary grizzly bear range is located in the northern sections of the highway so it is expected that the highest quality habitat and therefore the

most impact to grizzly bears will be in that area. This area already has various types of disturbance resulting from logging and oil and gas development. It is likely that this project will add an additional pressure onto a vulnerable grizzly bear population.

The study area has been subject to previous development including oil and gas exploration and extraction, forestry, roads and agriculture. Wolverines are known to use the project area and may be impacted by this project through increased human activity, traffic levels and habitat fragmentation of the study area; the effects are likely to be cumulative with existing developments.

5.2.9 Species at Risk Impacts

Impacts to species at risk have been discussed in the sections for the various taxonomic groups of organisms. The major differences in impacts on species at risk and more common species are that many species at risk are very poor at finding and colonizing new patches of habitat, patches of suitable habitat are generally rare, and our understanding of what comprises suitable habitat (especially in the long term) is very poor. As a result local impacts on species at risk are of greater long-term significance than are impacts on common species.

5.3 Potential Changes to the Physical and Biological Setting

5.3.1 Fish and fish habitat, as defined in the Fisheries Act

Fish may be impacted during construction and operation of the highway by dewatering of sections of streams during construction of stream crossing structures, or during maintenance during operation of the highway. Fish may also be impacted by downstream sedimentation during construction and maintenance. The Environmental Impact Statement will include mitigation measures to result in little or no actual impacts to fish. Fish may also be impacted by increased fishing pressure as a result of increased access to the area resulting from construction of the highway.

Fish habitat may be impacted during construction and operation of the highway by construction of stream crossing structures, by removal of riparian vegetation in the clearance width, downstream sedimentation, alteration of channel morphology and dynamics, introduction of deleterious substances, and/or filling of stream channel area by roadbed or protective structures such as riprap. These potential impacts will be mitigated as required by the *Fisheries Act*, with the Environmental Impact Statement including the mitigation measures.

5.3.2 Aquatic species, as defined in the Species at Risk Act

There are no aquatic species at risk, as defined in the Species at Risk Act, known to occur in the Project area[8].

5.3.3 Migratory birds, as defined in the Migratory Birds Convention Act, 1994.

Migratory birds may be impacted during construction and operation of the highway through vegetation clearance, dust, noise and other disturbance, and vehicle collisions. Destruction of active nests will be mitigated as required by the Migratory Birds Convention Act. Some migratory birds may also be impacted by increased hunting pressure as a result of increased access to the area resulting from construction of the highway.

Migratory bird habitat may be impacted as a result of removal of vegetation from the clearance area, by noise and other disturbance, by dust and pollutants, and by light pollution (primarily vehicle lights). These potential impacts will be addressed as required by the *Migratory Birds Convention Act* with the Environmental Impact Statement including the mitigation measures.

5.4 Extra-territorial Changes to the Environment

There are no anticipated changes to the environment, as a result of carrying out the designated project, on federal lands, in a province other than the province in which the project is proposed to be carried out, or outside of Canada.

5.5 Effects on Aboriginal Peoples of Changes to the Environment

There are unlikely to be any effects on the health and socio-economic conditions of aboriginal peoples of the construction of Highway 947, because there are no reserves or other settlements within or near the Project area. The physical and cultural heritage of the area has been assessed for any structure, site or thing that is of historical, archaeological, paleontological or architectural significance with few effects anticipated (Appendix 15). The current use of lands and resources for traditional purposes is being determined through consultation.

[8] Fisheries and Oceans Canada http://www.dfo-mpo.gc.ca/species-especes/listing-eng.htm.

6 ENGAGEMENT AND CONSULTATION WITH ABORIGINAL GROUPS

6.1 Aboriginal Groups Interested in, or Affected by, the Designated Project

The Canadian Environmental Assessment Agency provided a list of aboriginal groups potentially affected by the Project. However, Alberta Transportation has concluded that only one of those aboriginal groups is potentially required to be consulted, the Paul First Nation (Table 8).

6.2 Engagement and Consultation Activities with Aboriginal Groups

Alberta Transportation has identified that consultation is required with the first eight aboriginal groups listed in Table 12, and dialogue with them to the end of 2013 is summarized in the table. Engagement and consultation are on-going.

6.3 Key Comments and Concerns Expressed by Aboriginal Groups

No comments and concerns have been expressed by Aboriginal groups to date.

6.4 Traditional Use of Lands and Resources by Aboriginal Groups

No information on current use of lands and resources for traditional purposes by Aboriginal groups or peoples (information provided verbally or in writing, and past or present studies) is available as yet.

6.5 Consultation Plan for Aboriginal Engagement

The CEAA has been consulted regarding the list of aboriginal groups that are required to be engaged for this Project. The Paul First Nation will be sent a notification package in December 2013, with the objective of completion of consultation prior to submission of the Environmental Impact Statement.

Alberta Transportation is also opening dialogue with three additional Aboriginal Groups: the Nakcowinewak Nation of Canada, Foothills Ojibway First Nation, and Metis Nation Alberta Region 4, which may elect to be involved in the process of gathering environmental information. This dialogue is to fullfill CEAA Section 18 federal requirements, over and above the Government of Alberta consultation practices and policies.

Table 12. Aboriginal Interaction Summary

First Nation	Contact person	Date of First Contacting	Date FN responded to interest in meeting	FN meeting scheduled/ confirmed	Meeting dates	Meeting details	Comments
Alexander First Nation	Ken S. Arcand Executive Director Alexander Industry Relations. 780-939-4757 kenarcand@gmail.com or Ryan Arcand	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	No response after numerous voicemails and emails (Feb 20,26,27 and March 27)	Yes/ postponed	August 27/13, Dec. 2/13 (cancelled due to weather)	Met with Ryan Arcand (Ken Arcand's assistant) to introduce and discuss the project details and Ryan indicated that we would need to meet with Ken Arcand noting the project size and parameters.	Alexander did finally get back to Dockland in response to notification package with interest to meet. Dockland (Doug Krysa) met with Consultation assisitant Ryan Arcand August 27/13 for intitial meeting to introduce project. Communications with Ken Arcand Oct 11, 18 /13 to try to finalize meeting date with Ken was scheduled for Dec 2 but postponed/cancelled by Ken due to weather issues. Currently working on a date to reschedule with ARA, Alexander and Dockland.
Alexis Nakota Sioux Nation	(Previous Orlando Alexis) Current Duane Kootenay _ Interim Lands Consultation Manager 780-967-3573 duane.g.kootenay@hotmail.com	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	No response after numerous voicemails and emails (Feb 20, 26 and March 27)	Yes	Nov .19/13	Introduce project to Alexis, they will go over details and indicate if a site visit will be needed due to impacts. If so a budget is to be submitted by Jan. 15/14.	Orlando never responded to communication and package. Duane Kootney has replaced Orlando and indicated would like to meet. Introduced meeting to Duane Kottney and Dwayne Alexis Nov. 19/13. Alexis will review details and if required submitt a budget for site visit by Jan 15/14.
Enoch Cree Nation	Leigh Ann Ward -Consultation Lead Manager 780-470-4505 www.leighann_ward@live.ca	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	Feb. 27, 2013 email from Leigh Ann requesting to schedule meeting to discuss.	Yes	Mar-20	Will review project information details and bring to elders to discussion which may need to schedule an onsite ground truthing of project to determine if traditional use areas are impacted. Next meeting to be detemined.	Will review information details and bring to elders for discussion which may need to schedule an on-site tour of project to determine if traditional use areas are impacted. Oct 2013 - in process of preparing budget and next meeting date to discuss budget, elder presentation and site visit. Next meeting to be determined. July/Aug/Sept/Oct/Nov sent emails, phone conversations, and voicemails to Leigh Ann Ward regarding a follow up meeting to discuss the budget as Encoh has indicated that a site visit is required. Enoch indicated that they were submitting a budget in July but nothing has been submitted to date.

First Nation	Contact person	Date of First Contacting	Date FN responded to interest in meeting	FN meeting scheduled/ confirmed	Meeting dates	Meeting details	Comments
Louis Bull Tribe	Lorraine White - Consultation Coordinator 780-585-3978 lorrainew@louisbulltribe.ca	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	No response after numerous voicemails and emails (Feb 20, 27 and March 27)	No	n/a	n/a	
Montana First Nation	Suzzane Life - Consultation Coordinator 780-585-3744 suzannelife@montanafirstnation.com	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	March 4, 2013 email from Suzzane requesting to schedule meeting to discuss.	Yes	May 6 and July 12, 2013	Will review information details and bring to elders for discussion which may need to schedule an on-site ground truthing of project to determine if traditional use areas are impacted. Next meeting to be detemined.	Will review information details and bring to elders for discussion which may need to schedule an on-site tour of project to determine if traditional use areas are impacted. Next meeting to be determined. -- July/Aug/Sept/Oct/Nov Suzzane is requesting we meet with chief and council and economic coordinator, she is in process of supplying us with dates. Have had no repsonse to emails and voicemails since last meeting in July on dates to meet with Chief and council.
Saddle Lake Cree Nation	Frank Cardinal - Consultation Coordinator 780-726-3744 frankcardinak@saddlelake.ca	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	Apr. 3, 2013 email from Frank Cardinal requesting to schedule meeting to discuss.	Yes	April 15, and July 9th	Will review information details and bring to elders for discussion which may need to schedule an on-site ground truthing of project to determine if traditional use areas are impacted. Next meeting to be detemined.	Will review information details and bring to elders for discussion which may need to schedule an on-site tour of project to determine if traditional use areas are impacted. Next meeting to be determined. Frank has been requesting a follow up meeting to discuss the budget and site visit however budget has been approved but currently under review for funding source.
Samson First Nation	Norine Saddleback - Consultation Coordinator 780-585-3793 norrinesaddleback9@gmail.com	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	Feb. 27, 2013 email from Norine Saddleback requesting to schedule meeting to discuss.	Yes	April 2 and August 16	Requesting to schedule an on-site meeting to determine impacted areas. Samson provide budget May 29th to have approved for on-site meeting.	Requesting to schedule an onsite meeting to determine impacted areas. Samson provided budget May 29th to have approved for on-site meeting. Budget submitted to AT however scope of work in budget is more than required. Dockland supplied AT`s format to Samson to review. SCN to provide re-vamp budget near beginning Nov./13. November 26 phone call and email requesting budget follow up meeting by Samson. In process of

First Nation	Contact person	Date of First Contacting	Date FN responded to interest in meeting	FN meeting scheduled/ confirmed	Meeting dates	Meeting details	Comments
							scheduling meeting - Dec 2,2013.
Sunchild First Nation	(Previous Dorren Daychief) Byron Daychief - Consultation Coordinator 403-989-3740 daycheifb@hotmail.com	Nofication Package mailed January 31, 2013. Date of first call to FN- Feb. 20, 2013	March 4, 2013 email from Doreen Daychief who was coordinator at that time now Byron Daycheif.	Yes	May-30	Not known to date as of May 29, 2013	Oct 22, 2013 phone conversation to Byron, he stated would like to hold 2nd meeting. Emails and voicemails Sept/Oct/Nov. to supply dates for follow up meeting but no response to date for next meeting.
Paul First Nation	Dennis Paul - Consultation Coordinator	Added to consultation list Nov. 29/13. Notification package to be sent out Dec 2013		to be determined	to be determined		

7 CONSULTATION WITH THE PUBLIC AND OTHER PARTIES

7.1 Stakeholders and Consultation to Date

Consultation 1970 to 2001 included:

- Chevron Standard Oil Co.
- Hudson Bay Oil Co.
- Delsing Construction (Edson)
- Northwest Pulp and Power
- Bill Nigro (sawmill operator, Edson)
- Unidentified forest industry interests
- Department of Energy and Natural Resources
- Alberta Environment and Sustainable Resource Development
- Alberta Lands and Forests
- Alberta Environmental Protection
- Alliance Pipeline

A current consultation plan, including a list of stakeholders that may be interested and potentially affected by the carrying out of the designated project will be developed and implemented as part of the Environmental Impact Statement.

7.2 Key Comments and Concerns Expressed by Stakeholders

There have been no current comments and concerns expressed to date by stakeholders. Historical comments and concerns are summarized in the 1975 and 2001 reports regarding the alignment of Highway 947.

7.3 On-going and Proposed Stakeholder Consultations

A current consultation plan, including a list of stakeholders that may be interested and potentially affected by the carrying out of the designated project will be developed and implemented as part of the Environmental Impact Statement.

7.4 Consultations with Other Jurisdictions

No other jurisdictions have been consulted with to this date.

8 EXECUTIVE SUMMARY

HIGHWAY 947 EXTENSION PROJECT

PROJECT DESCRIPTION

Proposed
Environmental Impact Statement

29 January 2014

EXECUTIVE SUMMARY

Submitted To:

ALBERTA TRANSPORTATION
North Central Region

Prepared For

ARA Engineering Ltd
Suite 101, 110 Country Hills Landing NW
Calgary, Alberta
T3K 5P3

Prepared By

Ecofor Consulting Ltd
9940 – 104th Ave
Fort St. John, BC
V1J 2K3
(250) 787-6009

EPN: 2011-2136-155

ECOFOR
natural and cultural resource consultants

1.0 Project's Name, Nature and Proposed Location

The name of the Project is *Alberta Highway 947 from Highway 16 to the Athabasca River Bridge*.

The Project is an extension of the existing Highway 47 north from the intersection of Highway 16, about 10 km west of Edson, Alberta. From Hwy 16 it runs north to tie into a bridge crossing over the Athabasca River, at the south end of an existing section of Highway 947, between Fox Creek and Whitecourt (Figure 1). Highway 947 will be constructed with a gravel roadway surface, with provision to pave at a later date.

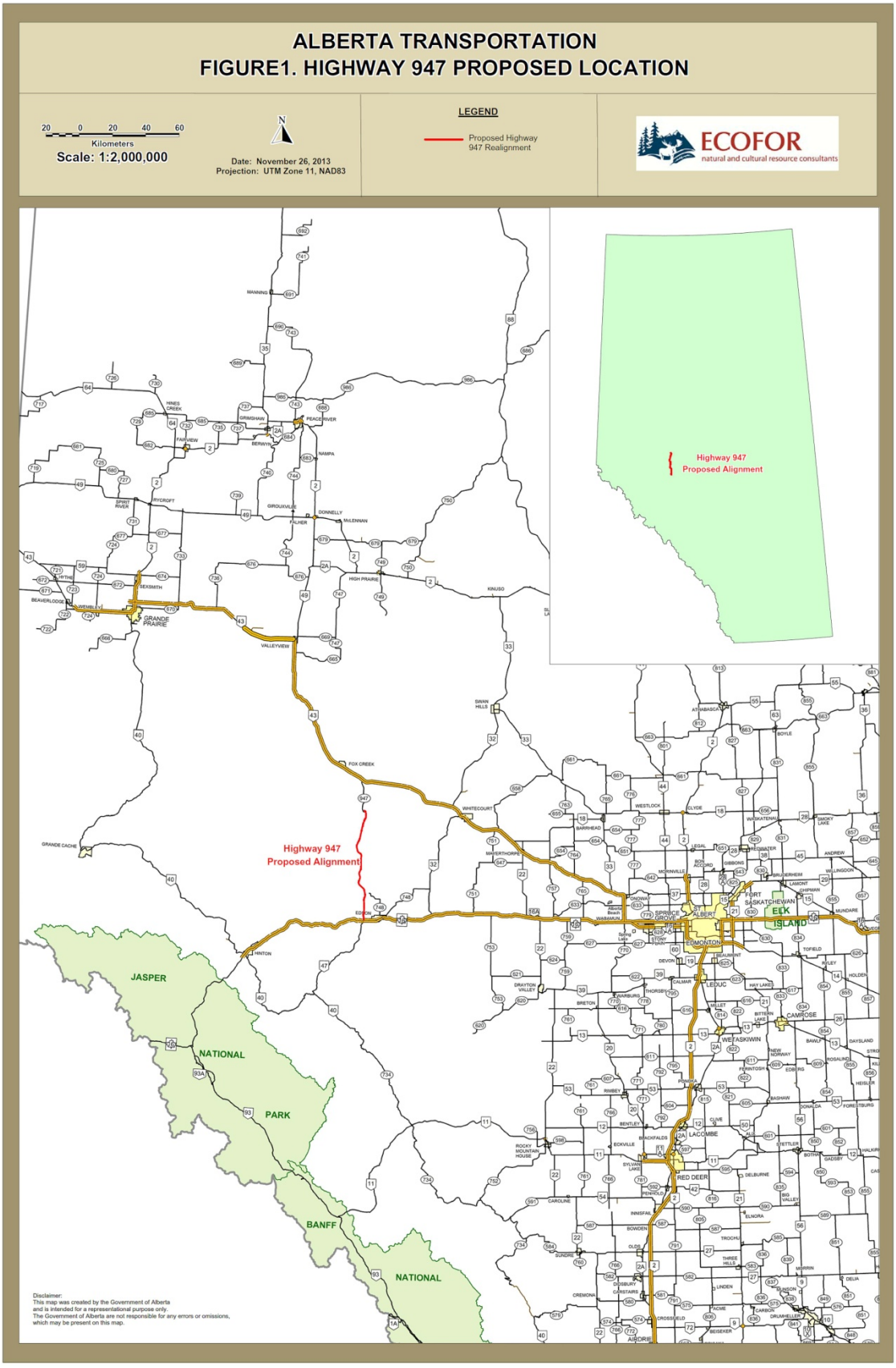
2.0 Proponent's Name and Contact Information

The Proponent is:

Alberta Transportation
4999 - 98th Ave, 3rd Floor
Edmonton, AB T6B 2X3
Canada
Phone: 780-643-1525
Fax: 780-415-0475

The primary representative for the purpose of the description of the project is:

Stephen Legaree, PBiol
Environmental Coordinator, North Central Region
Alberta Transportation
Suite 310, 4999 - 98th Ave, 3rd Floor
Edmonton, AB T6B 2X3
Canada
Phone: 780-643-1525
Fax: 780-415-0475
Email: stephen.legaree@gov.ab.ca


ALBERTA TRANSPORTATION
FIGURE1. HIGHWAY 947 PROPOSED LOCATION
20 0 20 40 60
Kilometers
Scale: 1:2,000,000
N
Date: November 26, 2013
Projection: UTM Zone 11, NAD83
LEGEND
Proposed Highway 947 Realignment
ECOFOR
natural and cultural resource consultants
Highway 947 Proposed Alignment
Highway 947 Proposed Alignment
JASPER
NATIONAL
PARK
BANFF
NATIONAL
EDMONTON
RED DEER
LACOMBE
CAMROSE
LEDUC
GRANDE PRAIRIE
FOX CREEK
WHITECOURT
HINTON
Disclaimer:
This map was created by the Government of Alberta
and is intended for a representational purpose only.
The Government of Alberta are not responsible for any errors or omissions,
which may be present on this map.

3.0 Consultations with Aboriginal Peoples and the Public

Consultation with the public and other jurisdictions has not yet been completed.

Requests for consultation were made to the Alexander First Nation, Alexis Nakota Sioux Nation, Enoch Cree Nation, Louis Bull Tribe, Montana First Nation, Saddle Lake Cree Nation, Samson First Nation, and Sunchild First Nation. Discussions are on-going with the Enoch Cree Nation, Montana First Nation, Paul First Nation, Saddle Lake Cree Nation, Samson First Nation and Sunchild First Nation. Other aboriginal groups have not responded to date.

4.0 Other Relevant Information

The environmental assessment and regulatory requirements of other jurisdictions that are relevant to this project include

- Canadian Environmental Assessment Act (Canada)
- Fisheries Act (Canada)
- Navigable Waters Protection Act (Canada)
- Migratory Birds Convention Act (Canada)
- Species at Risk Act (Canada)
- Water Act (Alberta)
- Wildlife Act (Alberta)
- Historical Resources Act (Alberta)
- Environmental Protection and Enhancement Act (Alberta)

There are no Regional environmental studies or plans for the Project area.

5.0 Context and Objectives

The location of Highway 947 is an important north-south corridor from west of Edson on Hwy 16 north to an existing bridge across Athabasca River. Currently the general area of Highway 947 is served by a series of existing resource roads. The most northern section of Highway 947, from the Athabasca River north to Highway 43 was constructed in 1970-73. This section of the highway was constructed to service the Kaybob gas field and the resulting sulphur extraction plant just south of the Athabasca River.

The first report proposing Highway 947 south of the Athabasca River was produced in 1975. Hence the proposed route has a history of over 40 years. Yellowhead County would like to see this project complete as it would support and facilitate the economic activity (oil and gas, and increased log hauling, etc.) in the region, and will contribute some of the required funding and manage some of the construction. Local industry (oil/gas/forestry) are very supportive of this project as they see the benefits in terms of efficient transportation of people and products in the area, as well as increased safety for industry and the public by reducing heavy traffic on Hwy 32. It will be a forestry log haul route for logs

moving from Edson/Hinton area to Whitecourt, avoiding the need to utilize local roads and causing conflict with residences/school buses, etc. Recreational traffic mostly travels to the Silver Summit ski resort.

Some potential benefits of this initiative may include:

- create employment/economic spin-off;
- create a transportation corridor from Edson to the Fox Creek area on a provincial highway;
- and reduce industrial traffic volumes that currently use Hwy 32 going to Fox Creek area via Whitecourt.

The objective of the Project is to build and operate a modern roadway to connect Highway 16, about 10 km west of Edson, to an existing bridge across the Athabasca River. Highway 947 will provide a safe, rapid travel route from Highway 16 near Edson to Highway 43 between Fox Creek and Whitecourt. The new highway will be 69.2 km long, and will be designed as a 2-lane paved highway with a 10 m top width and a design speed of 110 km/hr. Stage 1 will be a gravel road with a posted speed of 80 km/hr, with paving (Stage 2) planned to occur at a later time.

Design and construction of the alignment will require a number of watercourse crossings, including two major bridges at Edson River and Pine Creek, standard bridges, and culverts. The project will also involve works at local roads to maintain existing road configurations. The Environmental Impact Statement will provide details on the alignment, stream crossing structures and proposed mitigation measures.

6.0 Regulations Designating Physical Activities

The new highway is 69.2 km long and will be predominantly located on a new right-of-way. Therefore the Canadian Environmental Assessment Act (CEAA) Regulations (2012) may apply to this Project under the *Regulations Designating Physical Activities*:

> 28. The construction, operation, decommissioning and abandonment of
>
> (b) an all-season public highway that will be more than 50 km in length and either will be located on a new right-of-way or will lead to a community that lacks all-season public highway access

The capacity of the borrow pits, quarries and gravel pits required for the highway have not yet been determined. Therefore the following section of the *Regulations* may apply:

> 17. The construction, operation, decommissioning and abandonment, or an expansion that would result in an increase in production capacity of more than 35%, of
>
> (i) a stone quarry or gravel or sand pit with a production capacity of 1 000 000 t/a or more

7.0 Physical Works

Highway construction will involve a survey for the clearance width, vegetation and surface soil clearance, bridge and culvert installation, and constuction of the roadbed. The details of these works have not yet been determined; they will be part of the Environmental Impact Statement.

8.0 Capacity of the Project

Highway 947 will be 69.2 km of new highway, which may cause the Project to fall under the Canadian Environmental Assessment Act. There will be a number of sites developed for excavation of gravel and rock for use in construction of the highway. These sites have not yet been designed, but none are anticipated to individually reach 1,000,000 tons per annum production. However, the total capacity of all the sites may exceed that level. The Environmental Impact Statement will include the details of the gravel and rock extraction sites, including their anticipated production, required for the highway.

The traffic capacity of the new highway has not been calculated. However it is anticipated to considerably exceed the capacity of the existing network of industrial roads that presently carry traffic in the area. Highway 947 will be designed to carry all types of motor vehicle traffic, from passenger cars to heavy industrial trucks.

9.0 Activities to be Performed in Relation to the Project

The Project consists of several phases with various components, starting with the work required to develop the Environmental Impact Statement, followed by highway construction, and finally its operation. The Highway is anticipated to continue to exist, operate, and be maintained indefinitely into the future. Many of the activities will be performed simultaneously or during overlapping time frames.

Highway Design

The route of the proposed highway was first determined in 1975, and minor revisions were done in 2001. The Environmental Impact Statement will include a proposed area to be surveyed and marked for clearance. The final area to be surveyed and cleared will depend on the results of the Environmental Impact Statement and the resulting Environmental Assessment; hence the field work will not be done until completion of those processes. The proposed survey and clearance locations that will be included in the Environmental Impact Statement are anticipated to be a close approximation of the final locations, subject only to changes resulting from the Environmental Assessment.

Environmental Values Assessment

Field environmental assessment work will be done to provide information for the Environmental Impact Statement. The "environmental" work broadly includes studies of all *valued ecosystem components* (VECs). The VECs that have been identified to date include:

Biophysical Environment VECs

- fish
- wildlife
- species at risk
- plants
- amphibians
- migratory birds
- weeds
- wetlands
- streams
- ecosystems
- landforms
- soils
- surface hydrology
- groundwater
- noise
- air quality

Human Environment VECs

- historical resources
- archaeological resources
- palaeontological resources
- aboriginal and community values
- socio-economic values

All the VECs will be addressed in the Environmental Impact Statement. Additional VECs may be identified through aboriginal and community consultation and socio-economic review, in which case they will also be addressed in the Environmental Impact Statement. Some of this work requires permits from the provincial and federal governments, and it may also require the involvement of local aboriginal and other communities, organizations and individuals.

Construction

Field construction activities will commence with clearing vegetation from the width of the right-of-way. Top soils will be stripped and stockpiled for later use in reclamation of disturbed areas not used for roadbed or road surface. Borrow pits, gravel pits and rock quarries will be developed, and the materials used in the construction of the highway. The right-of-way will be levelled and graded, the roadbed constructed, and the highway will initially be surfaced with gravel and asphalt will be applied in the future. Bridges and culverts will be installed at stream crossings and other locations where drainage is required to carry fish and/or water from one side of the highway to the other. The right-of-way will be shaped to provide drainage away from the roadbed, including drainage ditches, and areas not to be used by traffic will be revegetated. A more detailed description of the construction process will be included in the Environmental Impact Statement.

Operation

During the operational phase there will be a wide range of vehicles using the highway, primarily motorized (cars, trucks) but with some unmotorized (bicycles, primarily after paving). Foot traffic may occasionally use the sides of the highway, although this is anticipated to be rare because of the general

lack of settlement along the route. A more detailed description of the operational phase will be included in the Environmental Impact Statement.

Maintenance

Maintenance activities include ditch maintenance; snow clearing; general road maintenance such as grader work, sign maintenance, weed mowing, and, after paving, line painting and pavement patching; bridge maintenance; and culvert maintenance. A more detailed description of maintenance will be included in the Environmental Impact Statement.

Decommissioning and Closure

The highway will be operational indefinitely into the future; therefore no decommissioning or closure activities are planned for the highway itself. Borrow pits, gravel pits, rock quarries, and laydown areas that are closed after the completion of construction will have reclamation prescriptions specified in the Environmental Impact Statement. In many cases the reclamation prescription for such areas will be designed to be part of fish and wildlife habitat mitigation and compensation measures.

10.0 Wastes to be Generated During the Project

The existing air quality in the vicinity of the Project is influenced by traffic and nearby industrial activities. Local road traffic and oil/gas industry are the predominant existing sources of air contaminant emissions in the Project area, with forest harvesting sporadically producing emissions. In the vicinity of the Project area, existing contributors to air pollution include combustion emissions from vehicle traffic and machinery; forest harvest waste burning; generation of airborne dust by traffic; natural gas wells; gas flaring; gas processing plants; and other oil/gas industry plants. These emissions are anticipated to remain unchanged as a result of the construction of Highway 947.

The new highway length will be 69.2 km, including sections built over existing local roads. This is shorter than the existing winding route along existing resource roads. However, traffic volumes can be expected to increase, due to the higher quality and traffic speed of the new highway. Driving conditions on the new highway will be easier than the existing roads, and hence less fuel will be burned to travel each kilometer. It is unclear at this time whether there will be a net increase or decrease in emissions, including greenhouse gasses, from motorized traffic in the local area. There is unlikely to be a net change in total automobile traffic in this region of Alberta; hence here is unlikely to be a net regional change in gas emissions.

Greenhouse gas production is anticipated to temporarily increase during the construction phase, because the machinery will produce greenhouse gasses in addition to those produced by the existing traffic on the existing roads.

Liquid discharges from the highway will primarily be water. There will likely be small discharges of petroleum products due to spills and machinery malfunction during construction; these will be addressed as described in the Environmental Construction Operations Plan (ECOPlan) prepared by the

construction contractor prior to construction. Measures to guide the contractor's ECOPlan will be included in the Environmental Impact Statement. There will be minor discharges of petroleum products such as oils from leaks from vehicle engines during the long term operation of the highway, and occasional larger spills due to accidents. Mitigation measures to minimize the environmental impact of such spills, such as highway design measures, will be included in the Environmental Impact Statement.

Waste disposal is a component of the Environmental Construction Operations Plan (ECOPlan), which will be prepared by the construction contractor prior to construction. The ECOPlan will detail the specific waste stream and hazardous management procedures applicable to the contractor's scope of work and work plan. Anticipated wastes include cement, concrete, wood products, oils, fluids, and asphalt. All waste materials will be retained in appropriate containment onsite and then transferred to appropriate recycling or disposal facilities at appropriate times during the project.

Maintenance work during the operational phase will also produce wastes. Road works and resurfacing will be conducted in accordance with Alberta Transportation standards and the contractor will be required to dispose of waste asphalt or other materials in appropriate locations, similarly to what was prescribed for the construction phases. Spills and other wastes associated with the road users will be handled according to applicable provincial and federal regulations.

11.0 Phases and Schedule of the Project

The environmental assessment work and historical resources assessment and mitigation work is expected to be completed by December 31, 2014. The highway right-of-way and clearance area will be surveyed and marked in 2015, with concurrent clearance of the alignment right-of-way followed by grade construction and watercourse crossings. Completion of Phase 1 of the highway construction (gravel surfaced roadway) is anticipated for 2016, at which time the operational phase will commence. Phase 2 construction (asphalt paving) has not been scheduled, and will depend on traffic use and funding availability. Staging areas for construction materials and equipment will be specified in the Environmental Impact Statement, and will be within the assessment area. Additional details of the scheduling and staging will depend on the outcomes of information resulting from aboriginal and community consultation, environmental assessments, and budget planning, and will be provided in the Environmental Impact Statement.

Road building and infrastructure construction works are not seasonally constrained, and may occur in any season. Timing constraints may be placed on select aspects of the project and will be stipulated by the environmental assessment and the associated authorizations or approvals. Proposed timing constraints will be stated in the Environmental Impact Statement.

The operation of the highway is anticipated to start in late 2016, and is intended to continue indefinitely. There will be no decommissioning and abandonment phases.

Construction activities will include vegetation clearance (trees, shrubs, herbs); excavating; grading; de-watering of wetlands, streams, ponds and saturated soils; drilling at bridge sites; piling installation;

infilling of depressions and stream crossing structure approaches; and installing stream crossing and other structures. This work will utilize earthen materials from borrow excavations and quarries near the site. Gravel and riprap materials if required will come from an aggregate source; the locations have not yet been determined. Materials such as geotextile and geo-products, culverts, bridge and overpass components, cement, precast concrete products, asphalt, and fuel will come from suppliers selected by the contractor.

Reclamation works, if and where required, will occur in accordance with applicable Alberta Environment and Sustainable Resource Development guidelines.

Operation of the completed highway will include maintenance activities. Roadway runoff and ditch maintenance will involve use of labour and machinery. Snow clearing will involve use of snowplows, with sand and/or chemical compounds applied in accordance with Alberta Transportation standards and specifications. Road maintenance activities will be scheduled as required throughout the operational stage of the project. Road maintenance could involve use of machinery and any of the associated materials identified for use in the construction phase.

The requirement for illumination will be determined through the detailed design process. If illumination is required for the project then there will be some energy needs, resulting in a requirement for construction of electrical infrastructure.

Toxic or hazardous materials may be used during the construction and would include the fuel and associated fluids to operate the construction and maintenance machinery, cement used for the construction, asphalt for the paving, and road de-icing chemicals used during the operation. All of these materials would be used in accordance with federal and provincial regulatory requirements.

Toxic, hazardous, or otherwise dangerous materials may be present during roadway operation, because it is a transportation corridor intended to transport goods. It is possible that vehicles using the highway could be hauling toxic substances. In Canada the transport of toxic substances is controlled by the Transportation of Dangerous Goods regulations. Transporters are in many cases required to have protection measures, including response plans and spill containment plans in place.

12.0 Project Location

The south end of the Project is located at the existing junction of Highway 16 and Highway 47, about 10 km west of Edson, Alberta. The south end of the Project is at 53° 34’ 06” N 116° 34’ 52.53” W; also UTM Zone 11u.527732.5935568. It is at the corners of SE 16 53 18 W5M, SW 15 53 18 W5M, NE 9 53 18 W5M, and NW 10 53 18 W5M.

The north end of the Project is at the north end of an existing bridge across the Athabasca River, west of Whitecourt, Alberta. The north end of the Project is at 54° 09’ 12” N, 116° 35’ 56” W; also UTM Zone 11u.526205.6000657. It is at NW 35 59 18 W5M.

The nearest urban area is the community of Edson, about 10 km east of the south end of the project. The community of Fox Creek is about 30 km northwest of the north end of the Project, and Whitecourt is about 55 km east of the north end. One residential property is directly impacted. The highway is generally located distant from residential and urban areas.

The Project is not in close proximity to any Federal Lands or Aboriginal Lands. The closest reserve is approximately 19 km to the northeast of the north end of the project, with another approximately 49 km to the east.

13.0 Federal Financial Support

There is no proposed or anticipated federal financial support that federal authorities are, or may be, providing to the designated project.

14.0 Federal Lands

There is no federal lands that may be used for the purpose of carrying out the designated project, including no granting of interest in federal land (i.e., easement, right of way, or transfer of ownership).

15.0 Federal Legislation or Regulatory Requirements

Highway 947 may be required to meet the requirements of the Canadian Environmental Assessment Act (CEAA), as specified in the *Regulations Designating Physical Activities*.

Fish and fish habitat, as defined under the Fisheries Act, will be impacted during construction of stream crossings. For some of the streams a *Notification* will be all that is required; for a few of the streams an *Authorization* may be required.

Watercourses will be assessed under the criteria of the Navigable Waters Protection Act to determine if they may be deemed navigable. If they are deemed navigable, Transport Canada approval may be required for stream crossing structures.

Highway 947 will pass through habitat used by birds that are protected under the *Migratory Birds Convention Act*. The requirements of the *Act* will be met.

16.0 Physical and Biological Setting

16.1 Air

The air quality is apparently generally good, with the predominant air flow moving eastward from the Rocky Mountains towards the prairies. There are no large urban areas or industrial centers to the west, from which large-scale pollution can be carried. The nearest large urban center is Edmonton, AB, about 200 km to the east; little influence on air quality in the Project area can be expected on the rare occasions when the winds are from the east. Gas production flaring likely produces some air pollution. Considerable amounts of dust are generated by traffic on local unpaved resource roads; the traffic includes a high proportion of heavy truck traffic.

16.2 Water

The Water Survey of Canada (WSC) operates or has compiled data from a network of hydrometric stations in the vicinity of the study area. The mean annual runoff increases from 117,000 $m^3/km^2/yr$ in the south to 152,000 $m^3/km^2/yr$ in the northern section of the alignment. These values correspond to average annual runoff depths of 117 to 152 mm which is approximately 20 to 30% of the average annual precipitation.

The seasonal variation in discharge indicates that the snowmelt freshet dominates the annual hydrograph in larger streams such as Sundance Creek or Athabasca River. Streamflow begins to increase in March or April, typically peaks in June or July and reaches winter base flow conditions by November or December. Precipitation events augment streamflow throughout the open water periods and can result in substantial flood flows during the height of the snowmelt in May, June or July.

The short term seasonal data from the four small (<24 km2) gauged watersheds in the vicinity of the proposed highway alignment suggest that the snowmelt freshet begins in late-March or early-April, peaks in mid-May and is more or less completed by mid-June. Subsequent open water flows are strongly influenced by rainfall activity with convective processes resulting in short-duration events which can exceed the snowmelt peak. Streamflows are substantially reduced by late-September.

The record of annual maximum daily and instantaneous data collected at the long term stations Athabasca River near Windfall and Sundance Creek indicate the timing of regional floods in these larger watersheds. These data suggest that sizeable flows occurred in 1965, 1972, 1980, 1982, 1997 and 2011. Data compiled by the Alberta Ministry of Environment and Sustainable Resource Development indicate that heavy precipitation associated with the June 2013 flood did not extend north into the project area. A review of how runoff values in the 30-years between 1971 and 2000 have compared to those recorded in the preceding time periods indicates that the mean annual discharge has been increasing in west-central Alberta.

Analysis of digital 1:20,000 scale topographic mapping, combined with field review during initial fisheries studies, indicates that the proposed highway alignment will cross 32 mapped watercourses. Five small

mapped streams at the northern end of the alignment could not be located in the field. There are other sites where streams closely parallel the route of the highway.

The digital topographic data indicate that the basin areas upstream of the highway crossings range from <0.3 km^2 to 218 km^2. The majority of the stream crossings have upstream basin areas of <5 km^2 and, with the exception of four crossings, all the crossings have upstream catchments of <15 km^2. The three larger streams include the Edson River's mainstem crossing (basin area 218 km^2), crossing of two unnamed tributaries to Edson River (basin areas 20 and 61.68 km^2) and a crossing of Pine Creek (basin area 176.1 km^2).

The majority of the small stream crossings on the alignment consist of narrow, single thread channels and appear laterally stable in areas where the bank vegetation has not been disturbed. These channels are unlikely to pose significant or unusual design challenges. The largest watershed with a stream crossing is Edson River. This consists of an irregular, single thread and likely incised channel. The proposed alignment crosses at the apex of a wide radius and apparently laterally stable meander bend. The northern Edson River tributary crossing is located near an existing road. The channel consists of a small irregular channel which has formed a narrow discontinuous valley flat incised within a higher plain. The channel appears to be laterally stable.None of these crossings appear to have unusual hydrotechnical issues. The second largest watershed with a stream crossing is Pine Creek. This irregularly meandering channel is flowing within a moderately wide valley flat. The channel contains unvegetated gravel bars indicating that the channel is laterally mobile and is periodically transporting a coarse-textured bed load. The proposed highway crossing is located within or near a previously cleared right-of-way. The crossing design will need to consider future channel instability and provide passage for water, coarse sediment and, potentially, debris.

16.3 Terrain and Vegetation

16.3.1 Terrain

The physiography of the Project area places it as part of the Southern Western Alberta Plains and the Alberta Uplands. Within that classification, the highway falls within the Edson Lowland, Edson Benchland, Mayberne Tableland and Athabasca Benchland physiographic subdivisions. Those are described as follows:

- The Edson lowland corresponds to an undulating to gently rolling topography smoothed out by glaciolacustrine sediments from the last glaciation. Its altitude varies from 900 à 1000 m and its upper limit occurs around Km 15.
- The Edson Benchland lies between the Edson Lowland and the toe of the Mayberne Tableland. The topography forms a plateau-benchland landscape varying from 1000 to 1100 meters of elevation. It is comprised between Km 15 and 30.

- The Mayberne Tableland lies between km 30 and 55. It consists of high plateaus of 1100 to 1250m overhung by flat top parallel ridges isolated by mostly steep-side valleys. Those summits reach an elevation of 1450 m.
- The Athabasca Benchland is the uppermost physiographic division and lies from km 55 to 69. As for the Edson Benchland, the topography forms a plateau-benchland landscape, generally ending at the foot of the Mayberne Tableland, but in addition steep-sided valleys are cut through the plateaus. The elevation varies from 800 m to 1100m.

The Mayberne Tableland draws the waterline between the Pine Creek watershed facing north and the Edson River area and other unnamed creeks watersheds flowing south-easterly. Pine creek connects directly to the Athabasca river while the Edson drainage area drains through the McLoad river, which also connects with the Athasbasca further down. Except on the Mayberne Tableland and active alluvial plains, the area is covered by a dense forest boreal forest.

The study area is underlain by rocks belonging to the Paskapoo Formation of Pleistocene age. This formation is composed of weakly consolidated beds of sandstone, silt-stone, mudstone and shale with interbedded strata of shale, coal, chert and conglomerates consisting predominantly of metaquartzite, sandstone and chert. The sedimentological sequence and the subsequent natural processes left four main types of surficial material in the area: glacial (62.6%), alluvial (12.1%) glaciolacustrine (11.2%), colluvial (8.3%), glaciofluvial (5.6%) and a tiny area of Eolian (0.2%). Those units are described below according their distribution across the highway corridor and their sedimentological and morphological settings; and finally a brief summary was achieved.

Till is the most widespread material in the study area. It is overlaid by glaciolacustrine sediments in the Edson Lowland and Benchland, and is mainly reworked as alluvial and colluvial material in the Pine creek valley. Glaciofluvial, eolian and stagnant ice moraine deposits can also be found locally in this valley. Finally, pre-glacial valleys filled with glacial sediments would locally underlay the highway corridor.

The study area is composed of a majority of Luvisolic soils (56.6%). In order of importance the rest of the area is covered by Regosolic soils (15.5%), Brunisolic soils (8.7%), Organic soils (8.0%), Gleysolic soils (7,7%) and Nonsoils (3.5%). The Luvisolics soils are mainly found on the lower half of the highway corridor (< km 35) and in the Pine creek valley (km 55). The Regosolic soils found in the highway environment are located in the Pine Creek valley between km 42 and 61. Brunisolic Soils are located on the last ten kilometers of Pine Creek valley (Km 60 to 69). Organic soils form isolated patches found between km 0 and 25. Gleysolic soils are in the upper section of the Pine creek valley (km 35 to km 52). The Nonsoil category corresponds most of the time to very steep slope topography with heterometric coarse material highly disturbed by river erosion and mass wasting processes. They are found mainly on the steep sides of lower Pine Creek valley (km 58 to 68) and in contact with the Edson River (km 6).

The lower section of Pine Creek valley (km 55 to 69) is characterized by U shape profile typical of glaciated valleys. Those valleys are likely due to mass wasting processes mainly because of their high gradient, but also because streams may have modified or are still modifying the toe slope profile and

initiating instabilities. According to the information available, the west side of Pine Creek valley between km 58 and 66 could have instability signs and possible predispositions for landsliding.

For its last 20 km Pine Creek shows a channel pattern varying from braided to anastomosed with some meandering sections with an estimated 0.0088 slope gradient. The 130 km^2 watershed is 35 km long by 2 to 18 km wide. Its upper half drains steep sided slopes surrounded by a flat summit of an average elevation of 1250 m. At its mid-point the river bed lies at an altitude of 1000 m, and at its mouth it sits at 800 m. This watershed morphology results in a highly reactive watershed likely to generate flash floods and thus river bank erosion. This, in fact, happened in summer 2012 and led to the washout of existing road sections in the lower section of the river.

16.3.2 Vegetation

The Project area is within the Foothills Natural Region, which includes the Lower and Upper Foothills Natural Subregions. The topography is highly variable, ranging from sharp, bedrock-controlled ridges near the mountains to rolling and undulating terrain in the north and east. Mixed forests of aspen, lodgepole pine, white spruce and balsam poplar with variable understories on Gray Luvisolic soils are dominant on average sites at lower elevations. Mixed forests of aspen, lodgepole pine, white spruce and balsam poplar with variable understories on Gray Luvisolic soils are dominant on average sites at lower elevations. Lodgepole pine forests with less diverse understories and well developed feathermoss layers on Brunisolic Gray Luvisols are typical of higher elevations (Natural Regions Committee 2006).

The Project area is mostly within the Lower Foothills Subregion, with the central, higher elevation part of the Project in the Upper Foothills Subregion. Within the Lower Foothills Subregion, forests on upland sites are typically deciduous or mixedwood with aspen, balsam poplar, white birch, lodgepole pine, white spruce and black spruce as common associates. Wetlands are mainly vegetated by stunted black spruce and tamarack or shrub-graminoid communities (Natural Regions Committee 2006).

The Upper Foothills Natural Subregion is dominated by forests that are typically even-aged fire origin lodgepole pine stands, often with an understory of black spruce. White spruce stands occur along river valleys and on lower slopes. Deciduous and mixedwood stands are restricted to southerly and westerly slopes where conditions are similar to those found at lower elevations. Shrubby grasslands occur on the driest sites, and poor to rich fens dominated by black spruce, tamarack, shrubs and herbs occur on low, wet sites (Natural Regions Committee 2006).

The study area is dominated by natural and semi-natural ecosystems, with frequent gravel and dirt roads and trails. Clearings for power transmission lines and pipelines are the dominant land use within and adjacent to the study area.

All vascular and some non-vascular plant species present in the project area were recorded for at least one site within the Project area. The Project area within 150 m of the centreline was searched on foot for rare plants in 2012 and 2013. Voucher specimens were collected for identification as required, and a database of all records was compiled.

There were 302 species of plants recorded from the Project area in 2012 - 2013. Of these, a total of 5 plant species are *at risk* -- *Botrychium lanceolatum* (S2), *Botrychium pinnatum* (S3), *Chrysosplenium iowense* (S3), *Lactuca biennis* (S2), and *Pinguicula villosa* (S2) [S2 - provincially threatened; S3 - provincially special concern].

The relatively undisturbed nature of the Project area results in a limited distribution and relatively low abundance of noxious weeds. Three noxious weeds have been recorded from the Project area - Canada thistle, common tansy, and oxeye daisy. Roadsides, drill pads, powerline and pipeline right-of-ways, and other disturbed areas typically have these species throughout the study area. Some were also found in naturally disturbed areas such as beaver dams.

16.4 Wetlands

There are 38 wetlands within 150 m of the proposed centreline of the highway, which have been field verified and classified. Forested bogs and fens predominate, with a small amount of marsh, swamp, and shallow water pond areas.

Wetland Area Within 150 m of the Proposed Centerline:

Wetland Classes	Area within 150 m of centerline (ha)	% of Area within 150 m of centerline
Bog	34.5	1.65%
Fen	48.8	2.33%
Marsh	18.2	0.87%
Shallow Water	1.0	0.05%
Swamp	7.5	0.36%
TOTAL	**110.0**	**5.26%**

Peatlands, comprised of bogs and fens, made up 15 of the wetland areas and cover an area of 83.3 ha within the Project area (4.0 %). In some cases it can be difficult to distinguish between bogs and fens; vegetation cover provides some indication, but the underlying hydrology can be difficult to detect. Fens typically originate in areas with mineral rich water—the water contains minerals because it is constantly (if slowly) moving overland or subsurface. Water in bogs is mineral poor and generally acidic; it originates mainly from rainfall. Fens can also be nutrient poor, resulting in a gradient of nutrient richness from bog to fen, for which it is sometimes difficult to delineate individual peatland areas. Nonetheless, many peatlands exhibit similar vegetation communities, and mitigation recommendations for peatlands are based not on the specific wetland class, but on the vegetation and wildlife resources identified within. Some peatlands are commonly referred to as "muskeg".

Non-peatland wetlands (marshes, swamps, and shallow water) comprise 26.7 ha within the Project area (1.3%). These wetlands tended to be small and isolated when compared to the some of the extensive peatland areas; excluding several wetland complexes associated with stream areas altered by beavers.

Marshes and swamps were primarily distinguished by the abundance of trees over 6 m tall. Marshes and swamps can be quite similar in vegetation and other characteristics when tall shrubs are present. Shallow water wetlands require open water to cover greater than 75% of the wetland area. Most open water within the Project area is within streams or beaver ponds—which are also associated with the surrounding wet areas, and tended to be classified as marshes or swamps. Shallow water wetlands are rare in the Project area.

Bogs: Six wetlands within the Project area are classified as bogs. Most of the bogs are forested to some degree and have areas within the Project area that range from 0.3 ha to 17.1 ha. The larger bog areas tend to extend far beyond the boundaries of the Project area. Three CWCS bog subforms were identified: Flat Bog, Blanket Bog, and Basin Bog. Flat bogs are not confined within a well-defined basin and tend to cover extensive, flat, lowland areas. Blanket bogs also commonly cover extensive areas, however, they are found on gentle slopes. Basin bogs are confined to relatively discrete basins with no feeder streams and have a generally flat surface that is not raised above the surrounding area.

Fens: Ten wetlands were identified as fens within the Project area. Fens, also being peatlands, bear a strong resemblance to many of the described bogs. Fens differ in terms of vegetation, often with a large component of sedge in non-treed fens, or larch in treed fens. The dominance of these vegetation types is indicative of more nutrient rich water, which is a defining characteristic of fens. Because fens also tend to have moving water (overland or subsurface), the characteristics of local geography / hydrology also play a role in determining whether wetlands were fens or bogs (i.e. in areas where direction drainage was evident, especially in conjunction with identified drainages, a wetland is more likely a fen).

Three CWCS fen subforms were identified in the Project area: Horizontal fen, basin fen, and spring fen. Horizontal fens (similar to Flat Bogs) tend to occur in large poorly defined depressions, usually on gently sloped surfaces. Basin Fens are confined within basins in the local geography, but often have out-flowing streams. Spring fens occur in locations that have mineral rich springs providing the ground water.

Swamps: Within the Project area, four wetlands were classified as swamps. Two subforms of swamp were identified: Basin Swamp and Riverine Swamp. Basin Swamps usually occur in well-defined basins and may develop a layer of peat. Riverine Swamps occur along watercourses (permanent and intermittent).

Marshes: Fifteen wetlands were classified as marshes within the Project area. Four marsh subforms were identified, based largely on drainage characteristics: Linked Basin Marsh (n=2), Isolated Basin Marsh (n=5), Discharge Basin Marsh (n=1) and Riparian Stream Marsh (n=7). Basin Marshes are found within well-defined basins or depressions, and receive water from precipitation, surface runoff, groundwater discharge, and stream inflows. Discharge Basin Marshes receive most of their water from groundwater discharge, and are found in low lying areas. Isolated Basin Marshes are usually in shallow depressions and lack surface inlets or outlets. Linked Basin Marshes have inlets and outlets but may only have water during times of high runoff. Riparian Stream Marshes are located along stream channels, embankments and riparian zones.

Shallow Water: Only one shallow water wetland was found within the Project area. The subform was identified as Linked Basin Water, which is defined as occupying a well-defined basin with in- and out-flowing streams.

16.5 Fish

The Project is located within the Edson River drainage to the south and the Pine Creek drainage to the north; both drainages are part of the Athabasca River watershed. The Project area has high potential for fisheries values, with native mountain whitefish, burbot and Athabasca rainbow trout. The Project area is within Fish Management Zone ES3.

The Edson River drainage supports *at-risk* and *sensitive* species that include Athabasca rainbow trout (at-risk), Arctic grayling (sensitive), northern redbelly dace (sensitive), and spoonhead sculpin (sensitive). Records of secure species include brook stickleback, burbot, finescale dace, lake chub, longnose dace, longnose sucker, mountain whitefish, trout perch and white sucker. The exotic species brook trout has also been historically found within this drainage.

The Pine Creek drainage supports *at-risk* and *sensitive* species that include Athabasca rainbow trout (at-risk), Arctic grayling (sensitive), bull trout (sensitive) and spoonhead sculpin (sensitive). Records of secure species include burbot, lake chub, longnose dace, longnose sucker, mountain whitefish and white sucker.

16.6 Birds

A total of 40 hours were spent in the field conducting nesting bird surveys in 2012, and 64 hours in 2013. There were 69 different bird species or groups of species recorded -- 52 in 2012 and 44 in 2013. Some birds were not able to be identified to species due to similarities in appearance and song to a closely related species (blackbirds) or because scat was used to identify species presence (grouse). One bird species (three-toed woodpecker) was recorded as an incidental observation during other work in February 2013, and then was recorded during the surveys in 2013. The nests of 4 species were found in the survey area. In 2012, two song sparrow nests were found (one had eggs and the other had chicks); cliff swallows were nesting under the bridge over the Athabasca River; and one American robin nest with chicks was found. In 2013 a grey jay nest was found and cliff swallow nests were again observed in a second location. Most of the other birds were likely breeding in the area. There were 23 species recorded in 2012 but not 2013, and 13 species recorded in 2013 but not 2012. This reflects a combination of habitat differences (especially elevation) and normal year-to-year variation in brid presence and abundance.

Thirteen species were common throughout the study area in one or both years: alder flycatcher, cliff swallow, gray jay, red-breasted nuthatch, American robin, ruby-crowned kinglet, Swainson's thrush, Tennessee warbler, yellow warbler, yellow-rumped warbler, chipping sparrow, dark-eyed junco and white-throated sparrow. Twelve species are fairly common in one or both years: ruffed grouse, grouse species, Wilson's snipe, northern flicker, gray jay, boreal chickadee, ruby-crowned kinglet, hermit thrush, warbling vireo, song sparrow, and brewers and/or rusty blackbirds (could not be distinguished).

The April 2013 survey detected six owls of four different species: northern saw-whet owl, boreal owl, long-eared owl, and great horned owl. A great gray owl was observed hunting prior to the commencement of the survey. Single individuals of long-eared and great gray owls were seen during the May 2013 nesting bird survey.

Eight species are bird *species at risk*. They are all listed as sensitive by Alberta ESRD, and are on the ACIMS watch list: osprey, American kestrel, sandhill crane, pileated woodpecker, least flycatcher, common yellowthroat, western tanager, and great gray owl. No rusty blackbirds were confirmed, because their song could not be distinguished from Brewer's blackbird, but they are likely present.

16.7 Amphibians

Amphibians breed in open-water such as ditches, ponds, lakes, ponded streams, and shallow-water wetlands. They migrate to the breeding sites in the spring, and migrate to upland living areas for the summer. Three species of amphibians have been found within the study area:

- Wood Frog, *Rana sylvatica*
- Boreal Chorus Frog, *Pseudacris maculata*
- Western Toad, *Anaxyrus boreas* (calling population)

It is unlikely that any other amphibian species occur within the Project area.

Amphibians recorded 2012 - 2013 included 2 sites with Western Toads, 45 sites with Wood Frogs, and 20 sites with Boreal Chorus Frogs. Fourteen sites had tadpoles too young reliably identify. In the Project area, Western Toads are rare, Boreal Chorus Frogs are uncommon, and Wood Frogs are common.

16.8 Mammals

Most mammals living in the Project area are of commercial and cultural importance for hunters and trappers. The surveys confirm the presence of 18 species or groups of species of mammals:

- American badger
- black bear
- moose
- red squirrel
- white-tail deer, mule deer
- snowshoe hare
- weasel species
- American marten
- fisher
- Canada lynx
- coyote
- shrew species
- vole species
- mouse species
- grey wolf
- wolverine
- northern river otter
- red fox

The greatest numbers of species found in winter were in the coniferous and mixed habitat types, with 14 species being found in each. The riparian habitat type had the next most at 13 species, while the deciduous habitat type had the least species with only 8 species found in total. The long-tailed weasel and wolverine are ranked ‘may be at risk’ by Alberta ESRD. The tracks of different weasel species could

not be distinguished; hence it is unknown whether the tracks were made by a long-tailed weasel or another weasel species. Wolverine tracks were found in several places along the study area. American badger, fisher and Canada lynx are ranked as 'sensitive' by Alberta ESRD. Fisher and marten tracks could not be distinguished, but Canada lynx tracks were common throughout the study area. American badger was only seen once, crossing a road near the Project area, but is assumed to use the Project area.

16.9 Species at Risk

Athabasca rainbow trout are a genetically distinct population of rainbow trout that is unique to the Athabasca River watershed, and is presently ranked as *at risk* in Alberta. The trout occur throughout the Pine Creek watershed, including in many of the small headwaters tributaries, and locally in the Edson River watershed. Northern redbelly dace occur in some tributaries of the Edson River, but do not appear to occur in the Pine Creek watershed. They are ranked as 'sensitive' by Alberta ESRD. In contrast, bull trout occur in the main channel of Pine Creek, but do not appear to occur in the Edson River watershed. They are also ranked as 'sensitive' by Alberta ESRD.

Western Toads are listed as Sensitive by Alberta SRD and Special Concern under Schedule 1 of the federal Species at Risk Act. The "calling" population-type is present in the Highway 947 study area. Fair to good habitat for Western Toads exists within the study area, with breeding and overwintering habitat present in small wetlands and ponded water along streams.

Trumpeter swans are listed as 'at risk' by Alberta ESRD and designated as "Threatened" under the Alberta Wildlife Act. There is one identified Trumpeter Swan lake just to the east of the Project area, near the south end, which has the ungazetted name of "Lacy's Lake". The osprey is classified as 'sensitive' by Alberta ESRD. The species is uncommon but widespread, and is vulnerable to loss of nest sites. The osprey returns to the same nest year after year. One osprey has been observed in the project area. The great grey owl is classified as 'sensitive' by Alberta ESRD. Both observations of the owl were of it hunting along the current power transmission line right-of-way that parallels the proposed highway right-of-way. The pileated woodpecker is classified as 'sensitive' by Alberta ESRD. The species is uncommon but widespread, and is vulnerable to loss of large diameter trees used for nesting. One was observed in the project area. The rusty blackbird was classified as 'Special Concern' by COSEWIC in April of 2006 and is classified as 'Sensitive' by Alberta ESRD. The rusty blackbird could not be distinguished from the brewer's blackbird during the 2012 survey, but both these species may be nesting within the study area.

American badger is ranked as sensitive by Alberta ESRD and one was seen crossing a resource road near the Project area. Canada lynx are ranked as 'sensitive' by Alberta ESRD. Canada lynx were found throughout the study area during the winter track surveys in 2013. Fisher are ranked as 'sensitive' by Alberta ESRD. Many tracks classified as marten/fisher were found within the study area during the winter track surveys. One fisher was seen crossing a road just outside the project area, confirming the presence of the species. Wolverine are classified as 'may be at risk' by Alberta ESRD and as 'special concern' by COSEWIC. Wolverine tracks were found in the study area during the winter track surveys.

17.0 Fisheries Act, Species at Risk Act, and Migratory Birds Convention Act

Fish may be impacted during construction and operation of the highway during dewatering of sections of streams during construction of stream crossing structures, or during maintenance during operation of the highway. Fish may also be impacted by downstream sedimentation during construction and maintenance. These impacts will be mitigated so as to result in few or no actual impacts to fish. Fish may also be impacted by increased fishing pressure as a result of increased access to the area resulting from construction of the highway.

Fish habitat may be impacted during construction and operation of the highway by construction of stream crossing structures, by removal of riparian vegetation in the clearance width, downstream sedimentation, alteration of channel morphology and dynamics, introduction of deleterious substances, and/or filling of stream channel area by roadbed or protective structures such as riprap. These impacts will be avoided where possible, and, where avoidance is not possible, mitigated or compensated as required by the *Fisheries Act*. There are no aquatic species at risk, as defined in the Species at Risk Act, known to occur in the Project area.

Migratory birds may be impacted during construction and operation of the highway through vegetation clearance, dust, noise and other disturbance, and vehicle collisions. Destruction of active nests will be mitigated as required by the Migratory Birds Convention Act. Some migratory birds may also be impacted by increased hunting pressure as a result of increased access to the area resulting from construction of the highway.

Migratory bird habitat may be impacted as a result of removal of vegetation from the clearance area, by noise and other disturbance, by dust and pollutants, and by light pollution (primarily vehicle lights). These impacts will be avoided where possible, and, where avoidance is not possible, mitigated or compensated as required by the *Migratory Birds Convention Act*.

18.0 Extra-territorial Changes to the Environment

There are no anticipated changes to the environment, as a result of carrying out the designated project, on federal lands, in a province other than the province in which the project is proposed to be carried out, or outside of Canada.

19.0 Effects on Aboriginal Peoples

The effects on the health and socio-economic conditions of aboriginal peoples of the construction of Highway 947 is being determined through consultation. There are no reserves or other settlements within or near the Project area. The physical and cultural heritage of the area has been assessed for any structure, site or thing that is of historical, archaeological, paleontological or architectural significance with few effects anticipated. The current use of lands and resources for traditional purposes will be determined through consultation.

9 REFERENCES

Abbaspour, Karim C., Monireh Faramarzi and Elham Rouholahnejad. 2010. Hydrological Modeling of Alberta using SWAT Model: A preliminary report. http://www.albertawater.com. 83 p.

Alberta Agriculture and Rural Development. 2013. Understanding Groundwater. Information regarding groundwater quality is published on the Alberta Agriculture and Rural Development website (http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wwg406#movement). (accessed August 21, 2013).

Alberta Biodiversity Monitoring Institute, 2013. Biodiversity Browser: Species. http://www.abmi.ca/abmi/biodiversitybrowser/species.jsp (accessed April 25, 2013).

Alberta Environment 2007. Provincial Wetland Restoration / Compensation Guide. Revised Edition - February 2007. Environmental Partnerships and Education Branch, Alberta Environment, Edmonton, AB. ii + 16 pp. http://environment.alberta.ca/documents/Provincial_Wetland_Restoration_Compensation_Guide_Feb_2007.pdf.

Alberta Environment and Sustainable Resource Development. 2013. Precipitation Map June 19-22, 2013. Downloaded from http://www.environment.alberta.ca/forecasting/data/precipmaps/event.pdf.

Alberta Government. 2005. Alberta Wildlife Animal Care Committee Class Protocol #006. Environment and Sustainable Resource Development, Wildlife Management Branch. http://srd.alberta.ca/FishWildlife/WildlifeResearchCollection/documents/WRClassProtocol006-CallPlaybackForOwls.pdf (accessed Jan 18, 2013).

Alberta Soil Information Centre. 2001. AGRASID 3.0: Agricultural Region of Alberta Soil Inventory Database (Version 3.0). Edited by J.A. Brierley, T.C. Martin, and D.J. Spiess. Agriculture and Agri-Food Canada, Research Branch; Alberta Agricultrue, Food and Rural Development, Conservation and Development Branch.

Alberta Sustainable Resource Development and Alberta Conservation Association. 2010. Status of the Grizzly Bear (*Ursus arctos*) in Alberta: Update 2010. Alberta Sustainable Resource Development. Wildlife Status Report No. 37 (Update 2010). Edmonton, AB 44pp.

Alberta Sustainable Resource Development and Alberta Conservation Association. 2010. Status of the Woodland Caribou (*Rangifer tarandus caribou*) in Alberta: Update 2010. Alberta Sustainable Resource Development. Wildlife Status Report No. 30 (Update 2010). Edmonton, AB 88pp.

Alberta Sustainable Resource Development. 2005. Status of the barred owl (*Strix varia*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 56, Edmonton, AB. 15 pp.

Alberta Sustainable Resource Development. 2003. Status of the Brown Creeper (*Certhia americana*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 49, Edmonton, AB. 30 p

Alberta Transportation. 2001. Guidelines on Flood Frequency Analysis. Unpublished report prepared by Transportation & Civil Engineering Division, Civil Projects Branch. 74 p.

Alberta Transportation. 2004. Guidelines on Extreme Flood Analysis. Unpublished report prepared by Transportation & Civil Engineering Division, Civil Projects Branch. 87 p., plus appendices.

Alberta Transportation. 2006a. Hydrotechnical Design Guidelines for Stream Crossings. 8 p.

Alberta Transportation. 2006b. Development of Runoff Depth Map for Alberta. 8 p.

Alberta WaterSmart. 2013. The 2013 Great Alberta Flood: Actions to Mitigate, Manage and Control Future Floods. Downloaded from www.albertawatersmart.com. 27 p.

Alexander, S.M. and N.M. Waters. 2000. The effects of highway transportation corridors on wildlife: a case study of Banff National Park. Transportation Research Part C 8 (2000) 307-320.

Alexis, Stephanie. 2012. Alexis Nakota Sioux Nation - Our History. Alexis Nakota Sioux Nakota Sioux Nation Education Portal. Alexis Board of Education. Glenevis, Alberta. http://www.alexised.ca/alexis-heritage-institute.aspx.

ARA Engineering. 2012. Stream and Utility Crossing Assessment for Hwy 947:08 - :10 (CON0012287). Letter report to Alberta Transportation, dated April 23rd. 3 p., plus drawings.

Atkinson, N. and Lyster, S. 2010. Bedrock topography of Alberta, Canada [map]. Scale 1:1,500,000. Energy Resources Conservation Board, ERCB/AGS Map 550.

B.C. Ministry of Water, Land and Air Protection. 2004. Sandhill Crane (*Grus canadensis*) in Accounts and Measures for Managing Identified Wildlife – Accounts V. 2004. B.C. Ministry of Water, Land and Air Protection, Victoria, B.C. (Available: http://www.env.gov.bc.ca/wld/frpa/iwms/accounts.html) (accessed May 7, 2013).

Barrow, Elaine and Ge Yu. 2005. Climate Scenarios for Alberta. Report prepared for the Prairie Adaptation Research Collaborative in co-operation with Alberta Environment. 73 p.

Beaverhill Bird Observatory. 2003. Owl Survey Instruction Booklet. Edmonton, AB: Beaverhill Bird Observatory. 18 pp.

Benítez-López, A., R. Alkemade, and P.A. Verweij. 2010. The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. Biological Conservation. 143 (2010) 1307–1316.

Bock, M.D., Brierley, J.A., Walker, B.D., Thomas, C.J. and Smith, P.E. (2006). Alberta Soil Names File (Generation 3) User's Handbook. Land Resource Unit Research Branch, Agriculture and Agri-Food Canada, 140 pp. http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag10989/$FILE/new_gen3_document.pdf (Viewed on August 5th 2013).

Boves, T.J., and J.R. Belthoff. 2012. Roadway Mortality of Barn Owls in Idaho, USA. The Journal of Wildlife Management 76(7):1381‐1392.

Cairns, A. L. and E. S. Telfer. 1980. Habitat use by 4 sympatric ungulates in boreal mixed wood forest. Journal of Wildlife Management, 44, 849-57.

Canadian Amphibian and Reptile Conservation Network. 2010. http://www.carcnet.ca/english/tunnels/amph_tunnels.php. Accessed Sept 1, 2011.

Carter, M.R. (993. Soil sampling and methods of analysis. Canadian Society of Soil Science, Lewis Plublishers, Boca Raton, Florida 823 p.

Clayton, K. M. 2000. Status of the Short-eared Owl (*Asio flammeus*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 28, Edmonton, AB. 15 pp.

Chalfoun, A.D., F.R. Thompson III, and M. J. Ratnaswamy. 2002. Nest Predators and Fragmentation: a Review and Meta-Analysis. Conservation Biology, Volume 16, No. 2, Pages 306–318.

COSEWIC. 2002. COSEWIC assessment and status report on the western toad Bufo boreas in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 31 pp. http://publications.gc.ca/collections/Collection/CW69-14-346-2003E.pdf.

COSEWIC 2002. COSEWIC assessment and update status report on the woodland caribou (*Rangifer tarandus caribou*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 98 pp.

COSEWIC 2004. COSEWIC assessment and update status report on the Loggerhead Shrike (*excubitorides* subspecies *Lanius ludovicianus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC 2006. COSEWIC assessment and status report on the Rusty Blackbird (*Euphagus carolinus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC 2007a. COSEWIC assessment and status report on the Common Nighthawk (*Chordeiles minor*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 25 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm). (accessed April 29th, 2013)

COSEWIC. 2007b. COSEWIC assessment and status report on the Olive-sided Flycatcher (*Contopus cooperi*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 25 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm). (accessed April 29th, 2013)

COSEWIC. 2008. COSEWIC assessment and update status report on the Short-eared Owl (*Asio flammeus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm). (accessed April 29th, 2013)

COSEWIC. 2009. COSEWIC assessment and status report on the Yellow Rail (*Coturnicops noveboracensis*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 32 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm). (accessed April 29th, 2013)

COSEWIC. 2010. COSEWIC assessment and status report on the Sprague's Pipit (*Anthus spragueii*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 34 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2011. COSEWIC assessment and status report on the Barn Swallow (*Hirundo rustica*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. (http://www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2012a. COSEWIC assessment and status report on the Grizzly Bear (*Ursus arctos*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 84 pp. (http://www.registrelep-sararegistry.gc.ca/default_e.cfm) (accessed April 22, 2013).

COSEWIC. 2012b. COSEWIC Species profile: Wolverine western population. Committee on the Status of Endangered Wildlife in Canada. (http://www.sararegistry.gc.ca/species/speciesDetails e.cfm?sid=172#ot18) (accessed April 23, 2013).

COSEWIC. 2012c. Technical Summary and Supporting Information for an Emergency Assessment of the Northern Myotis (*Myotis septentrionalis*) Terrestrial Mammal Subcommittee, COSEWIC. Canada. http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/ca_chauvesouris_nordique_northern_myotis_0212_e.pdf (accessed April 22, 2013).

COSEWIC. 2012d. COSEWIC assessment and status report on the Western Toad *Anaxyrus boreas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiv + 71 pp. http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Western%20Toad%20_2013_e.pdf.

Dickason, Olive Patricia. 1992. Canada's First Nations: A History of Founding Peoples from Earliest Times. University of Oklahoma Press. Toronto, Ontario, Canada.

Dumanski, J., Macyk, T.M., Veauvy, C.F. and Lindsay, J.D. 1972. Soil Survey and Land Evaluation of the Hinton-Edson Area, Alberta. Alberta Institute of Pedology, Report No. S-72-31, 119 p., + Map 83-F, E-1/2, 83-F, W-1/2. http://sis.agr.gc.ca/cansis/publications/surveys/ab/ab31/index.html (viewed August 5th 2013).

Dyke, A. 2004. An outline of North American deglaciation with emphasis on central and northern Canada. In Eds J. Ehlers, P.L. Gibbard, Quaternary glaciations extend and chronology: Part 2 North America. pp. 373-423.

Edwards, B., Hoekstra, R., Monette, B., Gallien O.J., Davis B. 1986. Physiographic Subdivisions of Alberta. Land Research Centre, Research Branch, Agriculture Canada, Ottawa. Scale 1:500,000. http://sis.agr.gc.ca/cansis/publications/surveys/ab/abp/index.html (Viewed on July 16th 2013).

Federation of Alberta Naturalists. 2007. Atlas of Breeding Birds of Alberta: A Second Look. Edmonton, Federation of Alberta Naturalists.

Findlay, Heather. 2007. The Plains People. Canada's First Peoples. Goldi Productions Ltd. Canada. http://firstpeoplesofcanada.com/fp_groups/fp_plains1.html.

Fisher Habitat and Forest Management Web Module. Fisher Ecology and Forests. http://fisher.forrex.org/.

Forman, R.T.T. and L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics 29:207–31.

Forman, R.T.T. and R.D. Deblinger. 2000. The Ecological Road-Effect Zone of a Massachusetts (U.S.A.) Suburban Highway. Conservation Biology, Volume 14, No. 1, Pages 36–46.

Government of Alberta, 2012. Alberta Wild Species General Status Listing – 2010. Environment and Sustainable Resource Development, Fish and Wildlife Division. http://srd.alberta.ca/FishWildlife/SpeciesAtRisk/GeneralStatusOfAlbertaWildSpecies/GeneralStatusOfAlbertaWildSpecies2010/SearchForWildSpeciesStatus.aspx (accessed April 2, 2013).

Government of Alberta. 2014. Interactive Map. http://www.aboriginal.alberta.ca/930.cfm.

Ground-based Inventory Methods for Ungulate Snow-track Surveys. 2006. Standards for Components of British Columbia's Biodiversity No.33a, Ministry of Environment, Ecosystems Branch for the Resources Inventory Standards Committee.

Hamilton, W.N., Price, M.C. and Langenberg, C.W. 1999. Geological Map of Alberta. Alberta Geological Survey, Alberta Energy and Utilities Board, Map no. 236, Scale 1:1,000,000. http://www.ags.gov.ab.ca/publications/MAP/PDF/MAP_236.PDF (Viewed on August 5th 2013).

Hannah, K. C. 1999. Status of the Northern Pygmy Owl (*Glaucidium gnoma californicum*) in Alberta. Alberta Environmental Protection, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 20, Edmonton, AB. 20 pp.

Hillman, G.R., J.M. Powell and R.L.Rothwell. 1978. Hydrometeorology of the Hinton-Edson area, Alberta, 1972-1975. Fish. Environ. Can., Can. For. Serv., North. For. Res. Centr., Edmonton, Alberta. Inf. Rep. NOR-XD-202. 171 p.

Hudson, H.R. and B. Trevor. 1984. Peak Runoff from Small Rural Drainage Basins in North Central Alberta. Alberta Research Council. 123 p.

Indian Claims Commission. 2005. The Facts on Claims. Indian Claims Commission. Canada.

Kienzle, Stefan W. (no date). Water Yield and Streamflow Trend Analysis for Alberta Watersheds. Downloaded from http://www.albertawater.com. 14 p.

Knapik L.J. and Lindsay, J.D. 1983. Reconnaissance Soil Survey of the Iosegun Lake Area Alberta. Soil Division of Alberta Research Council, Bulletin 43, 93 p., + Map 83K-NE-SE-SW-NW. http://sis.agr.gc.ca/cansis/publications/surveys/ab/ab43/index.html (Viewed on August 5th 2013).

Kobylarz, Beth. 2003. The effect of road type and traffic intensity on amphibian road mortality. Journal of Service Learning in Conservation Biology 1:10-15. http://campus.murraystate.edu/academic/faculty/hwhiteman/pdf/consbioljournalvol1-bkobylarz.pdf.

James, M. L. 2000. Status of the Trumpeter Swan (*Cygnus buccinator*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 26, Edmonton, AB. 21 pp.

Kociolek, A.V., A. P. Clevenger, C.C. St. Clair, and D.S. Proppe. 2011. Effects of Road Networks on Bird Populations. Conservation Biology, Volume 25, No. 2, 241–249.

Lapp, Suzan and Stefan Kienzle. (no date). Impacts of Long-term Climate Cycles on Alberta: A summary. Downloaded from http://www.albertawater.com. 12 p.

Lemay, T.G. and S. Guha. 2009. Compilations of Alberta Groundwater Information from Existing Maps and Data Sources. ERCB/AGS Open File Report 2009-02.

Lewis, M. Paul, Gary F. Simons, and Charles D. Fennig (eds.). 2013. *Ethnologue: Languages of the World, Seventeenth edition.* Dallas, Texas: SIL International. Online version: http://www.ethnologue.com.

Lyster, S. and Andriashek, L. 2010. Insights into the internal architecture of the Paskapoo Formation. GeoCanada 2010 – Working with the Earth. Available online: http://cseg.ca/assets/files/resources/abstracts/2010/0512_GC2010_Insights_into_Internal_Architecture_of_Paskapoo.pdf [paper] and http://www.ags.gov.ab.ca/conferences/geocanada2010/paskapoo-architecture-lyster.pdf [poster] Accessed July 12, 2013.

Mazerolle, M.J. 2004. Amphibian road mortality in response to nightly variations in traffic intensity. Herpetologica 60: 45–53.

McCrossan, R.G. and Glaister, R.P. 1964. Geological History of Western Canada. Alberta Society of Petroleum Geology, 232 p.

Mose, H.C. 1965. A guide to understanding Saskatchewan soils. Saskatchewan Institute of Pedology, Depatment of Soil Sciences, University of Saskatchewan, Saskatoon.

Natural Regions Committee 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece, Government of Alberta, Pub. No. T/852, 254 p. http://www.tpr.alberta.ca/parks/heritageinfocentre/docs/NRSRcomplete%20May_06.pdf (viewed August 7, 2013)

Neill, C.R., D.I. Bray, Maria F. Schouten and J.R. Card. 1970. Selected Characteristics of Steamflow in Alberta. Research Council of Alberta in association with Water Resources Division, Alberta Department of Agriculture. River Engineering and Surface Hydrology Report 70-1. 55 p.

Neill, C.R. and W.E. Watt. 2001. Report on Six Case Studies of Flood Frequency Analyses. Report prepared for Alberta Transportation, Transportation and Civil Engineering Division, Civil Projects Branch. 58 p.

Nemanishen, W. 1977. Incorporating River Basin Physiography and Climatic Factors in Flood Frequency Analysis. In: Proceedings, Canadian Hydrology Symposium: '77-Floods. National Research Council of Canada, Associate Committee on Hydrology. pp. 224-255.

Norton, M.R. 2001. Status of the Cape May Warbler (*Dendroica tigrina*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 33, Edmonton, AB. 20 pp.

Norton, M. R. 1999. Status of the Black-throated Green Warbler (*Dendroica virens*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 23, Edmonton, AB. 24 pp.

Pauly, G. B. 2008. Phylogenetic systematics, historical biogeography, and the 2358 evolution of vocalizations in Nearctic toad (Bufo). Ph.D. Dissertation, 2359 University of Texas, Austin, Tex. xvi + 165 pp.

Petersen, S. 1997. Status of the Wolverine (*Gulo gulo*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 2, Edmonton AB. 17pp.

Pettapiece, W.W. 1986. Physiographic subdivisions of Alberta [map]. Scale 1:1,500,000. Canada Land Resource Research Centre, Agriculture Canada.

Prescott, D. R. C., and R. R. Bjorge. 1999. Status of the Loggerhead Shrike (*Lanius ludovicianus*) in Alberta. Alberta Environment, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 24, Edmonton, AB. 28 pp.

Prescott, D. R. C., and R. R. Bjorge. 1997. Status of the Sprague's Pipit (A*nthus spragueii*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 10, Edmonton, AB. 14 pp.

Prest, V. K. 1969. Retreat of Wisconsin and Recent ice in North America, Geological Survey of Canada, Map 1257.

Prior, G.J., Hathway, B., Glombick, P.M., Pana, D.I., Banks, C.J. Hay, D.C., Schneider, C.L., Grobe, M., Elgr, R. and Weiss, J.A. 2013. Bedrock geology of Alberta [map]. Scale 1:1,000,000. Alberta Energy Regulator, AER/AGS Map 600.

Reijnen, R. and R. Foppen. 1997. Disturbance by traffic of breeding birds: evaluation of the effect and considerations in planning and managing road corridors. Biodiversity and Conservation 6: 567-581 (1997).

Reijnen, R. and R. Foppen. 2006. Chapter 12: Impact of road traffic on breeding bird populations. In: The Ecology of Transportation: Managing Mobility for the Environment, John Davenport and Julia L. Davenport (eds.). Environmental Pollution Volume 10: 255-274.

Resources Inventory Committee (RIC). 1998. Inventory Methods for Marten and Weasels. 1998. Standards for Components of British Columbia's Biodiversity No.24. Ministry of Environment, Lands and Parks, Resources Inventory Branch for the Terrestrial Ecosystems Task Force, Resources Inventory Committee.

Resources Inventory Committee (RIC). 1999a. Inventory Methods for Forest and Grassland Songbirds. 1999. Standards for Components of British Columbia's Biodiversity No.15. Ministry of Environment, Lands and Parks, Resources Inventory Branch for the Terrestrial Ecosystems Task Force, Resources Inventory Committee.

Resources Inventory Committee (RIC). 1999b. Inventory Methods for Medium-sized Territorial Carnivores: Coyote, Red fox, Lynx, Bobcat, Wolverine, Fisher & Badger. Standards for Components of British Columbia's Biodiversity No.25. Ministry of Environment, Lands and Parks, Resources Inventory Branch for the Terrestrial Ecosystems Task Force, Resources Inventory Committee.

Resources Inventory Standards Committee (RISC). 2006a. Inventory Methods for Owl Surveys. Standards for Components of British Columbia's Biodiversity No.42. Ecosystems Branch of the Ministry of the Environment for the Resources Inventory Standards Committee.

Resources Inventory Standards Committee (RISC). 2006b. Ground-based Inventory Methods for Ungulate Snow-track Surveys Standards for Components of British Columbia's Biodiversity No. 33a. Ecosystems Branch of the Ministry of the Environment for the Resources Inventory Standards Committee.

Ridington, Robin. 2013. Aboriginal People: Subarctic. The Canadian Encyclopedia. Historica Foundation. http://www.thecanadianencyclopedia.com.

Robinson, C., P.N. Duinker, and K.F. Beazley. 2010. A conceptual framework for understanding, assessing, and mitigating ecological effects of forest roads. Environmental Review 18: 61–86.

Roed, M.R. 1975. Canadian and Laurentide Multiple Glaciation West-Central Alberta, Canada. Canadian Journal of Earth Sciences, 12 (9): 1493-1516.

Roed, M.A 1970. Surficial geology of the Edson area (NTS 83F), Department of Energy Mines and Resources, Government of Alberta, Map no. 139 and 33, 1:250,000. http://www.ags.gov.ab.ca/publications/abstracts/MAP_139.html (Viewed on August 5th 2013).

Seneka, M. 2004. Trends in historical annual flows for major rivers in Alberta, technical report, Alberta Environment, Edmonton, Canada. (Avail. at http://environment.gov.ab.ca/info/library6792.pdf).

Sibley, D.A. 2003. The Sibley Field Guide to Birds of Western North America. Knopf Doubleday Publishing Group. 471 pages.

St-Onge, D.A. 1972. Sequence of glacial lakes in north-central Alberta. Geological Survey of Canada, Bulletin no. 213, 16 p.

Stephens, S.E., D.N. Koons, J.J. Rotella, and D.W. Willeya. 2003. Effects of habitat fragmentation on avian nesting success: a review of the evidence at multiple spatial scales. Biological Conservation 115 (2003) 101–110.

Takats, D. L., C. M. Francis, G. L. Holroyd, J. R. Duncan, K. M. Mazur, R. J. Cannings, W. Harris, D. Holt. 2001. Guidelines for Nocturnal Owl Monitoring in North America. Beaverhill Bird Observatory and Bird Studies Canada, Edmonton, Alberta. 32 pp.

Takats, D.L. and G.L. Holroyd. 1997. Owl broadcast surveys in the Foothills Model Forest. In: Biology and Conservations of Owls of the Northern Hemisphere by J.R. Duncan, D.H.Johnson, and T.H. Nicholls (eds.). USDA Forest Service General Technical Report NC-190. pp. 421-431.

Takats Priestley, L. 2003. Alberta Nocturnal Owl Survey Instruction Booklet. Beaverhill Bird Observatory, Edmonton, Alberta. 19 pp.

Trombulak, S.C. and C.A. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology, Volume 14(1): 18–30.

Utting, D.J. 2013. Surficial geology of the Fox Creek area (NTS 83K/SE). Alberta Geological Survey, Government of Alberta, Map no. 562, 1:100,000. http://www.ags.gov.ab.ca/publications/abstracts/MAP_562.html (viewed August 5, 2013).

Vogwill, R.I.J. 1983. Hydrogeology of the Edson area, Alberta. Earth Sciences Report 79-7. Alberta Research Council.

Wolfart, H.C. 1996. Sketch of Cree, an Algonquian Language. In: Handbook of North American Indians, Vol. 17: Language. P 390:439. Smithsonian Institution. Washington, USA.

WorleyParsons. 2011. Groundwater in Alberta - An Assessment of Source, Use and Change. Report prepared for the Alberta Water Research Institute. Available online: http:// http://www.albertawater.com/index.php/projects-research/dynamics-of-alberta-s-water-supply/41-water-research/dynamics-of-alberta-s-water-supply/588-groundwater-in-alberta-an-assessment-of-source-use-and-change.

Appendixes

Appendix 1. Highway 947 Proposed Alignment

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 1

150 0 150 300 450

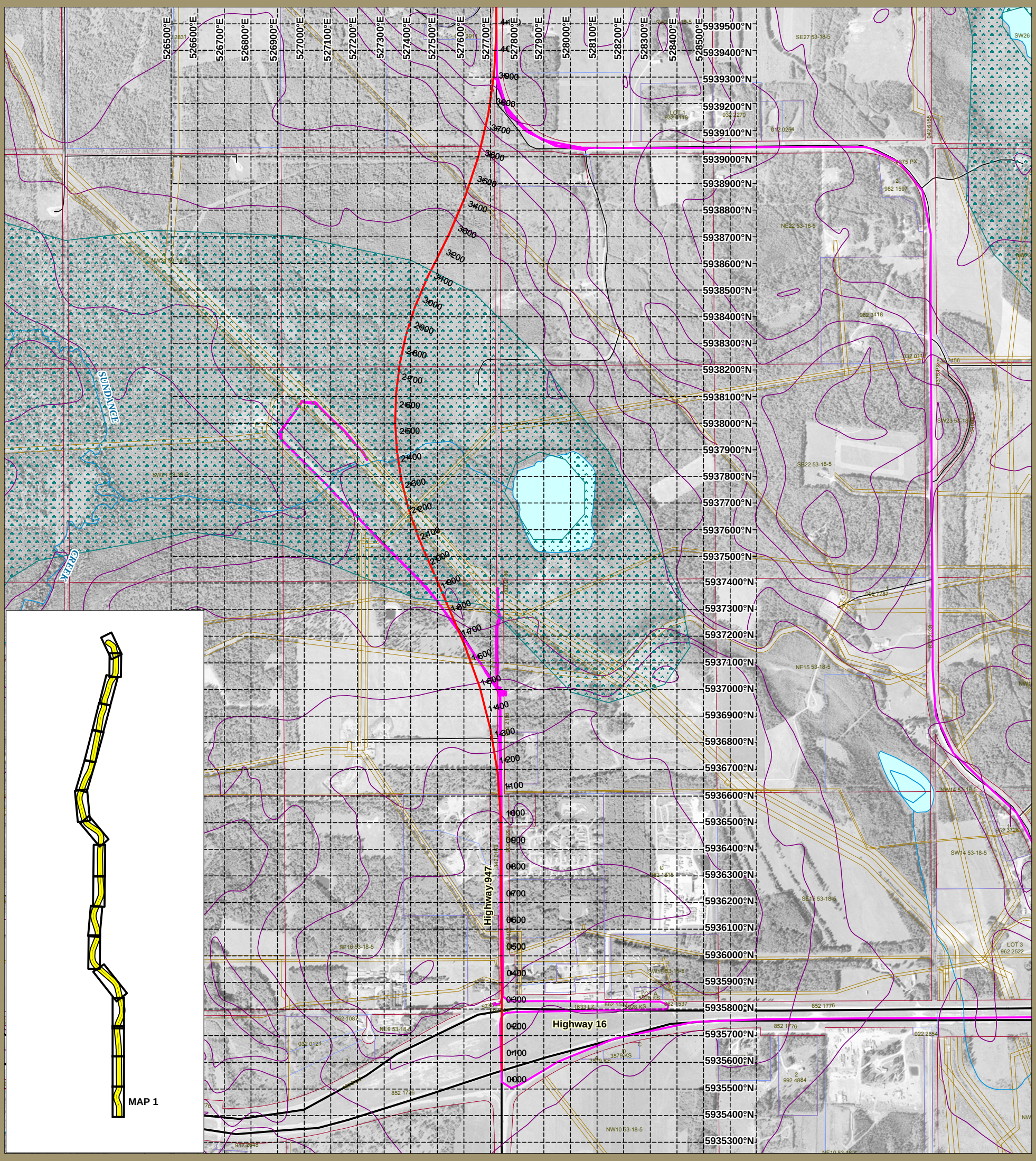
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Legal Lot Lines
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Lakes
- Streams
- AT Roads
- Paved Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills

ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 2

150 0 150 300 450

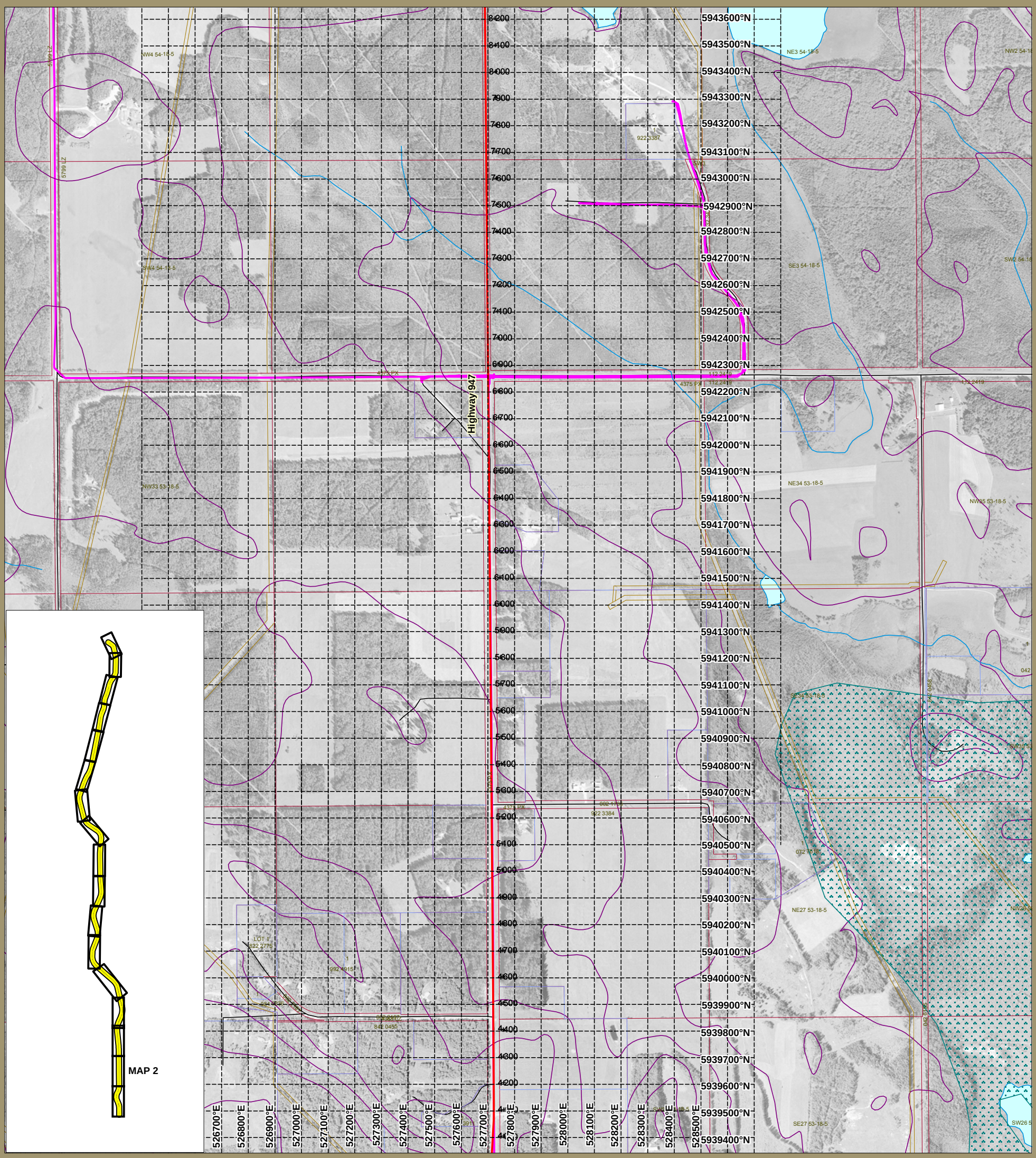
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

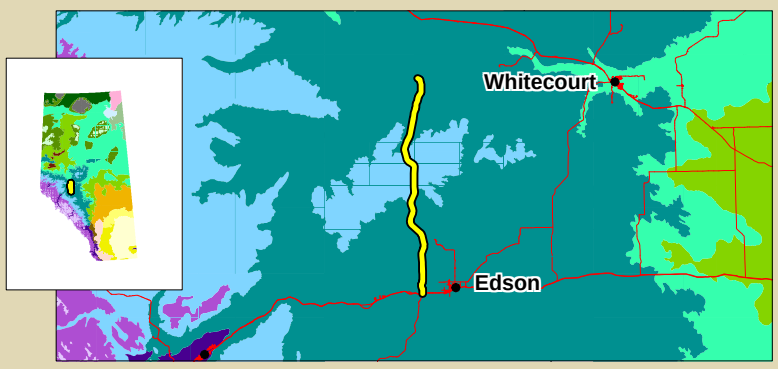
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Legal Lot Lines
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Lakes
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 3

150 0 150 300 450

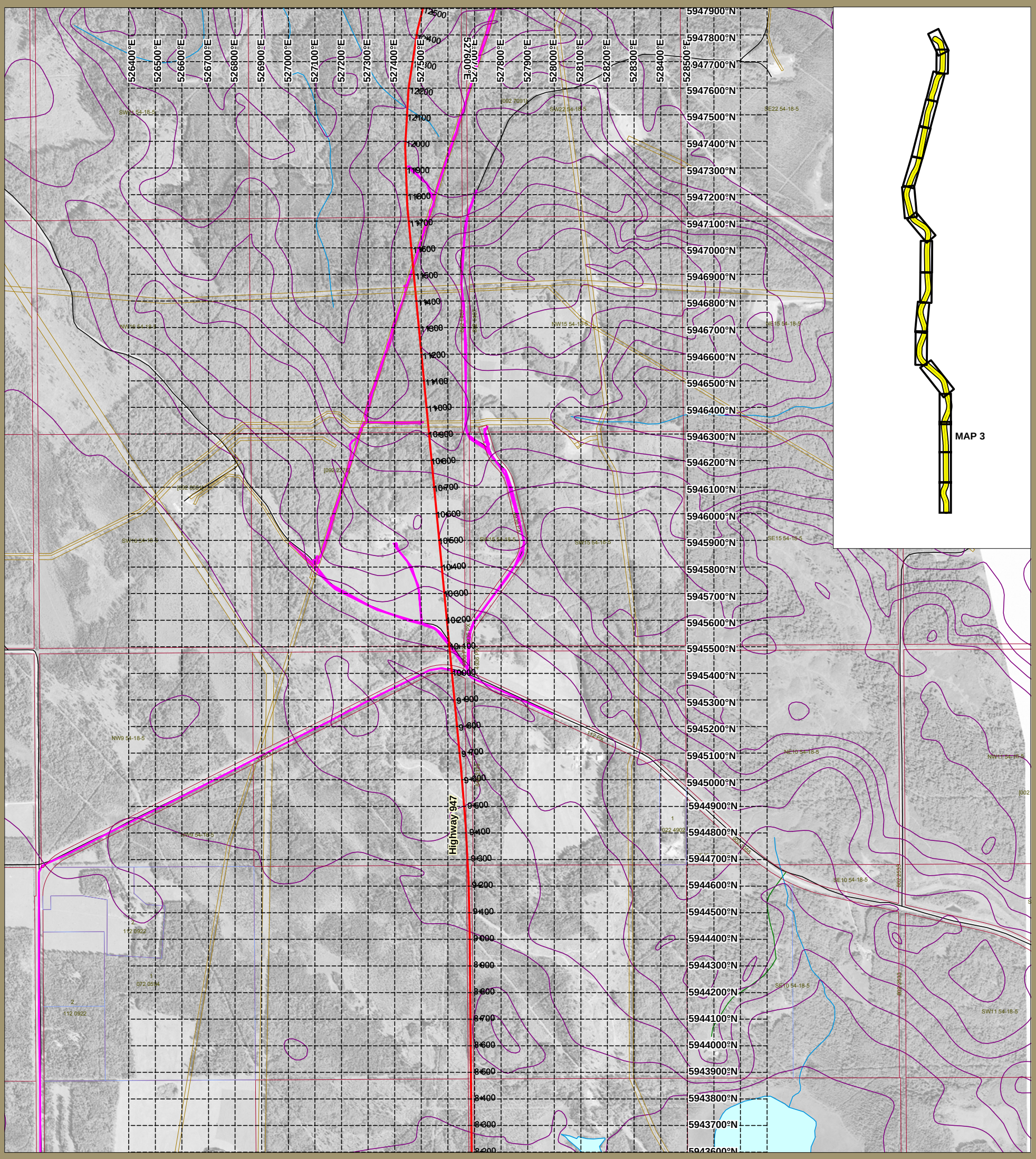
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

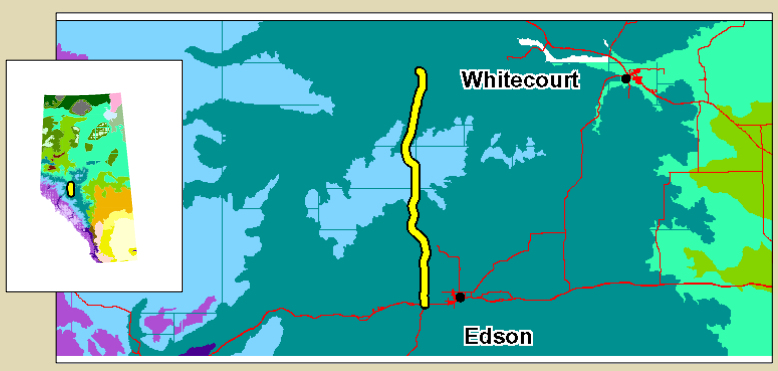
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Legal Lot Lines
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Lakes
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 4

150 0 150 300 450

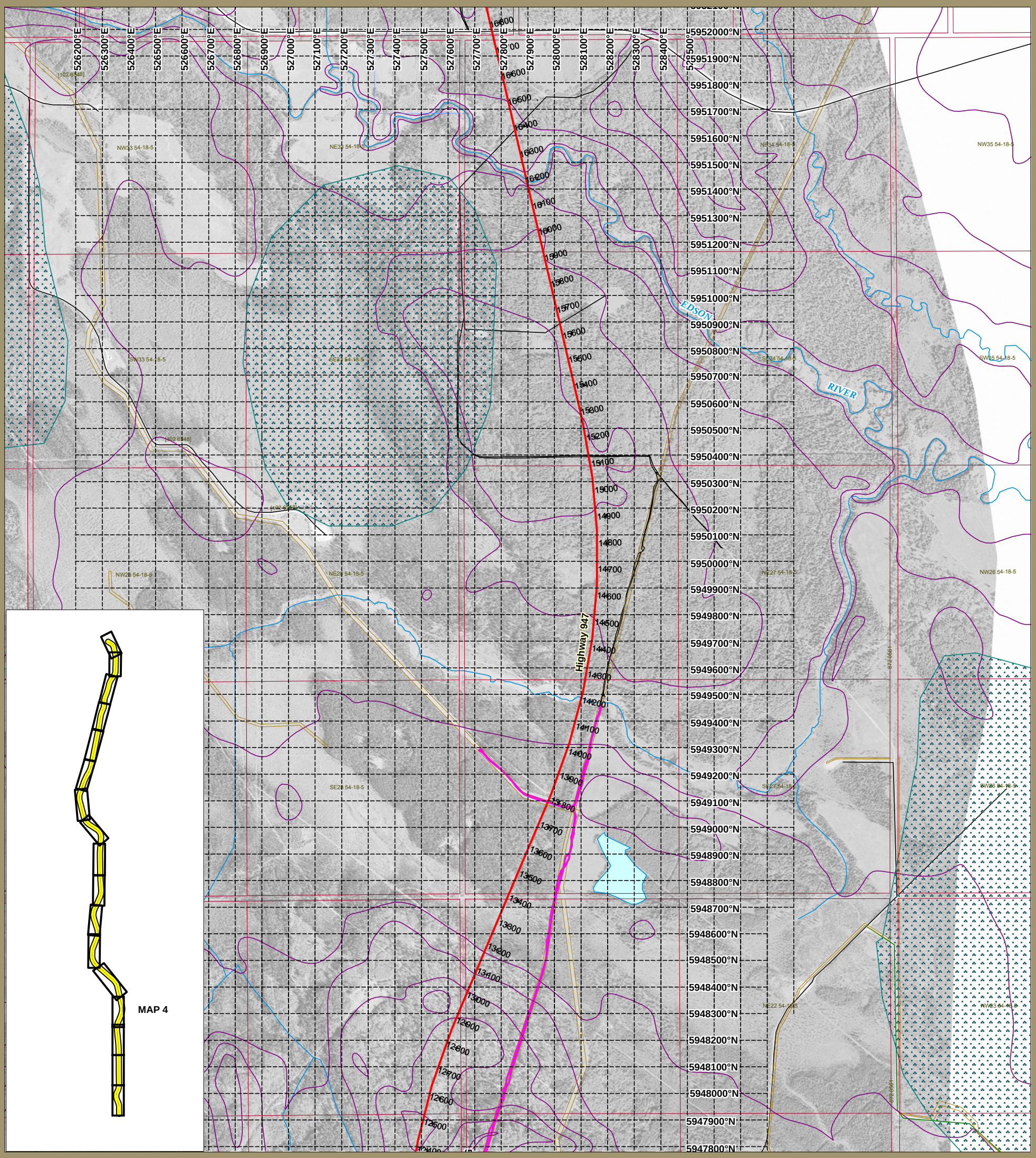
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

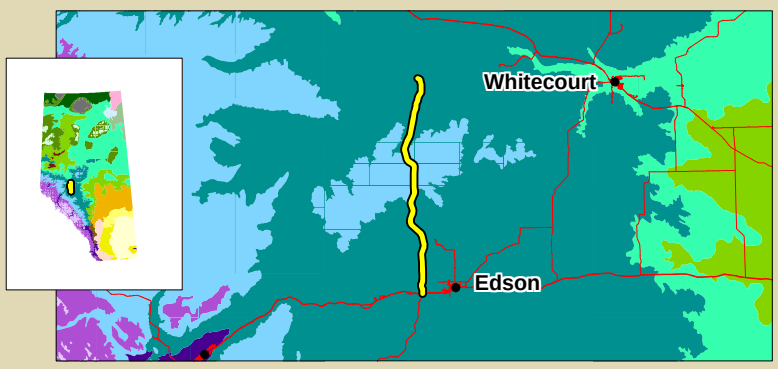
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Lakes
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 5

150 0 150 300 450

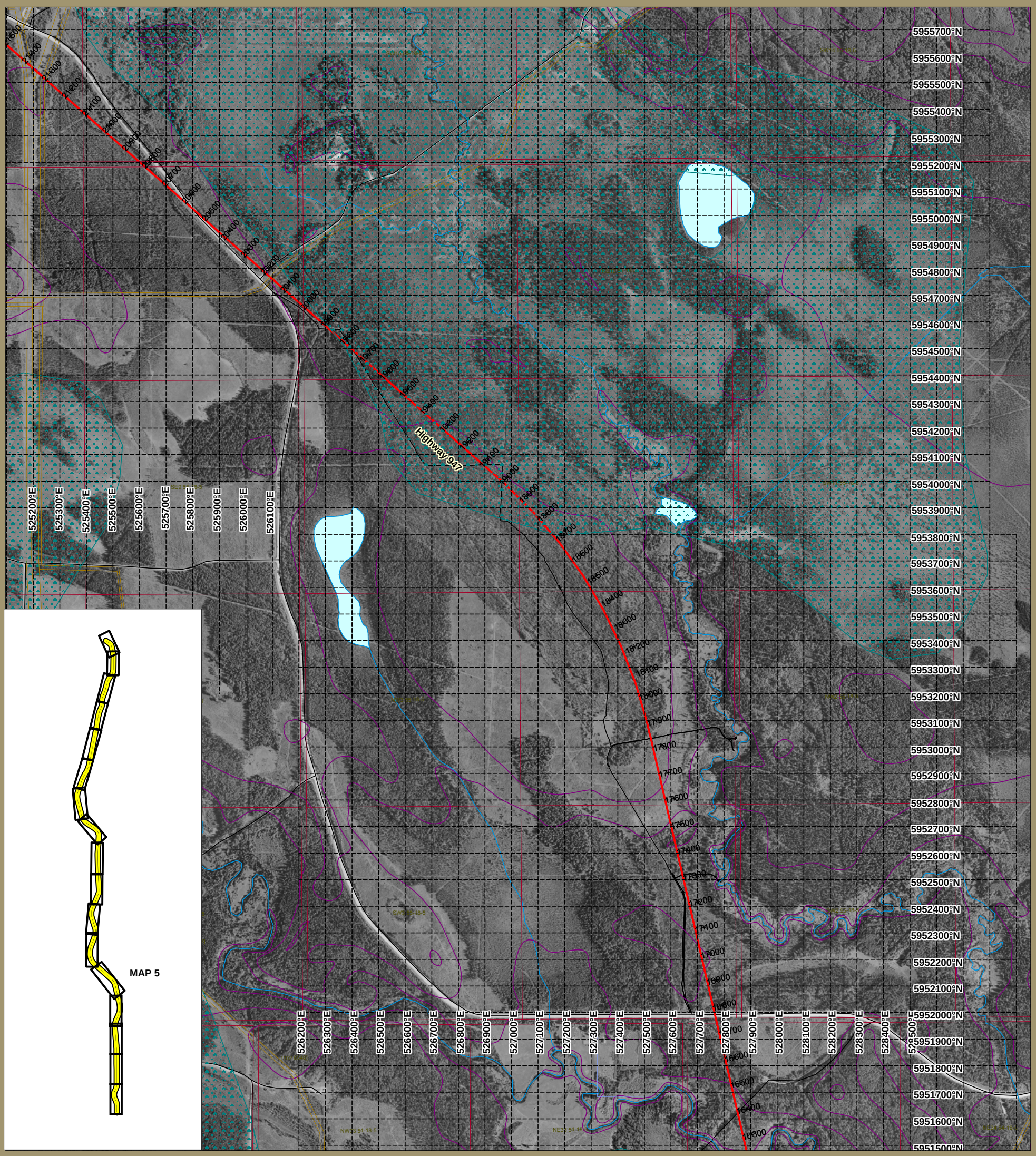
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

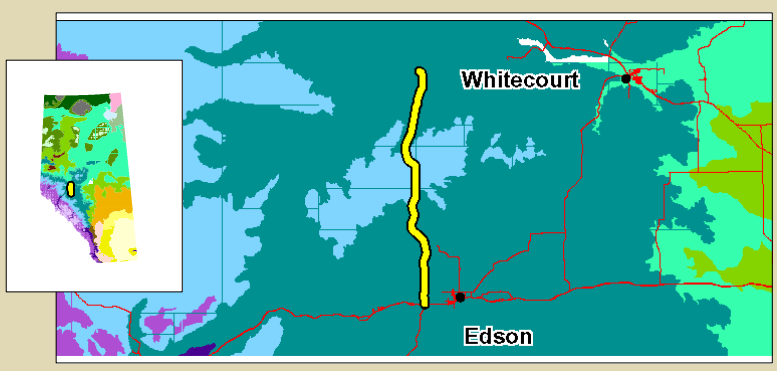
LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Lakes
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 6

150 0 150 300 450

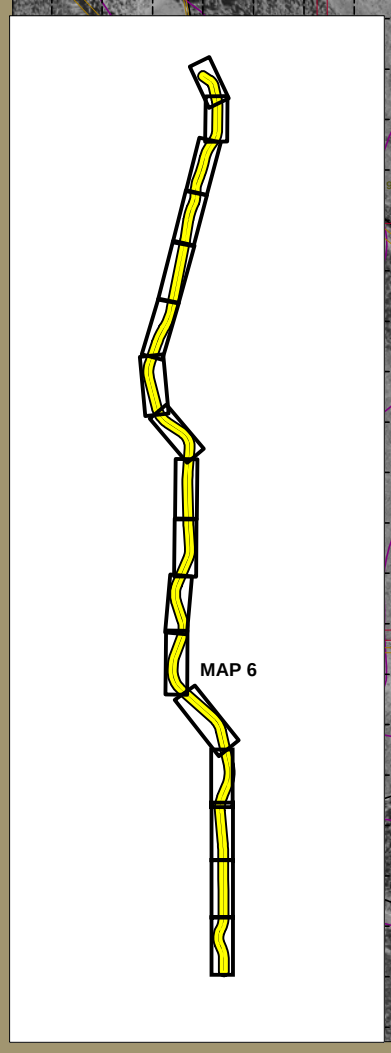
Meters

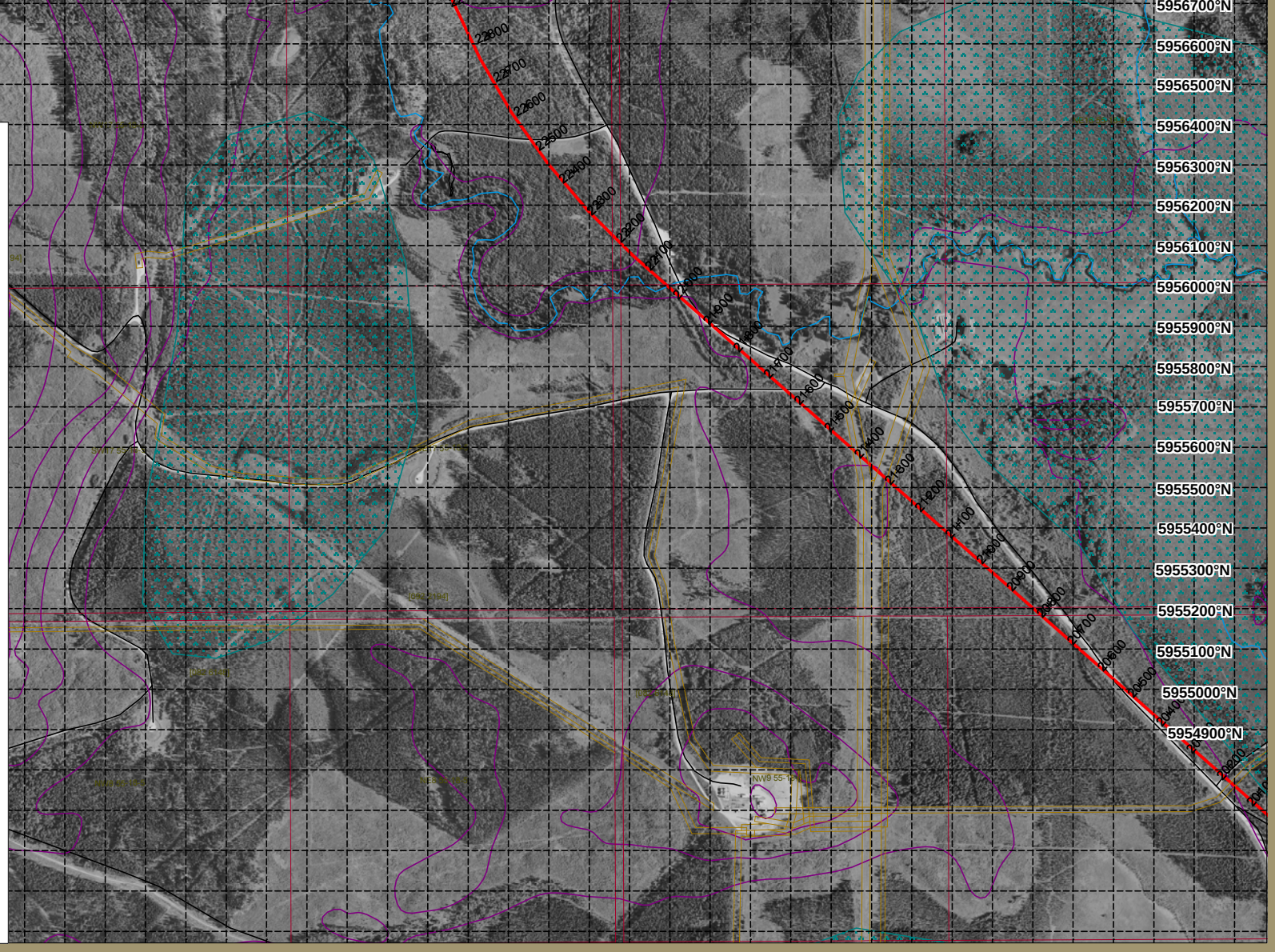
Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

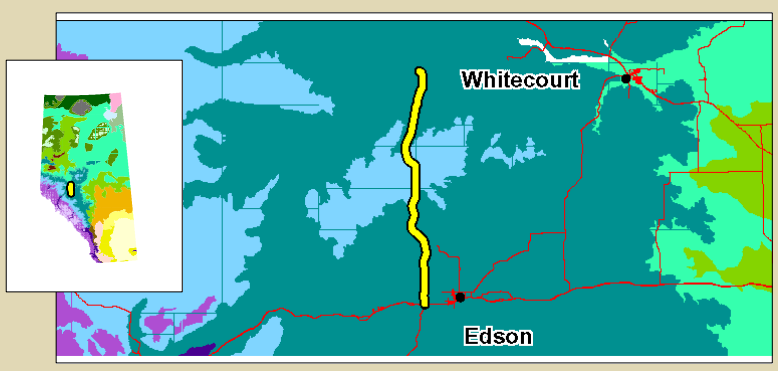
- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified





Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 7

150 0 150 300 450

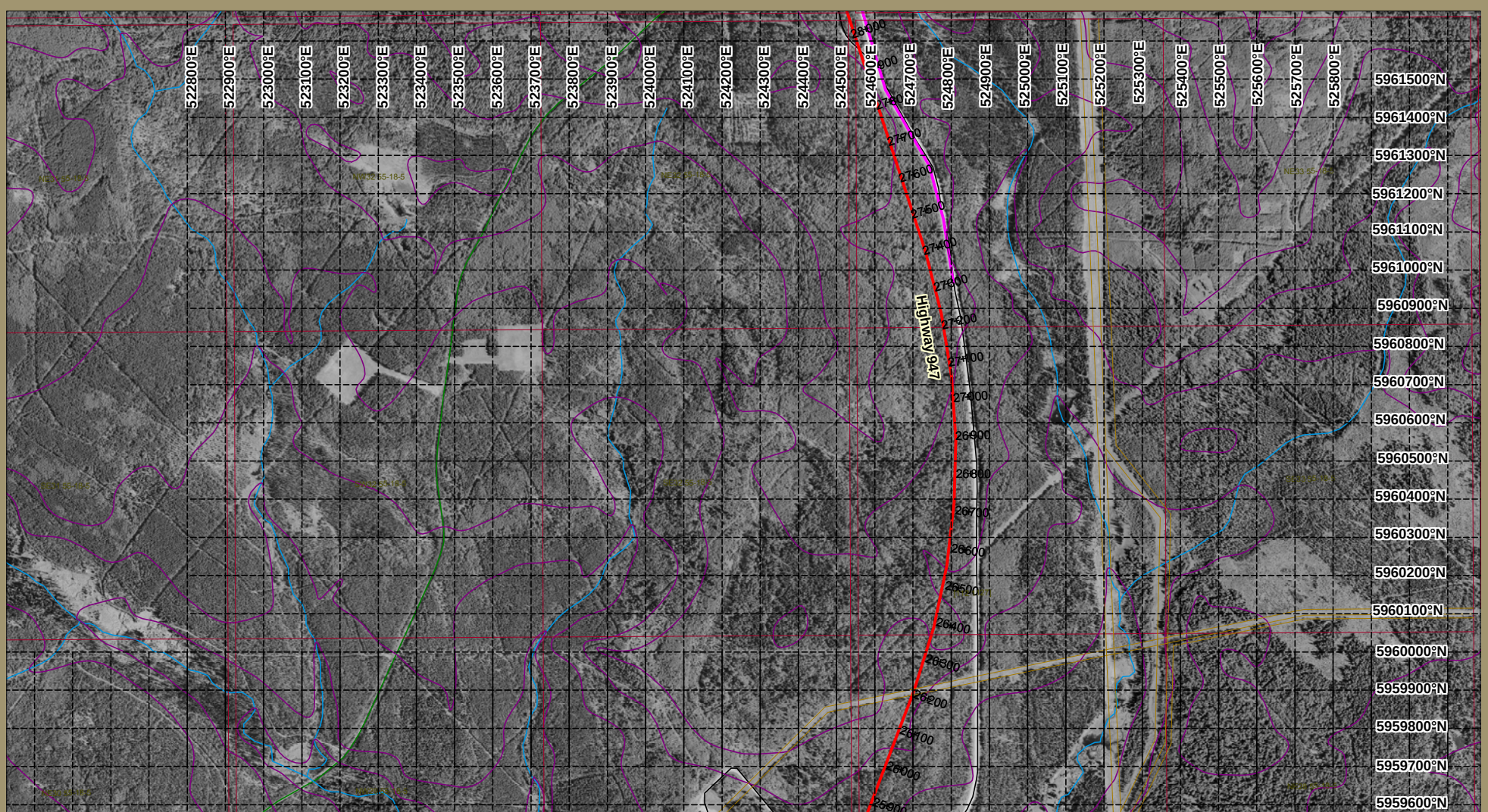
Meters

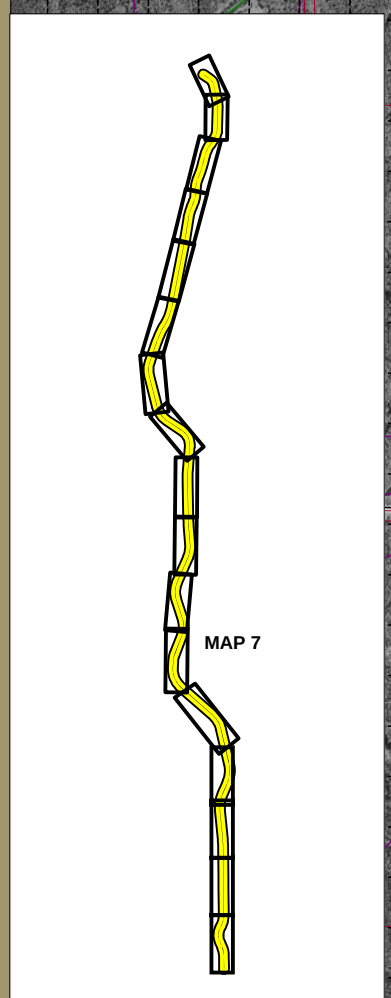
Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

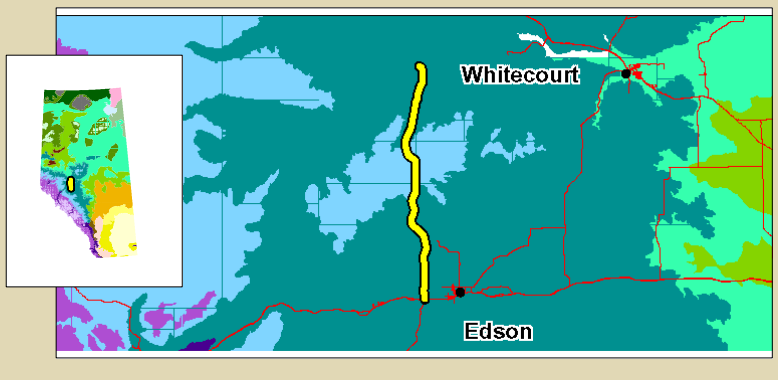
- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads





Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 8

150 0 150 300 450

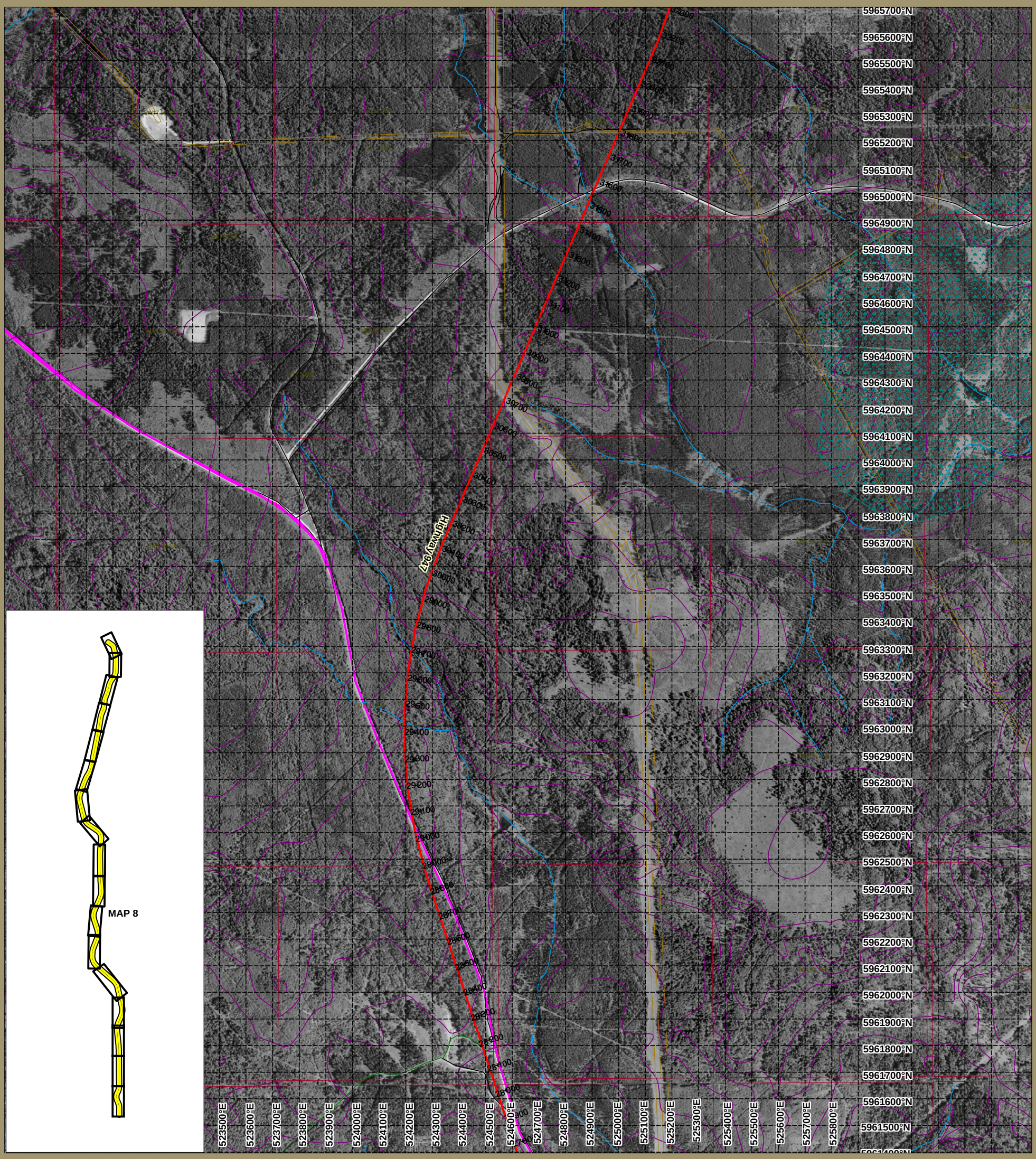
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

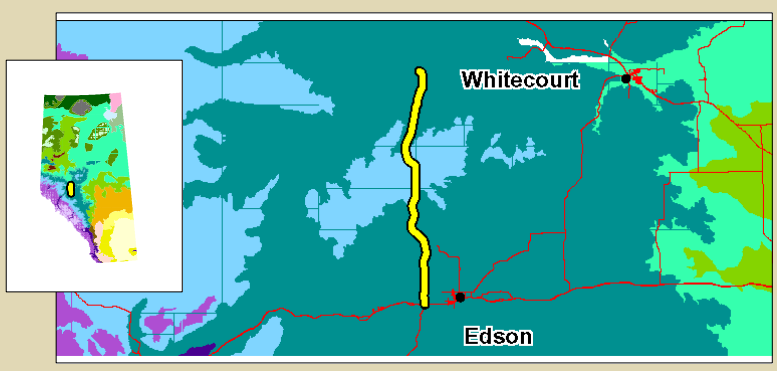
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 9

150 0 150 300 450

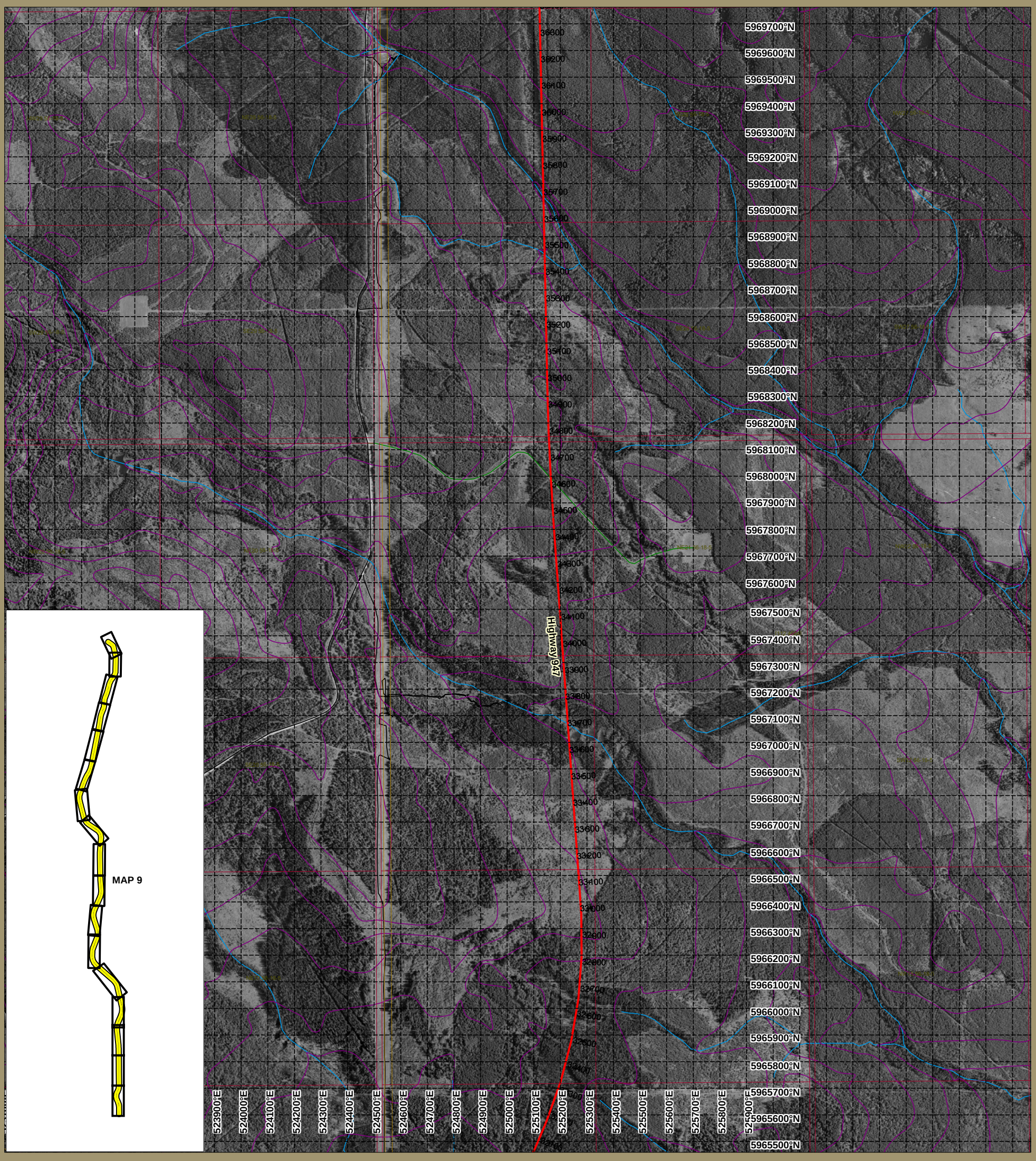
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

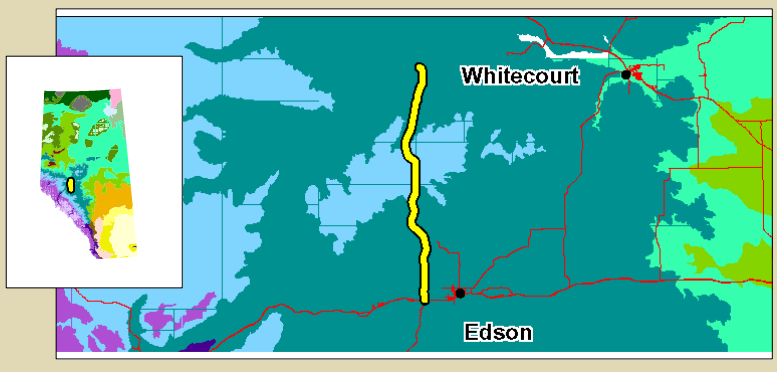
LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 10

150 0 150 300 450

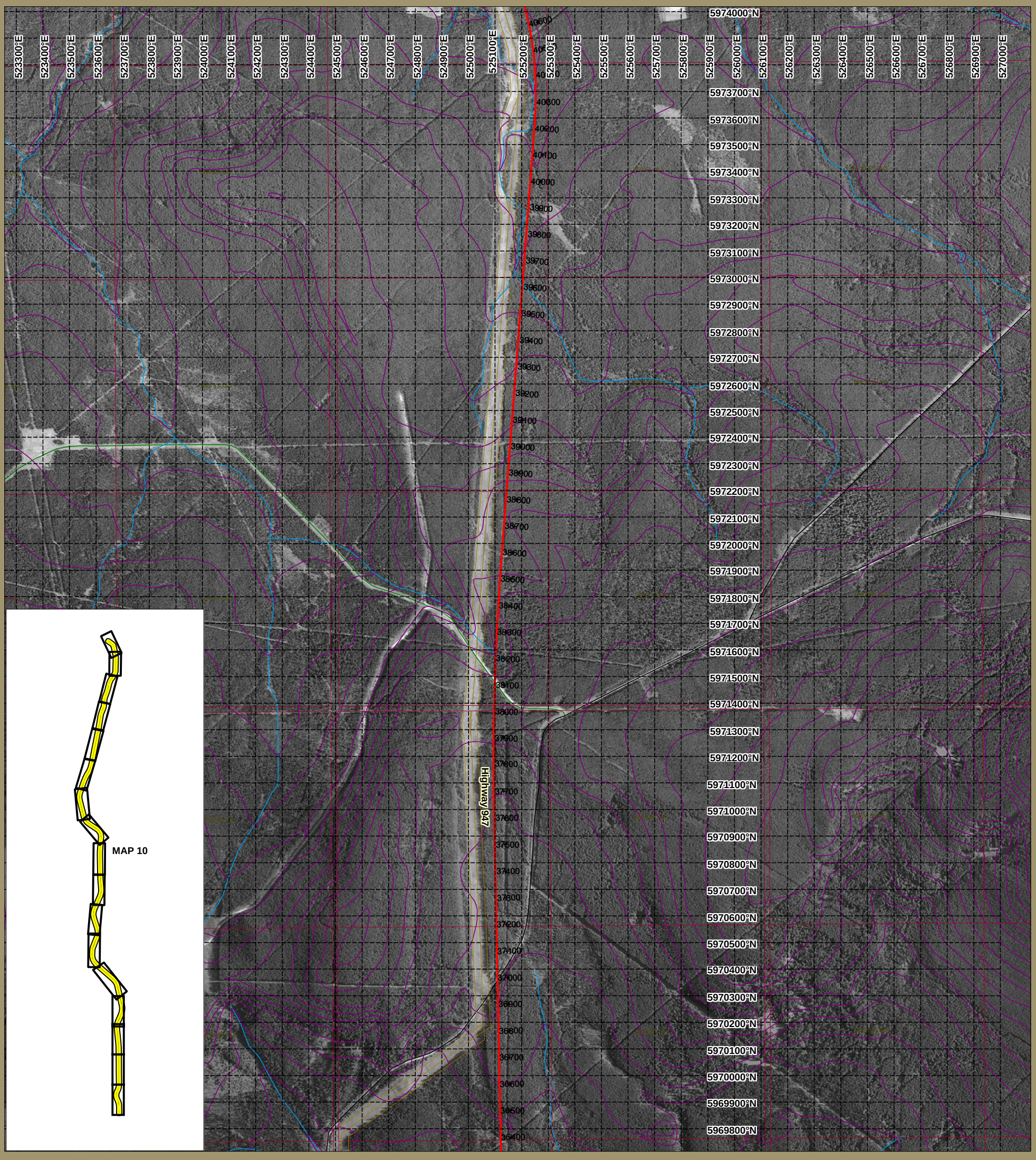
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

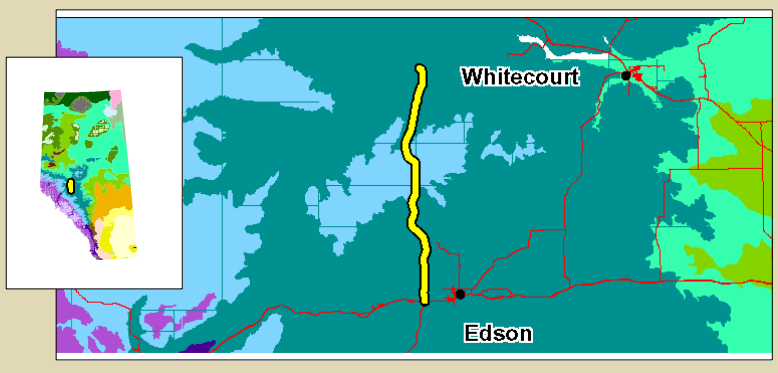
LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 11

150 0 150 300 450

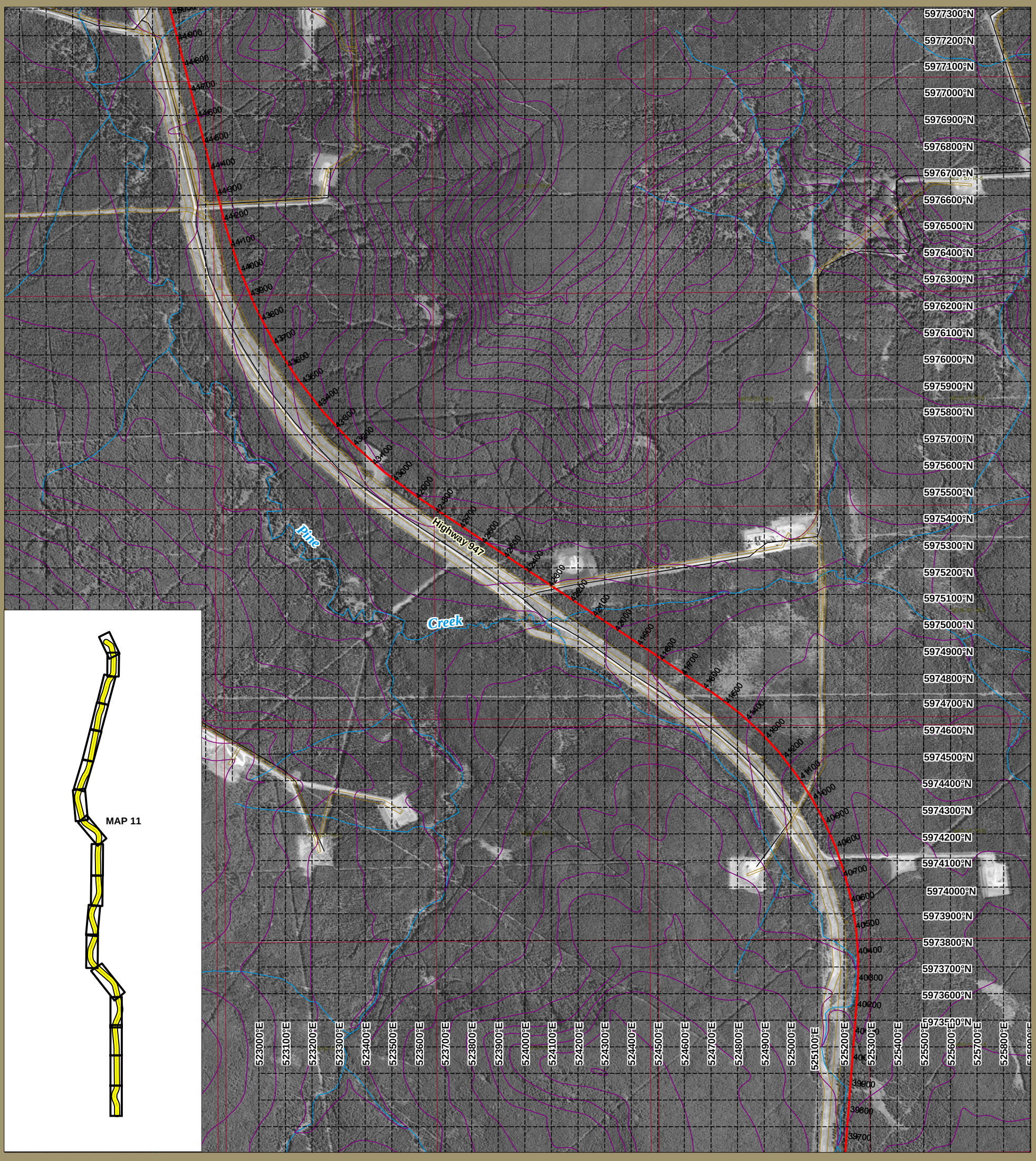
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

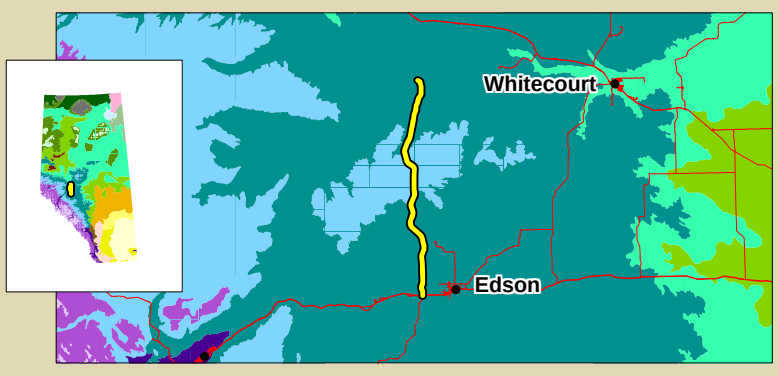
LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 12

150 0 150 300 450

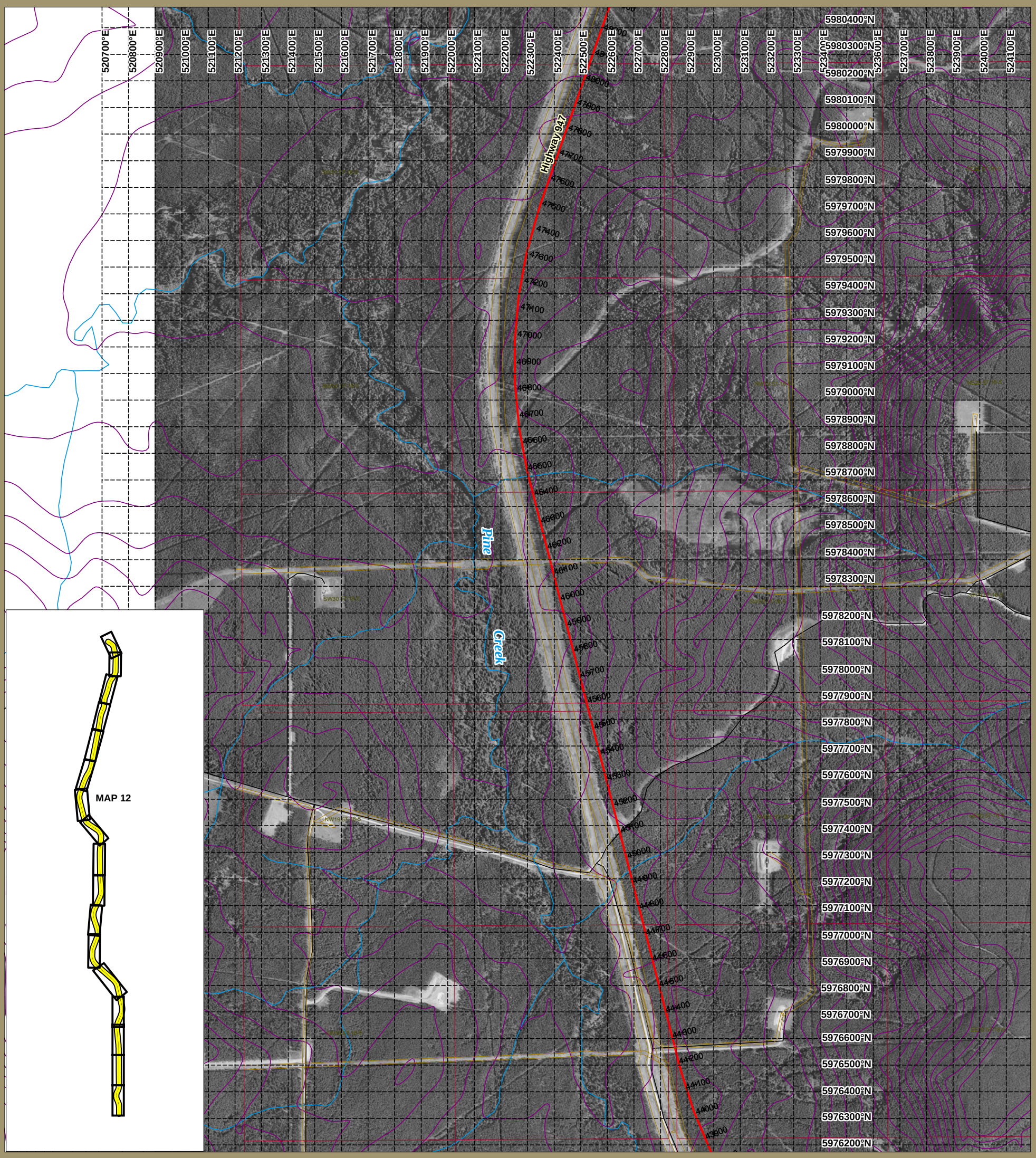
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

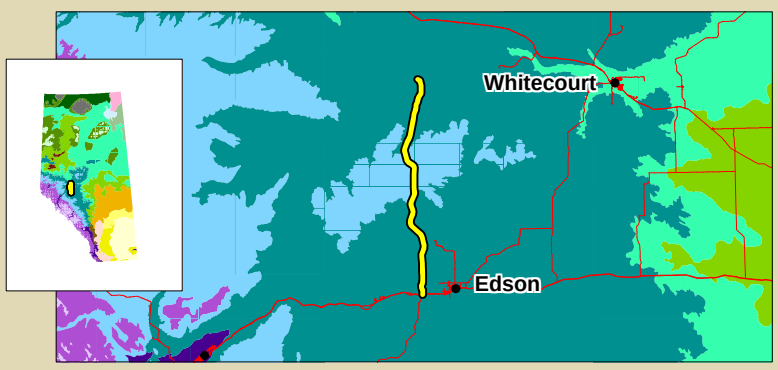
LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 13

150 0 150 300 450

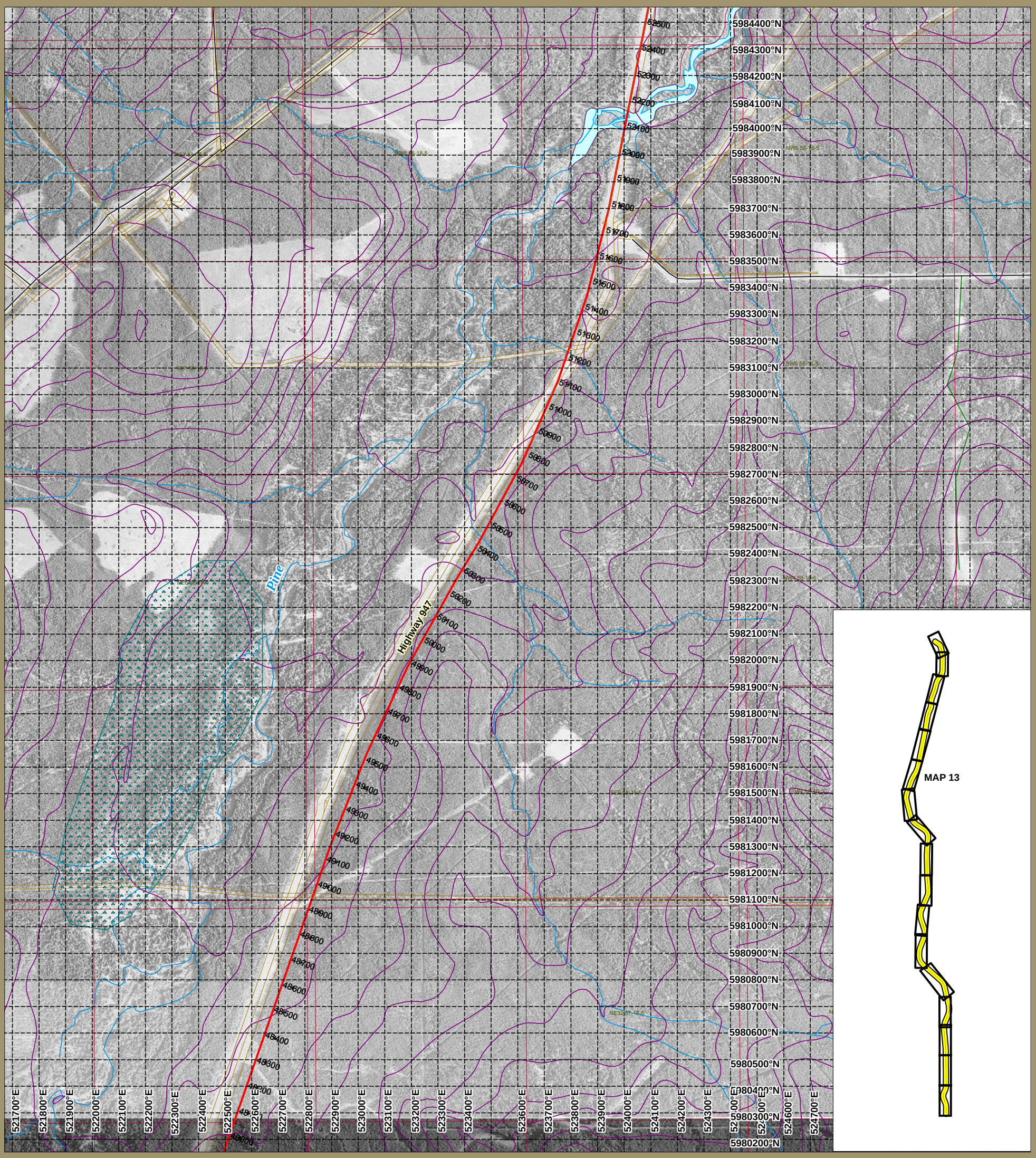
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Waterbodies
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills

ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 14

150 0 150 300 450

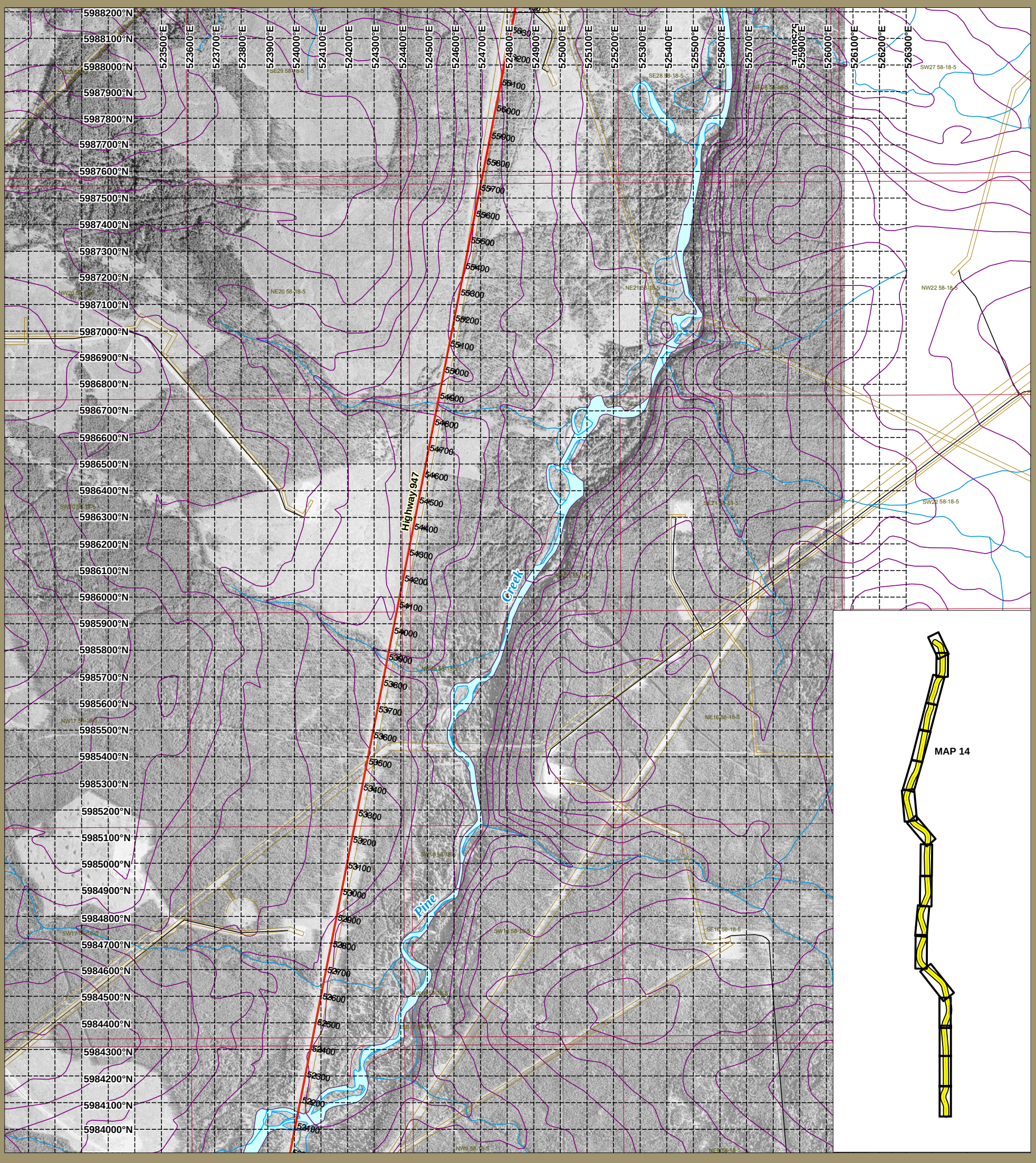
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

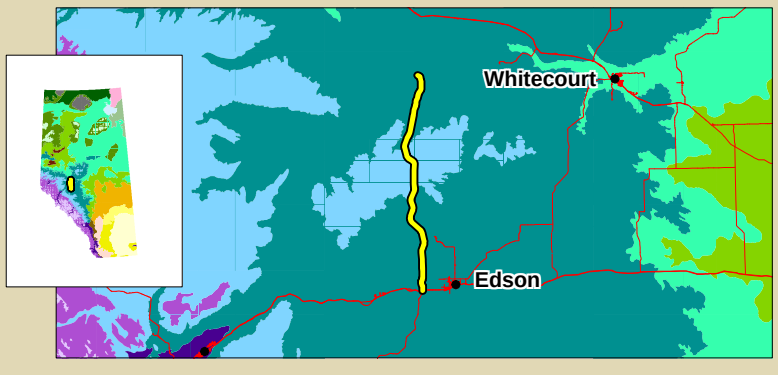
LEGEND

- Proposed Highway 947 Alignment
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Waterbodies
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 15

150 0 150 300 450

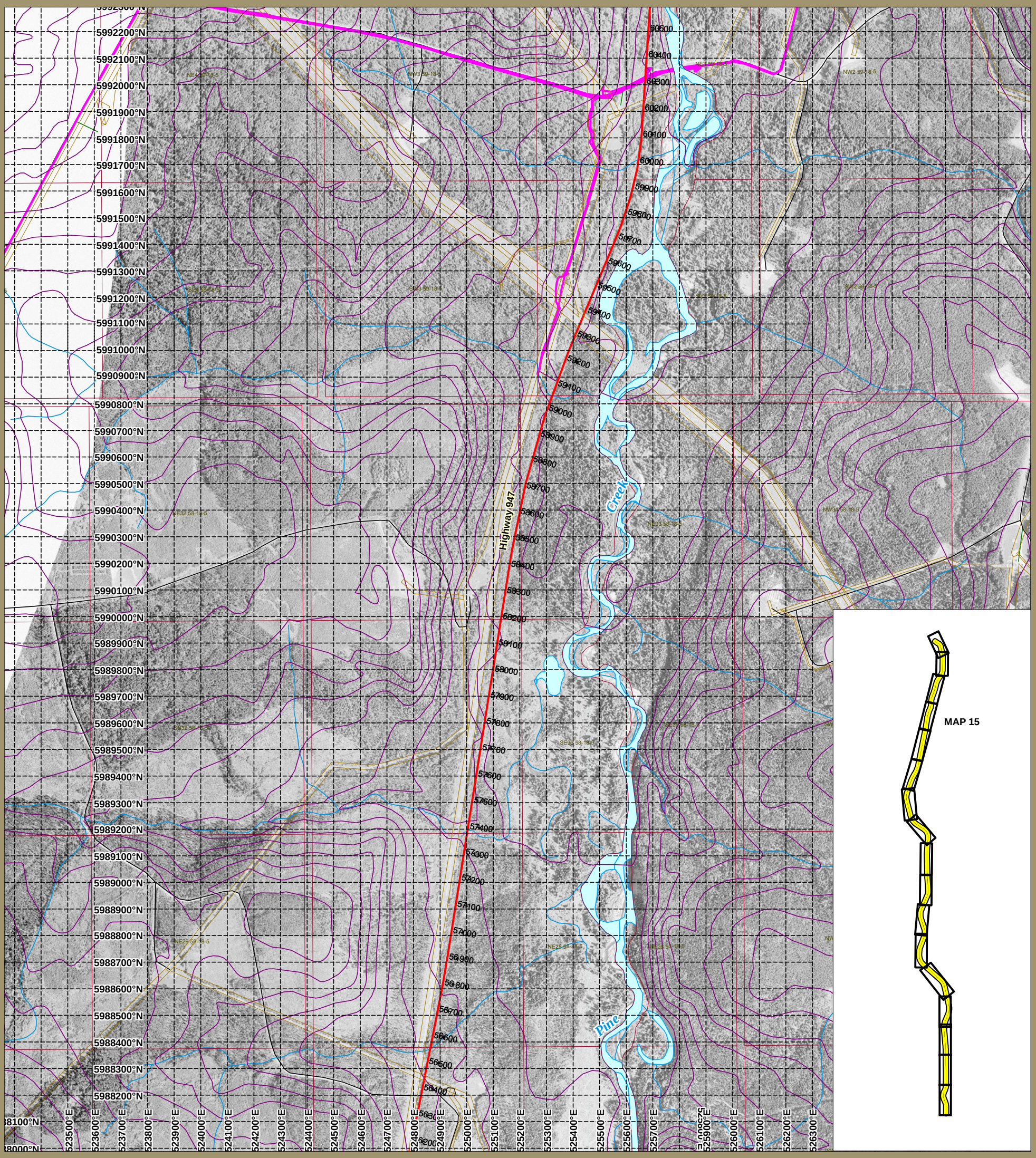
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

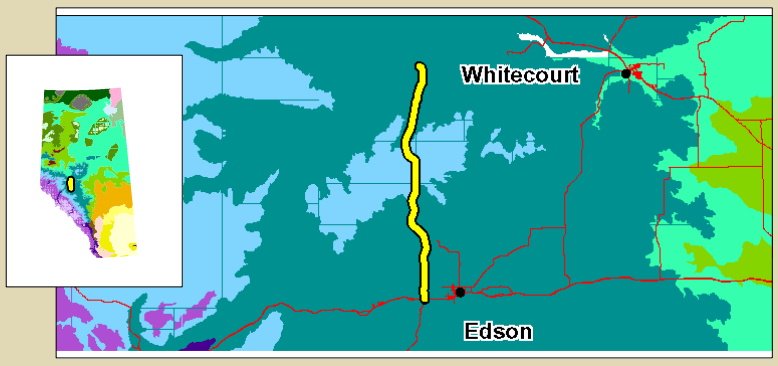
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Waterbodies
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 16

150 0 150 300 450

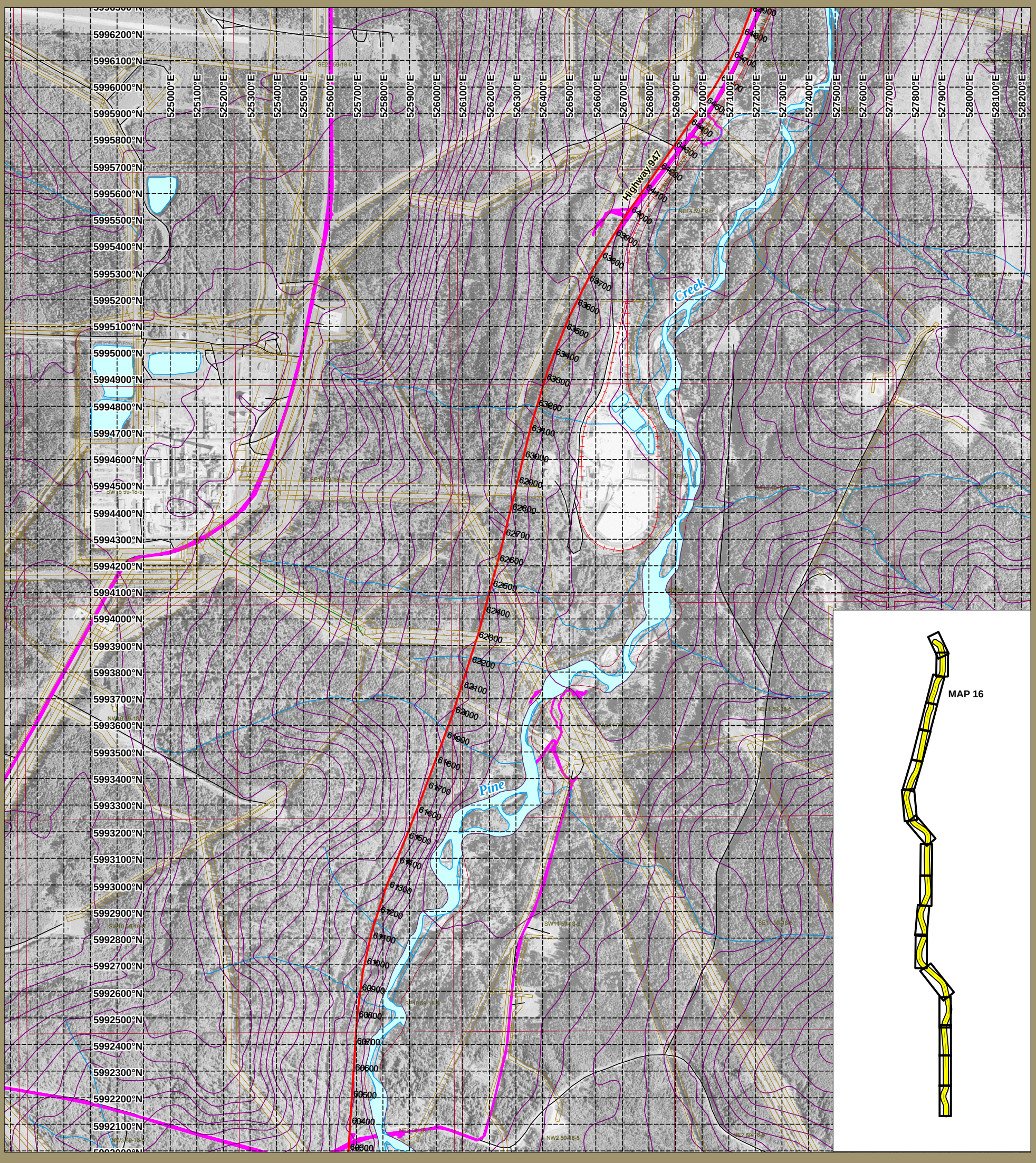
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

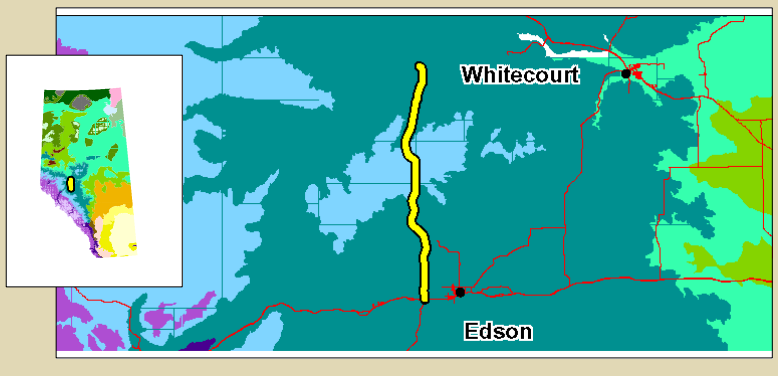
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Railway
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Waterbodies
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 17

150 0 150 300 450

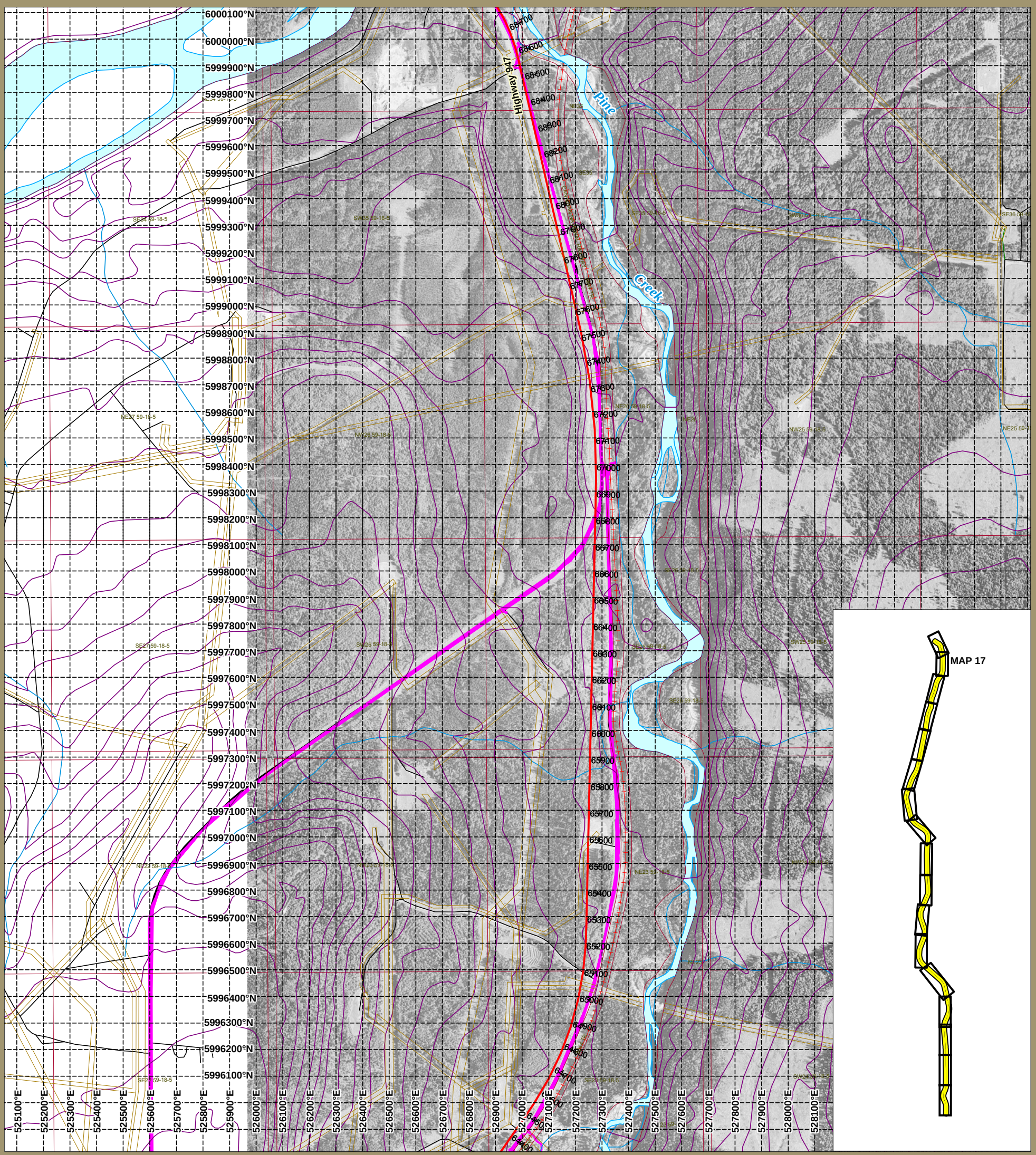
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

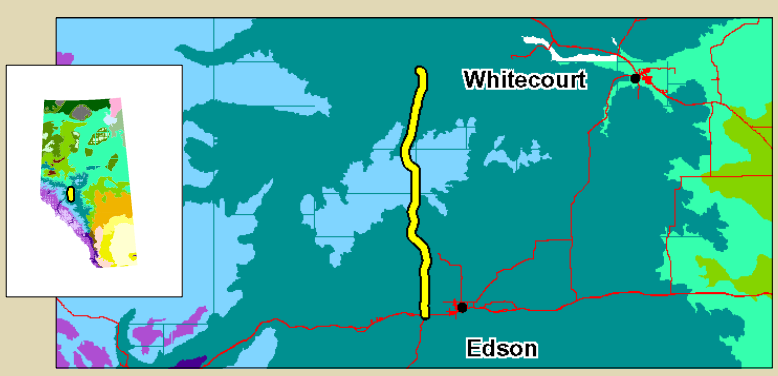
LEGEND

- Proposed Highway 947 Alignment
- Updated Access Roads
- Contours
- Legal Sections
- Railway
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Waterbodies
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947-MAP 18

150 0 150 300 450

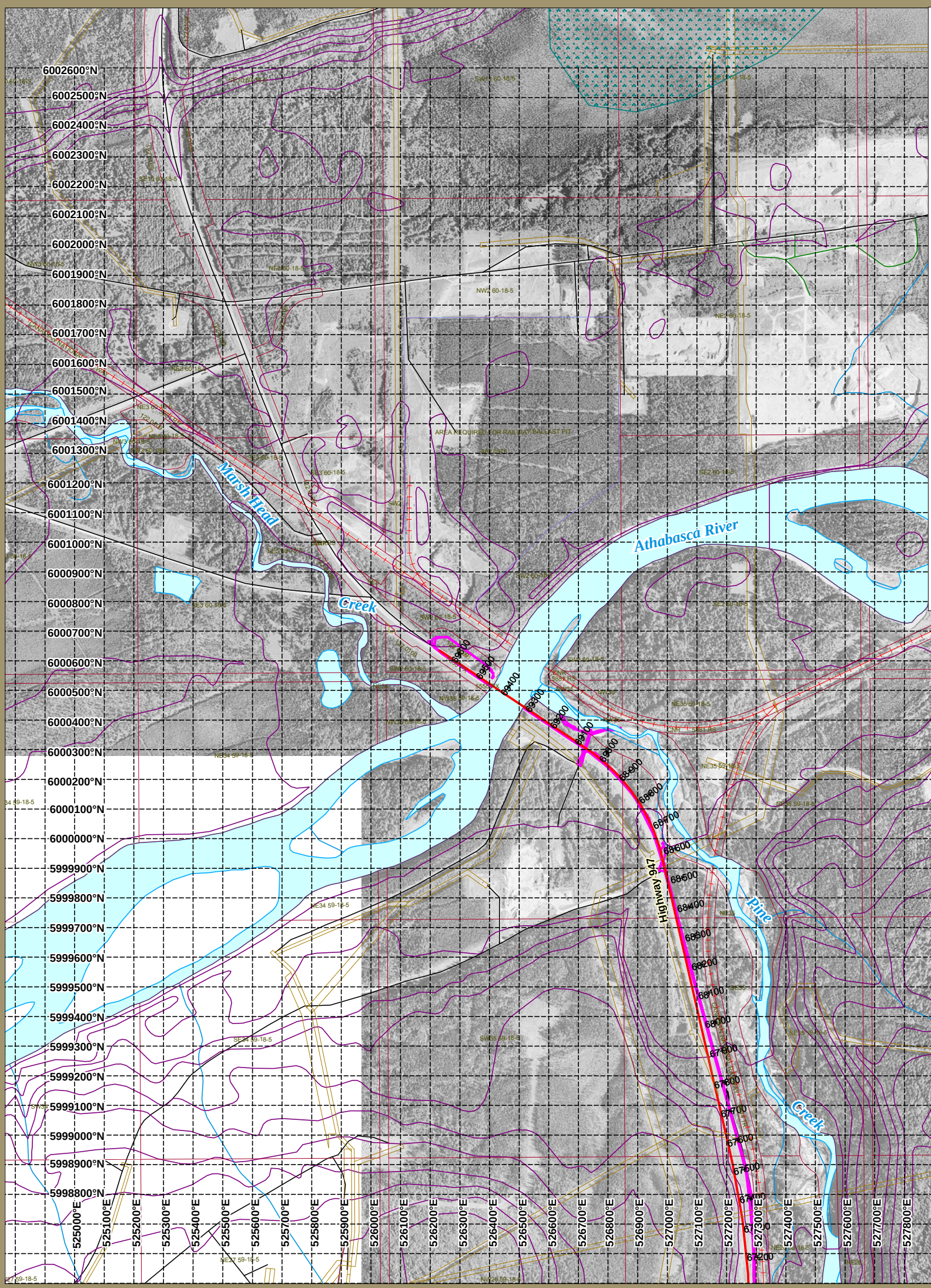
Meters

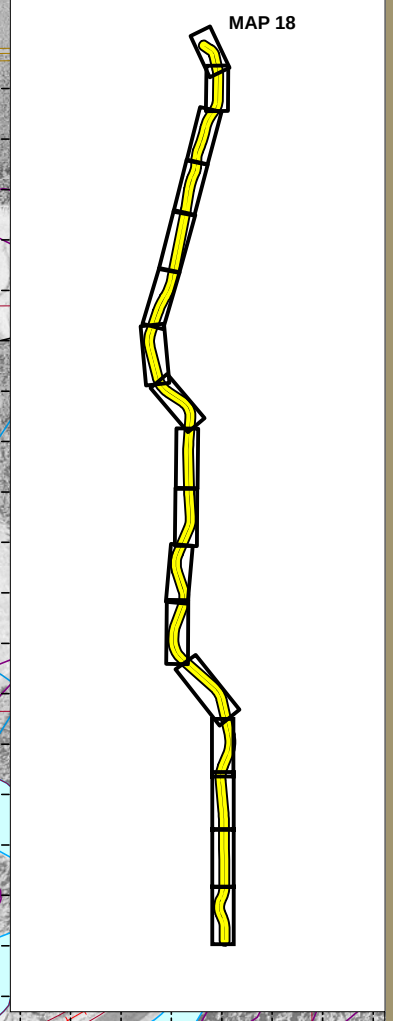
Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

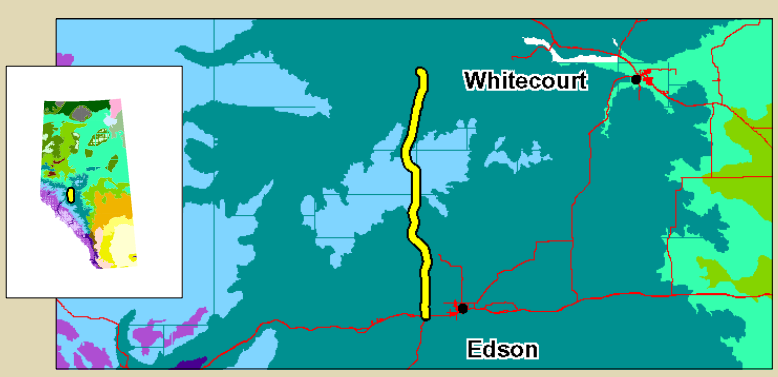
- Proposed Highway 947 Alignment
- Updated Access Roads
- Railway
- Contours
- Legal Sections
- Legal Lot Lines
- Utility Right of Ways - Gas/ Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Wetlands
- Waterbodies
- Streams
- AT Roads
- Roads - Gravel/ Unimproved/Unclassified
- Winter Roads





Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

Appendix 2. Photographs of SensitiveWork Areas of the Project

Photograph legends are formed of "KM:" = kilometers north of Highway 16; "Site" = the site number shown on the maps in Appendix 8 (wetlands) and Appendix 15 (streams); "BF" = the "Bridge File" number assigned to a stream crossing site by Alberta Transportation (not always available); and whether "fish" are known to use the stream, or "fish not recorded".

KM: 2.380 Site s0101 & WET-001 BF 85229 (fish) (Linked Basin Water)

KM: 2.380 Lake upstream of Site s0101

KM: 2.600 Site WET-003 (Isolated Basin Marsh)

KM: 2.800 Site WET-004 (Horizontal Fen)

KM: 7.000 Site WET-005 (Flat Bog)

KM: 7.200 Site s0201 (fish)

KM: 7.600 Site WET-007 (Flat Bog)

KM: 8.000 Site WET-008 (Flat Bog)

KM: 8.400 Site WET-009 (Horizontal Fen)

KM: 8.900 Site WET-010 (Basin Fen)

KM: 9.800 Site WET-013 (Linked Basin Marsh)

KM: 13.300 Site WET-014 (Basin Fen)

KM: 14.200 Site WET-011 (Riparian Stream Marsh)

KM: 14.600 Site WET012 (Isolated Basin Marsh)

KM: 16.310 Site s0501 BF 85217 Edson River (fish)

KM: 17.300 Site s0502 (fish). Right bank.

KM: 20.800 Site WET-016 (Horizontal Fen)

KM: 21.700 Site WET-018 (Basin Swamp)

KM: 22.000 Site s0601 BF 85231 (fish). Existing resource road crossing structure.

KM: 24.800 Site s0702 BF 85232 (fish).

KM: 24.850 Site s0701 (fish). Culvert plunge pool

KM: 29.800 Site s0802 BF 85233 (no fish recorded)

KM: 31.500 Site WET-018 (Riverine Swamp)

KM: 31.510 Site s0803 BF 85234 (fish). Pond area.

KM: 32.600 Site MP10W3 (Linked Basin Marsh)

KM: 33.600 Site MP10W4 (Riparian Stream Marsh)

KM: 37.000 Site MP10W5 (Riverine Swamp)

KM: 39.500 Site MP10W6 (Riparian Stream Marsh)

KM: 39.900 Site MP10W5 (Flat Bog)

KM: 40.150 Site s1104 (no fish recorded)

KM: 40.200 Site MP09W1 (Riparian Stream Marsh)

KM: 40.400 Site MP09W1 (Riparian Stream Marsh)

KM: 40.400 Site s1103 (no fish recorded)

KM: 40.510 Site s1102 (no fish recorded)

KM: 40.600 Site MP09W2 (Riparian Stream Marsh)

KM: 41.100 Site MP11W1 (Horizontal Fen)

KM: 41.500 Site MP11W2 (Blanket Bog)

KM: 42.100 Site s1101 BF 85237 (fish)

KM: 44.875 Site s1106 BF 85238 (fish)

KM: 45.830 Site s1201 (no fish recorded). Culvert under existing resource road.

KM: 46.410 Site s1203 (no fish recorded)

KM: 50.500 Site s1304 BF 85239 (fish)

KM: 51.250 Site s1305 (no fish recorded)

KM: 52.100 Site s1306/1307 BF 77858 Pine Creek (fish). Upstream view of crossing site.

KM: 52.500 Site MP14W1 (Basin Swamp)

KM: 52.650 Site s1402 BF 85240 (fish)

KM: 52.900 Site MP14W2 (Basin Bog)

KM: 53.500 Site MP14W3 (Discharge Basin Marsh)

KM: 53.860 Site s1403 (fish)

KM: 53.900 Site MP14W4 (Isolated Basin Marsh)

KM: 54.200 Site MP14W5 (Horizontal Fen)

KM: 54.700 Site MP14W6 (Horizontal Fen)

KM: 54.830 Site s1401 (no fish recorded)

KM: 55.300 Site MP14W7 (Isolated Basin Marsh in power transmission line and pipeline right of way)

KM: 56.580 Site s1503 (no fish recorded)

KM: 55.600 Site MP14W8 (Isolated Basin Marsh)

KM: 57.400 Site s1502 BF 85241 (fish)

KM: 57.600 Site MP15W1 (Riparian Stream Marsh)

KM: 57.700 Site s1501 (no fish recorded)

KM: 59.100 Site s1504 BF 85242 (fish)

KM: 59.200 Site MP15W2 (Horizontal Fen)

KM: 59.500 Site MP15W3 (Spring Fen)

KM: 61.100 Site s1610 (no fish recorded)

KM: 61.820 Site s1605 (no fish recorded)

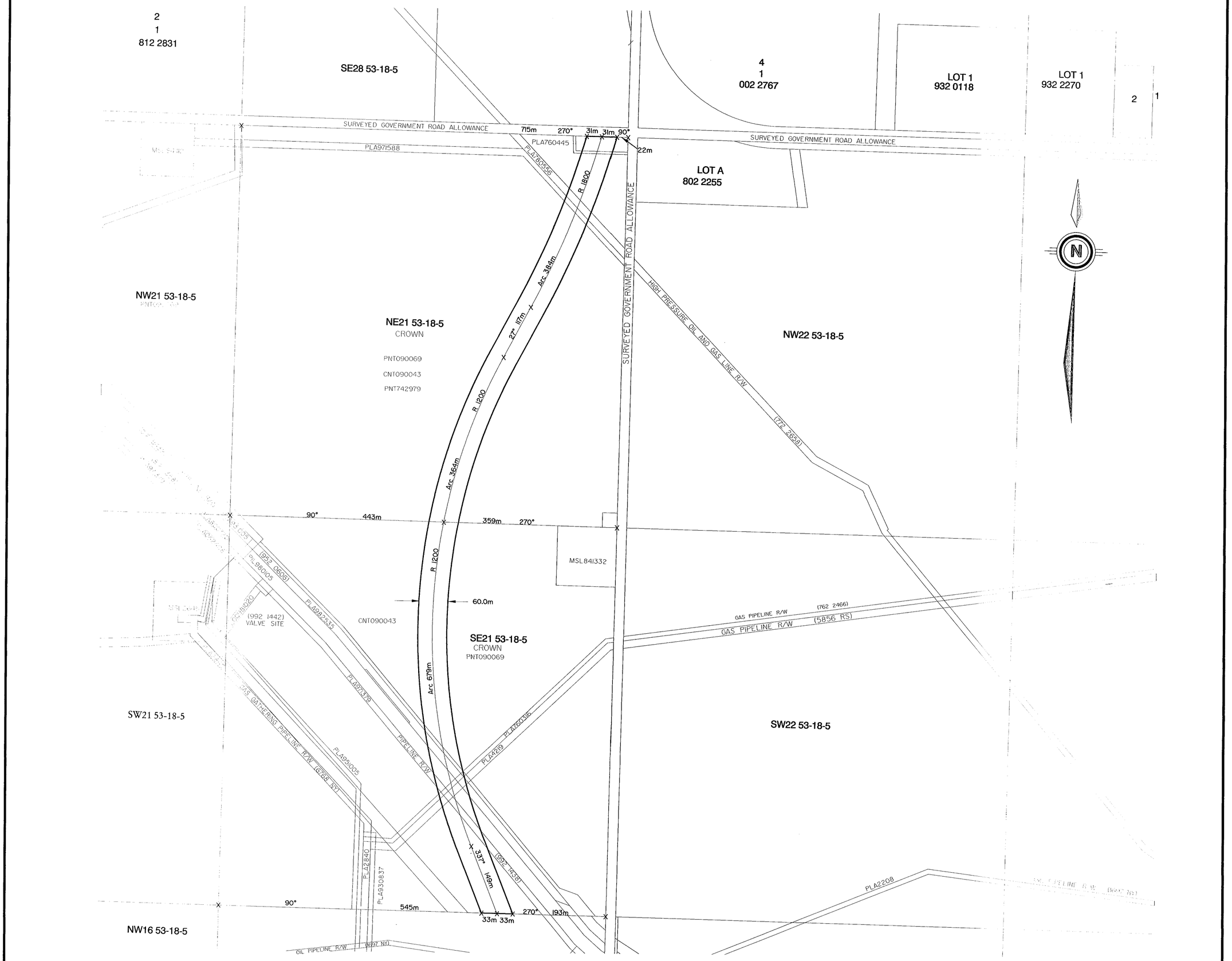
KM: 62.510 Site s1603 (no fish recorded)

KM: 63.770 Site s1607 (no fish recorded)

KM: 65.900 Site s1702 (no fish recorded)

KM: 69.000 Athabasca River BF76986 bridge (fish)

Appendix 3. Land Dispositions affected by the Project



Plan Showing

RIGHT OF WAY REQUIRED WITHIN:

SE21 & NE21
Twp 53 Rge 18 W5 M

AREA REQUIRED WITHIN:

SE21	5.0 ha	12.4Ac.
NE21	5.2 ha	12.8Ac.
TOTAL AREA:	10.2 ha	25.2Ac.

SKETCH PLAN

DISTANCES IN METRES AND DIRECTIONS ARE SHOWN AS AZIMUTHS

Plan Showing
RIGHT-OF-WAY REQUIRED FOR HWY 947

Scale 1:5000

Date JULY 29,2011

SHEET 1 of 1

PORTIONS REFERRED TO SHOWN AS ———

Remarks: PROPOSED RIGHT-OF-WAY LOCATED FROM 1:20000 PARCEL MAPS

Job No. EP11-0001

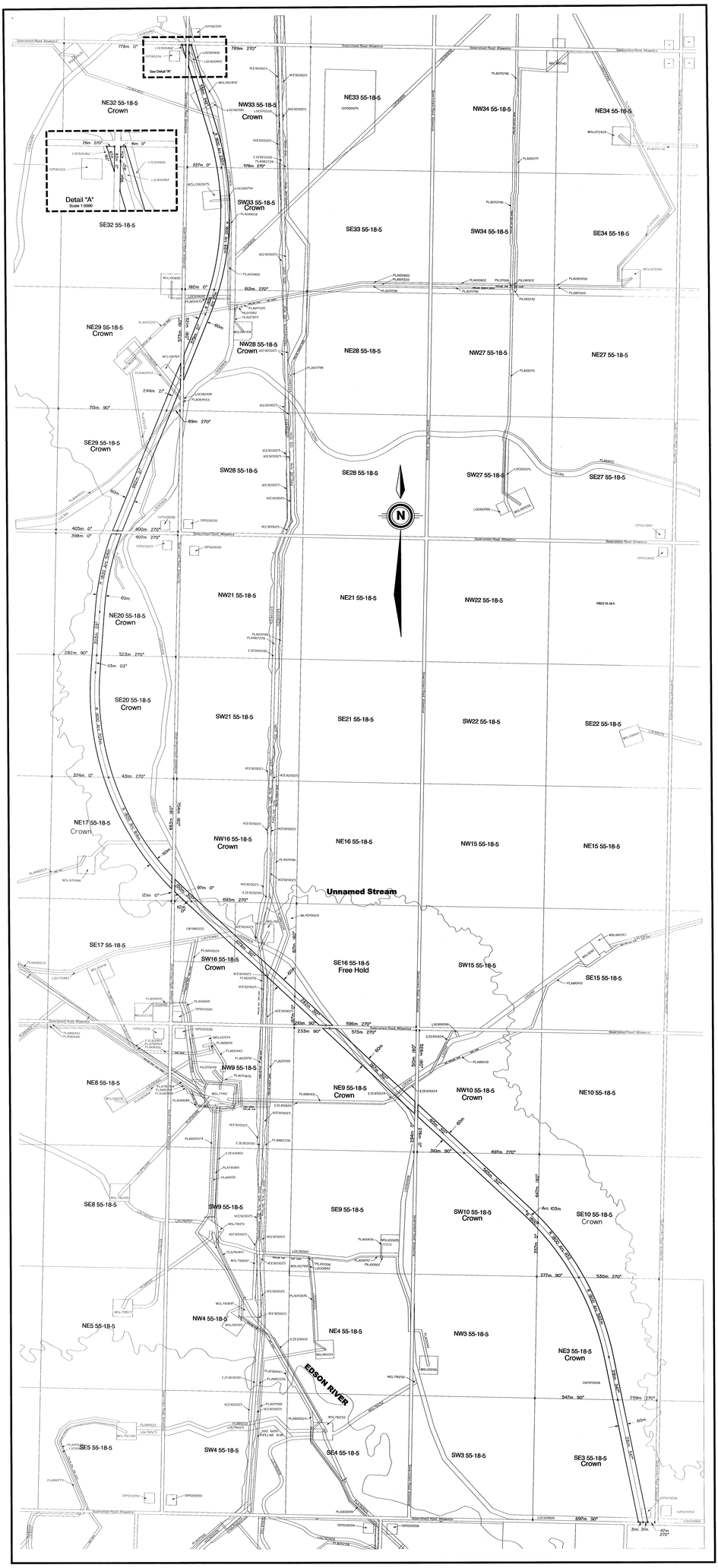
PLAN PREPARED BY : OS

Land Titles Survey Stamp

7863 RN
2011-10-17
RDS 110074
SKT 27

amec
Environment & Infrastructure

SW3 55-18-5
SE3 55-18-5 Crown
SW2 55-18-5
SPRUCEDALE
JOHNSONDALE
Grand Forks Road - Kilowatsu
Grand Forks Road - Kilowatsu
NW33 54-18-5
NE33 54-18-5
NW34 54-18-5 Crown
GRANDMEADOW
KILDONAN RIVER
SW33 54-18-5
SE33 54-18-5 Crown
GRANDMEADOW
SW34 54-18-5 Crown
NW28 54-18-5
NE28 54-18-5 Crown
NW27 54-18-5 Crown
SW27 54-18-5 Crown
SE28 54-18-5
NE21 54-18-5 Crown
NW22 54-18-5 Crown
SE21 54-18-5 Crown
SW22 54-18-5 Crown
NE16 54-18-5 Crown
NW15 54-18-5
SE16 54-18-5
SW15 54-18-5 Crown
NE9 54-18-5
NW10 54-18-5
NW9 54-18-5
NE10 54-18-5
SE9 54-18-5 Crown
SW10 54-18-5 Crown
NE4 54-18-5 Crown
NW3 54-18-5
SE4 54-18-5 Crown
SW3 54-18-5 Crown
NE33 53-18-5
NW34 53-18-5
LOT 1
942 4095
1
2
1
1
102 4802
102 8480
102 1288
103
PLAN 79
PLAN 942 4095
PLAN 102 4802
PLAN 102 8480
PLAN 102 1288
PLAN 103
PLAN 942 4095
PLAN 79



AREA REQUIRED WITHIN:

QUARTER SECTION	AREA (ha)
NE3 55-18-5	5.12
SE3 55-18-5	4.95
NE9 55-18-5	4.60
SW10 55-18-5	4.01
SE10 55-18-5	2.72
NW10 55-18-5	2.49
SE16 55-18-5	1.69
SW16 55-18-5	5.57
NW16 55-18-5	0.91
NE17 55-18-5	4.89
SE20 55-18-5	4.89
NE20 55-18-5	4.90
SE29 55-18-5	5.17
NE29 55-18-5	1.49
NW28 55-18-5	3.33
SW33 55-18-5	4.87
NW33 55-18-5	4.70
NE32 55-18-5	0.11
TOTAL AREA:	66.41 ha

Plan Showing

RIGHT OF WAY REQUIRED WITHIN:

SE3, NE3, NE9, NW10, SE10, SW10, SE16, SW16, NW16
NE17, SE20, NE20, SE29, NE29, NW28, SW33, NW33, NE32

in TWP55 R 18 W5

SKETCH PLAN

DISTANCES IN METRES AND DIRECTIONS ARE SHOWN AS AZIMUTHS

Plan Showing

RIGHT-OF-WAY REQUIRED FOR HWY 947

PORTIONS REFERRED TO SHOWN AS

Scale 1:20000

Date AUGUST 03,2018

SHEET 1 of 1

Remarks

PROPOSED RIGHT-OF-WAY LOCATED FROM 1:20000 PARCEL MAPS

Job No. EPN-0001

PLAN PREPARED BY : OS

Technical Services Stamp

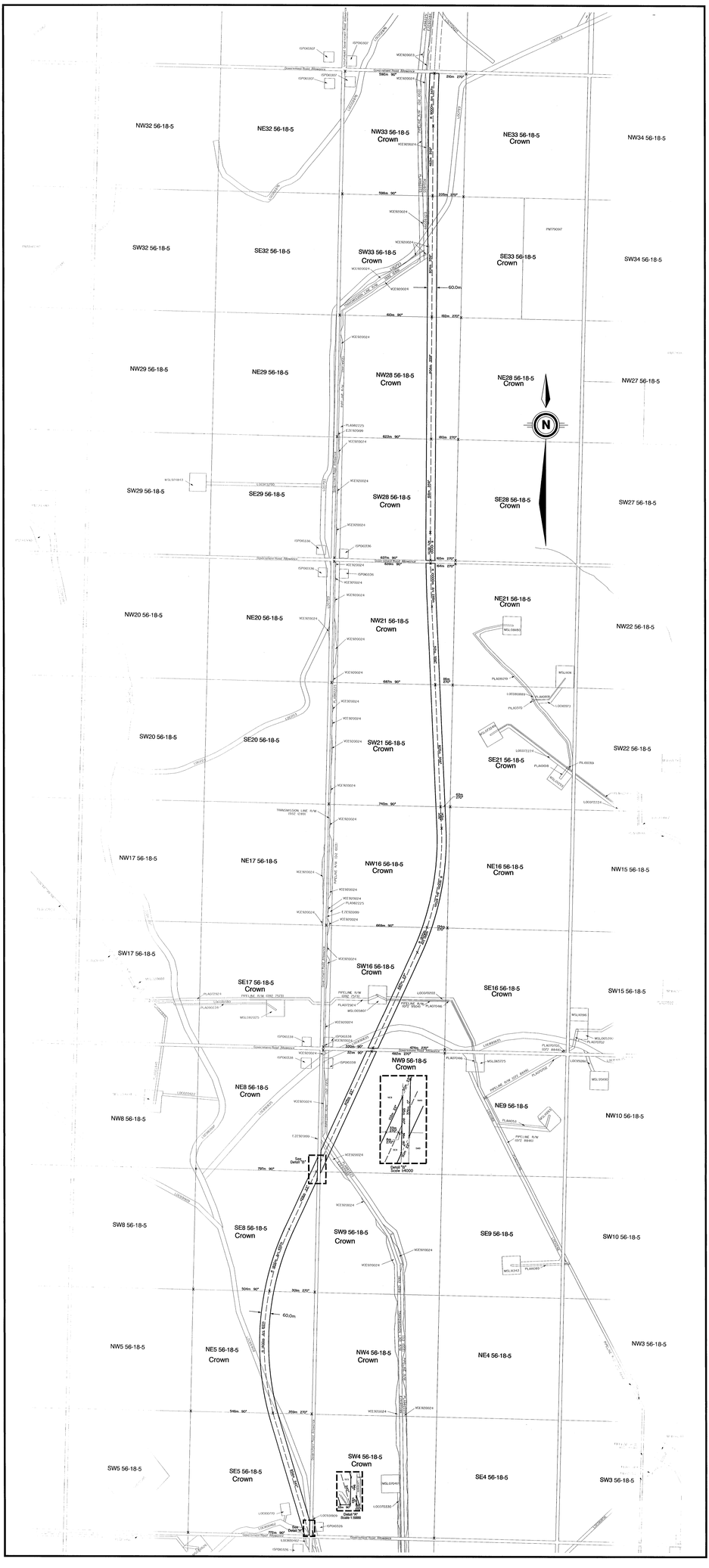
Type: TB61 RN

Version: 2011-10-14

File: RDS 110075

Revision Number: SKT 37

amec Environment & Infrastructure



AREA REQUIRED WITHIN:

QUARTER SECTION	AREA (ha)
SW4 56-18-5	0.01
SE5 56-18-5	4.92
NE5 56-18-5	4.87
SE8 56-18-5	5.08
SW9 56-18-5	0.002
NE8 56-18-5	0.19
NW9 56-18-5	4.83
SW16 56-18-5	5.24
NW16 56-18-5	4.88
SW21 56-18-5	4.83
NW21 56-18-5	4.83
SW28 56-18-5	4.82
NW28 56-18-5	4.82
SW33 56-18-5	4.82
NW33 56-18-5	4.87

TOTAL AREA: 59.012 ha

Plan Showing

RIGHT OF WAY REQUIRED WITHIN:

SW4, SE5, NE5, SE8, SW9, NE8, NW9, SW16, NW16
SW21, NW21, SW28, NW28, SW33, NW33

in TWP56 R 18 W5

SKETCH PLAN

DISTANCES IN METRES AND DIRECTIONS ARE SHOWN AS AZIMUTHS

Plan Showing

RIGHT-OF-WAY REQUIRED FOR HWY 947

Scale 1:80000

Date SEPTEMBER 22,2011

SHEET 1 of 1

PORTIONS REFERRED TO SHOWN AS

Remarks: PROPOSED RIGHT-OF-WAY LOCATED FROM 1:20000 PARCEL MAPS NAD83 10tm COORDINATES

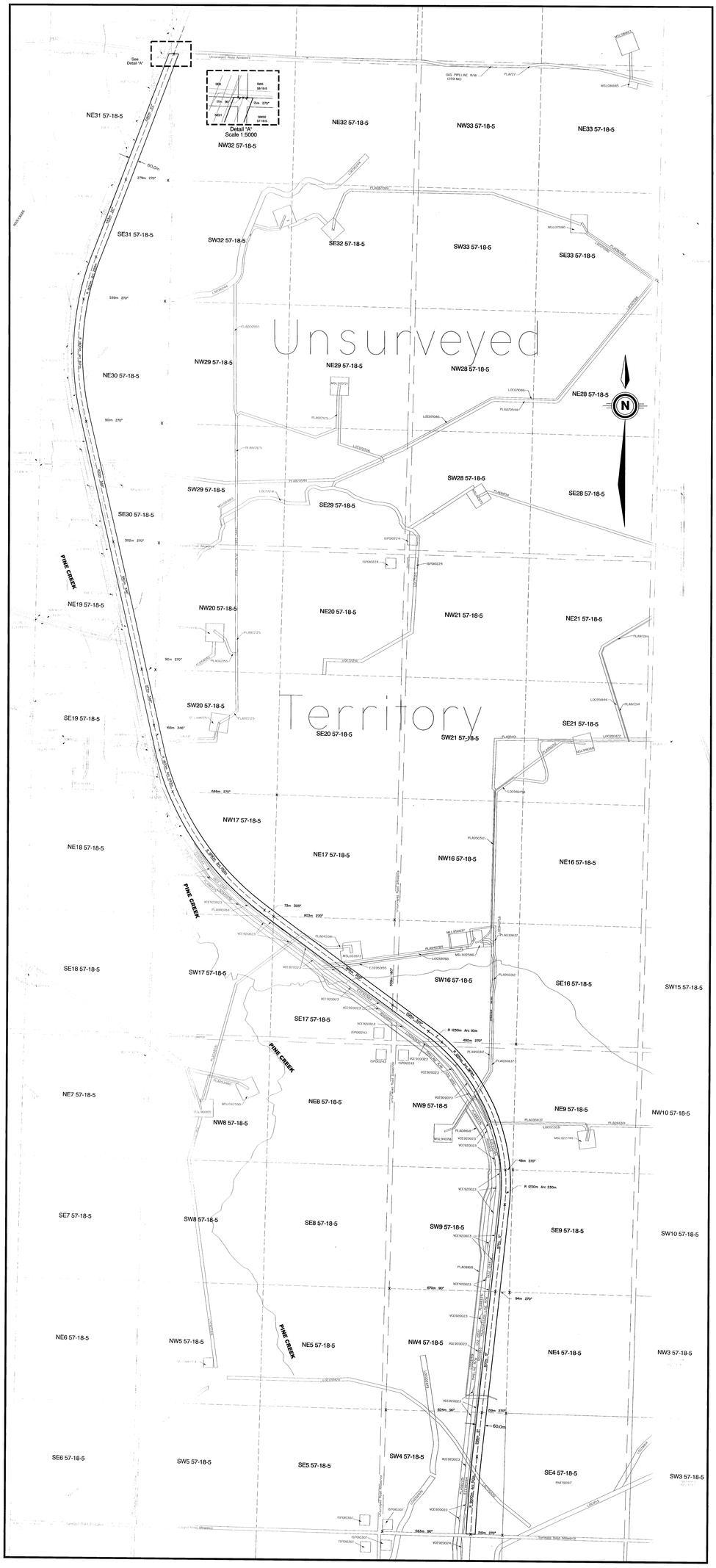
Job No. EPII-0001

PLAN PREPARED BY : OS

Technical Services Stamp

Plan: 7855 RN
Version: 2011 - 10 - 11
File: RDS 110070
Examined: SRT 27

amec Environment & Infrastructure



AREA REQUIRED: 65.43 ha.

Plan Showing

RIGHT OF WAY REQUIRED WITHIN:

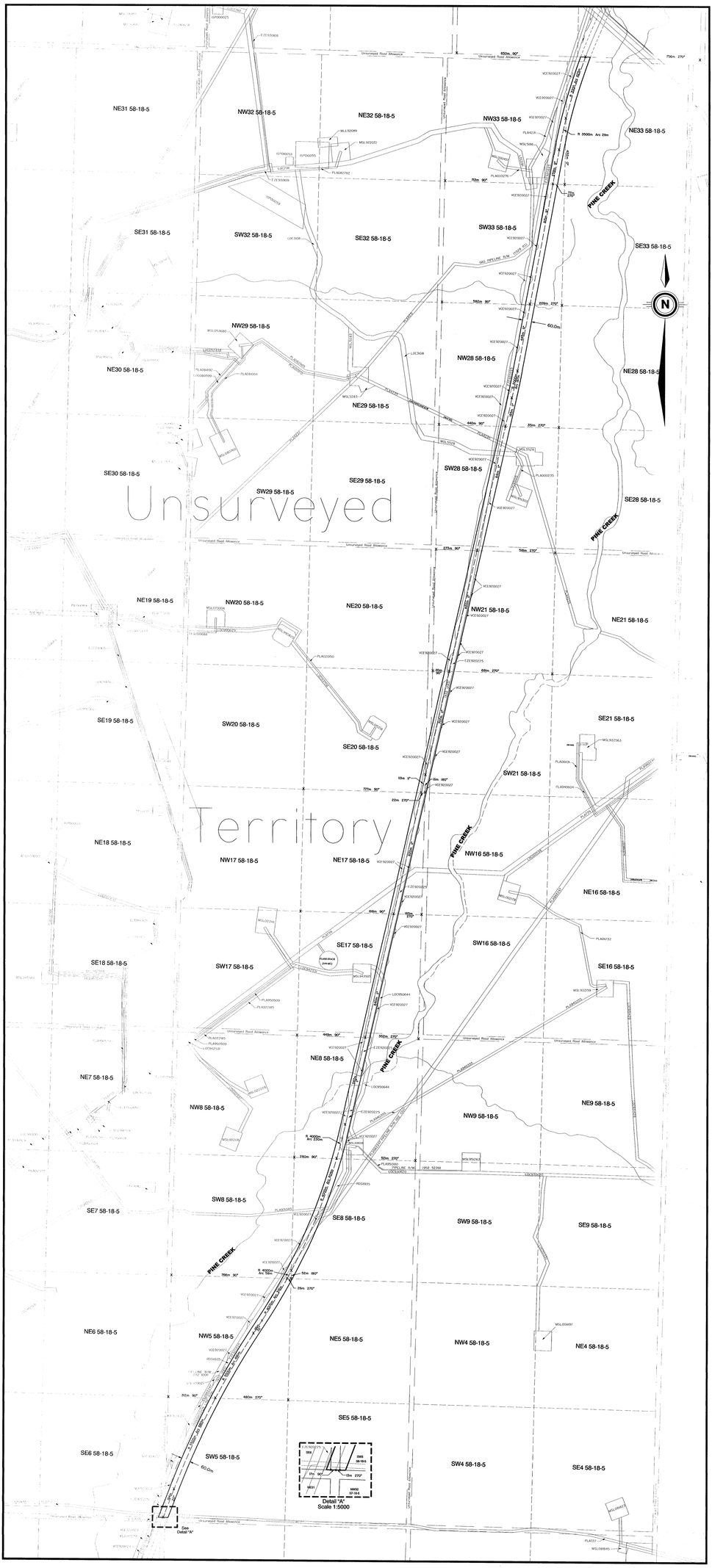
SW4, NW4, SW9, NW9, SW16, ALL 17, SE19, NE19, SW20
SE30, NE30, SE31, NE31, NW32

in TWP57 R 18 W5

SKETCH PLAN

DISTANCES IN METRES AND DIRECTIONS ARE SHOWN AS AZIMUTHS	Plan Showing: RIGHT-OF-WAY REQUIRED FOR HWY 947	Scale: 1:10000	Technical Services Stamp
		Date: SEPTEMBER 23,2011	Plan #: 78 57 RN
		SHEET 1 of 1	Version: 2011-10-12
	PORTIONS REFERRED TO SHOWN AS ———		File: RDS 110073
Remarks: PROPOSED RIGHT-OF-WAY LOCATED FROM 1:20000 PARCEL MAPS NAD83 10m COORDINATES			TECHNICAL EXAMINER: SKT 27
Job No. EPR-0001	PLAN PREPARED BY : OS		

amec
Environment & Infrastructure



AREA REQUIRED: 60.62 ha.

Plan Showing

RIGHT OF WAY REQUIRED WITHIN:

SW5, NW5, NE5, SE6, SW8, SE8, NE8, NW16, SE17, NE17
SE20, SW21, NW21, SW28, NW28, SW33, NW33, NE33

in TWP58 R 18 W5

SKETCH PLAN

DISTANCES IN METRES AND DIRECTIONS ARE SHOWN AS AZIMUTHS

Plan Showing
RIGHT-OF-WAY REQUIRED FOR HWY 947

Scale 1:10000
Date SEPTEMBER 26,2011
SHEET 1 of 1

PORTIONS REFERRED TO SHOWN AS

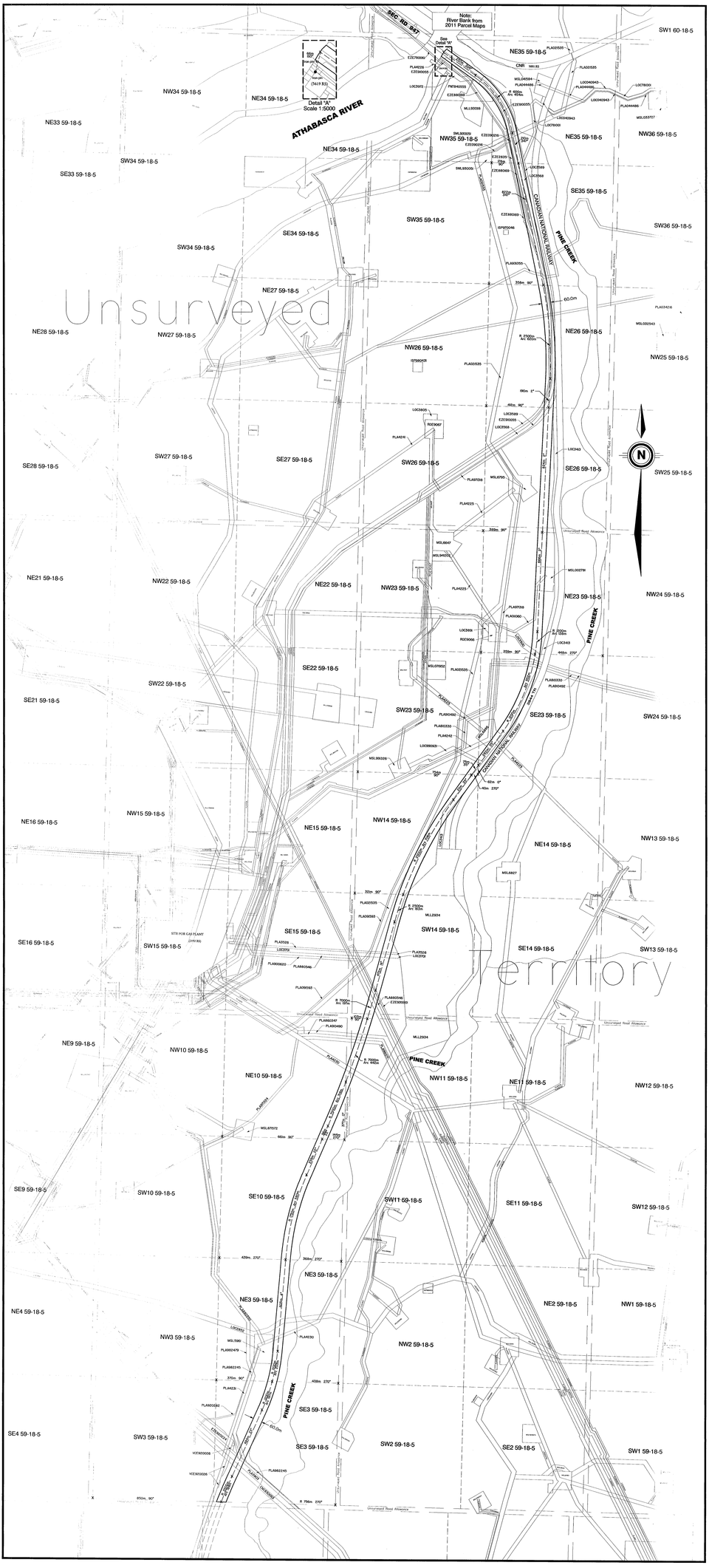
Remarks: PROPOSED RIGHT-OF-WAY LOCATED FROM 1:20000 PARCEL MAPS NAD83 10m COORDINATES

Job No. EP8-0001

PLAN PREPARED BY : OS

Technical Services Stamp
Plan #: 7854 RN
Version: 2011-10-24
File: RDS_110071
Technical Services SKT 27

amec
Environment & Infrastructure



AREA REQUIRED: 61.38 ha.

Plan Showing

RIGHT OF WAY REQUIRED WITHIN:

SE3, NE3, SE10, NE10, NW11, SW14, NW14, SW23, SE23
NE23, SE26, NE26, SE35, NE35, NW35

in TWP59 R 18 W5

SKETCH PLAN

DISTANCES IN METRES AND DIRECTIONS ARE SHOWN AS AZIMUTHS	Plan Showing: RIGHT-OF-WAY REQUIRED FOR HWY 947	Scale: 1:10000	Technical Services Stamp
		Date: SEPTEMBER 28,2011	Plan #: 7856 RN
		SHEET 1 of 1	Version: 2011-10-12
	PORTIONS REFERRED TO SHOWN AS		File: ROS 110072
Remarks: PROPOSED RIGHT-OF-WAY LOCATED FROM 1:20000 PARCEL MAPS NAD83 10tm COORDINATES			Technical Services: SKT JJ
Job No. EPII-0001	PLAN PREPARED BY : OS		

amec
Environment & Infrastructure

Appendix 4. Correspondance associated with the 2001 Alignment Update

2600-947-10-58

Alberta
AGRICULTURE, FOOD AND RURAL DEVELOPMENT

Public Lands

Memorandum

SH 947

FROM: Darlene Craven, Specialist
Roadway & Reservations Program
Industrial Land Services

OUR FILE: RDS 11935

YOUR FILE: 3-SR-74

TO: Michelle McKay
Transportation & Utilities

DATE: April 15, 1999

TELEPHONE: 427-4682

Provisional Roadway Reservation (RDS 11935)

This is to advise that Provisional Roadway Reservation, RDS 11935 has been approved for **interest purposes** only. Attached please find the Terms for this approval.

As set out in condition #3, note that before construction begins 6(six) copies of the updated plans must be forwarded to this office.

If you have any questions, please contact me at the above number.

Thank you.

D.M. Craven

Attachments
cc: Field - Evansburg, Attn: Dave Karasek
cc: Forestry - Whitecourt(NES-3C), Attn: Kevin Hakes
- Edson(NES-2C)
cc: Fish & Wildlife - Edson, Attn: Jan Ficht
- Whitecourt, Attn: Arlen Todd
cc: Water Resources - (NES), Attn: Rod Lumabi

RECEIVED
APR 19 1999
AB. TRANSPORTATION & UTIL.
Planning Services Branch

D.M. Craven, Specialist
Roadway & Reservations Programs
AFRD, Rural Development
Industrial Land Services
7000 - 1113 St. Rm. 200
Ph# 427-4682 FAX# 422-0454
craven@agric.gov.ab.ca

Printed on recycled paper

ALBERTA
MINISTER OF TRANSPORTATION AND UTILITIES

MLA Grande Prairie - Smoky

M.O. 3/99

GOVERNMENT OF ALBERTA

DEPARTMENT OF TRANSPORTATION AND UTILITIES

MINISTERIAL ORDER

I, WALTER PASZKOWSKI, Minister of Transportation and Utilities, pursuant to section 7 of the *Public Highways Development Act*, make the Secondary Highways Designation Amendment Order, as set out in the attached Appendix.

DATED at Edmonton, Alberta this 21 day of APRIL, 1999.

Walter Paszkowski

WALTER PASZKOWSKI
Minister of Transportation and Utilities

420 Legislature Building, Edmonton, Alberta, Canada T5K 2B6 Telephone 403/427-2080 Fax 403/422-2722
Northern Alberta Railway Station, Box 329, Sexsmith, Alberta, Canada T0H 3C0 Telephone 403/568-2560, Fax 403/568-3099

TORCHINSKY ENGINEERING LTD.
CONSULTING ENGINEERS

130 Sioux Road
Sherwood Park, Alberta
T8A 3X5
PHONE : (780) 464-4550
FAX : (780) 464-4533

Date: April 19, 1999
File: D12EDH999472.901

Dianne George, Coordinator, Reclamation and Roads Section
Land Administration Division, Environmental Protection
3rd Floor,, South Tower 9915 - 108 Street
Edmonton, Alberta T5K 2G8

RE : Secondary Highway 947 - Highway 16 to Athabasca River

Torchinsky Engineering Ltd. have been commissioned by Alberta Transportation and Utilities to review the entire route for the above noted project that was established, approved through the referral process, surveyed and partially cleared in the 1970's. The terms of our agreement is to ensure that an alignment is still protected and constructable.

The study is being done as a result of Alliance Pipeline having received approval from Environmental Protection to construct a portion of their pipeline on the previously approved and cleared right of way between km 35 and km 51 as shown on the attached vicinity map. Meetings, discussions and correspondence between Environmental Protection, Alberta Transportation and Utilities and Alliance Pipeline along with some preliminary studies resulted in an agreement in principle that Alberta Transportation and Utilities would establish a new alignment to the east of the original alignment for this 16 km section.

Alliance Pipeline also received approval to construct their pipeline on a one km section of the cleared right of way near the Chevron Plant (km 60 to km 61), however, through the negotiation process, they have agreed to locate the pipeline outside the right of way.

In addition to the detailed study between km 35 and km 51, we will be carrying out a field inspection of the remainder of the route from Hwy 16 to the Athabasca River to insure the alignment is still constructable with respect to development encroachment.

Alberta Transportation and Utilities want to emphasize that the study is being carried out only to ensure that a constructable alignment is available for the future. There are no construction plans at this time. Once the study is complete, an updated Provisional Reservation application will be provided.

We intend to send you a more detailed referral with contour plans and mosaics showing the alignment in June 1999. This referral will include an overview by our bridge engineer, geotechnical engineer and environmental specialist.

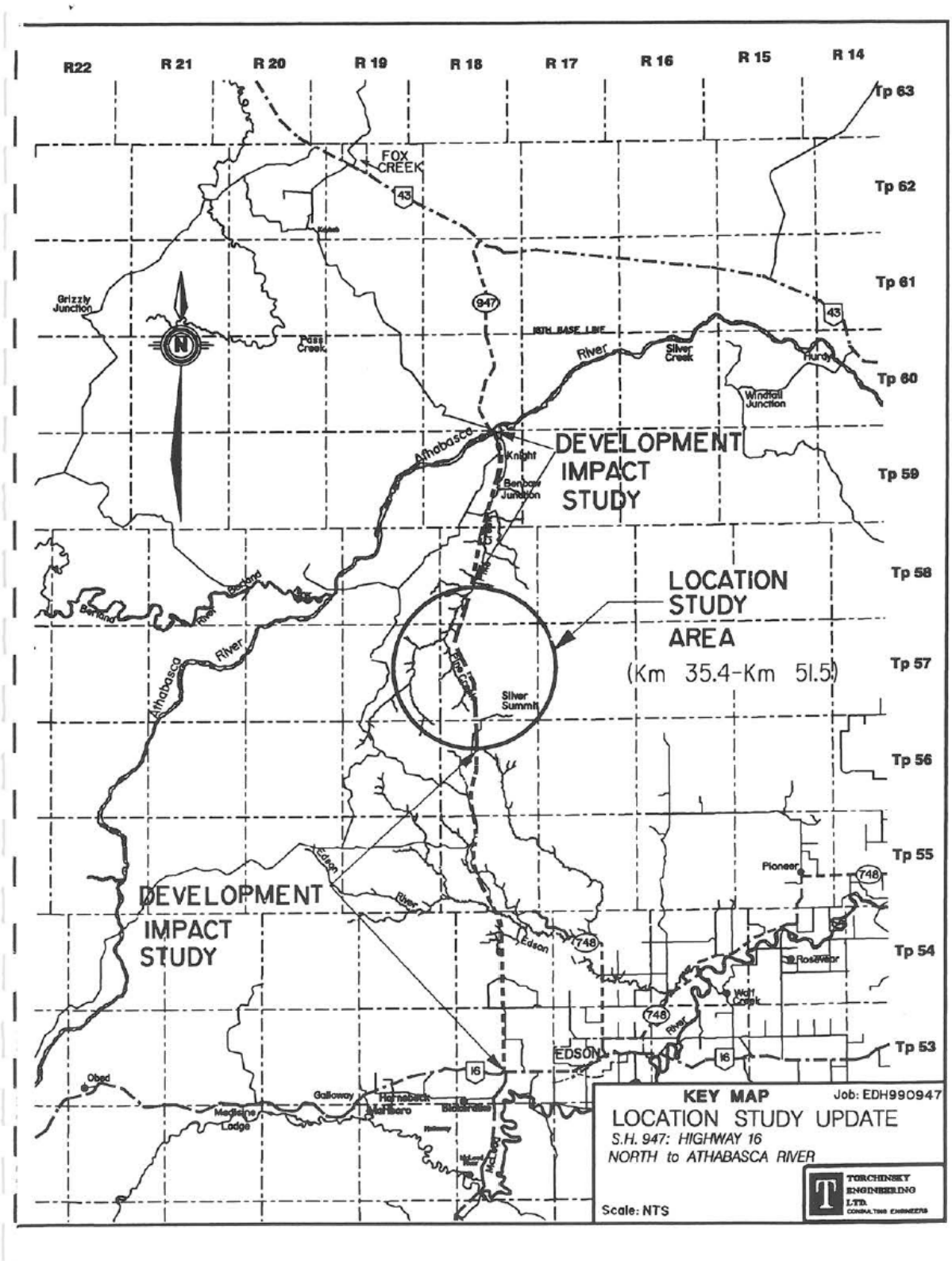
If you have any questions or require more information, please call me at 464-4550 or 478-2920.

Regards

TORCHINSKY ENGINEERING LTD.

Bill Leigh
Senior Manager, Functional Planning

⇨ Dan Kilborn, Alberta Transportation and Utilities
Roberta Clifford, Alberta Transportation and Utilities
Keith Helberg, Torchinsky Engineering Ltd.


R22
R 21
R 20
R 19
R 18
R 17
R 16
R 15
R 14
Tp 63
Tp 62
Tp 61
Tp 60
Tp 59
Tp 58
Tp 57
Tp 56
Tp 55
Tp 54
Tp 53
FOX CREEK
43
947
Grizzly Junction
Pass Creek
River
Silver Creek
Hurdy
Windfall Junction
Athabasca
Knight
Benbow Junction
DEVELOPMENT IMPACT STUDY
LOCATION STUDY AREA
(Km 35.4-Km 51.5)
Berland River
Silver Summit
Pioneer
748
Edson
Rosevear
Wolf Creek
EDSON
16
Obed
Galloway
Hardisty
Medicine Lodge
KEY MAP
Job: EDH990947
LOCATION STUDY UPDATE
S.H. 947: HIGHWAY 16
NORTH to ATHABASCA RIVER
Scale: NTS
TORCHINSKY ENGINEERING LTD.

Alberta
ENVIRONMENTAL PROTECTION

Land and Forest Service
Land Administration Division

Petroleum Plaza - South Tower
9915 - 108 Street
Edmonton, Alberta
Canada T5K 2G8

File No.

Telephone: 427-3570
Fax: 427-1185

May 19, 1999

Torchinsky Engineering Ltd.
130 Sioux Road
Sherwood Park, AB T8A 3X5

Attention: Bill Leigh

Re: S.H. 947, Highway 16 – Athabasca River

This project has been forwarded to the applicable areas of the provincial government and from a Fisheries and Wildlife perspective, the main concern is to realign the route between Km. 35 and 51. It is requested that the alignment avoid the riparian zone of Pine Creek, including the floodplain (preferably out of the watershed altogether). It is recommended to reduce the number of watercourse crossings of Pine Creek and reduce the impact on the streams in the area from right-of-way erosion both during construction and over the long term. More specific recommendations will be made once the detailed plans are reviewed.

It is recommended that prior to the start of any construction that both the Fish and Wildlife office and the Forestry office in Edson be contacted, to discuss this project, possibly with a pre-construction meeting. Contact Don Hildebrandt at 723-8244 and Janet Ficht at 723-8245. The Forest Officer is Quentin Spila at 723-8265.

If you have any questions regarding the above or require additional information, please contact this office.

Sincerely,

Dianne George, Coordinator
Reclamation and Roads Section

Printed on Recycled Paper

Alberta
COMMUNITY DEVELOPMENT

Cultural Facilities and
Historical Resources

Historic Sites Service

Old St. Stephen's College
8820 - 112 Street
Edmonton, Alberta
Canada T6G 2P8

Telephone 780/427-2022
Fax 780/427-3956

May 20, 1999

Our File(s): 4946-947-02

Mr. Bill Leigh
Torchinsky Engineering Ltd.
130 Sioux Road
Sherwood Park, Alberta
T8A 3X5

Dear Mr. Leigh:

SUBJECT: ALBERTA TRANSPORTATION & UTILITIES
SH 947:02 HWY. 16 TO ATHABASCA RIVER
HIGHWAY LOCATION STUDY
HISTORICAL RESOURCES ACT REQUIREMENTS

A copy of the captioned highway project was referred to the Cultural Facilities and Historical Resources Division of Alberta Community Development by the Land Reclamation and Roads Section of Alberta Environmental Protection. All agencies have completed their review of this project.

It has been determined that pursuant to Section 33(2) of the ***Historical Resources Act***, Alberta Transportation & Utilities is required to conduct an Historical Resources Impact Assessment on portions of this project, as well as associated borrow source locales prior to any construction occurring. The Historical Resources Impact Assessment is to be prepared in accordance with the instructions outlined in Schedule A (attached).

HISTORICAL RESOURCES POTENTIAL - EVALUATION

The location study area runs along the Pine Creek Valley. Although there are no known archaeological sites recorded in the area, sections of the proposed route have good archaeological potential. Any archaeological deposits found would be undisturbed.

INFORMATION AVAILABLE FROM ALBERTA COMMUNITY DEVELOPMENT

The Historic Sites Service of Alberta Community Development has compiled consultants lists for archaeologists, palaeontologists, and historians who are interested in the conduct of Historical Resources Impact Assessments.

...cont.

Printed on Recycled Paper

SCHEDULE A
***HISTORICAL RESOURCES ACT* REQUIREMENTS**
ALBERTA TRANSPORTATION & UTILITIES
PROPOSED S.H. 947 DEVELOPMENT HWY 16 -ATHABASCA RIVER
(PROJECT FILE 4946-947-02)

1. HISTORICAL RESOURCES IMPACT ASSESSMENT

Pursuant to Section 33:2 of the ***Historical Resources Act***, an Historical Resources Impact Assessment and any work resulting from this assessment is to be conducted on portions of this proposed project. This assessment is to be conducted on behalf of Alberta Transportation & Utilities by an archaeologist qualified to hold an Archaeological Research Permit within the Province of Alberta.

Timing: The Historical Resources Impact Assessment shall consist of the conduct of a pre-construction impact assessment.

2. SITE ASSESSMENT PROCEDURES

(a) Should the archaeological consultant(s) encounter any archaeological resources or historic period sites, the assessment of these sites is to comply with the Guidelines for Archaeological Permit Holders in Alberta.

(b) In order to conduct the Historical Resources Impact Assessment, the archaeological consultant must submit "An Application for a Permit to Excavate Historic Resources - Mitigative Research Project" to the Archaeology and Ethnology Section of the Provincial Museum of Alberta. Please allow ten (10) working days for the permit to be processed.

3. PALAEONTOLOGICAL

The palaeontological resource potential of the proposed development area is characterized on the Royal Tyrrell Museum of Palaeontology's "Palaeontological Resource Sensitivity Map" as unknown. Therefore, while a palaeontological resources impact assessment is not required for this project, pursuant to Section 27 of the ***Historical Resources Act***, should any palaeontological resources be discovered during the conduct of construction activities, staff of the Royal Tyrrell Museum (Andy Neuman, 823-7707) are to be contacted immediately. It may be necessary for our Department to issue further instructions regarding the documentation of these resources.

4. REPORTING THE DISCOVERY OF HISTORICAL RESOURCES

Pursuant to Section 27 of the ***Historical Resources Act***, Alberta Transportation & Utilities, and their representatives are required to report the discovery of any archaeological resources, palaeontological resources, or historic period sites which may be encountered during construction, and borrow source activities.

...cont.

DEPARTMENTAL CONTACTS

Andy Neuman
Curator
Collections Management
Royal Tyrrell Museum of Palaeontology
Box 7500
Drumheller, Alberta
T0J 0Y0

Tel. 403-823-7707
Fax. 403-823-7131

Heinz Pyszczyk
Parkland Archaeologist
Archaeological Survey
Archaeology and Ethnology Section
Provincial Museum of Alberta
12845 - 102 Avenue
Edmonton, Alberta
T5N 0M6

Tel. 780-453-9154
Fax. 780-454-6629

Barry Newton
Resource Management Planner
Resource Management Program
Community Heritage Services
Historic Sites Service
Cultural Facilities and Historical Resources Division
Alberta Community Development
8820 - 112 Street
Edmonton, Alberta
T6G 2P8

Tel. 780-431-2330
Fax. 780-427-3956

TORCHINSKY ENGINEERING LTD.
RECEIVED
MAY 25 1999

APPROVED

TORCHINSKY ENGINEERING LTD.
CONSULTING ENGINEERS

130 Sioux Road
Sherwood Park, Alberta
T8A 3X5
PHONE : (780) 464-4550
FAX : (780) 464-4533

Date: July 20, 1999
EDH 99 9472

Dianne George, Coordinator, Reclamation and Roads Section
Land Administration Division, Environmental Protection
3rd Floor, South Tower 9915-108 Street
Edmonton, Alberta T5K 2G8

Re: Secondary Highway 947 Highway 16 To Athabasca River

Further to our April 19, 1999 referral letter and your May 19, 1999 response we are forwarding the mosaic/profiles showing the proposed revision to the original surveyed and cleared highway alignment for the section of the above noted project between Km 35.4 and Km 51.5 for your comments.

As you are aware the objective of this study is to define a future highway alignment that is constructable and can be protected from future development. There is no construction schedule at this time. The study was necessitated by Alliance Pipeline receiving approval to construct their pipeline on this section of the cleared highway alignment.

Although the TransAlta powerline that was constructed on the cleared alignment was undertaken with an agreement that it would be relocated at TransAlta's cost when the alignment was required for highway construction, Alberta Infrastructure have instructed us to establish an alignment that does not interfere with the powerline or the proposed Alliance Pipeline. In addition there have been some other right of ways that have been allowed on the original alignment. Therefore the proposed new alignment has been placed far enough to the east to avoid conflict in some of the tight areas and allow for a 60m right of way.

Although the proposed revision is shown as joining the original alignment just south of the Pine Creek crossing, there are some issues still under investigation in this area. Developments by EnerMark Inc. that are on, adjacent or crossing the original alignment in the SE8 & NE8 - 58-18-5 create problems when attempting to tie the proposed revision into the original alignment and still utilize the original proposed Pine Creek Crossing. The location of the proposed Alliance Pipeline in this same area further complicates the matter. We are currently in discussions with these companies to determine impacts, costs and options.

SHERWOOD PARK • CALGARY • RED DEER • LLOYDMINSTER • HANNA • LETHBRIDGE • HIGH PRAIRIE

Other than the area mentioned above, the proposed revision is feasible and constructable, however there will be increased costs mainly as a result of right of clearing.

Based on the photos, contour maps, profiles, cross-sections, field inspections and a preliminary environmental overview, the proposed revision would result in the similar environmental impacts as the original alignment other than the additional right of way clearing.

Because of a delay in obtaining new photos to develop the mosaic/profiles and assess the new developments, we are behind schedule. Therefore we would appreciate your comments as soon as possible so Alberta Infrastructure can finalize their negotiations with the involved companies in a manner that does not delay activities. If a meeting to review the alignment and discuss issues would assist in shorter response time, we would appreciate having you arrange such a meeting.

Please call if you require additional information and can arrange a meeting.

Bill Leigh
Senior Manager Functional Planner

cc: Dan Kilborn
Keith Helberg

2

TORCHINSKY ENGINEERING LTD.
CONSULTING ENGINEERS

130 Sioux Road
Sherwood Park, Alberta
T8A 3X5
PHONE : (780) 464-4550
FAX : (780) 464-4533

EDH 99-9472
July 26, 1999

To: Paul Anderson, Environmental Manager
Alliance Pipeline
Suite 400, 605-5th Ave. S.W.
Calgary, Alberta
T2P 3H5

Re: Secondary Highway 947

Further to our telephone discussions last week, I am forwarding a mosaic/profile showing the proposed highway alignment revision south of Pine Creek. The proposed highway alignment is parallel and east of the original highway alignment from the Silver Summit area to the SE 8-58-18-5 where it transitions back to the original alignment to utilize the original crossing of Pine Creek. The mosaic also shows the proposed Alliance Pipeline.

As discussed we would appreciate your review of the area where the proposed Alliance Pipeline crosses the proposed highway alignment to determine if the proposed pipeline could be shifted to the west and outside the proposed highway right of way shown in yellow. This is a particularly tight area because of the proposed Alliance Pipeline, the existing EnerMark Resource pipeline, the power line and the limited opportunity to cross Pine Creek on tangent.

The tentative gradeline placed on the contour map profile indicates that the highway will be in a fill section across both pipelines and there is flexibility in the gradeline.

I have discussed the crossing of the EnerMark Resources pipeline and associated developments with Linda Belyea, EnerMark Resources and by copy of this letter and similar mosaic, I am asking for her comments.

If you have any questions, I can be reached by phone (780) 464-4550 (office), (780) 446-3370 (cell) or (780) 478-2920 (home).

Paul, I would also appreciate confirmation that the proposed Alliance Pipeline near the Chevron Plant was revised to eliminate conflict with the original highway alignment.

Bill Leigh
Senior Manager Functional Planning

cc: Dan Kilborn Alberta Infrastructure
Linda Belyea, EnerMark Resources
Western Canadian Place
1900, 700-9th Ave. S.W.
Calgary, Alberta
T2P 3V4

Alberta
ENVIRONMENTAL PROTECTION

Land and Forest Service
Land Administration Division

Petroleum Plaza - South Tower
9915 - 108 Street
Edmonton, Alberta
Canada T5K 2G8

File No.

Telephone: 415-4643
Fax: 422-4251

August 16, 1999

Torchinsky Engineering Ltd.
130 Sioux Road
Sherwood Park, AB T8A 3X5

Attention: Bill Leigh

Re: S.H. 947, Highway 16 – Athabasca River

This project has been forwarded to the applicable areas of the provincial government and there are no major concerns identified with this project proceeding. As outlined in my May 19, 1999 letter, there will be some concerns at the time this project is scheduled for construction. It is recommended that at that time, a pre-construction meeting with the Forestry and Fish and Wildlife offices in Edson be scheduled to review specific details of the alignment location.

If you have any questions regarding the above, or require additional information, please contact this office.

Sincerely,

Dianne George, Coordinator
Reclamation and Roads Section

TORCHINSKY ENGINEERING LTD.
RECEIVED
AUG 19 1999

APPROVED_____

Printed on Recycled Paper

The Enerplus Group

August 25, 1999

EnerMark Inc.

Western Canadian Place
1900, 700 - 9th Avenue S.W.
Calgary, Alberta
T2P 3V4

Telephone: (403) 298-2200
Fax: (403) 298-2211

Torchinsky Engineering Ltd.
130 Sioux Road
Sherwood, Alberta
T8A 3X5

Attention: Bill Leigh

Re: Secondary Highway 947
E 8-58-18 W5M
Kabob South Area
Our Files: S001698 and S001755

Further to your letter of July 26/99, EnerMark has reviewed the provided mosaic / profile and has no concerns with the proposed routing of highway 947, however, please contact us prior to any construction:

Contacts:	Ron Chapman	(403) 298-8854
	Dave Beattie	(403) 298-8822

Facilities on or near our 9-8-58-18 W5M site include the 9-8 well, a dehydrator, underground tanks and a pipeline, all for the production and transportation of sweet natural gas.

Please call me at (403) 298-8834, should you require further information.

Yours truly,
EnerMark Inc.

Linda Belyea
Land Administrator

cc: Dave Beattie
Ron Chapman

TORCHINSKY ENGINEERING LTD.
RECEIVED
AUG 27 1999

APPROVED_____

Appendix 5. Project area vegetation types

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 1

150 0 150 300 450

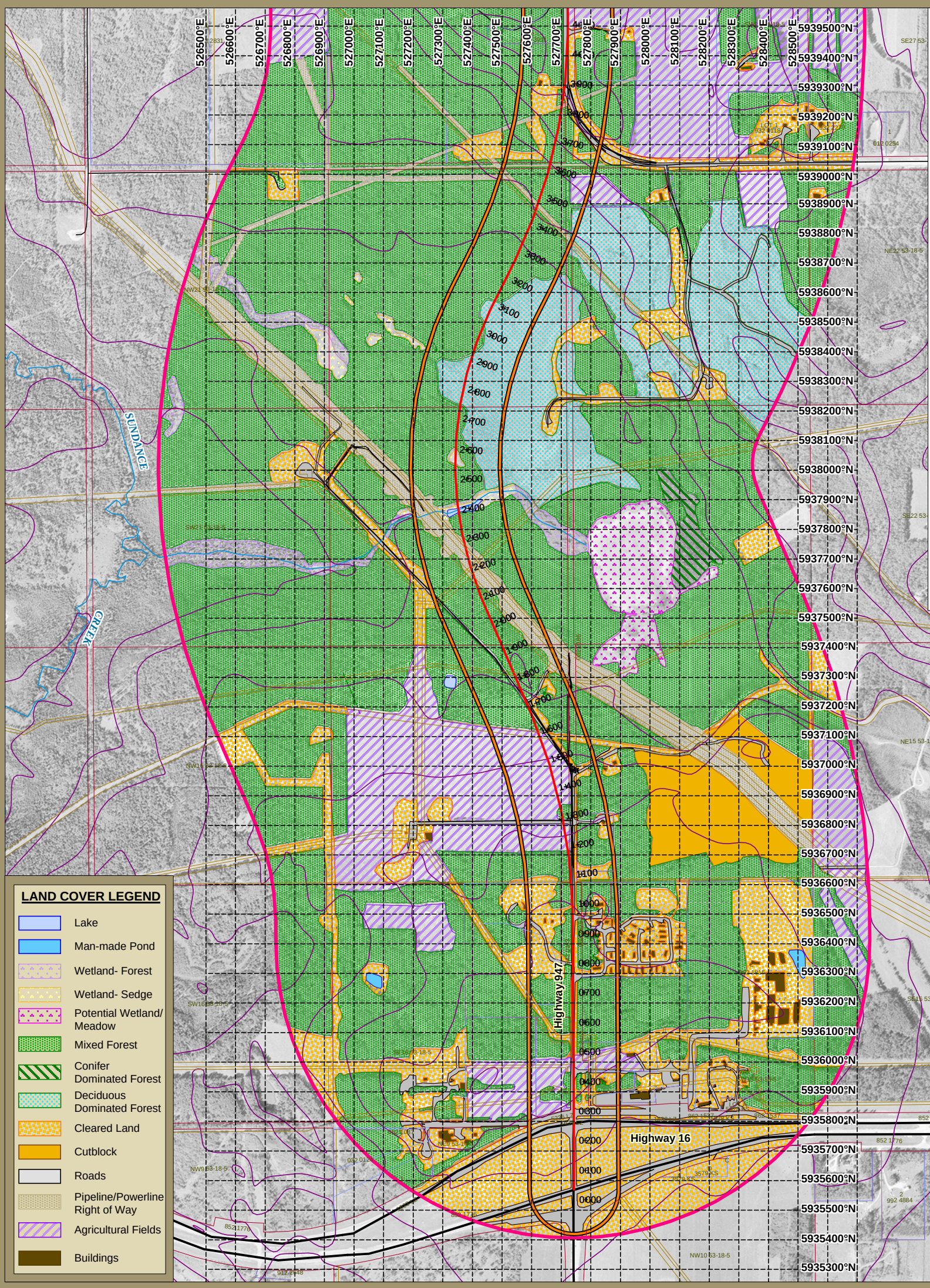
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Legal Lot Lines
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Paved Roads
- **0+100** Distance Along Centerline

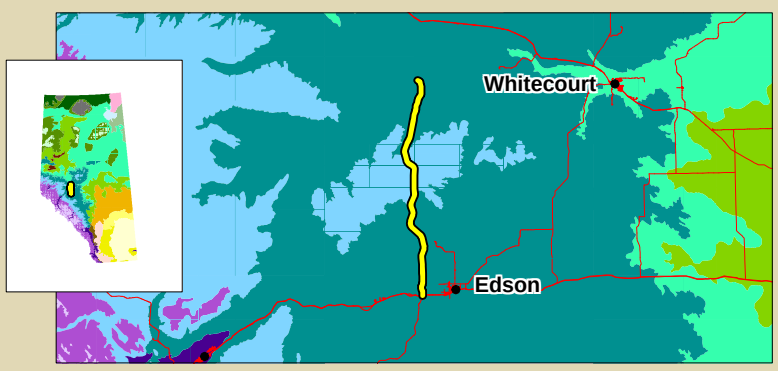


LAND COVER LEGEND

- Lake
- Man-made Pond
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Roads
- Pipeline/Powerline Right of Way
- Agricultural Fields
- Buildings

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 2

150 0 150 300 450

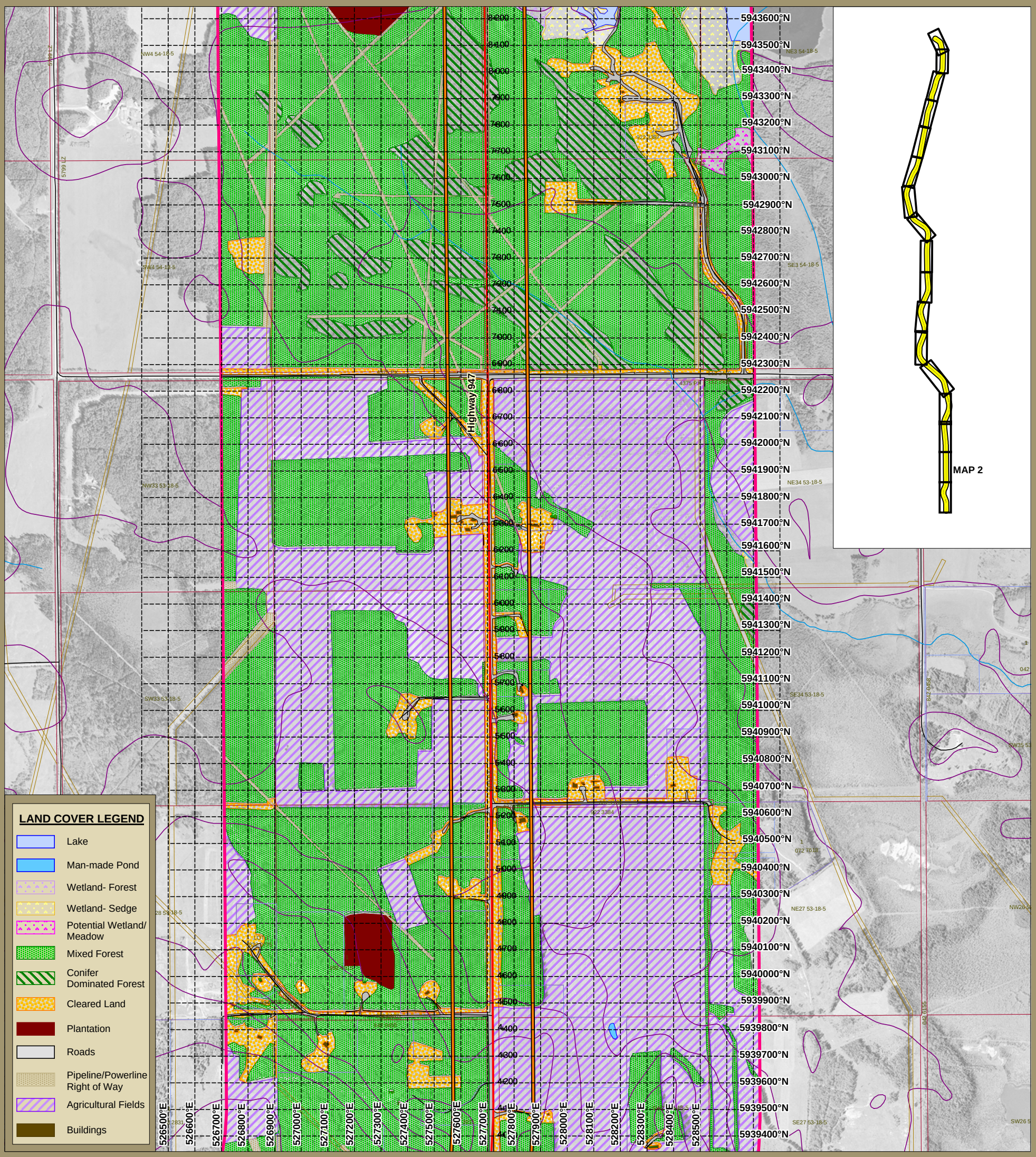
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Legal Lot Lines
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- 0+100 Distance Along Centerline

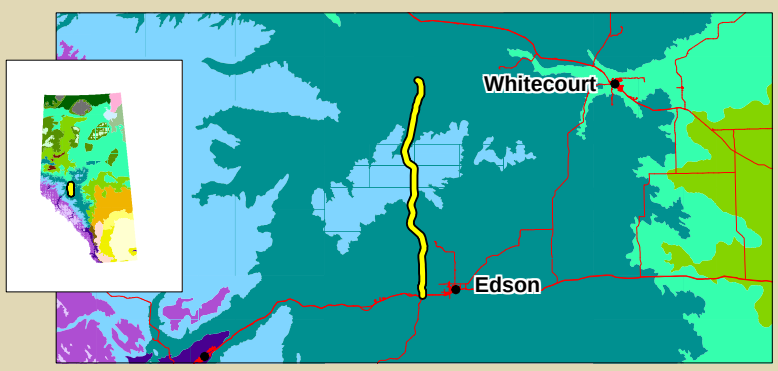


LAND COVER LEGEND

- Lake
- Man-made Pond
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Cleared Land
- Plantation
- Roads
- Pipeline/Powerline Right of Way
- Agricultural Fields
- Buildings

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 3

150 0 150 300 450

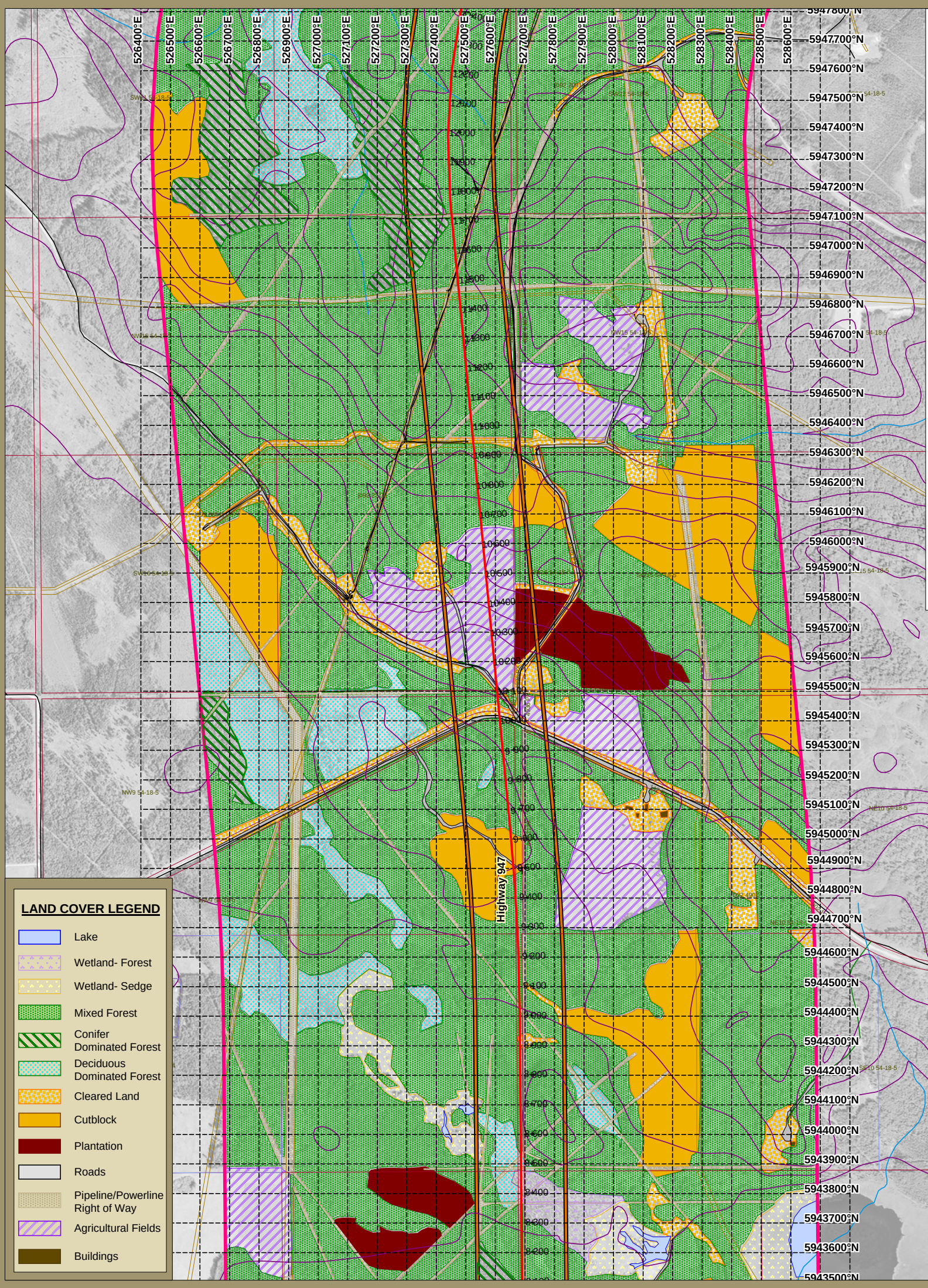
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Legal Lot Lines
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- 0+100 Distance Along Centerline

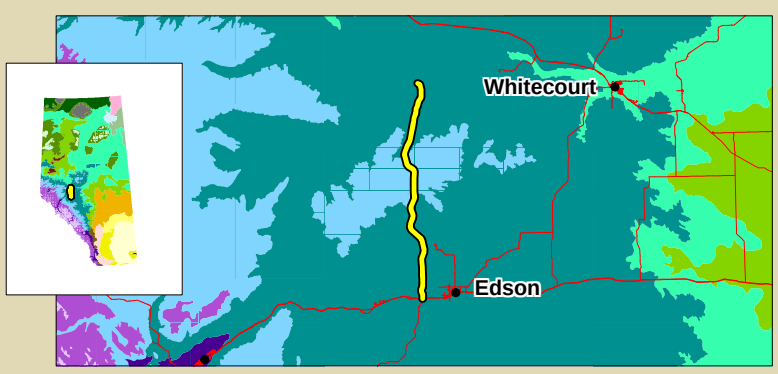


LAND COVER LEGEND

- Lake
- Wetland- Forest
- Wetland- Sedge
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Pipeline/Powerline Right of Way
- Agricultural Fields
- Buildings

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 4

150 0 150 300 450

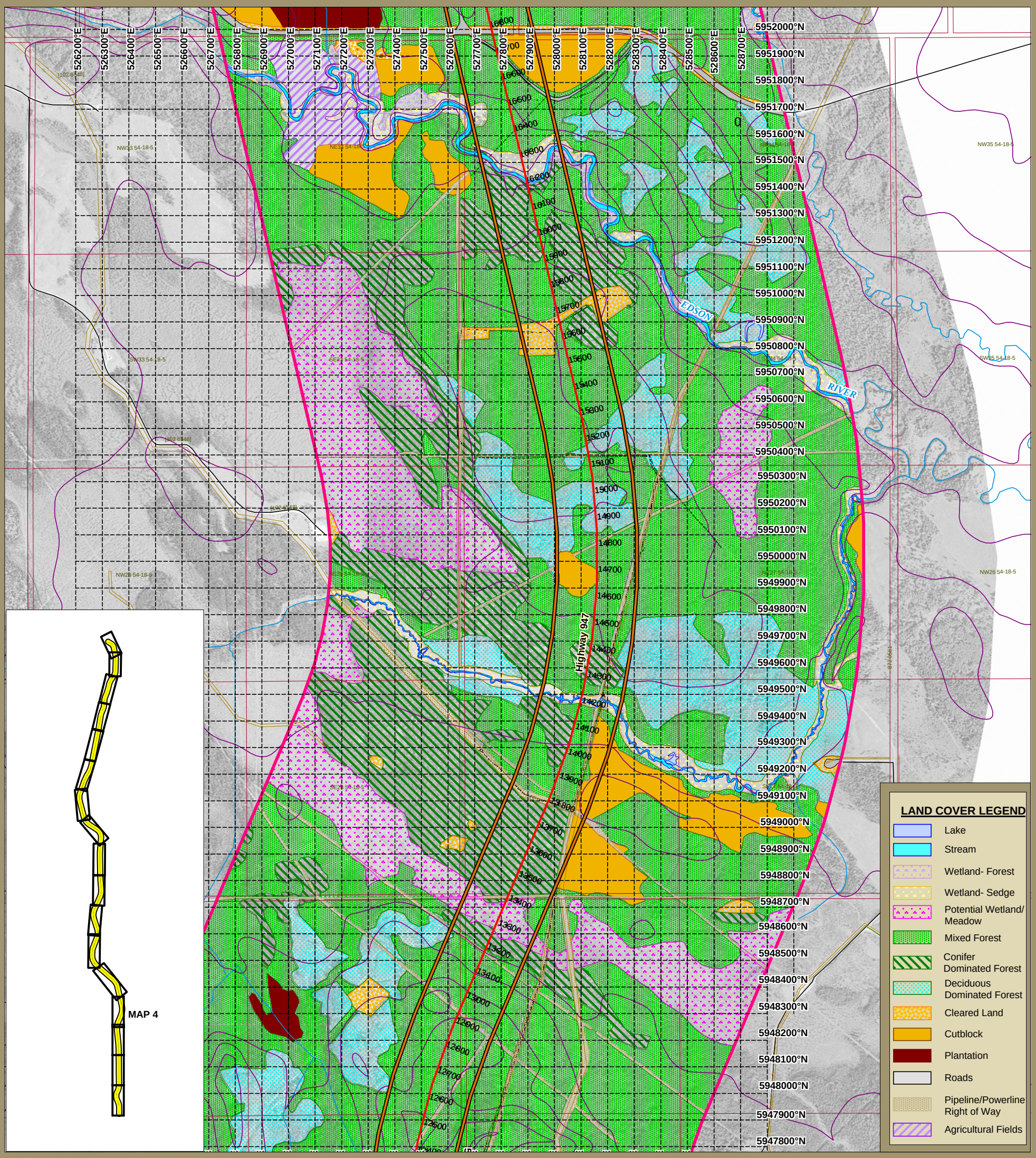
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Legal Lot Lines
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance Along Centerline

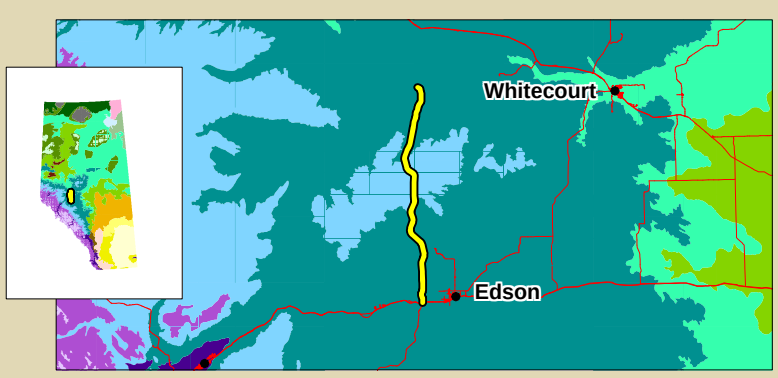


LAND COVER LEGEND

- Lake
- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Pipeline/Powerline Right of Way
- Agricultural Fields

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 5

150 0 150 300 450

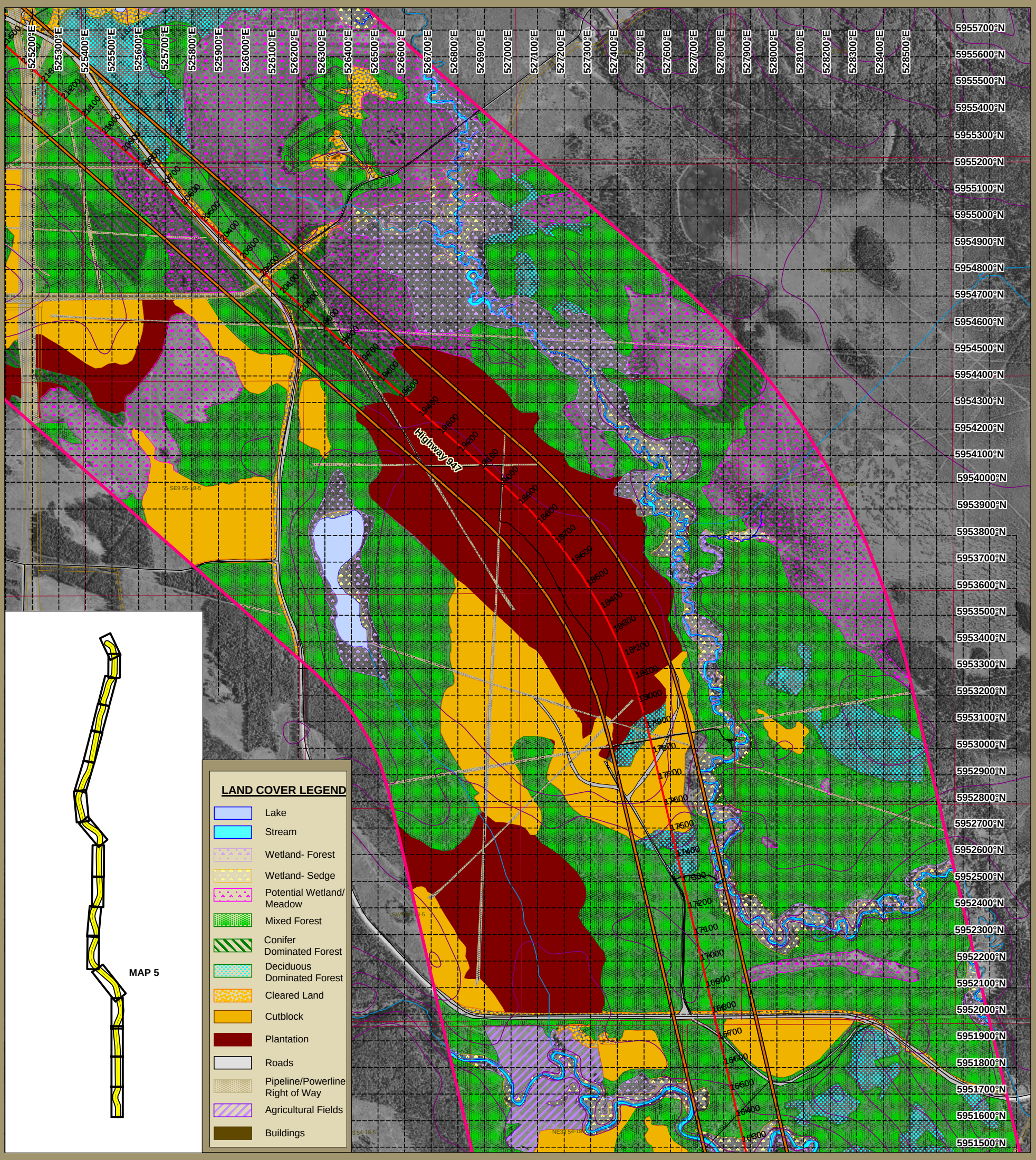
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

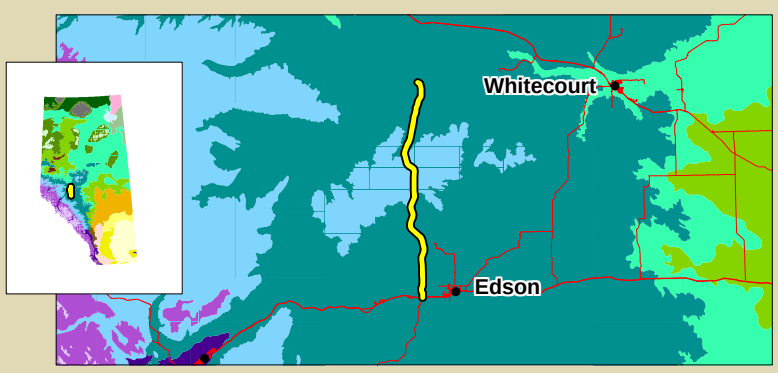
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Legal Lot Lines
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance Along Centerline



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 6

150 0 150 300 450

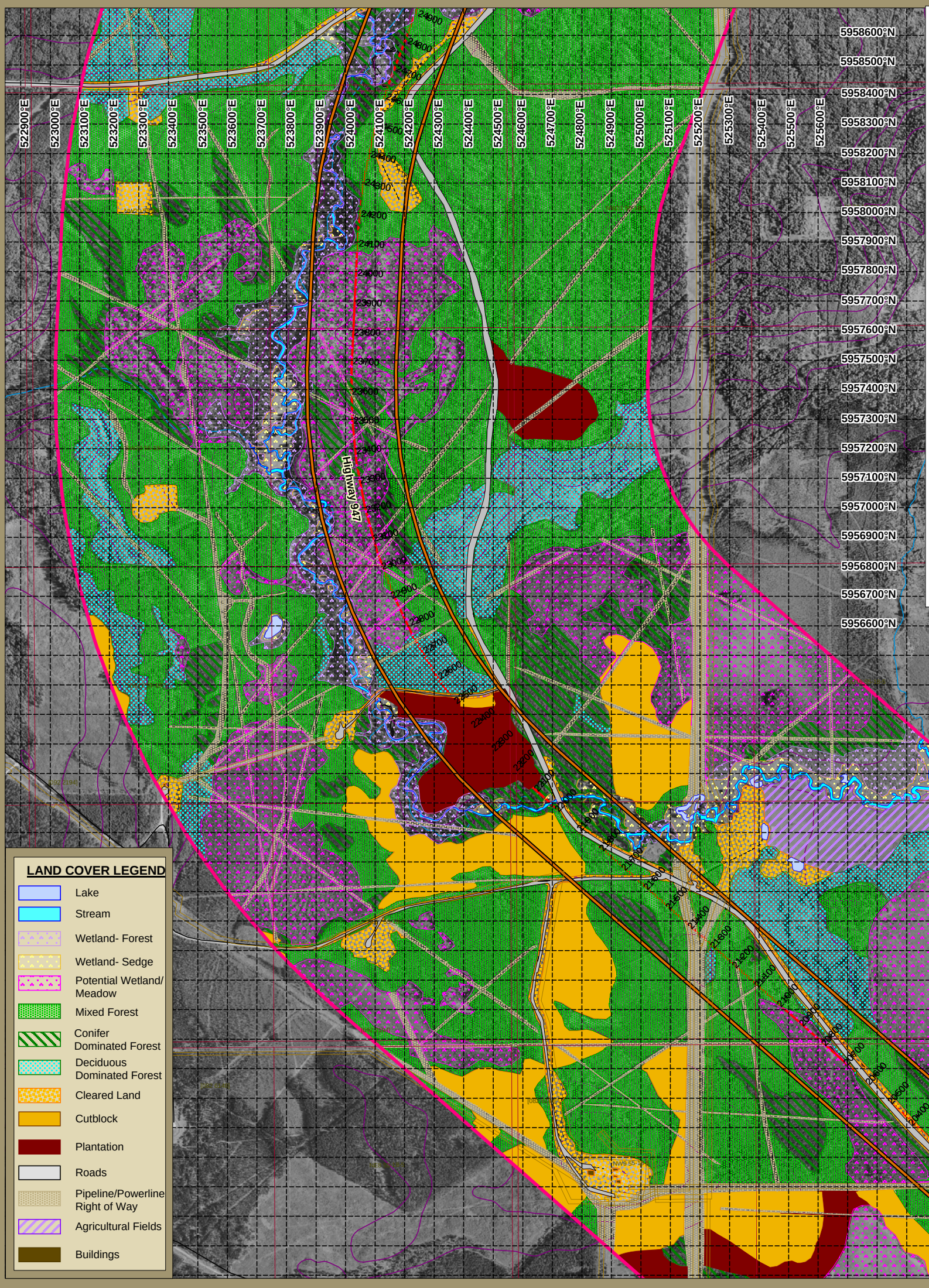
Meters

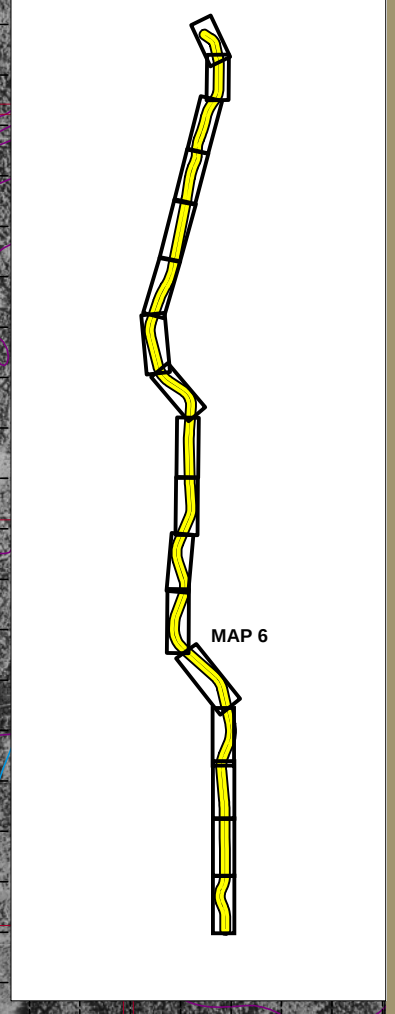
Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance Along Centerline



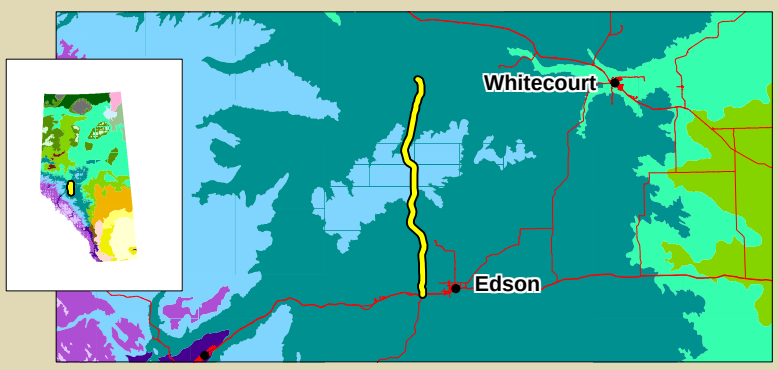


LAND COVER LEGEND

- Lake
- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Pipeline/Powerline Right of Way
- Agricultural Fields
- Buildings

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 7

150 0 150 300 450

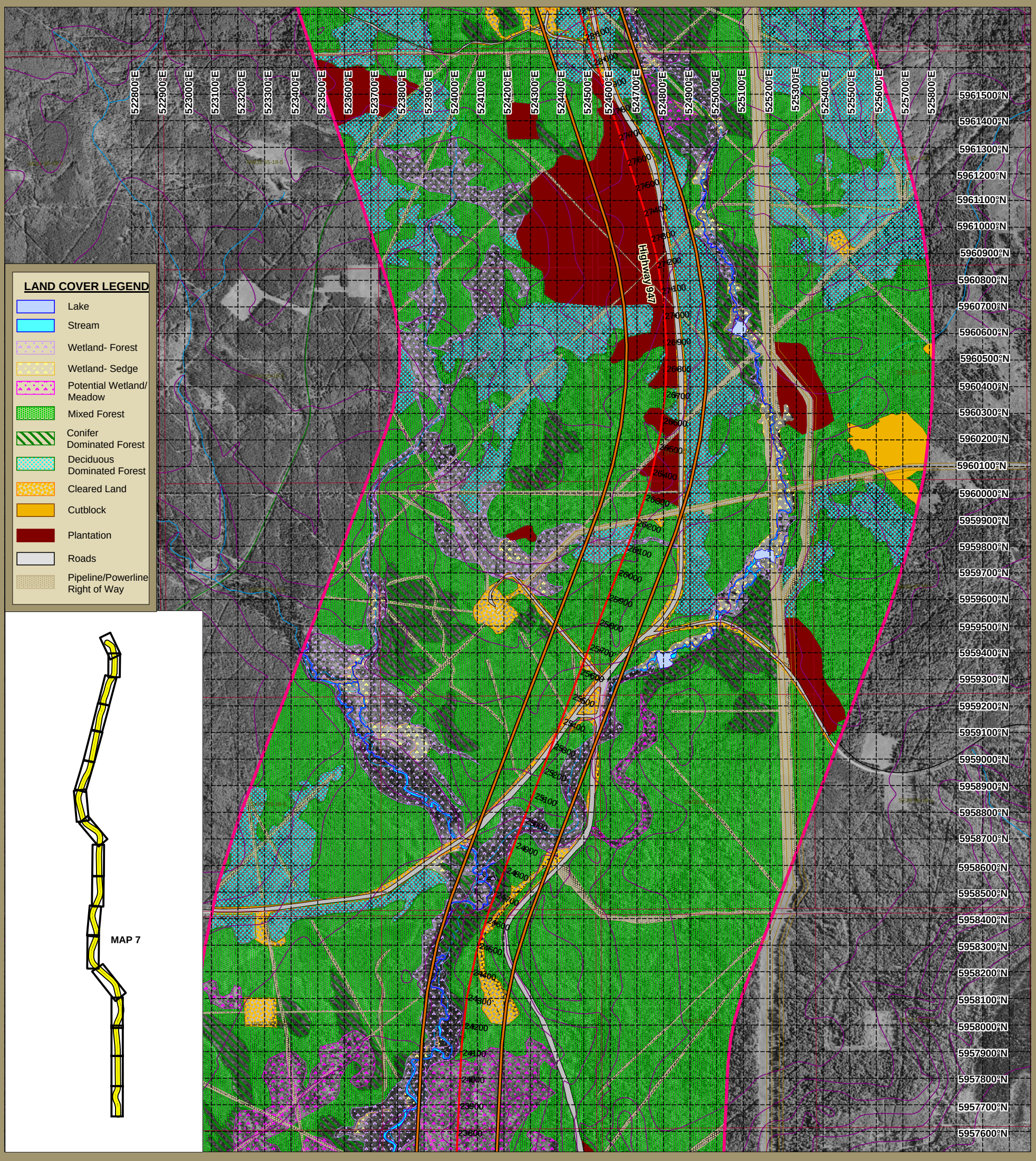
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

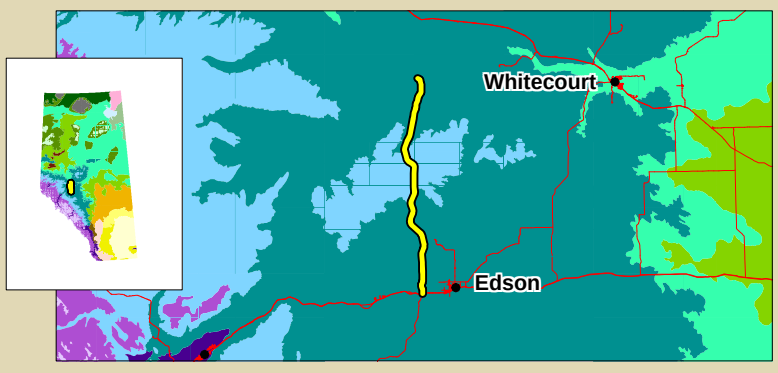
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- **0+100** Distance along Centerline



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 8

150 0 150 300 450

Meters

Scale: 1:15,000

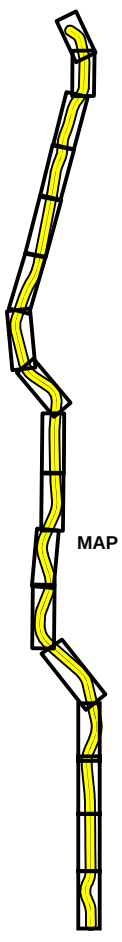
Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance along Centerline

LAND COVER LEGEND

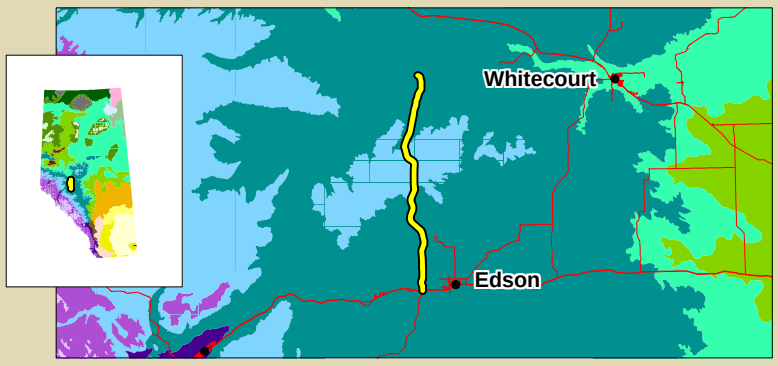
- Lake
- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Pipeline/Powerline Right of Way



MAP 8

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 9

150 0 150 300 450

Meters

Scale: 1:15,000

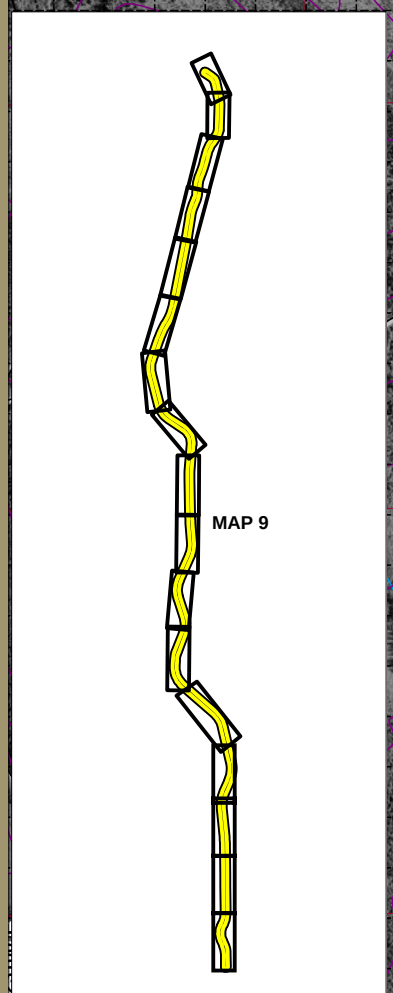
Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

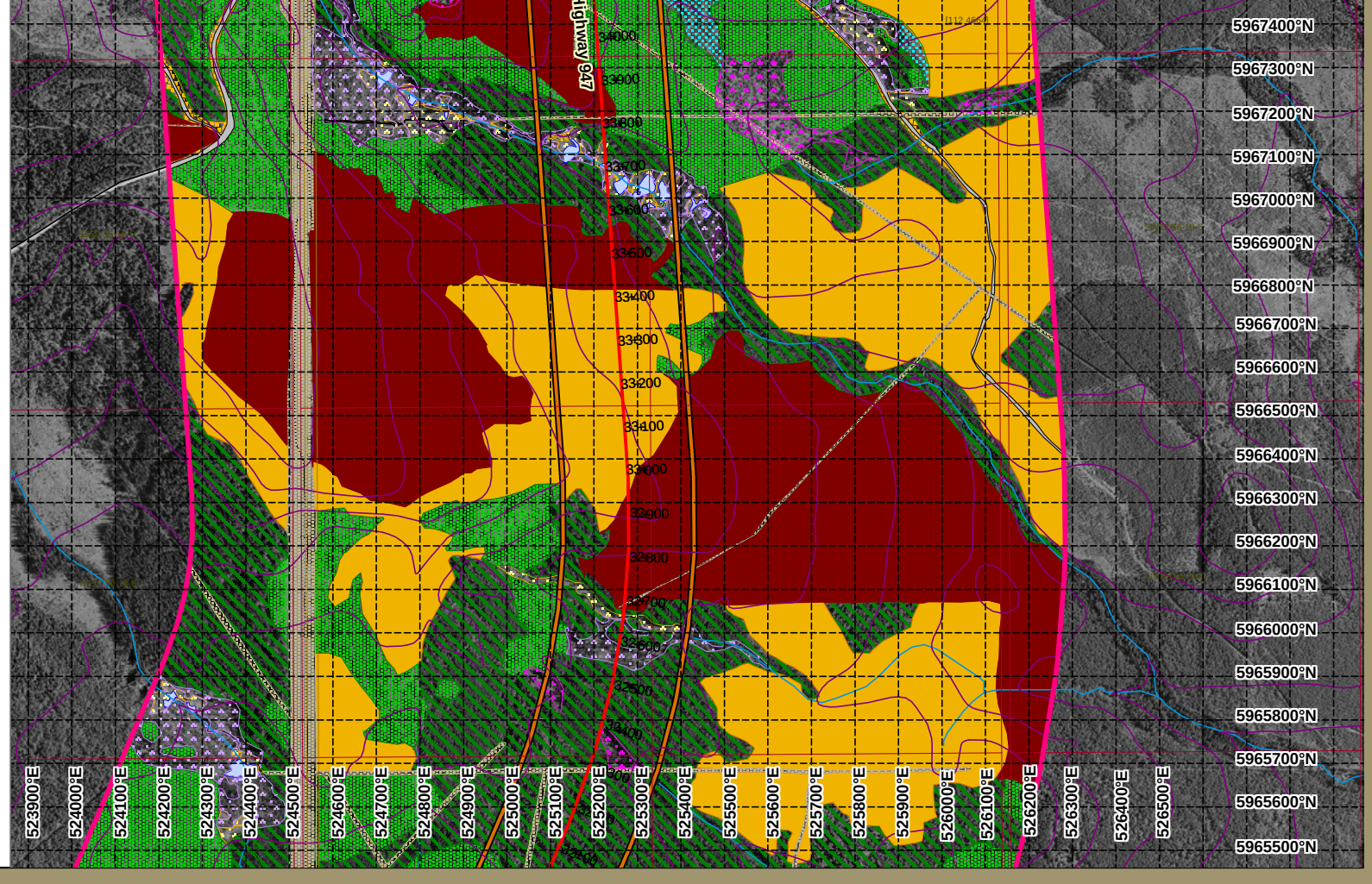
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- **0+100** Distance along Centerline

LAND COVER LEGEND

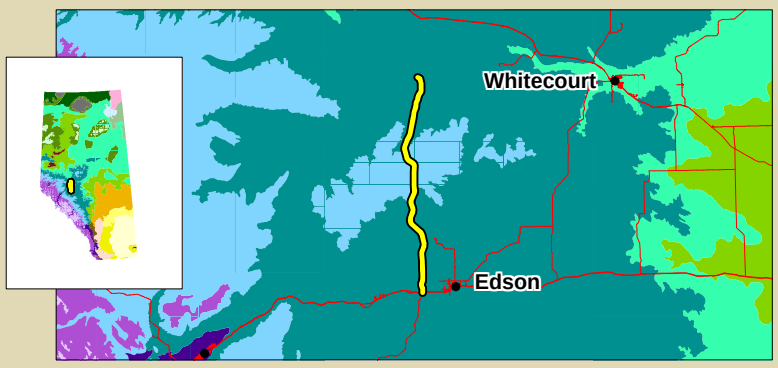
- Lake
- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Pipeline/Powerline Right of Way





Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 10

150 0 150 300 450

Meters

Scale: 1:15,000

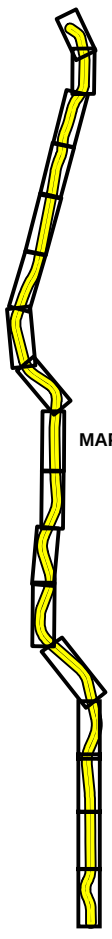
Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

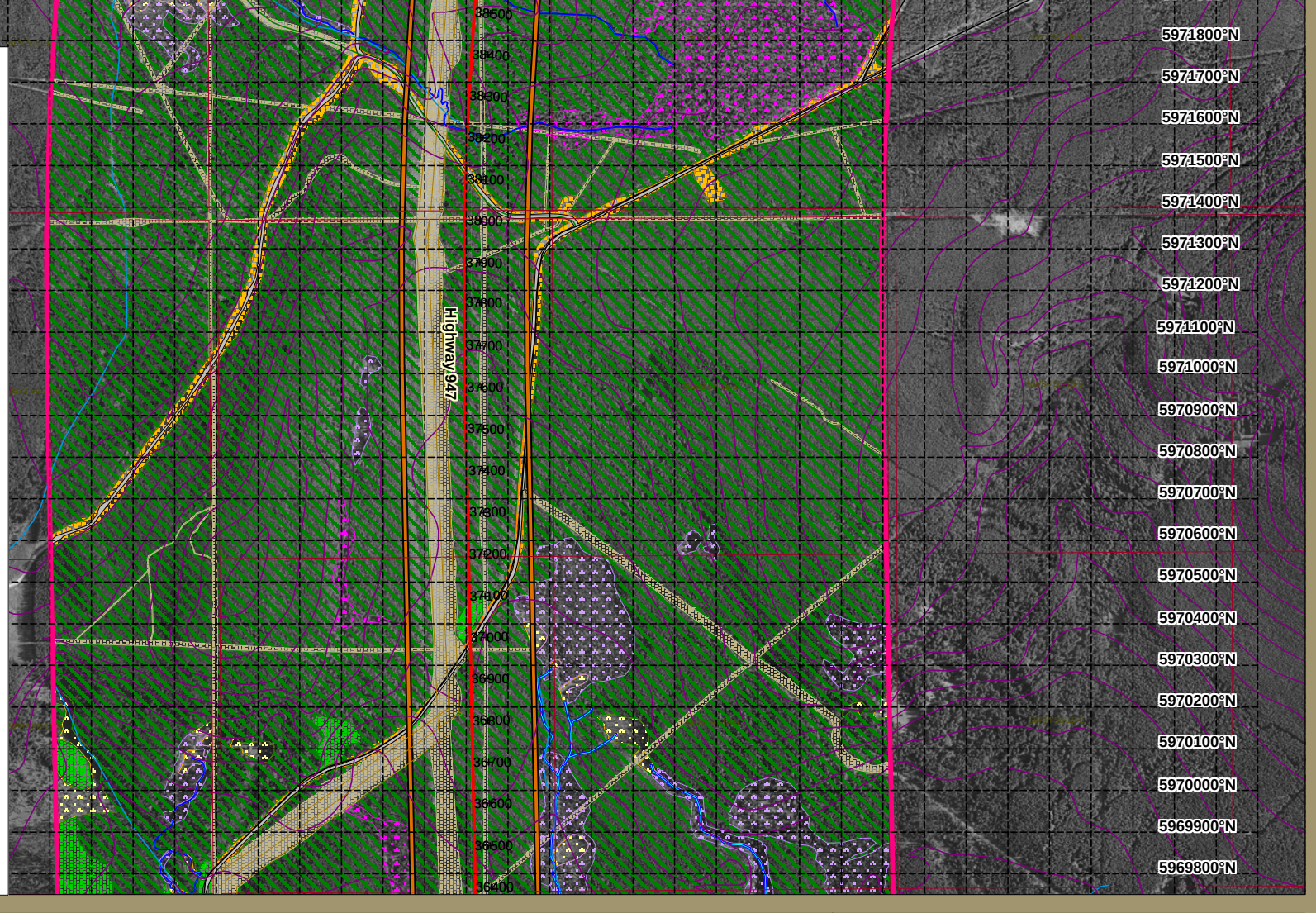
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- **0+100** Distance along Centerline

LAND COVER LEGEND

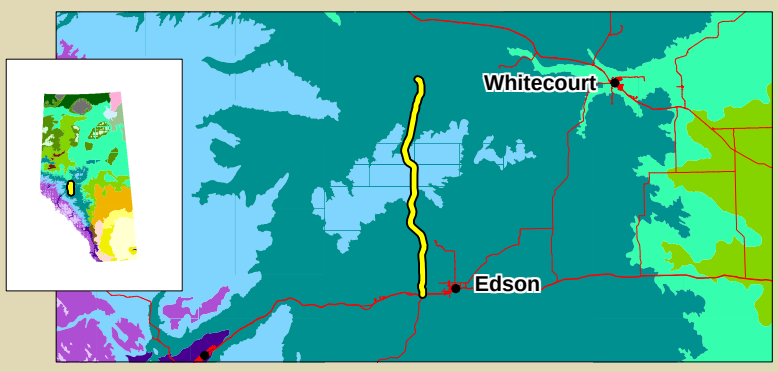
- Lake
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Cleared Land
- Roads
- Pipeline/Powerline Right of Way





Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 11

150 0 150 300 450

Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- 0+100 Distance along Centerline

LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Conifer Dominated Forest
- Cleared Land
- Roads
- Pipeline/Powerline Right of Way
- Buildings

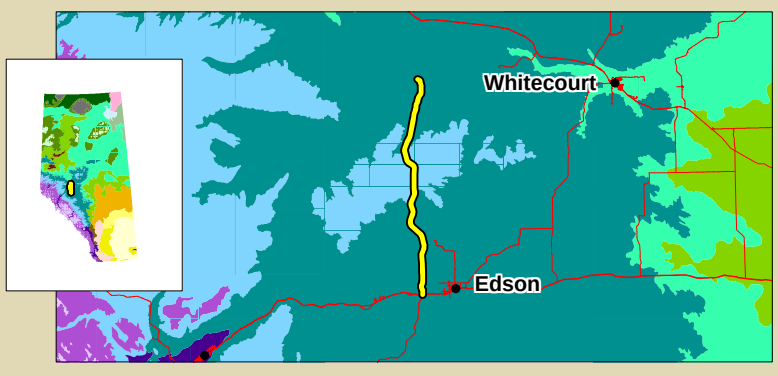
Pine Creek

Highway 947

MAP 11

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 11

150 0 150 300 450

Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance along Centerline

LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Conifer Dominated Forest
- Cleared Land
- Roads
- Pipeline/Powerline Right of Way
- Buildings

Pine Creek

Highway 947

MAP 11

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills

Whitecourt

Edson

ECOFOR
natural and cultural resource consultants

ALBERTA INFRASTRUCTURE AND TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 11

150 0 150 300 450

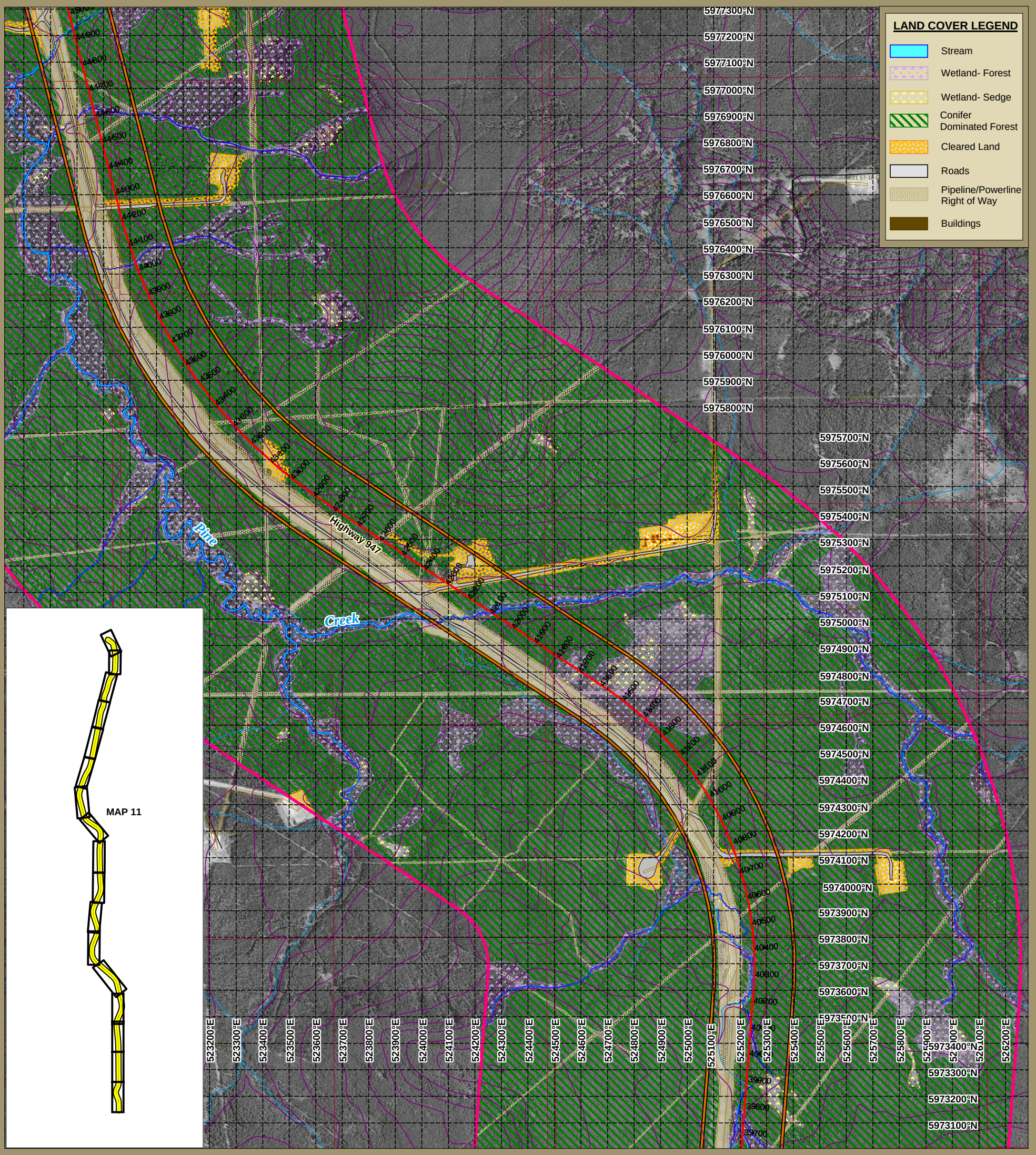
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

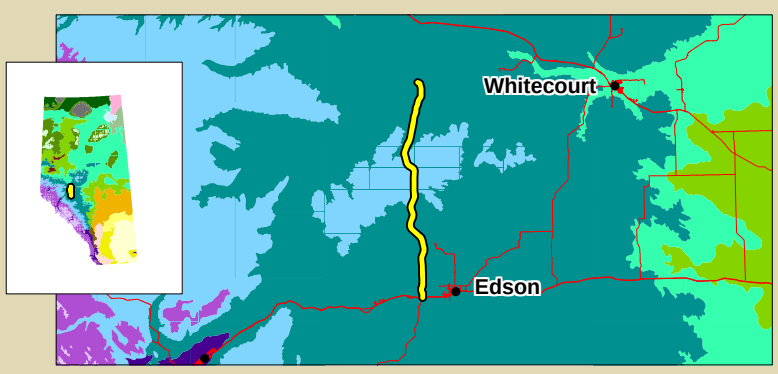
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- 0+100 Distance along Centerline



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 12

150 0 150 300 450

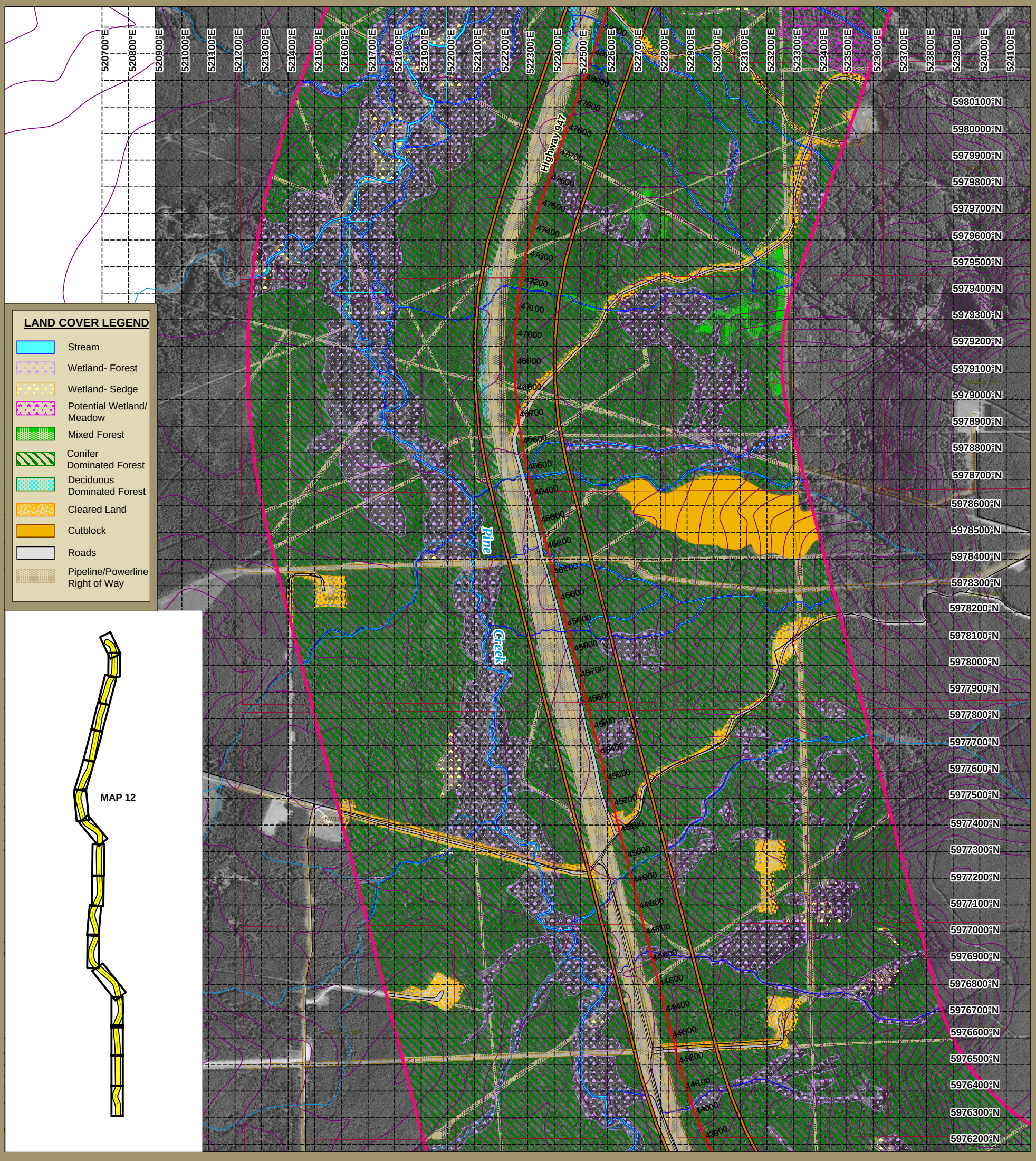
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance along Centerline



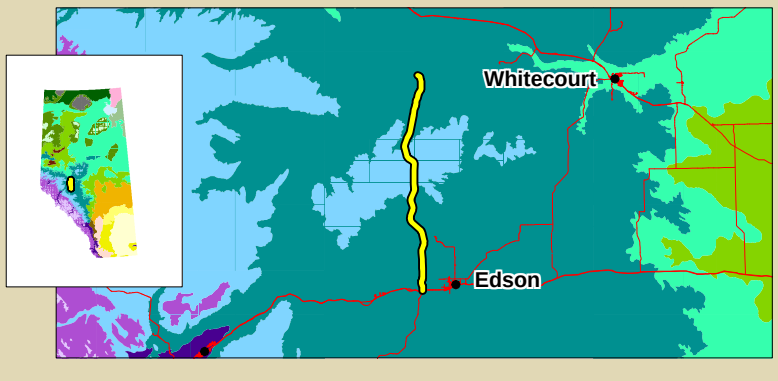
LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Roads
- Pipeline/Powerline Right of Way

MAP 12

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 13

150 0 150 300 450

Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- **0+100** Distance along Centerline

LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Roads
- Pipeline/Powerline Right of Way

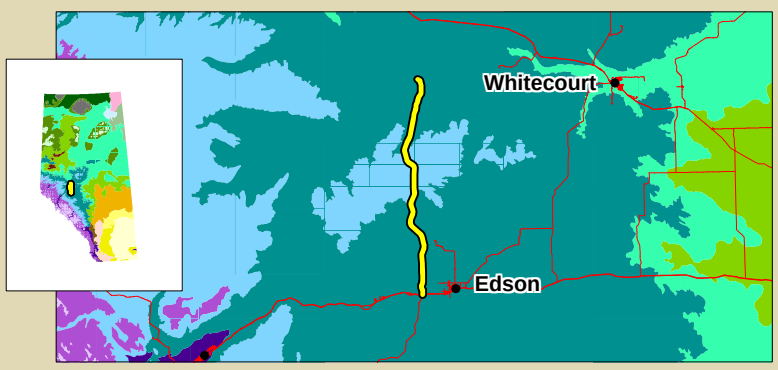
Pine

Highway 947

MAP 13

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 14

150 0 150 300 450

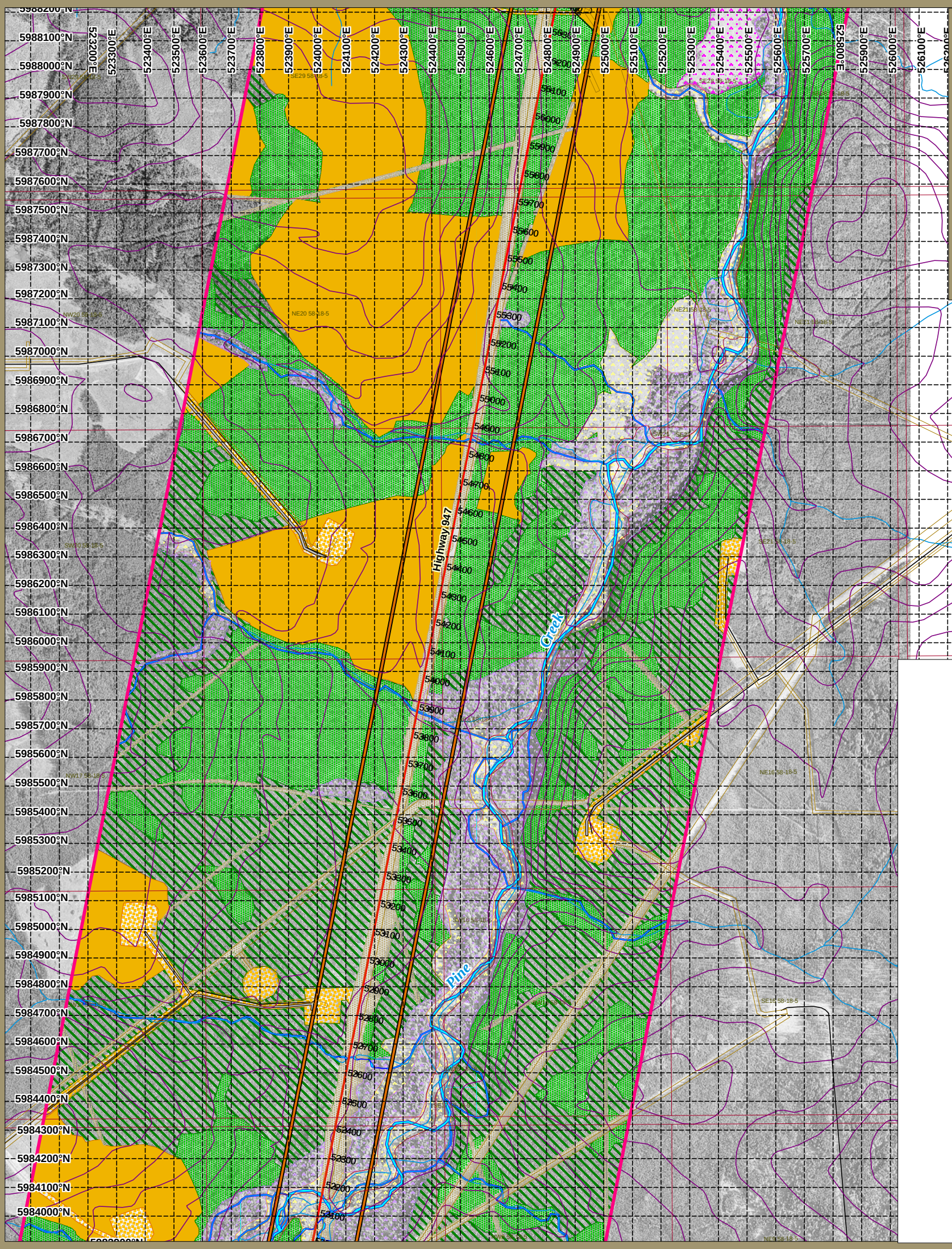
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

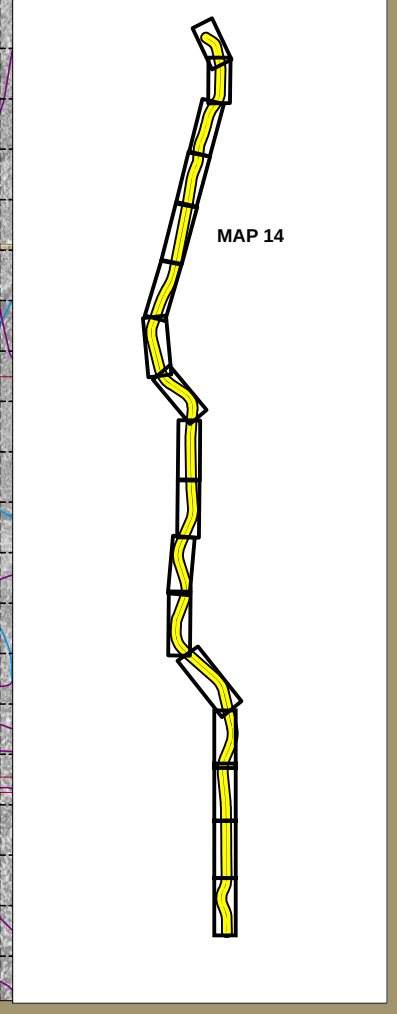
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance along Centerline



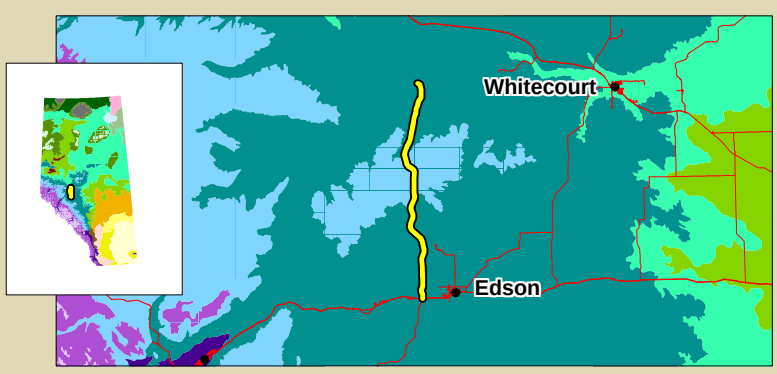
LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Cleared Land
- Cutblock
- Roads
- Pipeline/Powerline Right of Way



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 15

150 0 150 300 450

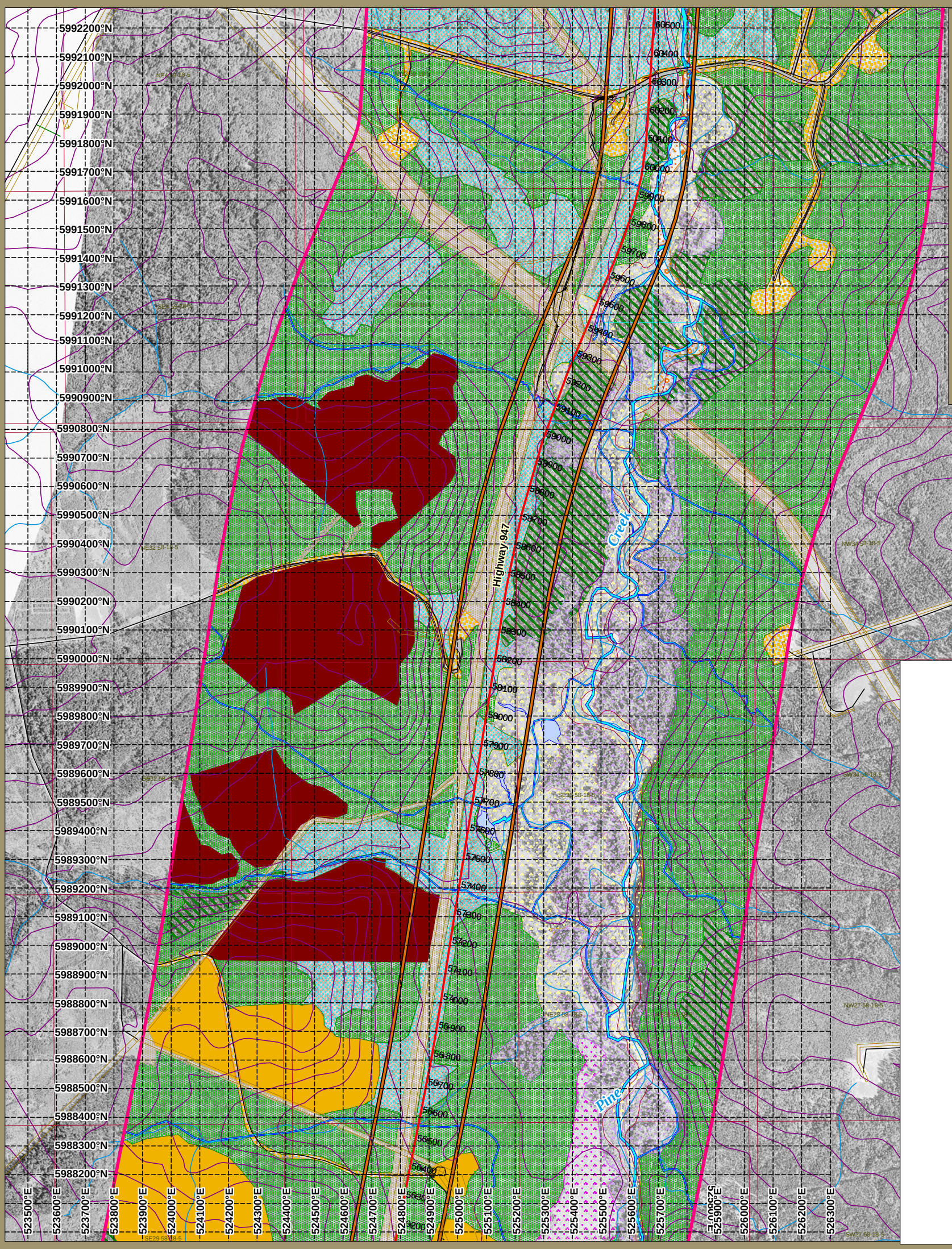
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

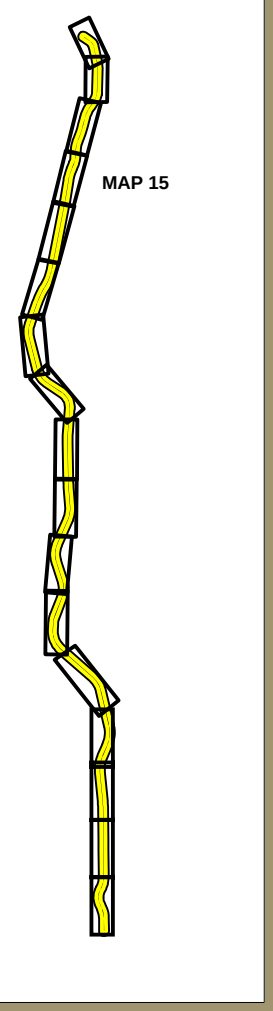
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- **0+100** Distance along Centerline



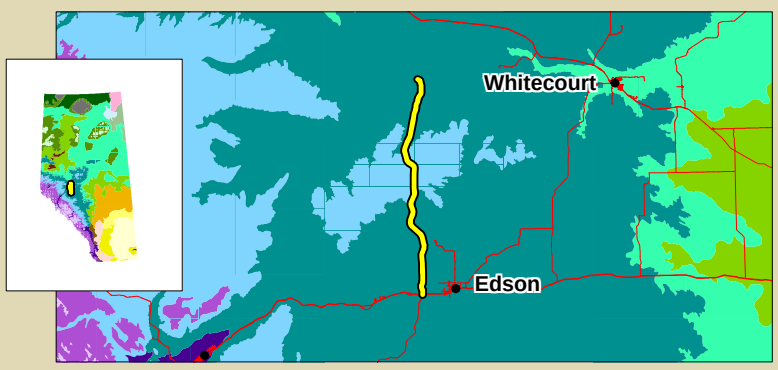
LAND COVER LEGEND

- Lake
- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Sand/Gravel Bar
- Pipeline/Powerline Right of Way



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 16

150 0 150 300 450

Meters

Scale: 1:15,000

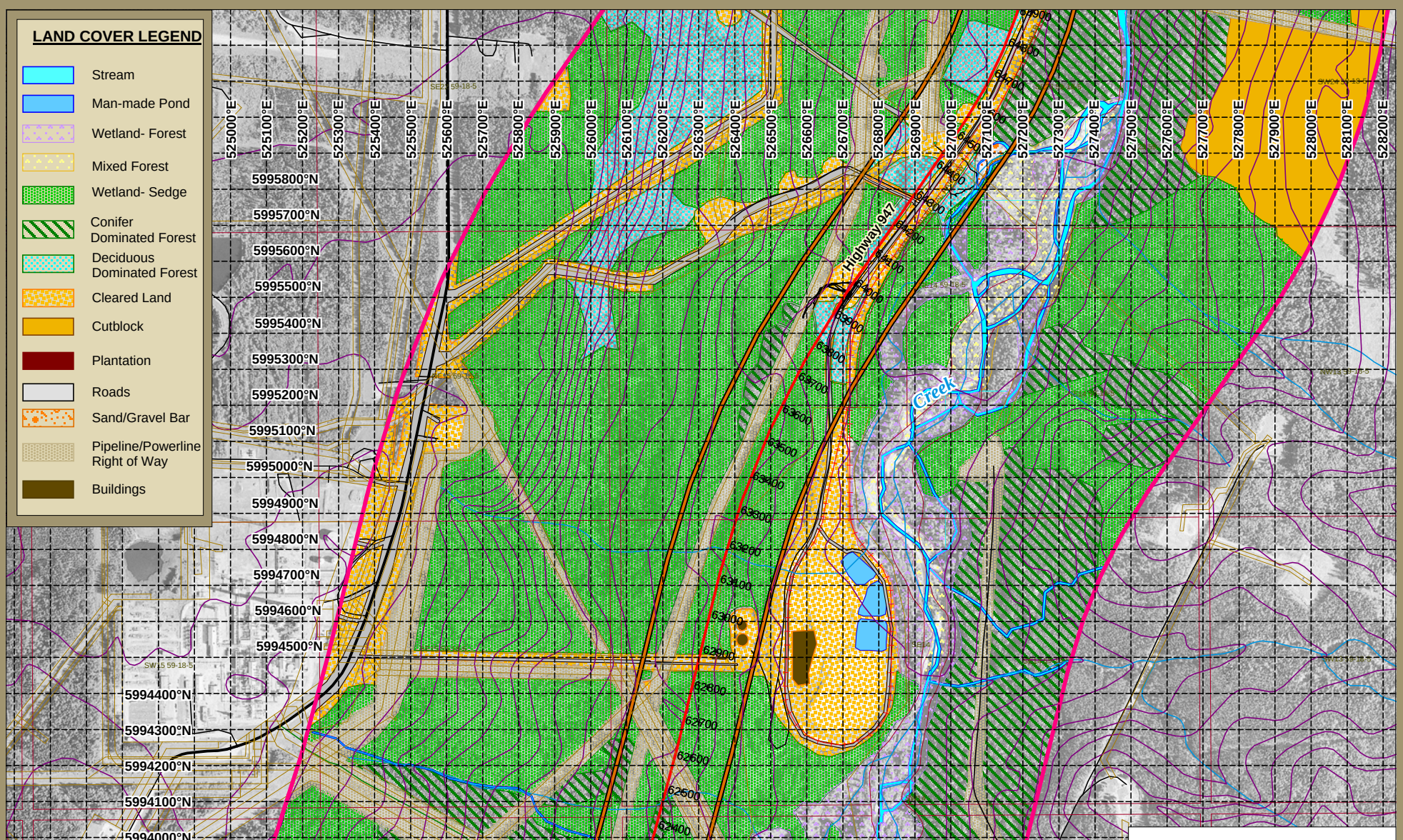
Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

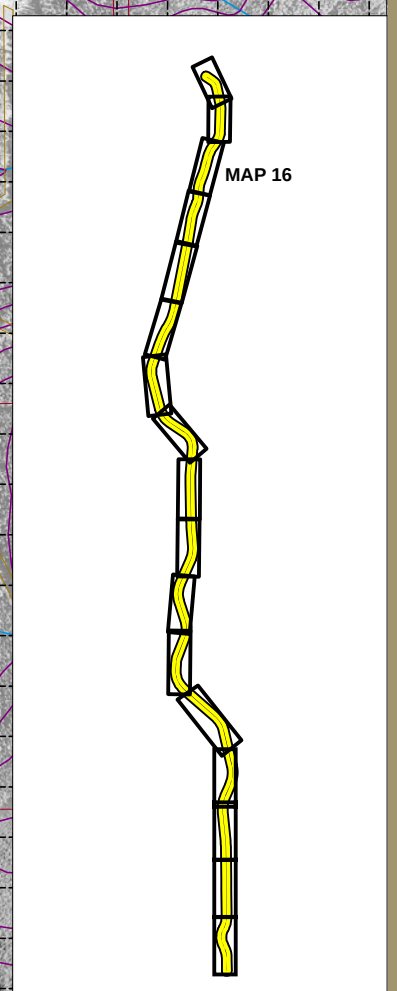
LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Railway
- AT Roads
- Paved Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance along Centerline

LAND COVER LEGEND

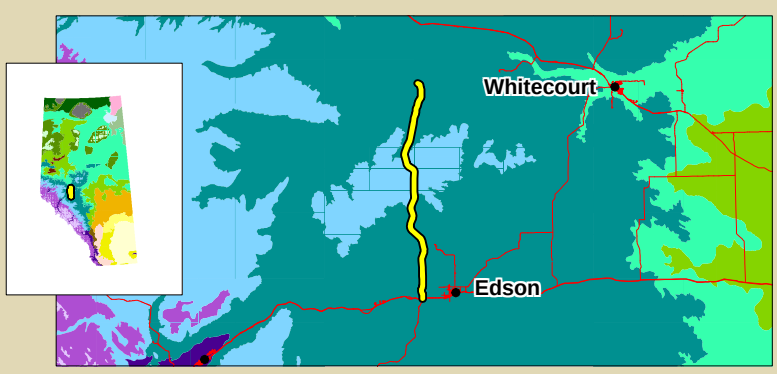
- Stream
- Man-made Pond
- Wetland- Forest
- Mixed Forest
- Wetland- Sedge
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Sand/Gravel Bar
- Pipeline/Powerline Right of Way
- Buildings





Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 17

150 0 150 300 450

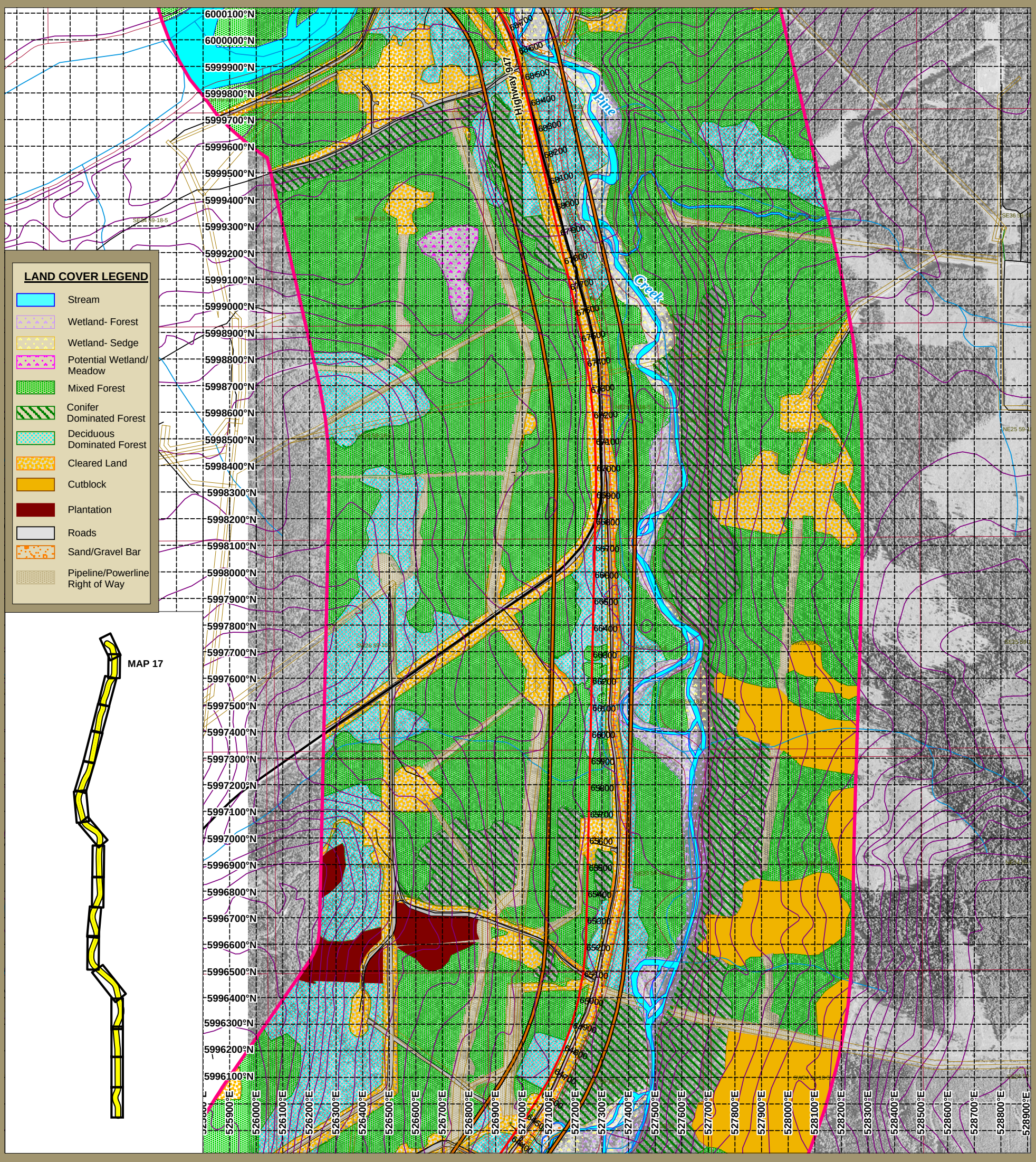
Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Sections
- Railway
- AT Roads
- Paved Roads
- Roads - Gravel/Unimproved/ Unclassified
- **0+100** Distance along Centerline

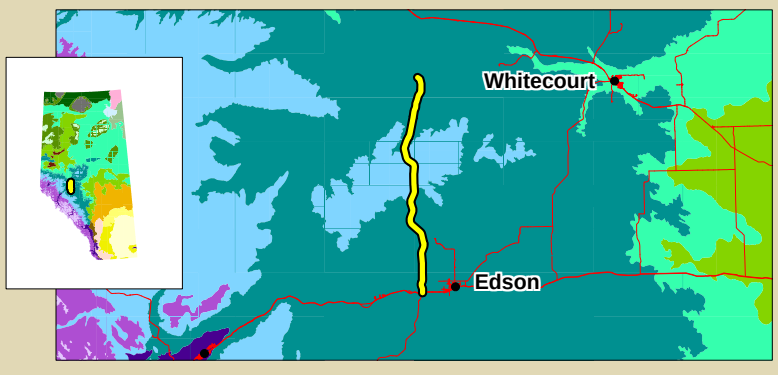


LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Cutblock
- Plantation
- Roads
- Sand/Gravel Bar
- Pipeline/Powerline Right of Way

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947- LAND COVER MAP 18

150 0 150 300 450

Meters

Scale: 1:15,000

Date: August 2013
Projection: 3TM117 NAD 83
(Grid - UTM Zone 11, NAD83)

LEGEND

- Core Study Area
- Local Study Area
- Utility Right of Ways - Gas/Oil Pipeline/Meter Stations/ Fibre Optics/Transmission
- Railway
- Streams
- Contours
- Proposed Highway 947 Alignment
- Legal Lot Lines
- Legal Sections
- AT Roads
- Paved Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- **0+100** Distance along Centerline

LAND COVER LEGEND

- Stream
- Wetland- Forest
- Wetland- Sedge
- Potential Wetland/ Meadow
- Mixed Forest
- Conifer Dominated Forest
- Deciduous Dominated Forest
- Cleared Land
- Roads
- Sand/Gravel Bar
- Pipeline/Powerline Right of Way

Marsh Head Creek

Athabasca River

Highway 47

Pine Creek

MAP 18

Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills

Whitecourt

Edson

ECOFOR
natural and cultural resource consultants

Appendix 6. Plant Species Recorded from the Project Area

Common Name	Latin Name	Conservation Rank		Tracked by ACIMS
		Alberta	Global	
Order Apiales Family Apiaceae				
blunt-fruited sweet cicely	*Osmorhiza chilensis*	S4	G5	N
cow parsnip	*Heracleum lanatum*	S5	G5	N
heart-leaved Alexanders	*Zizia aptera*	S5	G5	N
spreading sweet cicely	*Osmorhiza depauperata*	S5	G5	N
devil's-club	*Oplopanax horridus*	S3	G4G5	N
wild sarsaparilla	*Aralia nudicaulis*	S5	G5	N
Order Arales Family Lemnaceae				
common duckweed	*Lemna minor*	S5	G5	N
Order Asterales Family Asteraceae				
annual hawk's-beard	*Crepis tectorum*	SNA	GNR	N
arrow-leaved coltsfoot	*Petasites frigidus var. sagittatus*	S5	G5	N
balsam groundsel	*Senecio pauperculus*	S5	G5	N
broad-leaved everlasting	*Antennaria neglecta*	S5	G5	N
brook ragwort	*Senecio triangularis*	S4	G5	N
Canada goldenrod	*Solidago canadensis*	S5	G5	N
coltsfoot	*Petasites frigidus*	S5	G5	N
common dandelion	*Taraxacum officinale*	SNA	G5	N
common groundsel	*Senecio vulgaris*	SNA	GNR	N
common tansy	*Tanacetum vulgare*	SNA	GNR	N
common yarrow	*Achillea millefolium*	S5	G5	N
creeping thistle	*Cirsium arvense*	SNA	GNR	N
cut-leaved ragwort	*Senecio eremophilus*	S5	G5	N
Drummond's thistle	*Cirsium drummondii*	S5	G5	N
heart-leaved arnica	*Arnica cordifolia*	S5	G5	N
large northern aster	*Aster modestus*	S5	G5	N
leafy arnica	*Arnica chamissonis*	S5	G5	N
Lindley's aster	*Aster ciliolatus*	S5	G5	N
many-flowered yarrow	*Achillea sibirica*	S5	G5?	N
marsh aster	*Aster borealis*	S5	G5	N
meadow hawkweed	*Hieracium caespitosum*	SNA	GNR	N
narrow-leaved hawkweed	*Hieracium umbellatum*	S5	G5	N
ox-eye daisy	*Chrysanthemum leucanthemum*	SNA	GNR	N
palmate-leaved coltsfoot	*Petasites frigidus var. palmatus*	S5	G5T5	N
pearly everlasting	*Anaphalis margaritacea*	S4	G5	N
pineappleweed	*Matricaria matricarioides*	SNA	G5	N
prickly annual sow-thistle	*Sonchus asper*	SNA	GNR	N
purple-stemmed aster	*Aster puniceus*	S4	G5	N
showy everlasting	*Antennaria pulcherrima*	S4	G5	N
small-leaved everlasting	*Antennaria parvifolia*	S5	G5	N
smooth aster	*Aster laevis*	S5	G5	N

Common Name	Latin Name	Conservation Rank		Tracked by ACIMS
		Alberta	Global	
smooth perennial sow-thistle	*Sonchus uliginosus*	SNA	GNRTNR	N
tall blue lettuce	*Lactuca biennis*	S2	G5	Y
Tartarian lettuce	*Lactuca tatarica*	SU	G5	N
Order Bryales Family Aulacomniaceae				
tufted moss	*Aulacomnium palustre*	S5	G5	N
Order Callitrichales Family Callitrichaceae				
vernal water-starwort	*Callitriche verna*	S5	G5	N
Order Callitrichales Family Hippuridaceae				
common mare's-tail	*Hippuris vulgaris*	S5	G5	N
Order Campanulales Family Campanulaceae				
harebell	*Campanula rotundifolia*	S5	G5	N
Order Capparales Family Brassicaceae				
bitter cress	*Cardamine pensylvanica*	S5	G5	N
lyre-leaved rock cress	*Arabis lyrata*	S4	G5	N
shepherd's-purse	*Capsella bursa-pastoris*	SNA	GNR	N
stinkweed	*Thlaspi arvense*	SNA	GNR	N
wormseed mustard	*Erysimum cheiranthoides*	S5	G5	N
Order Caryophyllales Family Caryophyllaceae				
common chickweed	*Stellaria media*	SNA	GNR	N
common mouse-ear chickweed	*Cerastium vulgatum*	SNA	GNR	N
fleshy stitchwort	*Stellaria crassifolia*	S5	G5	N
long-leaved chickweed	*Stellaria longifolia*	S5	G5	N
long-stalked chickweed	*Stellaria longipes*	S5	G5	N
long-stalked mouse-ear chickweed	*Cerastium nutans*	S4	G5	N
northern stitchwort	*Stellaria calycantha*	S5	G5	N
lamb's-quarters	*Chenopodium album*	SNA	G5	N
strawberry blite	*Chenopodium capitatum*	S5	G5	N
Order Cornales Family Cornaceae				
bunchberry	*Cornus canadensis*	S5	G5	N
red-osier dogwood	*Cornus stolonifera*	S5	G5	N
Order Cyperales Family Cyperaceae				
awned sedge	*Carex atherodes*	S5	G5	N
Bebb's sedge	*Carex bebbii*	S4	G5	N
bristle-stalked sedge	*Carex leptalea*	S5	G5	N
close-sheathed cotton grass	*Eriophorum brachyantherum*	S3	G5	N
common great bulrush	*Schoenoplectus tabernaemontani*	S5	G5	N
Crawford's sedge	*Carex crawfordii*	S5	G5	N
few-flowered sedge	*Carex pauciflora*	S3	G5	N
golden sedge	*Carex aurea*	S5	G5	N
hoary sedge	*Carex canescens*	S5	G5	N

Common Name	Latin Name	Conservation Rank		Tracked
		Alberta	Global	by ACIMS
mud sedge	*Carex limosa*	S4	G5	N
northern bog sedge	*Carex gynocrates*	S5	G5	N
sheathed cotton grass	*Eriophorum vaginatum*	S5	G5	N
small bottle sedge	*Carex utriculata*	S5	G5	N
small-fruited bulrush	*Scirpus microcarpus*	S5	G5	N
thick-spike sedge	*Carex macloviana*	S3	G5	N
thin-leaved cotton grass	*Eriophorum viridi-carinatum*	S4	G5	N
two-seeded sedge	*Carex disperma*	S5	G5	N
two-stamened sedge	*Carex diandra*	S5	G5	N
water sedge	*Carex aquatilis*	S5	G5	N
wool-grass	*Scirpus cyperinus*	S3	G5	N
Order Cyperales Family Poaceae				
awnless brome	*Bromus inermis*	S5	G5	N
bluebunch fescue	*Festuca idahoensis*	S4	G5	N
bluejoint	*Calamagrostis canadensis*	S5	G5	N
common tall manna grass	*Glyceria grandis*	S5	G5	N
crested wheatgrass	*Agropyron cristatum*	SNA	G5	N
drooping wood-reed	*Cinna latifolia*	S4	G5	N
fowl bluegrass	*Poa palustris*	S5	G5	N
fowl manna grass	*Glyceria striata*	S4	G5	N
foxtail barley	*Hordeum jubatum*	S5	G5	N
fringed brome	*Bromus ciliatus*	S5	G5	N
narrow reed grass	*Calamagrostis stricta*	S4	G5T5	N
northern reed grass	*Calamagrostis inexpansa*	S5	G5T5	N
purple oat grass	*Schizachne purpurascens*	S5	G5	N
reed canary grass	*Phalaris arundinacea*	S5	G5	N
rough hair grass	*Agrostis scabra*	S5	G5	N
short-awned foxtail	*Alopecurus aequalis*	S5	G5	N
slender wheatgrass	*Elymus trachycaulus*	S5	G5	N
slough grass	*Beckmannia syzigachne*	S5	G5	N
smooth wild rye	*Elymus glaucus*	S3	G5	N
timothy	*Phleum pratense*	SNA	GNR	N
white-grained mountain rice grass	*Oryzopsis asperifolia*	S4	G5	N
Order Dipsacales Family Caprifoliaceae				
bracted honeysuckle	*Lonicera involucrata*	S5	G5T4T5	N
buckbrush	*Symphoricarpos occidentalis*	S5	G5	N
low-bush cranberry	*Viburnum edule*	S5	G5	N
red elderberry	*Sambucus racemosa*	S4	G5	N
snowberry	*Symphoricarpos albus*	S5	G5	N
twinflower	*Linnaea borealis*	S5	G5	N
twining honeysuckle	*Lonicera dioica*	S5	G5	N
Order Dipsacales Family Valerianaceae				
northern valerian	*Valeriana dioica*	S5	G5	N
Order Equisetales Family Equisetaceae				

Common Name	Latin Name	Conservation Rank		Tracked by ACIMS
		Alberta	Global	
common horsetail	*Equisetum arvense*	S5	G5	N
common scouring-rush	*Equisetum hyemale*	S5?	G5	N
dwarf scouring-rush	*Equisetum scirpoides*	S5	G5	N
marsh horsetail	*Equisetum palustre*	S5	G5	N
meadow horsetail	*Equisetum pratense*	S5	G5	N
swamp horsetail	*Equisetum fluviatile*	S5	G5	N
variegated horsetail	*Equisetum variegatum*	S5	G5	N
woodland horsetail	*Equisetum sylvaticum*	S5	G5	N
crowberry	*Empetrum nigrum*	S5	G5	N
Order Ericales Family Ericaceae				
bog cranberry	*Vaccinium vitis-idaea*	S5	G5	N
bog rosemary	*Andromeda polifolia*	S5	G5	N
common bearberry	*Arctostaphylos uva-ursi*	S5	G5	N
common blueberry	*Vaccinium myrtilloides*	S5	G5	N
common Labrador tea	*Ledum groenlandicum*	S5	G5	N
creeping snowberry	*Gaultheria hispidula*	S3	G5	N
dwarf bilberry	*Vaccinium caespitosum*	S5	G5	N
northern laurel	*Kalmia polifolia*	S3	G5	N
small bog cranberry	*Oxycoccus microcarpus*	S5	G5	N
Order Ericales Family Pyrolaceae				
common pink wintergreen	*Pyrola asarifolia*	S5	G5	N
lesser wintergreen	*Pyrola minor*	S4	G5	N
one-flowered wintergreen	*Moneses uniflora*	S5	G5	N
one-sided wintergreen	*Orthilia secunda*	S5	G5	N
Order Fabales Family Fabaceae				
alfalfa	*Medicago sativa*	SNA	GNR	N
alpine hedysarum	*Hedysarum alpinum*	S5	G5	N
alsike clover	*Trifolium hybridum*	SNA	GNR	N
American milk vetch	*Astragalus americanus*	S5	G5	N
bird's-foot trefoil	*Lotus corniculatus*	SNA	GNR	N
black medick	*Medicago lupulina*	SNA	GNR	N
Canadian milk vetch	*Astragalus canadensis*	S4	G5	N
cream-colored vetchling	*Lathyrus ochroleucus*	S5	G5	N
milk vetch	*Astragalus eucosmus*	S4	G5	N
northern hedysarum	*Hedysarum boreale*	S5	G5	N
purple peavine	*Lathyrus venosus*	S3	G5	N
red clover	*Trifolium pratense*	SNA	GNR	N
white clover	*Trifolium repens*	SNA	GNR	N
white sweet-clover	*Melilotus alba*	SNA	G5	N
wild vetch	*Vicia americana*	S5	G5	N
yellow lucerne	*Medicago falcata*	SNA	GNRTNR	N
Order Fagales Family Betulaceae				
alder	*Alnus viridis ssp. crispa*	S4S5	G5TNR	N
bog birch	*Betula glandulosa*	S5	G5	N

Common Name	Latin Name	Conservation Rank		Tracked
		Alberta	Global	by ACIMS
dwarf birch	*Betula pumila*	S5	G5	N
water birch	*Betula occidentalis*	S4	G4G5	N
white birch	*Betula papyrifera*	S4	G5	N
Order Filicales Family Dryopteridaceae				
lady fern	*Athyrium filix-femina*	S5	G5	N
oak fern	*Gymnocarpium dryopteris*	S5	G5	N
ostrich fern	*Matteuccia struthiopteris*	S3	G5	N
Order Gentianales Family Gentianaceae				
felwort	*Gentianella amarella*	S5	G5	N
spurred gentian	*Halenia deflexa*	S4	G5	N
Order Geraniales Family Balsaminaceae				
spotted touch-me-not	*Impatiens capensis*	S4	G5	N
western jewelweed	*Impatiens noli-tangere*	S3	G4G5	N
Order Geraniales Family Geraniaceae				
Bicknell's geranium	*Geranium bicknellii*	S5	G5	N
wild white geranium	*Geranium richardsonii*	S5	G5	N
Order Hypnales Family Entodontaceae				
Schreber's moss	*Pleurozium schreberi*	S5	G5	N
Order Hypnales Family Hylocomiaceae				
red-stemmed pipecleaner moss	*Rhytidiadelphus triquetrus*	S3S4	G5	N
stair-step moss	*Hylocomium splendens*	S5	G5	N
Order Hypnales Family Hypnaceae				
knight's plume moss	*Ptilium crista-castrensis*	S5	G5	N
Order Juncales Family Juncaceae				
alpine rush	*Juncus alpinoarticulatus*	S5	G5	N
chestnut rush	*Juncus castaneus*	S3	G5	N
knotted rush	*Juncus nodosus*	S5	G5	N
small-flowered wood-rush	*Luzula parviflora*	S5	G5	N
thread rush	*Juncus filiformis*	S3	G5	N
toad rush	*Juncus bufonius*	S5	G5	N
wire rush	*Juncus balticus*	S5	G5	N
Order Lamiales Family Boraginaceae				
tall lungwort	*Mertensia paniculata*	S5	G5	N
Order Lamiales Family Lamiaceae				
giant hyssop	*Agastache foeniculum*	S4	G4G5	N
heal-all	*Prunella vulgaris*	S3	G5	N
hemp-nettle	*Galeopsis tetrahit*	SNA	GNR	N
marsh hedge-nettle	*Stachys palustris*	S5	G5	N

Common Name	Latin Name	Conservation Rank		Tracked
		Alberta	Global	by ACIMS
marsh skullcap	*Scutellaria galericulata*	S5	G5	N
wild mint	*Mentha arvensis*	S5	G5	N
Order Liliales Family Liliaceae				
clasping-leaved twisted-stalk	*Streptopus amplexifolius*	S5	G5	N
fairybells	*Disporum trachycarpum*	S5	G5	N
false Solomon's-seal	*Smilacina racemosa*	S5	G5	N
star-flowered Solomon's-seal	*Smilacina stellata*	S5	G5	N
sticky false asphodel	*Tofieldia glutinosa*	S5	G5	N
three-leaved Solomon's-seal	*Smilacina trifolia*	S5	G5	N
western wood lily	*Lilium philadelphicum*	S5	G5	N
white camas	*Zigadenus elegans*	S5	G5	N
wild lily-of-the-valley	*Maianthemum canadense*	S5	G5	N
Order Lycopodiales Family Lycopodiaceae				
ground-pine	*Lycopodium obscurum*	S4	G5	N
round-branched tree-clubmoss	*Lycopodium dendroideum*	SNR	G5	N
running club-moss	*Lycopodium clavatum*	S3	G5	N
stiff club-moss	*Lycopodium annotinum*	S5	G5	N
Order Myrtales Family Onagraceae				
broad-leaved fireweed	*Epilobium latifolium*	S4	G5	N
common fireweed	*Epilobium angustifolium*	S5	G5	N
marsh willowherb	*Epilobium palustre*	S3	G5	N
small enchanter's nightshade	*Circaea alpina*	S4	G5	N
Order Najadales Family Juncaginaceae				
seaside arrow-grass	*Triglochin maritima*	S5	G5	N
Order Najadales Family Potamogetonaceae				
various-leaved pondweed	*Potamogeton gramineus*	S4	G5	N
Order Nepenthales Family Droseraceae				
oblong-leaved sundew	*Drosera anglica*	S3	G5	N
round-leaved sundew	*Drosera rotundifolia*	S5	G5	N
Order Ophioglossales Family Ophioglossaceae				
moonwort	*Botrychium lunaria*	S4S5	G5	N
northwestern grapefern	*Botrychium pinnatum*	S3	G4?	Y
Virginia grape fern	*Botrychium virginianum*	S4S5	G5	N
Order Orchidales Family Orchidaceae				
heart-leaved twayblade	*Listera cordata*	S4	G5	N
hooded ladies'-tresses	*Spiranthes romanzoffiana*	S5	G5	N
lesser rattlesnake plantain	*Goodyera repens*	S5	G5	N
northern green bog orchid	*Platanthera hyperborea*	S5	G5	N
pale coralroot	*Corallorhiza trifida*	S5	G5	N
round-leaved bog orchid	*Platanthera orbiculata*	S3	G5	N

Common Name	Latin Name	Conservation Rank		Tracked by ACIMS
		Alberta	Global	
round-leaved orchid	*Amerorchis rotundifolia*	S5	G5	N
spotted coralroot	*Corallorhiza maculata*	S3	G5	N
Order Papaverales Family Fumariaceae				
golden corydalis	*Corydalis aurea*	S5	G5	N
pink corydalis	*Corydalis sempervirens*	S5	G4G5	N
Order Pinales Family Pinaceae				
balsam fir	*Abies balsamea*	S5	G5	N
black spruce	*Picea mariana*	S5	G5	N
jack pine	*Pinus banksiana*	S5	G5	N
lodgepole pine	*Pinus contorta*	S5	G5	N
tamarack	*Larix laricina*	S5	G5	N
white spruce	*Picea glauca*	S5	G5	N
Order Plantaginales Family Plantaginaceae				
common plantain	*Plantago major*	SNA	G5	N
Order Polygonales Family Polygonaceae				
alpine bistort	*Polygonum viviparum*	S5	G5	N
curled dock	*Rumex crispus*	SNA	GNR	N
golden dock	*Rumex maritimus*	S5	G5	N
western dock	*Rumex occidentalis*	S5	G5T5	N
common hair-cap moss	*Polytrichum commune*	S5	G5	N
juniper hair-cap moss	*Polytrichum juniperinum*	S5	G5	N
Order Proteales Family Elaeagnaceae				
Canada buffaloberry	*Shepherdia canadensis*	S5	G5	N
Order Ranunculales Family Ranunculaceae				
blue columbine	*Aquilegia brevistyla*	S5	G5	N
bristly buttercup	*Ranunculus pensylvanicus*	S3	G5	N
celery-leaved buttercup	*Ranunculus sceleratus*	S5	G5	N
Lapland buttercup	*Ranunculus lapponicus*	S4	G5	N
large-leaved white water crowfoot	*Ranunculus aquatilis*	S5	G5	N
Macoun's buttercup	*Ranunculus macounii*	S5	G5	N
marsh-marigold	*Caltha palustris*	S5	G5	N
purple clematis	*Clematis occidentalis*	S5	G5	N
red and white baneberry	*Actaea rubra*	S5	G5	N
tall buttercup	*Ranunculus acris*	SNA	G5	N
tall larkspur	*Delphinium glaucum*	S5	G5	N
veiny meadow rue	*Thalictrum venulosum*	S5	G5	N
yellow anemone	*Anemone richardsonii*	S3	G5	N
yellow water crowfoot	*Ranunculus gmelinii*	S5	G5	N
Order Rosales Family Grossulariaceae				
bristly black currant	*Ribes lacustre*	S5	G5	N
northern black currant	*Ribes hudsonianum*	S5	G5	N

Common Name	Latin Name	Conservation Rank		Tracked
		Alberta	Global	by ACIMS
northern gooseberry	*Ribes oxyacanthoides*	S5	G5	N
skunk currant	*Ribes glandulosum*	S5	G5	N
wild black currant	*Ribes americanum*	S4	G5	N
wild red currant	*Ribes triste*	S5	G5	N
Order Rosales Family Rosaceae				
cloudberry	*Rubus chamaemorus*	S5	G5	N
dewberry	*Rubus pubescens*	S5	G5	N
dwarf bramble	*Rubus pedatus*	S4	G5	N
dwarf raspberry	*Rubus arcticus*	S5	G5	N
large-leaved yellow avens	*Geum macrophyllum*	S5	G5	N
marsh cinquefoil	*Potentilla palustris*	S5	G5	N
prickly rose	*Rosa acicularis*	S5	G5	N
purple avens	*Geum rivale*	S5	G5	N
rough cinquefoil	*Potentilla norvegica*	S5	G5	N
saskatoon	*Amelanchier alnifolia*	S5	G5	N
western mountain-ash	*Sorbus scopulina*	S4	G5	N
wild red raspberry	*Rubus idaeus*	S5	G5	N
wild strawberry	*Fragaria virginiana*	S5	G5	N
woodland strawberry	*Fragaria vesca*	S4	G5	N
yellow avens	*Geum aleppicum*	S5	G5	N
Order Rosales Family Saxifragaceae				
bishop's-cap	*Mitella nuda*	S5	G5	N
golden saxifrage	*Chrysosplenium iowense*	S3?	G3?	Y
green saxifrage	*Chrysosplenium tetrandrum*	S3S4	G5	N
laceflower	*Tiarella trifoliata*	S3	G5	N
northern grass-of-parnassus	*Parnassia palustris*	S5	G5	N
Order Rubiales Family Rubiaceae				
Labrador bedstraw	*Galium labradoricum*	S3	G5	N
northern bedstraw	*Galium boreale*	S5	G5	N
sweet-scented bedstraw	*Galium triflorum*	S5	G5	N
Order Leucodontales Family Climaciaceae				
	Climacium dendroides	S4	G5	N
Order Salicales Family Salicaceae				
aspen	*Populus tremuloides*	S5	G5	N
balsam poplar	*Populus balsamifera*	S5	G5	N
beaked willow	*Salix bebbiana*	S5	G5	N
bog willow	*Salix pedicellaris*	S4	G5	N
hoary willow	*Salix candida*	S4	G5	N
myrtle-leaved willow	*Salix myrtillifolia*	S5	G5	N
sandbar willow	*Salix exigua*	S5	G5	N
shrubby willow	*Salix arbusculoides*	S4	G5	N
Order Santalales Family Santalaceae				

Common Name	Latin Name	Conservation Rank		Tracked
		Alberta	Global	by ACIMS
northern bastard toadflax	*Geocaulon lividum*	S5	G5	N
Order Scrophulariales Family Lentibulariaceae				
common butterwort	*Pinguicula vulgaris*	S3	G5	N
flat-leaved bladderwort	*Utricularia intermedia*	S4	G5	N
small bladderwort	*Utricularia minor*	S4	G5	N
small butterwort	*Pinguicula villosa*	S2	G4	Y
Order Scrophulariales Family Scrophulariaceae				
American brooklime	*Veronica americana*	S5	G5	N
common red paintbrush	*Castilleja miniata*	S5	G5	N
cow-wheat	*Melampyrum lineare*	S3	G5	N
elephant's-head	*Pedicularis groenlandica*	S5	G5	N
hairy speedwell	*Veronica peregrina*	S5	G5	N
Labrador lousewort	*Pedicularis labradorica*	S5	G5	N
swamp lousewort	*Pedicularis parviflora*	S3	G4	N
yellow rattle	*Rhinanthus minor*	S4	G5	N
Order Solanales Family Menyanthaceae				
buck-bean	*Menyanthes trifoliata*	S5	G5	N
Order Sphagnales Family Sphagnaceae				
Girgensohn's moss	*Sphagnum girgensohnii*	S3	G5	N
Order Typhales Family Typhaceae				
common cattail	*Typha latifolia*	S5	G5	N
Order Urticales Family Urticaceae				
common nettle	*Urtica dioica*	S5	G5	N
Order Violales Family Violaceae				
bog violet	*Viola nephrophylla*	S4	G5	N
early blue violet	*Viola adunca*	S5	G5	N
kidney-leaved violet	*Viola renifolia*	S5	G5	N
marsh violet	*Viola palustris*	S4	G5	N
western Canada violet	*Viola canadensis*	S5	G5	N

Appendix 7. Field verified wetlands within 150m of centreline

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 1

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

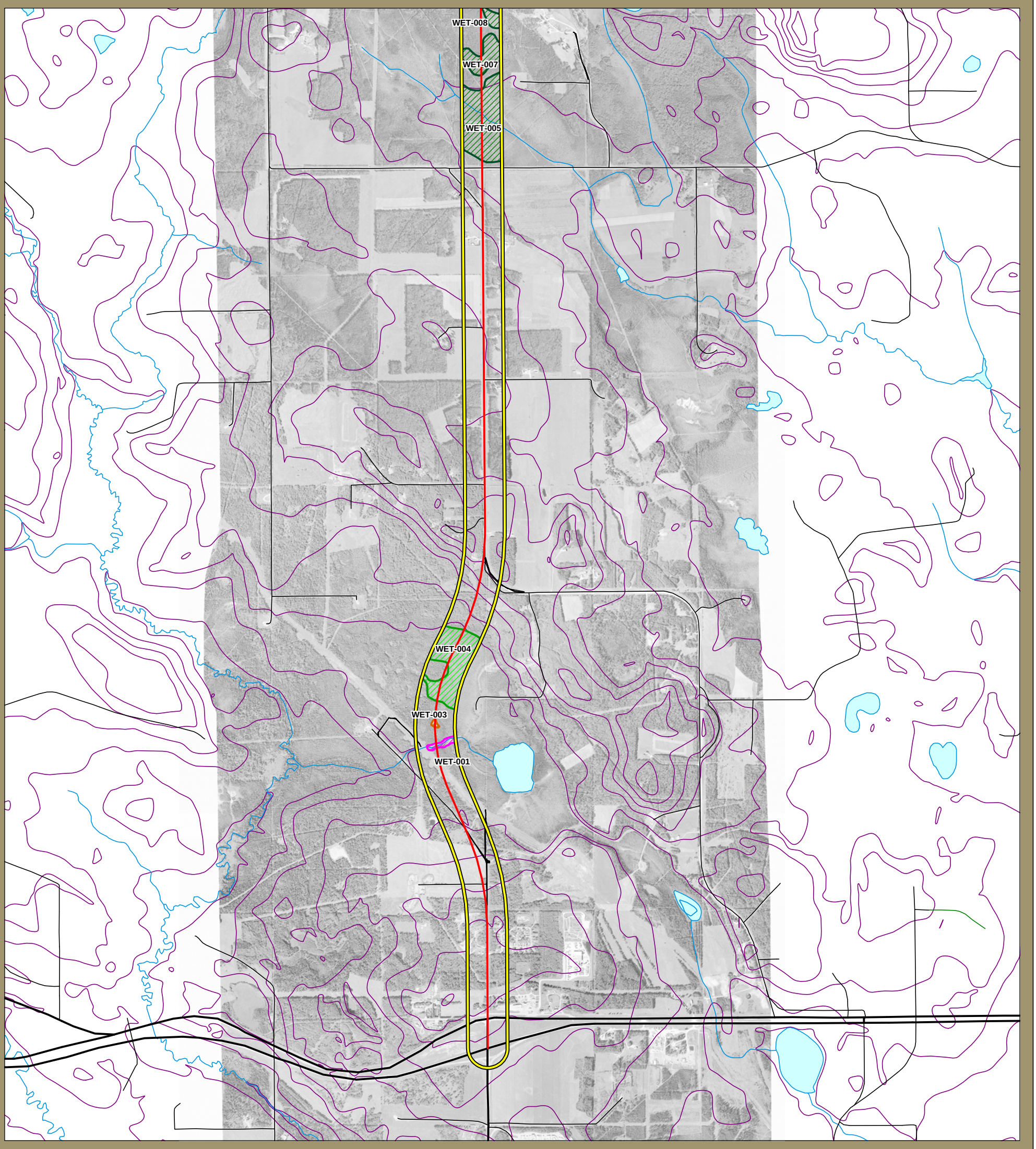
300 0 300 600 900

Meters

Scale: 1:30,000

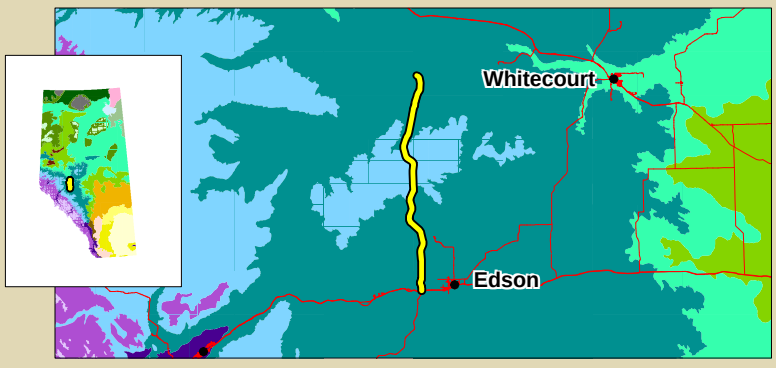
LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Waterbodies
- Streams
- Contours
- AT Roads
  - Paved Roads
  - Roads - Gravel/Unimproved/ Unclassified
  - Winter Roads
- Ecofor Identified Wetlands
  - Shallow Water
  - Marsh
  - Fen
  - Bog



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 2

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

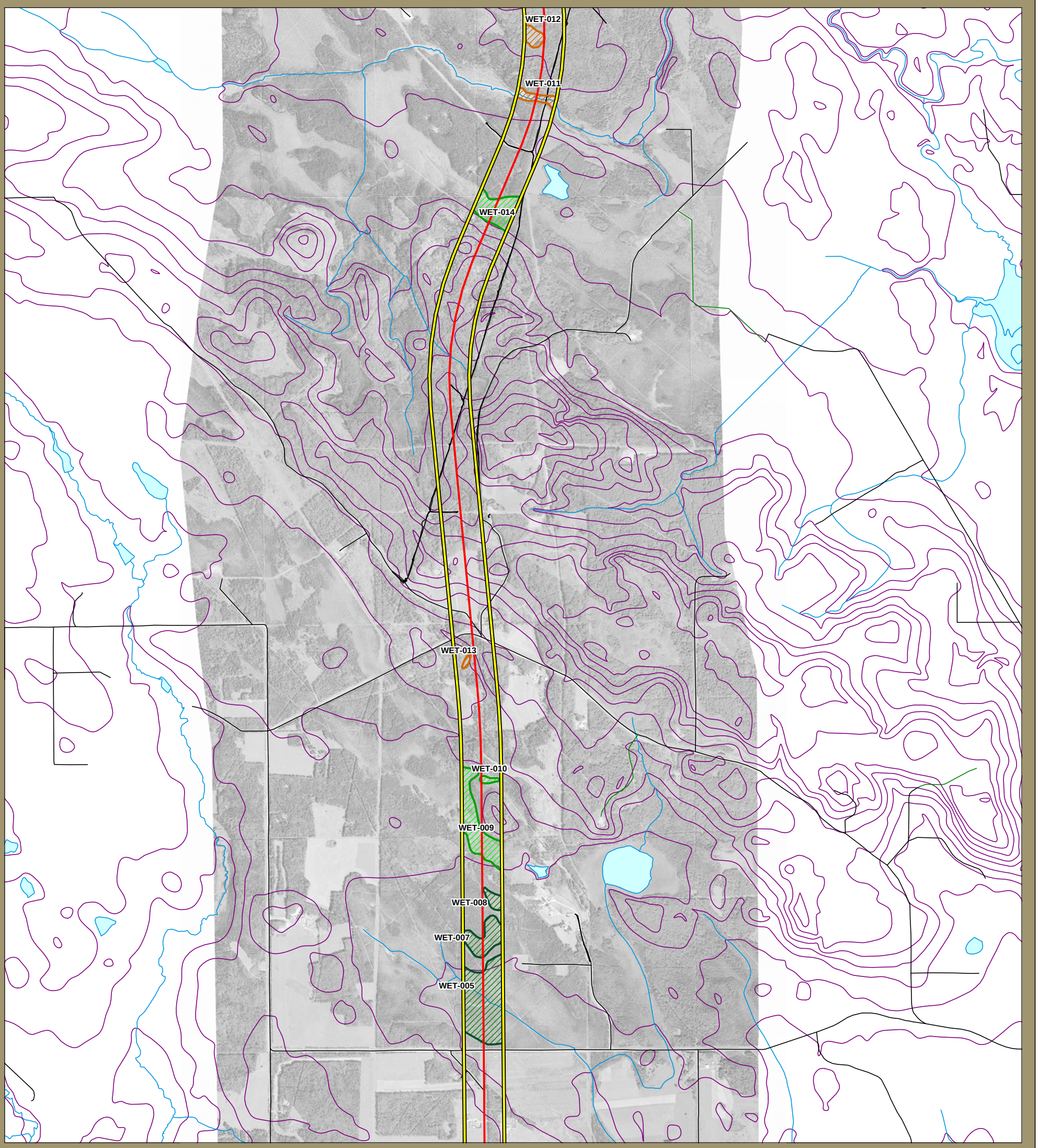
300 0 300 600 900

Meters

Scale: 1:30,000

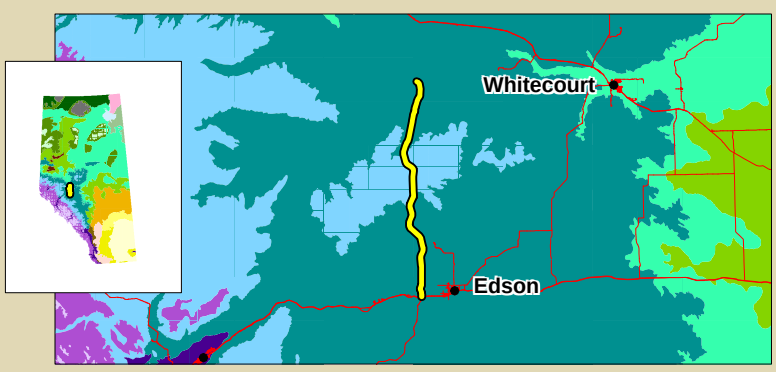
LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Waterbodies
- Streams
- Contours
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- Ecofor Identified Wetlands
  - Marsh
  - Fen
  - Bog



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 3

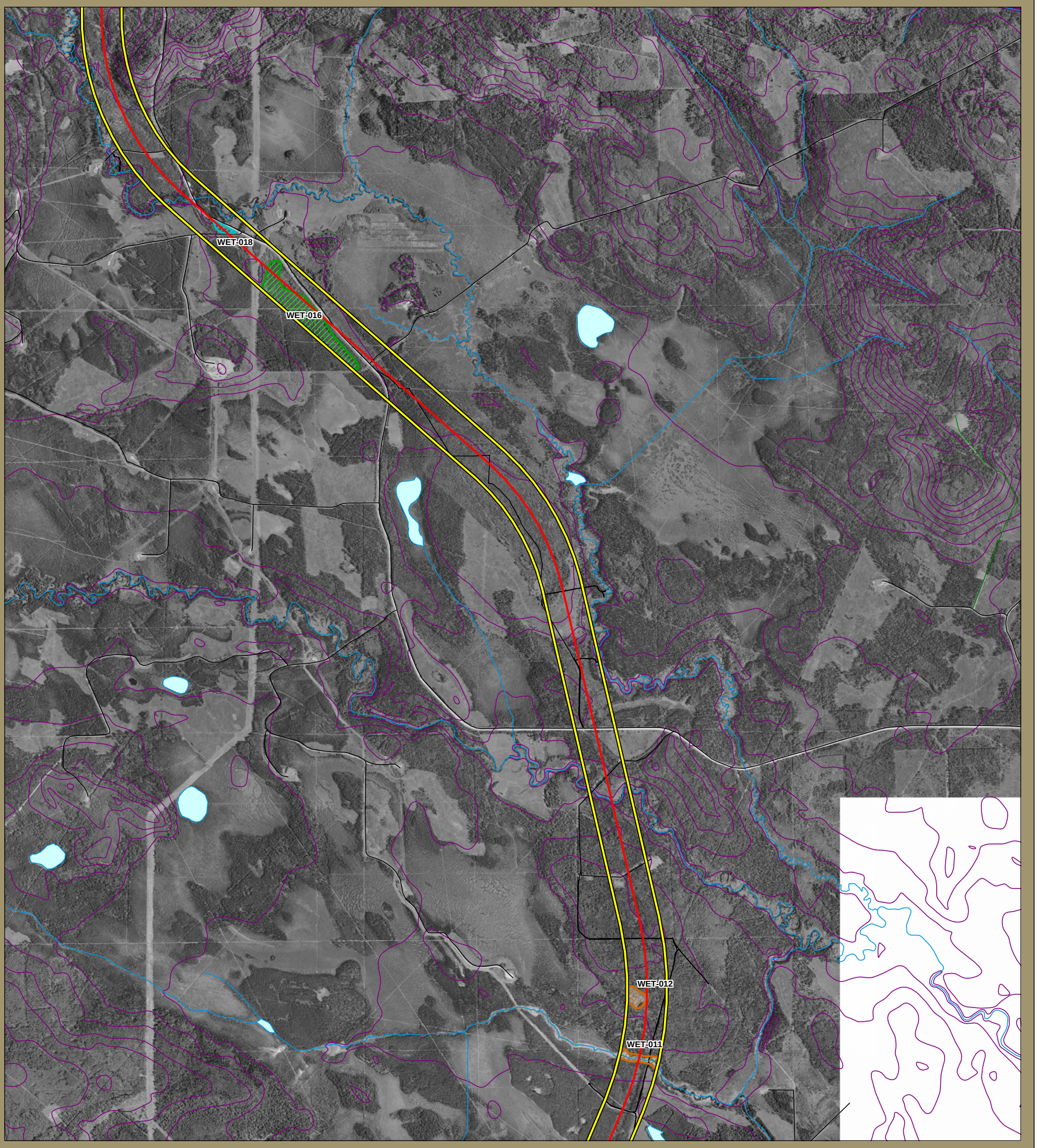
Projection: 3TM117 NAD 83
Date: March 1, 2013

N

300 0 300 600 900
Meters
Scale: 1:30,000

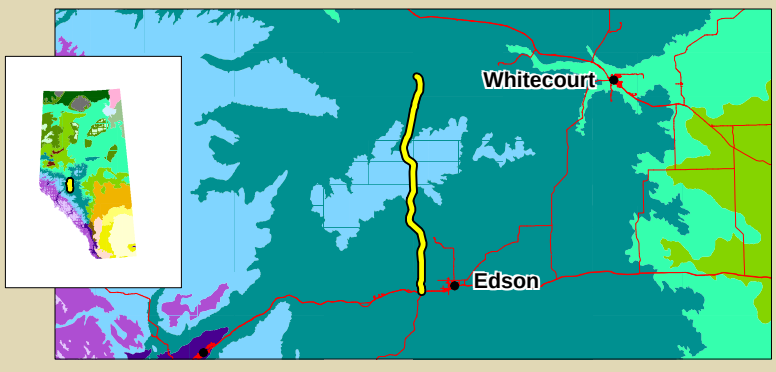
LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Waterbodies
- Streams
- Contours
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- Ecofor Identified Wetlands
  - Marsh
  - Swamp
  - Fen



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 4

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

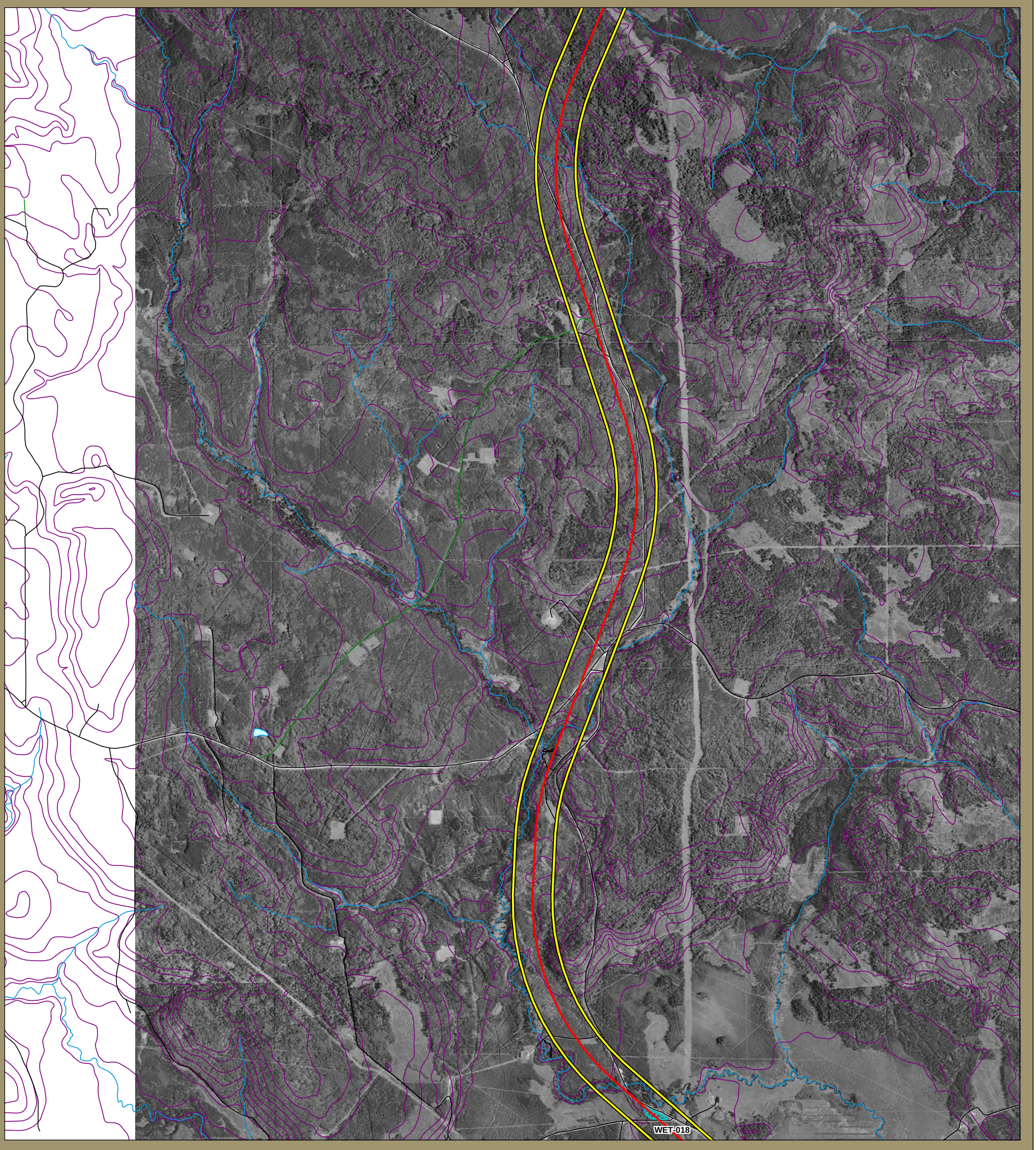
300 0 300 600 900

Meters

Scale: 1:30,000

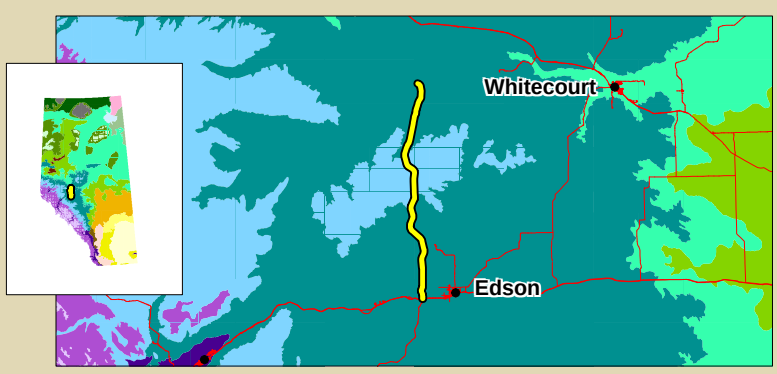
LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Waterbodies
- Streams
- Contours
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- Ecofor Identified Wetlands
- Swamp



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 5

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

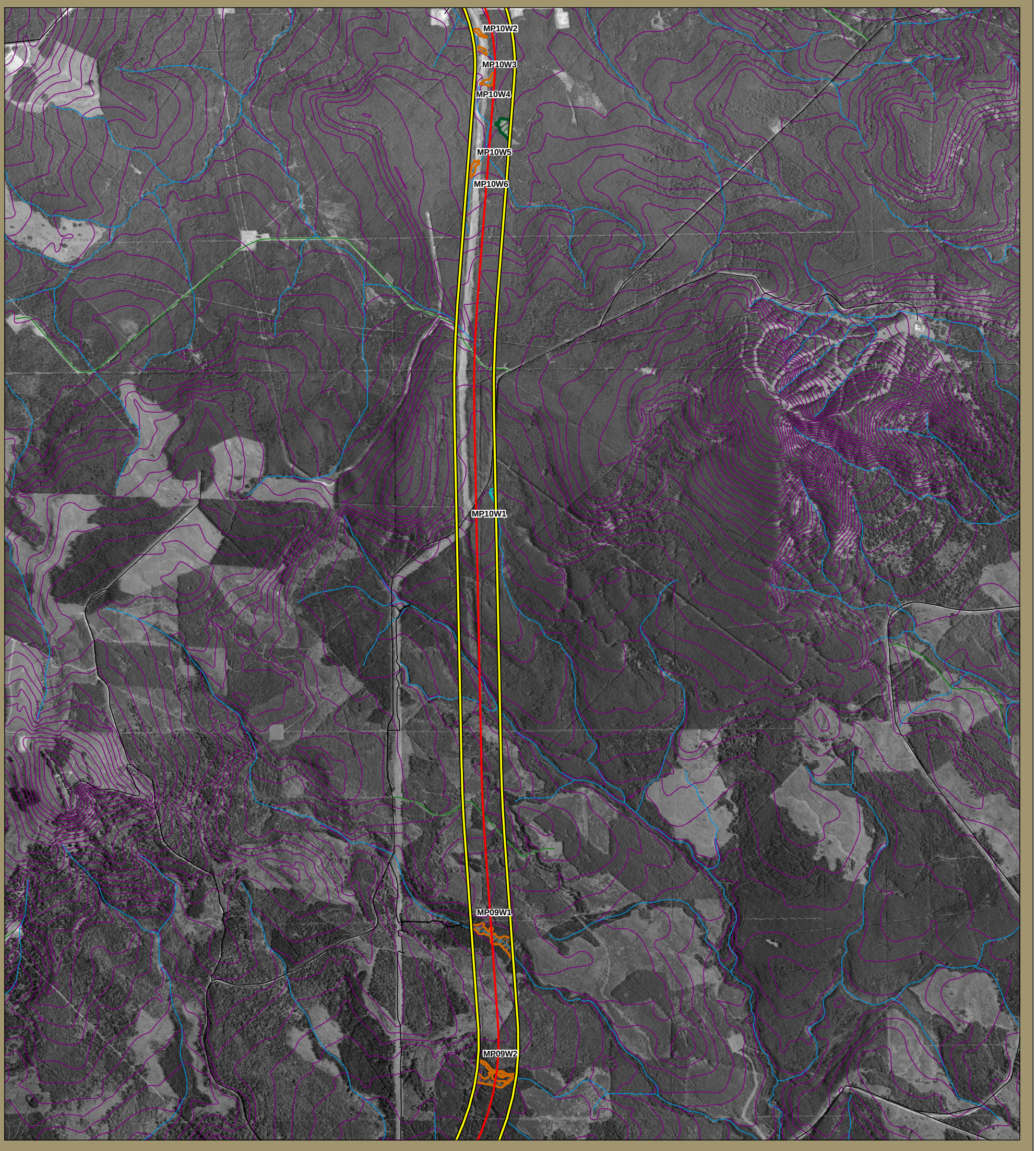
300 0 300 600 900

Meters

Scale: 1:30,000

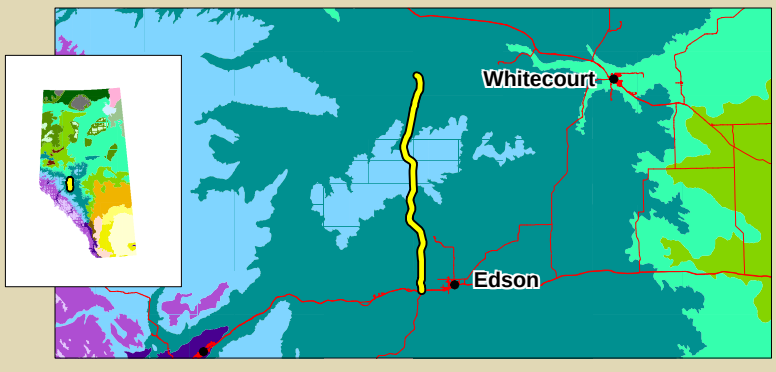
LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Streams
- Contours
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads
- Ecofor Identified Wetlands
  - Marsh
  - Swamp
  - Bog



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 6

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

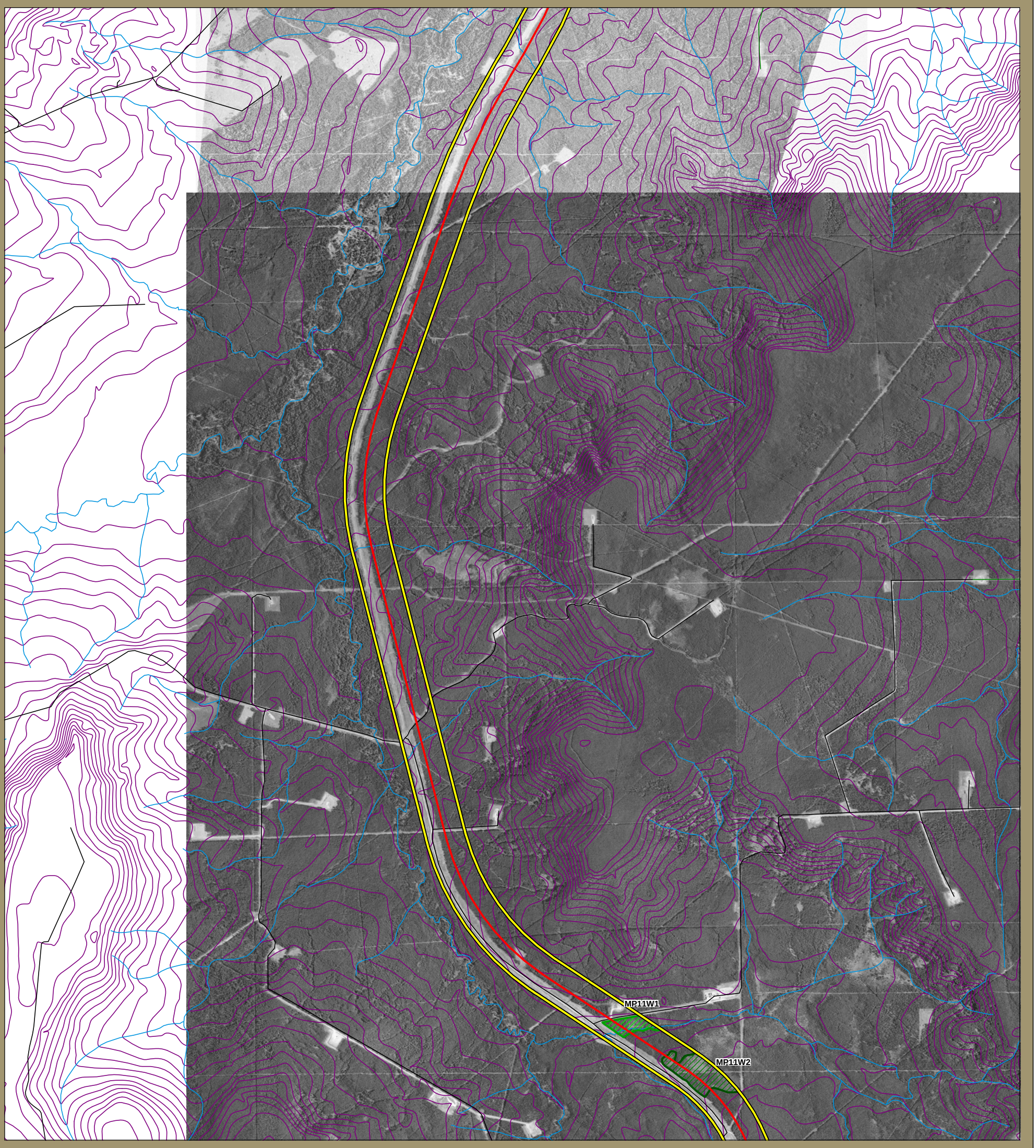
300 0 300 600 900

Meters

Scale: 1:30,000

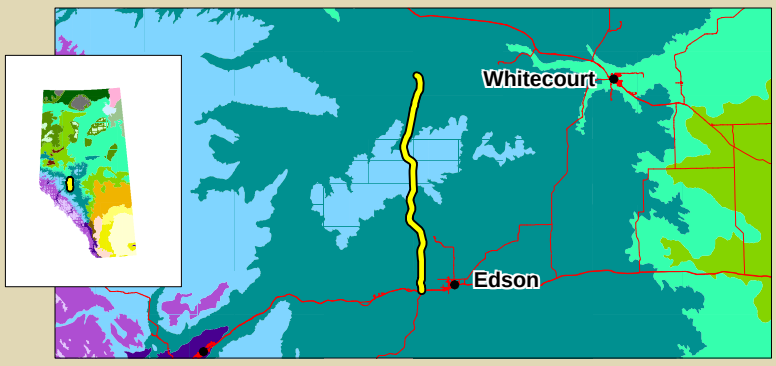
LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Streams
- Contours
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Ecofor Identified Wetlands
  - Fen
  - Bog



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 7

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

300 0 300 600 900

Meters

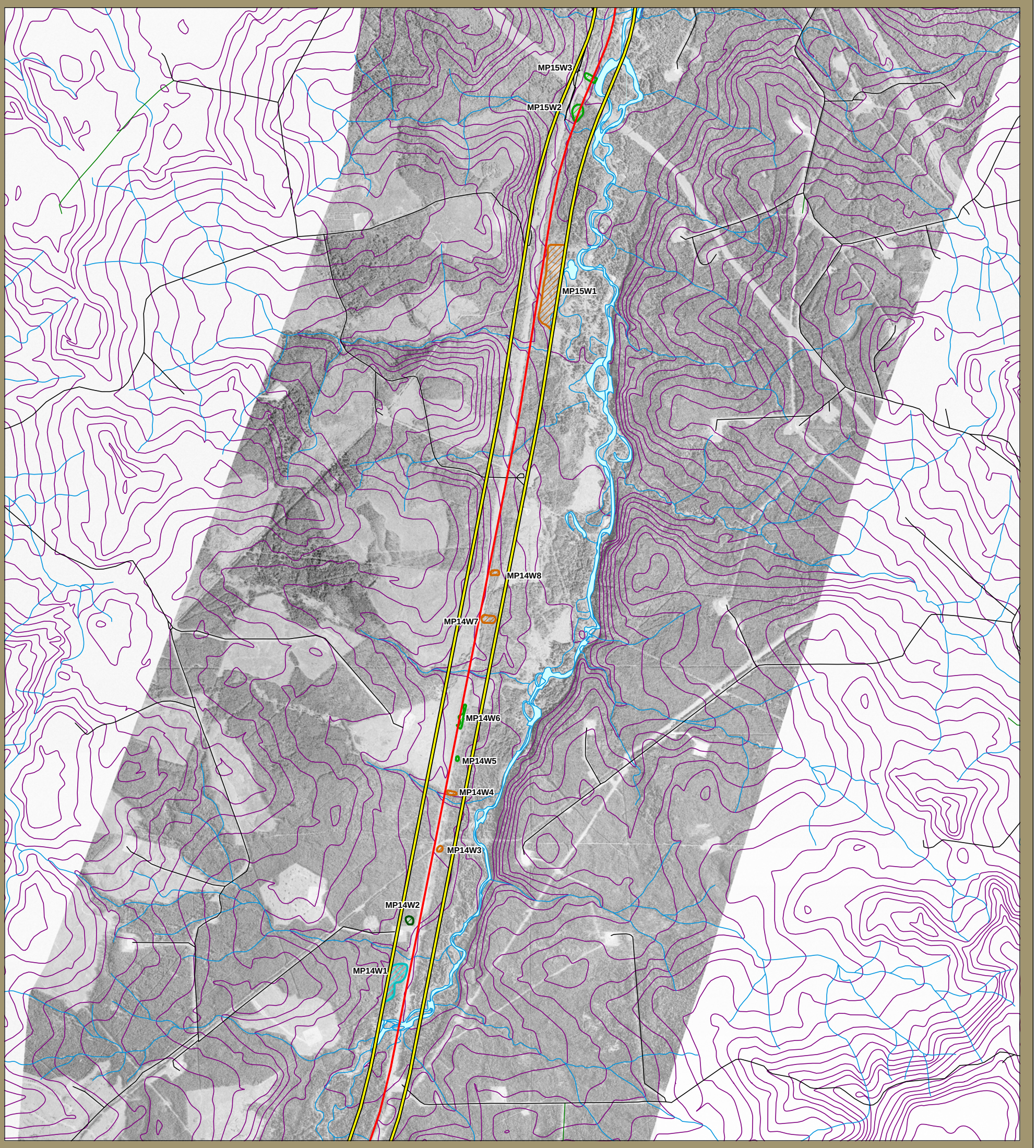
Scale: 1:30,000

LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Waterbodies
- Streams
- Contours
- AT Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads

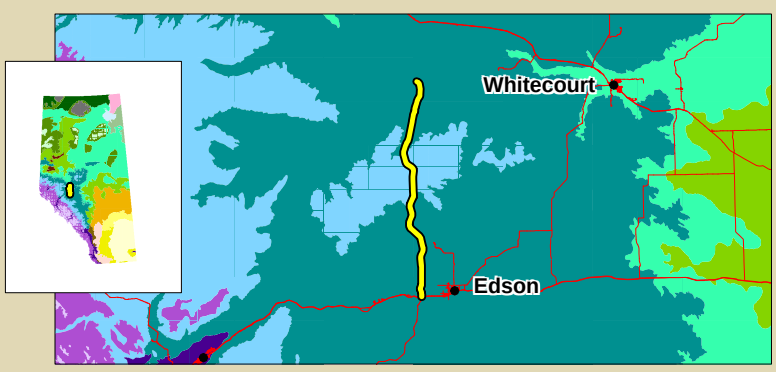
Ecofor Identified Wetlands

- Marsh
- Fen
- Swamp
- Bog



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

ALBERTA TRANSPORTATION
HIGHWAY 947 - BASELINE WETLAND AREAS - MAP 8

Projection: 3TM117 NAD 83
Date: March 1, 2013

N

300 0 300 600 900

Meters

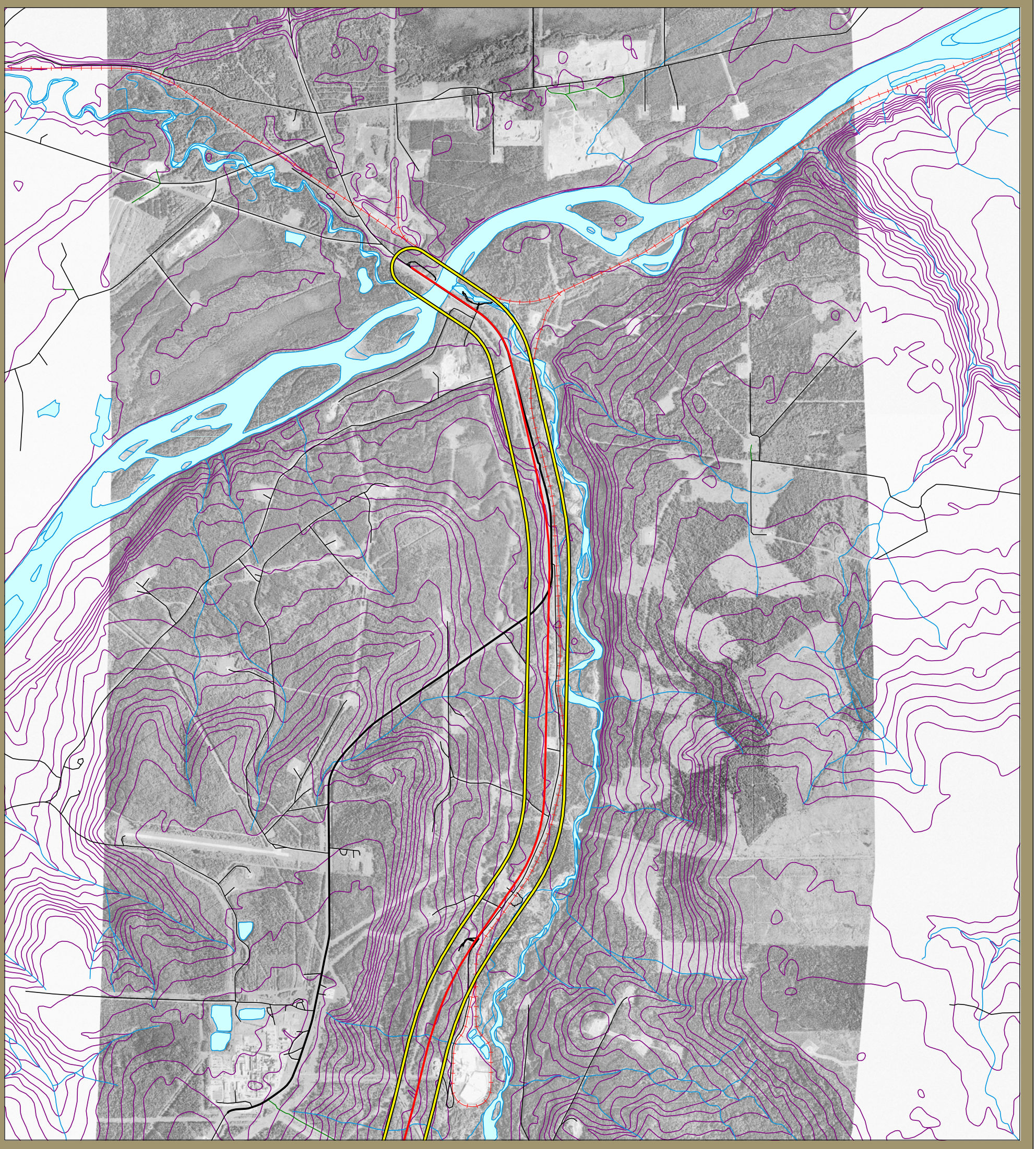
Scale: 1:30,000

LEGEND

- Study Area
- Proposed Highway 947 Alignment
- Streams
- Contours
- Railway
- Waterbodies

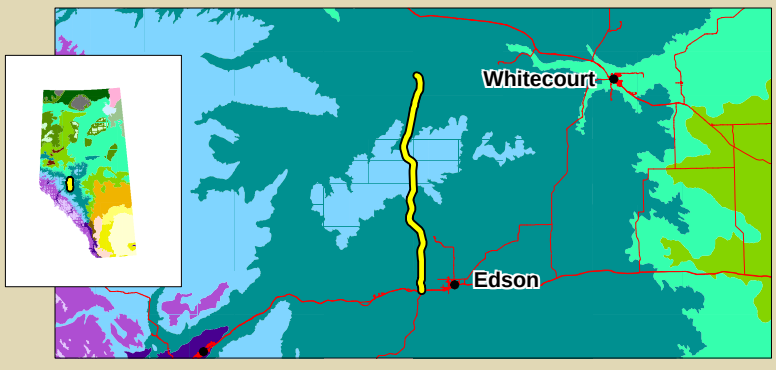
AT Roads

- Paved Roads
- Roads - Gravel/Unimproved/ Unclassified
- Winter Roads



Natural Regions/ Subregions of Alberta within Study Area

- Foothills - Lower Foothills
- Foothills - Upper Foothills



ECOFOR
natural and cultural resource consultants

Appendix 8. Wetlands - Canadian Wetland Classification System

Wetland Name	Field ID	Area	Classes	Form/subform	Wetland Type	Subdominant Type
W07+000	WET-005	17.1	Bog	Flat Bog	Coniferous Treed	Moss
W07+600	WET-007	5.2	Bog	Flat Bog	Coniferous Treed	Low Shrub
W08+000	WET-008	1.4	Bog	Flat Bog	Coniferous Treed	Moss
W39+900	MP10W5	1.1	Bog	Flat Bog	Moss	Graminoid - Sedge
W41+500	MP11W2	9.4	Bog	Blanket Bog	Coniferous Treed	Moss
W52+900	MP14W2	0.3	Bog	Basin Bog	Low Shrub	Moss
W02+800	WET-004	14.2	Fen	Horizontal Fen	Coniferous Treed	Moss
W08+400	WET-009	9.6	Fen	Horizontal Fen	Coniferous Treed	Graminoid - Sedge
W08+900	WET-010	0.6	Fen	Basin Fen	Graminoid - Sedge	Moss
W13+300	WET-014	6.2	Fen	Basin Fen	Coniferous Treed	Moss
W20+800	WET-016	12.9	Fen	Horizontal Fen	Graminoid - Sedge	Mixed Shrub
W42+100	MP11W1	3.6	Fen	Horizontal Fen	Graminoid - Sedge	Moss
W54+200	MP14W5	0.1	Fen	Horizontal Fen	Graminoid - Sedge	Moss
W54+700	MP14W6	0.4	Fen	Horizontal Fen	Graminoid - Sedge	Low Shrub
W59+200	MP15W2	0.8	Fen	Horizontal Fen	Mixed Shrub	Graminoid - Sedge
W59+500	MP15W3	0.4	Fen	Spring Fen	Graminoid - Sedge	Low Shrub
W02+600	WET-003	0.2	Marsh	Isolated Basin Marsh	Graminoid - Grass	Forb
W09+800	WET-013	0.4	Marsh	Linked Basin Marsh	Graminoid - Grass	Graminoid - Sedge
W14+200	WET-011	1.9	Marsh	Riparian Stream Marsh	Graminoid - Grass	Graminoid - Sedge
W14+600	WET-012	1.8	Marsh	Discharge Basin Marsh	Graminoid - Grass	Graminoid - Sedge
W32+600	MP09W2	1.9	Marsh	Linked Basin Marsh	Graminoid - Grass	Tall Shrub
W33+600	MP09W1	2.3	Marsh	Riparian Stream Marsh	Mixed Shrub	Graminoid - Sedge
W39+500	MP10W6	0.4	Marsh	Riparian Stream Marsh	Mixed Shrub	Graminoid - Grass
W40+200	MP10W4	0.4	Marsh	Riparian Stream Marsh	Mixed Shrub	Graminoid - Sedge
W40+400	MP10W3	0.2	Marsh	Riparian Stream Marsh	Graminoid - Sedge	Mixed Shrub

Wetland Name	Field ID	Area	Classes	Form/subform	Wetland Type	Subdominant Type
W40+600	MP10W2	0.2	Marsh	Riparian Stream Marsh	Graminoid - Sedge	Graminoid - Grass
W53+500	MP14W3	0.1	Marsh	Discharge Basin Marsh	Graminoid - Sedge	Mixed Shrub
W53+900	MP14W4	0.2	Marsh	Isolated Basin Marsh	Tall Shrub	Graminoid - Grass
W55+300	MP14W7	0.5	Marsh	Isolated Basin Marsh	Tall Shrub	Graminoid - Tall Rush
W55+600	MP14W8	0.2	Marsh	Isolated Basin Marsh	Graminoid - Grass	Tall Shrub
W57+600	MP15W1	7.5	Marsh	Riparian Stream Marsh	Mixed Shrub	Graminoid - Sedge
W02+400	WET-001	1	Shallow Water	Linked Basin Water	Graminoid - Grass	Graminoid - Sedge
W21+700	WET-018	0.7	Swamp	Basin Swamp	Tall Shrub	Graminoid - Grass
W31+500	MP08W1	4	Swamp	Riverine Swamp	Tall Shrub	Graminoid - Sedge
W37+000	MP10W1	0.3	Swamp	Riverine Swamp	Coniferous Treed	Graminoid - Sedge
W52+500	MP14W1	2.5	Swamp	Basin Swamp	Coniferous Treed	Graminoid - Grass

Appendix 9. Stream Crossing Locations

Some crossing sites have been assigned bridge file (BF) numbers and a structure type proposed / others have not yet reached that stage.

BF #	Structure Type	Ecofor Site Name	Location Township-Range	Location UTM Zone 11u		Stream Name	Watershed
				Easting	Northing		
85229	culvert	FM01POND01	SE 21-53-18-W5M	527383	5937883	Pond, on tributary to Little Sundance Creek	Edson River
		FM02STREAM01		527747	5942609	Tributary to Bench Creek	Edson River
		FM03STREAM01		527435	5946526	Secondary tributary to Edson River	Edson River
		FM03STREAM02		527390	5947564	Secondary tributary to Edson River	Edson River
85230	culvert	FM04STREAM01	SW 27-54-18-W5M	528174	5949455	Tributary to Edson River	Edson River
85217	major bridge	FM05STREAM01	NW 34-54-18-W5M	527749	5951519	Edson River	Edson River
		FM05STREAM02		527785	5952494	Tributary to Edson River	Edson River
85231	standard bridge	FM06STREAM01	NW 16-55-18-W5M	524737	5956016	Tributary to Edson River	Edson River
		FM06STREAM02		524300	5956223	Tributary to Edson River	Edson River
		FM07STREAM01		524043	5958662	Tributary to Edson River	Edson River
85232	culvert	FM07STREAM02	SE 29-55-18-W5M	524140	5958575	Secondary tributary to Edson River	Edson River
		FM08STREAM01		524046	5963088	Secondary tributary to Edson River	Edson River
85233	culvert	FM08STREAM02	NE 5-56-18-W5M	524147	5963406	Secondary tributary to Edson River	Edson River
85234	culvert	FM08STREAM03	NW 9-56-18-W5M	524858	5965014	Secondary tributary to Edson River	Edson River
85235	culvert	FM09STREAM01	SW 21-56-18-W5M	525002	5967155	Secondary tributary to Edson River	Edson River
85236	culvert	FM09STREAM02	NW 28-56-18-W5M	524608	5969587	Secondary tributary to Edson River	Edson River
		FM10STREAM01		525044	5971610	Secondary tributary to Pine Creek	Pine Creek
85237	culvert	FM11STREAM01	SE 17-57-18-W5M	524082	5975004	Pine Creek	Pine Creek
		FM11STREAM02		525150	5973920	Tributary to Pine Creek	Pine Creek
		FM11STREAM03		525166	5973810	Tributary to Pine Creek	Pine Creek
		FM11STREAM04		525152	5973544	Tributary to Pine Creek	Pine Creek
		FM11STREAM05		525120	5972938	Tributary to Pine Creek	Pine Creek
85238	culvert	FM11STREAM06	NE 19-57-18-W5M	522612	5977170	Tributary to Pine Creek	Pine Creek
		FM12STREAM01		522429	5978127	Tributary to Pine Creek	Pine Creek
		FM12STREAM02		522323	5978439	Tributary to Pine Creek	Pine Creek
		FM12STREAM03		522275	5978720	Tributary to Pine Creek	Pine Creek
		FM12STREAM04		522228	5979430	Tributary to Pine Creek	Pine Creek
		FM12STREAM05		522507	5980294	Tributary to Pine Creek	Pine Creek
		FM13STREAM01		522633	5980671	Tributary to Pine Creek	Pine Creek
		FM13STREAM02		522796	5981204	Tributary to Pine Creek	Pine Creek
		FM13STREAM03		522963	5981636	Tributary to Pine Creek	Pine Creek
85239	culvert	FM13STREAM04	NW 5-58-18-W5M	523423	5982509	Tributary to Pine Creek	Pine Creek
		FM13STREAM05		523816	5983146	Tributary to Pine Creek	Pine Creek
		FM13STREAM06		524024	5983919	Pine Creek braided channel	Pine Creek
77858	major	FM13STREAM07	NE 8-58-18-W5M	524056	5984006	Pine Creek braided channel	Pine Creek

BF #	Structure Type	Ecofor Site Name	Location Township-Range	Location UTM Zone 11u		Stream Name	Watershed
				Easting	Northing		
	bridge						
		FM14STREAM01		524441	5986729	Tributary to Pine Creek	Pine Creek
85240	culvert	FM14STREAM02	SE 17-58-18-W5M	524130	5984558	Tributary to Pine Creek	Pine Creek
		FM14STREAM03		524358	5985758	Tributary to Pine Creek	Pine Creek
		FM15STREAM01		525023	5989509	Tributary to Pine Creek	Pine Creek
85241	culvert	FM15STREAM02	SW 33-58-18-W5M	524924	5989197	Tributary to Pine Creek	Pine Creek
		FM15STREAM03		524838	5988381	Tributary to Pine Creek	Pine Creek
85242	culvert	FM15STREAM04	SE 3-59-18-W5M	525262	5990903	Tributary to Pine Creek	Pine Creek
		FM15STREAM06		525496	5991696	Tributary to Pine Creek	Pine Creek
		FM15STREAM07		525371	5991286	Tributary to Pine Creek	Pine Creek
		FM16STREAM01		527011	5995784	Tributary to Pine Creek	Pine Creek
		FM16STREAM03		526341	5994123	Tributary to Pine Creek	Pine Creek
		FM16STREAM04		526100	5993860	Tributary to Pine Creek	Pine Creek
		FM16STREAM05		526108	5993522	Tributary to Pine Creek	Pine Creek
		FM16STREAM06		526630	5995435	Tributary to Pine Creek	Pine Creek
		FM16STREAM07		526623	5995380	Tributary to Pine Creek	Pine Creek
		FM16STREAM08		526374	5994818	Tributary to Pine Creek	Pine Creek
		FM16STREAM09		526305	5994467	Tributary to Pine Creek	Pine Creek
		FM16STREAM10		525687	5992851	Tributary to Pine Creek	Pine Creek
		FM16STREAM11		525674	5992626	Tributary to Pine Creek	Pine Creek
		FM17STREAM01		527351	5998408	Tributary to Pine Creek	Pine Creek
		FM17STREAM02		527335	5997289	Tributary to Pine Creek	Pine Creek
		FM17STREAM03		526975	5999657	Tributary to Pine Creek	Pine Creek
n/a	bank protection	FM18STREAM02-A	NE 39-59-18-W5M	526740	6000363	Pine Creek	Pine Creek
n/a	bank protection	FM18STREAM02-B	NE 39-59-18-W5M	526622	6000455	Pine Creek	Pine Creek
n/a	bank protection	FM18STREAM03	NE 39-59-18-W5M	526986	5999982	Pine Creek	Pine Creek

Appendix 10. Birds Observed within the Project Area

Appendix 10.1 Nesting Bird Surveys 2012

SPECIES	BREEDING[1]	ABUNDANCE[2]	COMMENTS
Dabbling Ducks			
Mallard	P	UC	UTM: 527409 5937858
Diving Ducks			
Common Goldeneye	L	R	UTM: 527409 5937858 / single female observed / lots of potential nesting sites (cavities)
Common Merganser	L	UC	UTM: 524013 5958012 / single female observed / likely nesting on creek
Hooded Merganser	L	R	UTM: 526427 6000580 / single female observed on Athabasca River
Raptors			
Sharp-shinned Hawk	L	R	UTM: 527340 5997293 / observed calling from treetop
Red-tailed Hawk	P	R	UTM: 527442 5998225 / flew over Pine Creek
Merlin	P	R	UTM: 527701 5942269 / flew low overhead
Upland Game Birds			
Grouse *sp*.	L	FC	Likely Spruce and Ruffed present / observed a lot of sign
Gruiformes			
Sandhill Crane	P	UC	UTM: 527732 5936962 / two flew from farmer's field, others were observed outside study area nearby
Sandpipers			
Lesser Yellowlegs	L	R	UTM: 524010 5984762 / female giving alarm call / likely nest nearby
Wilson's Snipe	L	FC	Numerous individuals calling in flight / generally found near wetlands
Kingfishers			
Belted Kingfisher	P	UC	UTM: 528095 5949874 / UTM: 526427 6000580
Woodpeckers			
Northern Flicker	L	FC	Observed many individuals / plenty of large cavities for potential nest sites
Downy Woodpecker	L	R	Heard one calling / likely more abundant
Yellow-bellied Sapsucker	L	R	UTM: 526395 5954503 / observed male in dead aspen tree / likely more in study area

Three-toed Woodpecker	n/a	n/a	UTM: 524776 5955976 / Incidental observation in Feb 2013.
Flycatchers			
Alder Flycatcher	L	C	Heard singing at multiple sites / generally near water
Least Flycatcher	L	UC	Heard singing / generally near water
Vireos			
Blue-headed Vireo	L	UC	Heard three separate individuals singing / found in mature deciduous forest
Warbling Vireo	L	R	Heard one individual / likely more abundant / found in mature deciduous forest
Red-eyed Vireo	L	UC	Heard a few individuals singing / found in deciduous trees near top
Jays			
Gray Jay	L	FC	Observed many individuals
Crows			
American Crow	P	UC	Heard a few individuals calling
Common Raven	P	UC	Observed and heard a few individuals calling
Swallows			
Cliff Swallow	O	C	UTM: 526427 6000580 / four large clusters of nests on Athabasca River bridge / approximately 30 birds
Chickadees			
Black-capped Chickadee	P	UC	Observed a group of three
Boreal Chickadee	L	FC	Heard singing at many different sites
Nuthatches			
White-breasted Nuthatch	L	R	UTM: 524672 5956011l / likely more in area
Red-breasted Nuthatch	L	C	Heard singing at multiple sites
Kinglets			
Golden-crowned Kinglet	L	UC	Heard singing few times / observed near Pine Creek in mature spruce tree
Ruby-crowned Kinglet	L	FC	Heard singing numerous times / always in mature spruce trees
Thrushes			
Varied Thrush	L	UC	UTM: 527435 5997979 / heard multiple birds at this location but did not hear anywhere else

American Robin	O	C	Most common species in study area
Swainson's Thrush	L	C	Heard at many different sites in a variety of habitats
Hermit Thrush	L	FC	Heard at many different sites in a variety of habitats
Mimids			
Grey Catbird	P	R	UTM: 526427 6000580 / observed adjacent to Athabasca River bridge / found at northern limit of range
Waxwings			
Bombycilla sp.	P	UC	Could not distinguish between Bohemian and Cedar
Wood-Warblers			
Tennessee Warbler	L	C	One of most common warblers observed in study area
Orange-crowned Warbler	L	R	Heard singing only once / likely more abundant
Yellow Warbler	L	C	One of most common warblers observed in study area
Yellow-rumped Warbler	L	C	One of most common warblers / observed in variety of habitats at many sites
Northern Waterthrush	L	R	Observed one along Pine Creek / acting very territorially / likely nesting in area
Common Yellowthroat	L	R	Heard one singing along banks of Pine Creek / likely more abundant
Wilson's Warbler	L	UC	Heard singing
Tanagers			
Western Tanager	L	R	Heard one singing in deciduous forest
Sparrows			
Chipping Sparrow	L	C	Found in multiple habitats at multiple sites
Savannah Sparrow	L	R	Heard one calling from farmer's field
Song Sparrow	O	FC	Located nests on ground in grass fields / one nest had eggs / other nest had chicks
Lincoln's Sparrow	L	UC	Observed females giving alarm calls / likely nesting in study area (wetlands)
Dark-eyed Junco	L	C	Found in multiple habitats at multiple sites

White-throated Sparrow	L	C	Found in multiple habitats at multiple sites
Icterids			
Euphagus sp.	P	FC	Could not distinguish between Brewer's and Rusty Blackbird / both are common

[1]Breeding:

P = Possible / bird was seen either as single or flock but no singing was observed / no obvious reason to be believe nesting

L = Likely / male heard singing, adults acting territorially, females giving alarm calls

O = Observed / nest or chicks were found

[2]Abundance:

C = Common / greater than 10 birds seen or heard

FC = Fairly Common / between 5 and 10 birds seen or heard

UC = Uncommon / between 2 and 4 birds seen or heard

R = Rare / only 1 bird seen or heard

Appendix 10.2 Owl Surveys February and April 2013

Call Playback Surveys														
Survey and Station Number/ Description	UTM Zone 11u		Date	Time		Wind	Precip	Cloud Cover	Temp (°C)	Owls observed	Direction (compass degrees)	Distance (m)	Activity	Comments
	Easting	Northing		Time Start	Time End									
OS1- SC01	527244	5946246	24/02/2013	19:35	19:50	none	none	50	1	none				distant traffic
OS1- SC02	527756	5947847	24/02/2013	20:20	20:35	B2	none	80	1	none				constant low level noise (generator?)
OS1- SC03	528160	5949415	24/02/2013	20:58	21:13	none	none	80	1	none				constant low level noise (generator?)
OS1- SC04	528460	5950581	24/02/2013	21:43	21:58	none	none	80	0	none				
OS1- SC05	527806	5951602	24/02/2013	22:17	22:32	none	none	100	0	none				road noise (far away)
OS1- SC06	527007	5953522	24/02/2013	22:50	23:05	none	none	100	0	none				
OS1- SC07	526187	5954670	24/02/2013	23:25	23:40	none	none	90	0	none				mature forest
OS1- SC08	524535	5967191	25/02/2013	20:43	20:58	B1	snow	100	-5	none				mature forest
OS1- SC09	524886	5970068	25/02/2013	21:45	22:00	B1	snow	100	-5	none				immature forest
OS1- SC10	525061	5971841	25/02/2013	22:30	22:24	B1	light snow	100	-5	none				immature forest
OS1- SC11	525186	5973500	25/02/2013	23:05	23:20	B1	light snow	100	-5	none				mature forest
OS1- SC12	524280	5974861	25/02/2013	23:37	23:52	B1	light snow	100	-5	none				
OS2- MP01	527742	5936203	04/04/2013	23:19	23:30	B2	light snow	100	0	none				close to highway 16, 2 cars passed
OS2- MP02	527286	5937557	04/04/2013	23:43	23:54	B2	light snow	100	0	none				
OS2- MP03	527723	5939361	04/04/2013	0:18	0:29	B3	snow	100	0	none				windy
OS2- MP04	526705	6000255	05/04/2013	21:01	21:12	none	none	90	-7	none				trucks at Athabasca river; powerlines, CAGOx4 calling throughout survey
OS2- MP05	527286	5998682	05/04/2013	21:25	21:36	none	light snow	75	-9	none				

OS2- MP06	527355	5997065	05/04/2013	21:47	21:58	none	light snow	75	-9	NSWO	140	300	calling	called throughout, started during silent listening
OS2- MP07	526687	5995461	05/04/2013	22:15	22:26	none	none	80	-9	none				some noise from a small stream
OS2- MP08	526442	5993502	05/04/2013	23:55	0:06	B1	none	90	-11	none				gas plant; small stream
OS2- MP09	525654	5992017	05/04/2013	0:20	0:31	B2	none	90	-11	none				creek at valley bottom
OS2- MP10	525162	5990472	05/04/2013	1:37	1:48	B2	none	80	-11	none				
OS2- MP11	524899	5988794	05/04/2013	2:30	2:41	none	none	70	-11	NSWO	312	400	calling	called throughout
OS2- MP12	524654	5987209	06/04/2013	21:00	21:11	B1	light snow	100	-4	none				
OS2- MP13	524073	5984696	06/04/2013	22:45	22:56	none	light snow	100	-5	none				could not get to ROW
OS2- MP14	523853	5963768	06/04/2013	1:59	2:10	B1	snow	100	-8	none				
OS2- MP15	524384	5962307	06/04/2013	2:16	2:27	B1	snow	100	-8	none				
OS2- MP16	524839	5960727	06/04/2013	2:43	2:54	B1	light snow	100	-7	none				
OS2- MP17	524505	5959162	06/04/2013	3:04	3:15	B1-B3	light snow	100	-7	none				
OS2- MP18	524497	5957498	06/04/2013	3:24	3:35	B1	light snow	100	-7	none				
OS2- MP19	524783	5955919	06/04/2013	3:43	3:54	B1	light snow	100	-7	none				machinery in distance
OS2- MP20	526064	5954757	06/04/2013	4:03	4:14	B1	light snow	100	-6	none				machines in distance
OS2- MP21	523785	5983105	07/04/2013	21:00	21:11	B2	light snow	100	-5	none				
OS2- MP22	522981	5981707	07/04/2013	21:25	21:36	B3	light snow	100	-5	none				
OS2- MP23	522460	5980181	07/04/2013	21:40	21:51	none	none	100	-5	none				
OS2- MP24	522310	5978591	07/04/2013	22:14	22:25	B1	light snow	60	-5	none				machine at gas well to south
OS2- MP25	522646	5977028	07/04/2013	22:56	23:07	B2	light snow	60	-7	none				
OS2- MP26	523035	5975861	07/04/2013	23:17	23:28	B2(B3)	light snow	30	-7	none				<1.6 due to noise @MP25

OS2- MP27	524294	5974874	07/04/2013	23:40	23:51	B1	light snow	50	-8	none				revisit
OS2- MP28	525185	5973496	07/04/2013	0:15	0:26	B1-B2	light snow	60	-8	none				
OS2- MP29	525059	5971840	07/04/2013	0:42	0:53	B1	very light snow	20	-9	none				
OS2- MP30	525077	5970202	07/04/2013	3:40	3:51	B2-B3	very light snow	20	-9	none				moved from SC9 to be 1.6 from SC10?
OS2- MP31	524524	5968696	07/04/2013	4:03	4:14	B2	very light snow	30	-10	none				noise = wind
OS2- MP32	524534	5967185	08/04/2013	21:03	21:14	B2-B1	none	0	-7	none				
OS2- MP33	524880	5965303	08/04/2013	21:23	21:34	B1	none	0	-7	none				
OS2- MP34	524681	5964122	08/04/2013	21:45	21:56	B2-B3	none	0	-8	GHOW,BOOW	235, 75	500, 500	calling	CAGO; GHOW called throughout survey, BOOW began calling at NSWO call and continued till end
OS2- MP35	526984	5953550	08/04/2013	22:57	23:08	B1	none	0	-9	none				
OS2- MP36	527642	5952095	08/04/2013	23:22	23:33	B2	none	0	-9	UK	300	>800	calling	machine in distance, heard several single hoots after BARR but very far away
OS2- MP37	527637	5950497	08/04/2013	23:55	0:06	B1	none	0	-9	none				
OS2- MP38	528103	5949185	08/04/2013	0:34	0:45	B1	none	0	-10	none				
OS2- MP39	527760	5947856	08/04/2013	1:00	1:11	B1	none	100	-16	none				machine noise in distance to east
OS2- MP40	527274	5946333	08/04/2013	1:28	1:39	B1	none	100	-16	none				
OS2- MP41	527626	5945416	08/04/2013	3:40	3:51	B1	none	100	-15	none				
OS2- MP42	527699	5942219	08/04/2013	4:07	4:18	B1	none	100	-16	none				grader went by
OS2- MP43	527713	5940612	08/04/2013	4:25	4:36	none	none	100	-14	none				
OS2- MP44	525365	5971355	09/04/2013	21:03	21:14	B3/B4	none	100	1	none				got windy part way in
OS2- MP45	524863	5970087	09/04/2013	21:16	21:27	B2	none	100	0	none				trucks on Amoco Rd
OS2- MP46	524461	5968722	09/04/2013	21:37	21:48	B1	none	100	0	none				compressor in distance
OS2- MP47	524360	5967178	09/04/2013	21:53	22:04	B1	none	100	0	LEOW	214	100	calling	compressor in distance; LEOW started calling after BARR call

														played
OS2- MP48	524892	5965299	09/04/2013	22:29	22:40	none	none	100	0	none				compressor in distance
OS2- MP49	523848	5963772	09/04/2013	22:52	23:03	none	none	100	0	none				compressor in distance
OS2- MP50	524404	5962243	09/04/2013	23:11	23:22	none	none	100	0	none				compressor and truck in distance
OS2- MP51	524842	5960656	09/04/2013	23:31	23:42	none	none	100	1	none				compressor and truck in distance
OS2- MP52	524506	5959158	09/04/2013	23:48	23:59	none	none	100	0	none				1 truck passed
OS2- MP53	524506	5957423	09/04/2013	0:11	0:22	none	none	100	1	none				machine in distance
OS2- MP54	524797	5955901	09/04/2013	0:26	0:37	none-B1	none	100	0	none				1 transport truck passed
OS2- MP55	526061	5954764	09/04/2013	0:43	0:54	none	none	100	0	BOOW	25	50		distant machine; BOOW call (not song)after BOOW call played

Stand watches

Survey	UTM Zone 11u		Date	Time		Precipitation	Owls observed	Comments
	Easting	Northing		Start	End			
OSW1-1	528457	5943556	24/02/2013	17:45	18:00	none	none	
OSW1-2	525255	5955925	25/02/2013	18:01	18:17	moderate- heavy snow	none	

Appendix 11. Amphibians within Project area.

Species	Age	Date	UTM Zone 11	
			Easting	Northing
Boreal Chorus Frog	Adult	21-Jun-12	527324	5998364
Boreal Chorus Frog	Adult	18-Jun-12	527698	5944317
Boreal Chorus Frog	Adult	28-May-13	527418	5945088
Boreal Chorus Frog	Adult	28-May-13	527601	5944954
Boreal Chorus Frog	Adult	28-May-13	528116	5949031
Boreal Chorus Frog	Adult	27-May-13	527759	5952250
Boreal Chorus Frog	Adult	27-May-13	527643	5952416
Boreal Chorus Frog	Adult	27-May-13	527064	5953427
Boreal Chorus Frog	Adult	26-May-13	524761	5965237
Boreal Chorus Frog	Adult	30-May-13	527341	5938054
Boreal Chorus Frog	Adult	29-May-13	527465	5943998
Boreal Chorus Frog	Adult	29-May-13	527488	5944121
Boreal Chorus Frog	Adult	28-May-13	527447	5945081
Boreal Chorus Frog	Adult	26-May-13	525173	5967105
Boreal Chorus Frog	Adult	30-May-13	527438	5937504
Boreal Chorus Frog	Adult	29-May-13	525184	5973541
Boreal Chorus Frog	Adult	28-May-13	528258	5949365
Boreal Chorus Frog	Adult	28-May-13	528120	5949943
Boreal Chorus Frog	Adult	27-May-13	524107	5957709
Boreal Chorus Frog	Tadpole	23-May-17	526981	5996169
Western Toad	Adult	20-Jun-12	527454	5953302
Western Toad	Adult	27-May-13	527198	5954065
Wood Frog	Adult	23-Aug-12	525957	5954698
Wood Frog	Adult	21-Aug-12	527403	5937891
Wood Frog	Adult	17-Jun-12	527599	5937168
Wood Frog	Adult	17-Jun-12	527322	5938033
Wood Frog	Adult	18-Jun-12	527705	5942610
Wood Frog	Adult	18-Jun-12	527354	5946647
Wood Frog	Adult	17-Jun-12	527456	5937533
Wood Frog	Adult	17-Jun-12	527270	5938211
Wood Frog	Adult	17-Jun-12	527389	5938293
Wood Frog	Adult	18-Jun-12	527676	5942603
Wood Frog	Adult	18-Jun-12	527695	5944784
Wood Frog	Adult	18-Jun-12	527695	5944651
Wood Frog	Adult	18-Jun-12	527698	5944317

Species	Age	Date	UTM Zone 11	
			Easting	Northing
Wood Frog	Adult	18-Jun-12	527369	5946611
Wood Frog	Adult	19-Jun-12	527695	5949586
Wood Frog	Adult	19-Jun-12	527062	5954066
Wood Frog	Adult	19-Jun-12	527164	5954111
Wood Frog	Adult	20-Jun-12	527101	5954070
Wood Frog	Adult	20-Jun-12	526535	5954504
Wood Frog	Adult	20-Jun-12	525337	5955396
Wood Frog	Adult	20-Jun-12	524546	5956002
Wood Frog	Adult	20-Jun-12	524132	5957886
Wood Frog	Adult	20-Jun-12	524133	5957749
Wood Frog	Adult	20-Jun-12	524129	5957697
Wood Frog	Adult	21-Jun-12	527423	5997915
Wood Frog	Adult	25-Jul-12	525177	5966291
Wood Frog	Adult	23-Jul-12	527381	5937877
Wood Frog	Adult	23-Jul-12	527420	5938708
Wood Frog	Adult	24-Jul-12	527690	5943038
Wood Frog	Adult	25-Jul-12	528130	5949301
Wood Frog	Adult	7-Aug-12	527681	5952990
Wood Frog	Adult	25-Aug-12	522279	5978715
Wood Frog	Adult	21-Jul-12	527158	5996606
Wood Frog	Adult	23-Jul-12	527610	5937106
Wood Frog	Adult	28-May-13	527690	5948733
Wood Frog	Adult	27-May-13	527064	5953427
Wood Frog	Adult	27-May-13	526298	5954550
Wood Frog	Adult	27-May-13	526490	5954534
Wood Frog	Adult	24-May-13	525164	5989880
Wood Frog	Adult	24-May-13	525150	5989580
Wood Frog	Adult	27-May-13	527198	5954065
Wood Frog	Adult	30-May-13	524041	5958637
Wood Frog	Adult	30-May-13	524133	5958543
Wood Frog	Adult	23-May-13	526465	5994807
Wood Frog	Adult	23-May-17	526981	5996169
unknown	Tadpoles	17-Jun-12	527409	5937858
unknown	Tadpoles	17-Jun-12	527424	5937879
unknown	Eggs; Tadpoles	26-May-13	525143	5968360
unknown	Tadpole	28-May-13	528116	5949031
unknown	Tadpole	27-May-13	526298	5954550
unknown	Tadpole	27-May-13	524107	5957709
unknown	Tadpole	24-May-13	525150	5989580

Species	Age	Date	UTM Zone 11	
			Easting	Northing
unknown	Tadpole	29-May-13	527465	5943998
unknown	Tadpole	29-May-13	527447	5944078
unknown	Tadpole	25-May-13	524323	5985384
unknown	Tadpole	23-May-13	526465	5994807
unknown	Tadpole	23-May-13	527276	5996401
unknown	Tadpole	28-May-13	528258	5949365
unknown	Tadpole	28-May-13	528120	5949943

Appendix 12. Mammals within the Project area

Winter track count data

Appendix 9.1 Wildlife tracks densities in mature forest vs. immature forest and herbaceous habitat types, February 2013.

	Standardized track density (tracks/km/day)	
Species	**Mature (n=34.4 km)**	**Immature/Herbaceous (n=10.6 km)**
Red Squirrel*	2.57	1.25
Deer species*	0.42	1.05
Moose*	0.57	0.97
Snowshoe hare*	12.22	3.14
Weasel species	0.68	0.25
American Marten/Fisher	0.24	0.04
Canada Lynx	0.49	0.31
Coyote	0.24	0.31
Shrew species**	0.10	0.08
Vole species**	0.36	0.31
Mouse species**	0.21	0.08
Grouse species**	0.10	0.43
Grey Wolf	0.04	0
Wolverine	0.01	0.02
Northern River Otter	0.03	0.02
Red Fox	0	0.04
Total number of species	15	15

*Tracks of these species were present in very high densities in some transects. Where it was not possible to get an accurate count of the tracks, the data was omitted including the length of the affected transect.

**Transect length has been adjusted for these species so that only transects where these species were counted are included (One survey team counted mice, voles, shrews and grouse while the other did not.).

Appendix 9.2 Wildlife tracks densities in deciduous, coniferous, mixed and riparian habitat types, Feb 2013.

	Standardized Track Density (tracks/km/day)			
Species	**Deciduous (n=1.7 km)**	**Coniferous (n=24.1 km)**	**Mixed (n=13.1 km)**	**Riparian (n=6.9 km)**
Red Squirrel*	1.98	2.41	1.35	2.85
Deer species*	1.44	0.35	1.61	0.22
Moose*	2.17	0.61	1.03	0.75
Snowshoe hare*	2.47	9.75	9.97	14.73
Weasel species	0.36	0.60	0.22	0.97
American Marten/Fisher	0	0.22	0.03	0.08
Canada Lynx	0	0.44	0.53	0.34
Coyote	0.72	0.14	0.34	0.59
Shrew species**	0	0.14	0.03	0.11
Vole species**	1.13	0.14	0.31	0.54
Mouse species**	0.56	0.14	0.07	0.11
Grouse species**	0	0.28	0.38	0.11
Grey Wolf	0	0.05	0	0
Wolverine	0	0	0.06	0
Northern River Otter	0	0	0	0.17
Red Fox	0	0.01	0.03	0
Total number of species	8	14	14	13

*Tracks of these species were present in very high densities in some transects. Where it was not possible to get an accurate count of the tracks, the data was omitted including the length of the affected transect.

**Transect length has been adjusted for these species so that only transects where these species were counted are included (One survey team counted mice, voles, shrews and grouse while the other did not.).

Appendix 13. Species at Risk Potentially within Highway 947 Study Area

Species at risk that occur within the Lower Foothills (LF) and Upper Foothills (UF) Natural Subregions

Scientific Name	Common Name		Conservation Rank*		
			AB	Canada	Global
Amphibians		Area			
Ambystoma macrodactylum	Long-toed Salamander	LF UF	S3	N5	G5
Anaxyrus boreas	Western Toad	LF UF	S3	N4	G4
Lithobates pipiens	Northern Leopard Frog	LF	S2	N5	G5
Birds					
Cygnus buccinator	Trumpeter Swan	LF UF	S2S3	N4B,N4N	G4
Histrionicus histrionicus	Harlequin Duck	LF UF	S3	N4B,N4N	G4
Falco peregrinus	Peregrine Falcon	LF	S2S3	N3N,N4B	G4
Limnodromus griseus	Short-billed Dowitcher	LF	SU	N5B	G5
Fish					
Acipenser fulvescens	Lake Sturgeon	LF	SU	N3N4	G3G4
Hybognathus hankinsoni	Brassy Minnow	LF	SU	N5	G5
Onocorhynchus mykiss	Athabasca Rainbow Trout	LF UF		N5	G5
Mammals					
Taxidea taxus	American Badger	LF	S4	N4	G5
Lasiurus cinereus	Hoary Bat	LF	S2	N5	G5
Microtus xanthognathus	Taiga Vole	LF	SH	N5	G5
Ursus arctos horribilis	Grizzly Bear	LF UF	S2	N3	G4T3T4
Rangifer tarandus pop. 1	Woodland Caribou -- mountain ecotype	LF UF	S1	N?	G5T2Q
Rangifer tarandus pop. 14	Woodland Caribou -- boreal ecotype	LF UF	S2	N?	G5TNR
Invertebrates					
Aeshna tuberculifera	Black-tipped Darner	LF	S2S3	N4N5	G4
Boloria astarte	Astarte Fritillary	UF	S3	N5	G5
Boloria improba	Dingy Arctic Fritillary	UF	S2	N5	G5
Leucorrhinia glacialis	Crimson-ringed Whiteface	UF	S2	N5	G5
Lycaena phlaeas	Little Copper	LF UF	S2	N5	G5
Papilio machaon hudsonianus	Hudsonian Old World Swallowtail	UF	S2	N5	G5T5
Somatochlora albicincta	Ringed Emerald	UF	S2	N5	G5
Somatochlora cingulata	Lake Emerald	UF	S2	N5	G5
Somatochlora whitehousei	Whitehouse's Emerald	LF UF	S2	N5	G5
Plant Communities					
Populus tremuloides / Rubus parviflorus / Aralia nudicaulis	aspen / thimbleberry / wild sarsaparilla		S2S3	NNR	
Betula glandulosa / Festuca campestris	bog birch / mountain rough fescue		S2S3	NNR	
Festuca campestris - Leymus innovatus	mountain rough fescue - hairy wild rye		S2S3	NNR	
Plants - Liverworts					
Anastrophyllum helleranum	liverwort	LF UF	S2	NNR	G5
Anastrophyllum michauxii	liverwort	UF	S1	NNR	G4
Athalamia hyalina	liverwort	LF	S2	N2N3	G5
Barbilophozia binsteadii	liverwort	UF	S1	NNR	G4
Barbilophozia kunzeana	liverwort	LF UF	S2	NNR	G5
Barbilophozia quadriloba	liverwort	UF	S2	NNR	G5
Blasia pusilla	liverwort	LF	S1	NNR	G5
Calypogeia suecica	liverwort	UF	S1	NNR	G5
Chiloscyphus polyanthos	liverwort	LF UF	S1	NNR	G5
Conocephalum salebrosum	liverwort	LF UF	S2	NNR	GNR
Gymnocolea inflata	liverwort	UF	S1	NNR	G5
Jungermannia atrovirens	liverwort	UF	S2	N2N3	G4G5
Lophozia ascendens	liverwort	UF	S1	NNR	G4

Scientific Name	Common Name		Conservation Rank*		
			AB	Canada	Global
Lophozia badensis	liverwort	LF	S1	NNR	G5?
Lophozia excisa	liverwort	UF	S1	NNR	G5
Lophozia heterocolpos	liverwort	LF	S2	NNR	G5
Lophozia incisa	liverwort	LF	S2	NNR	G5
Lophozia laxa	liverwort	UF	S1	NNR	G4
Mannia pilosa	liverwort	LF	S1	N2N3	G4?
Moerckia hibernica	liverwort	LF UF	S1S2	NNR	G4?
Pellia endiviifolia	liverwort	LF	S2	NNR	G5
Pellia epiphylla	liverwort	LF	S1	NNR	G5
Pellia neesiana	liverwort	LF UF	S2	NNR	G5
Riccardia latifrons	liverwort	LF	S2	NNR	G4G5
Riccardia palmata	liverwort	LF	S1	NNR	G5
Ricciocarpos natans	liverwort	LF	S2	NNR	G5
Scapania curta	liverwort	UF	S2	NNR	G5
Scapania glaucocephala	liverwort	LF UF	S2	NNR	G4G5
Scapania paludicola	liverwort	LF UF	S2	NNR	G5
Scapania paludosa	liverwort	LF	S2	NNR	G5
Scapania undulata	liverwort	UF	S1	NNR	G5
Tritomaria exsecta	liverwort	UF	S1	NNR	G5
Tritomaria polita	liverwort	UF	S2	NNR	G4
Tritomaria scitula	liverwort	LF UF	S2S3	NNR	G4
Plants - Mosses					
Aloina rigida	aloe-like rigid screw moss	LF UF	S2	N4	G3G5
Amblyodon dealbatus	moss	LF UF	S2	N3N4	G3G5
Anoectangium aestivum	moss	UF	S1	NNR	G3G5
Anomobryum filiforme	moss	UF	S1	N3N5	G4G5
Aongstroemia longipes	spring moss	LF UF	S2	N4	G4G5
Atrichum selwynii	moss	LF	S2	N4	G4
Aulacomnium androgynum	little groove moss	LF UF	S2	N4	G5
Barbula coreensis	screw moss	LF	S1	NNR	G3G5
Brachythecium acuminatum	moss	LF	S1S2	NNR	G5
Brachythecium rutabulum	moss	LF UF	S2?	NNR	G5
Bryobrittonia longipes	moss	LF UF	S2	N3N4	G3G4
Bryum algovicum	moss	LF	S2	NNR	G4G5
Bryum arcticum	moss	UF	S1	NNR	G5?
Bryum cyclophyllum	round-leaved bryum	UF	S2	N3N4	G4G5
Bryum muehlenbeckii	moss	LF	S1S2	N4	G4G5
Bryum pallens	moss	LF UF	S2	NNR	G4G5
Bryum purpurascens	moss	LF	S1	NNR	G3G4
Bryum uliginosum	moss	LF	S2	NNR	G3G5
Buxbaumia aphylla	bug on a stick moss	UF	S2	NNR	G4G5
Campylium radicale	campylium moss	LF	S2	NNR	G3G5
Conardia compacta	moss	UF	S2	NNR	G3G5
Cynodontium alpestre	moss	UF	S1	NNR	G3G5
Dicranella crispa	curl-leaved fork moss	LF UF	S2	N4N5	G3G5
Dicranella heteromalla	silky fork moss	LF UF	S1	NNR	G5?
Dicranella palustris	drooping-leaved fork moss	UF	S1	N4N5	G5
Dicranella subulata	awl-leaved fork moss	LF UF	S2	NNR	G5?
Dicranum brevifolium	cushion moss	UF	SU	NNR	GU
Dicranum spadiceum	cushion moss	UF	S2	NNR	G5?
Dicranum tauricum	broken-leaf moss	LF	S1S2	NNR	G4
Didymodon fallax	fallacious screw moss	UF	S2	NNR	G5
Didymodon johansenii	moss	UF	S2	NNR	G5?
Didymodon rigidulus	rigid screw moss	LF UF	S2	NNR	G5

Scientific Name	Common Name		Conservation Rank*		
			AB	Canada	Global
Discelium nudum	naked weissia moss	UF	S1	N2N3	G3G4
Ditrichum montanum	moss	UF	S1	NNR	GU
Drepanocladus brevifolius	brown moss	UF	SU	NNR	GNRQ
Drepanocladus capillifolius	brown moss	UF	SU	NNR	GU
Drepanocladus crassicostatus	brown moss	UF	S2	NNR	G3G5
Encalypta intermedia	candle-snuffer moss	UF	S1	NNR	G4
Fissidens adianthoides	maidenhair moss	LF UF	S2	NNR	G5
Fontinalis dalecarlica	moss	LF	S1	NNR	G3G5
Fontinalis missourica	moss	LF	S1	NNR	G4G5
Fontinalis neomexicana	moss	UF	S1S2	NNR	G3G5
Grimmia montana	sun grimmia moss	LF UF	S2	NNR	G5?
Grimmia torquata	twisted-leaved grimmia moss	UF	S2	NNR	G3G5
Hygroamblystegium tenax	moss	LF	S2	NNR	G5
Hygrohypnum molle	moss	LF	S1S2	NNR	G4G5
Hygrohypnum ochraceum	moss	LF	S2	NNR	G5
Hypnum pallescens	moss	LF UF	S2	NNR	G5
Hypnum recurvatum	moss	UF	S2	NNR	G3G5
Leptodictyum humile	moss	LF	S1	NNR	G5
Limprichtia cossonii	moss	UF	SU	NNR	GU
Mnium ambiguum	moss	UF	S2	NNR	G5
Myurella tenerrima	moss	UF	S2	N4	G5
Neckera pennata	moss	LF	S2S3	NNR	G5
Oreas martiana	moss	UF	S1	NNR	G5?
Orthothecium strictum	moss	UF	S1S2	N3N4	G5?
Orthotrichum affine	moss	LF UF	SU	NNR	G3G5
Philonotis marchica	moss	UF	S1	NNR	G5
Pogonatum dentatum	hair-like pogonatum moss	LF UF	S2	NNR	G3G5
Pogonatum urnigerum	urn-like pogonatum moss	UF	S2S3	NNR	G5
Pohlia bulbifera	moss	LF UF	S1	NNR	G4G5
Polytrichum longisetum	slender hairy-cap moss	UF	S1	NNR	G5
Pseudoleskeella sibirica	moss	UF	S2	NNR	G5?
Pterygoneurum subsessile	moss	UF	S2	NNR	G4?
Racomitrium sudeticum	moss	UF	S1S2	NNR	G5?
Rhizomnium andrewsianum	moss	UF	S1	NNR	G3G5
Rhizomnium magnifolium	moss	LF UF	S2	NNR	G4G5
Schistidium pulvinatum	moss	UF	S1	NNR	G5
Schistostega pennata	luminous moss	LF	S1S2	NNR	G3G4
Scouleria aquatica	moss	UF	S2	NNR	G4
Seligeria campylopoda	moss	UF	S2	NNR	G3G5
Seligeria donniana	Donian beardless moss	LF UF	S2	NNR	G4G5
Sphagnum compactum	neat bog moss	UF	S2	NNR	G5
Sphagnum contortum	twisted bog moss	UF	S2	NNR	G5
Sphagnum fallax	peat moss	LF UF	S2	NNR	G5
Sphagnum lindbergii	Lindberg's bog moss	UF	S2	NNR	G5?
Sphagnum platyphyllum	moss	UF	S1	NNR	G5
Splachnum ampullaceum	flagon-fruited splachnum moss	LF	S2	NNR	G5
Splachnum luteum	yellow collar moss	LF UF	S3	N3N4	G4?
Splachnum rubrum	red collar moss	LF UF	S3	NNR	G4?
Splachnum sphaericum	globe-fruited splachnum moss	LF UF	S2	NNR	G3G5
Splachnum vasculosum	large-fruited splachnum moss	UF	S2	NNR	G3G5
Tayloria serrata	slender splachnum moss	LF UF	S2	NNR	G4
Tayloria splachnoides	splachnoid cyrtodon moss	UF	S1	N2N3	G2G3
Voitia nivalis	hidden kettle moss	UF	S1	NNR	G4
Warnstorfia tundrae	brown moss	LF UF	S2	NNR	GU

Scientific Name	Common Name		Conservation Rank*		
			AB	Canada	Global
Plants - Lichens					
Anaptychia crinalis	fringe lichen	UF	S2	NNR	G5
Aspicilia anseris	sunken disk lichen	UF	S2	NNR	G3G5
Bacidia bagliettoana	dot lichen	LF	S2	NNR	G5
Bacidia saxicola	dot lichen	UF	S2	NNR	GNR
Biatora turgidula	dot lichen	UF	S2	NNR	GNR
Bryoria nadvornikiana	old man's beard	UF	S2	NNR	GNR
Calicium salicinum	stubble lichen	LF	S1	NNR	G5
Caloplaca sinapisperma	firedot lichen	UF	S2S3	NNR	GNR
Chaenotheca chrysocephala	stubble lichen	UF	S2	NNR	G4G5
Cladonia bellidiflora	floral pixie	LF	S2S3	NNR	G5
Cladonia macrophylla	cladonia lichen	UF	S2	NNR	GNR
Cladonia metacorallifera	cladonia lichen	LF UF	S2	NNR	GNR
Cladonia squamosa	dragon cladonia lichen	LF	S2	NNR	G5
Cladonia umbricola	shaded cladonia	LF UF	S1	NNR	G3G5
Collema nigrescens	blistered jelly lichen	LF	S1	NNR	G5?
Collema subflaccidum	tree jelly lichen	LF	S2	NNR	G5?
Cyphelium tigillare	soot lichen	LF	S2	NNR	G5
Dactylina beringica	finger lichen	UF	S2S3	NNR	GNR
Fulgensia fulgens	sulphur lichens	UF	S2S3	NNR	G3G5
Heterodermia speciosa	powdered fringed lichen	LF	S2	NNR	G5?
Hypocenomyce anthracophila	dot lichen	LF	S1	NNR	G5?
Hypocenomyce friesii	clam lichen	LF UF	S2	NNR	G3G5
Hypogymnia enteromorpha	budding tube lichen	UF	S2	NNR	G4
Hypogymnia rugosa	wrinkled tube lichen	UF	S1S2	NNR	G4G5
Hypogymnia subobscura	heath tube lichen	UF	S2	NNR	G4G5
Hypogymnia vittata	brownish monk's-hood lichen	UF	S1S2	NNR	G4G5
Lecania dubitans	bean-spored rim-lichen	LF	S2S4	NNR	G4?
Lecanora cateilea	rim-lichen	LF UF	S2	NNR	GNR
Lepraria incana	dust lichen	UF	S2	NNR	GNR
Leptogium pseudofurfuraceum	dimpled jellyskin lichen	UF	S2	NNR	GNR
Leptogium subtile	jellyskin	UF	S1?	NNR	GNR
Melanohalea multispora	many-spored camoflage lichen	LF	S2S4	NNR	G5?
Melanohalea subelegantula	camouflage lichen	UF	S2S3	NNR	GNR
Micarea assimilata	assimilative dot lichen	UF	S2	NNR	G3G5
Mycoblastus affinis	kindred blood lichen	UF	S2	NNR	G3G5
Mycoblastus sanguinarius	bloody-heart lichen	LF UF	S2	NNR	G4G5
Mycocalicium subtile	lichen	LF	S2S4	NNR	G4G5
Myxobilimbia sabuletorum	dot lichen	LF	S2	NNR	G4G5
Nephroma bellum	naked kidney lichen	LF	S2	NNR	G3G5
Nephroma isidiosum	lichen	UF	S1	NNR	G3G5
Peltigera horizontalis	flat fruited pelt lichen	LF	S2S3	NNR	G5
Peltigera polydactyla	alternating dog-lichen	LF UF	S2	NNR	G5?
Pertusaria borealis	lichen	UF	S1	NNR	GNR
Pertusaria sommerfeltii	lichen	UF	S1?	NNR	G4G5
Phaeophyscia nigricans	shadow lichen	UF	S2	NNR	G4
Physcia biziana	frosted rosette lichen	LF	S1S2	NNR	G5
Physcia phaea	black-eyed rosette lichen	UF	S2S3	NNR	G4G5
Physcia tenella	fringed rosette lichen	LF	S2	NNR	G4
Physconia perisidiosa	crescent frost lichen	LF UF	S2	NNR	G3G5
Protoblastenia rupestris	orange dot lichen	UF	S2S3	NNR	G4G5
Pseudevernia consocians	lichen	UF	S1	NNR	G3G5
Ramalina farinacea	dotted ramalina	LF	S3	NNR	G3G5
Ramalina intermedia	rock ramalina	LF	S2	NNR	G4G5

Scientific Name	Common Name		Conservation Rank*		
			AB	Canada	Global
Ramalina obtusata	hooded ramalina	LF	S2	NNR	G5?
Ramalina roesleri	frayed ramalina	LF	S1	NNR	G3G5
Rinodina albertana	pepper-spore lichen	LF	S2	NNR	GNR
Rinodina archaea	brown pepper-spore lichen	UF	S2	NNR	G4G5
Rinodina exigua	spoke pepper-spore lichen	LF UF	S1S2	NNR	GNR
Rinodina metaboliza	pepper-spore lichen	LF	S2S4	NNR	GNR
Solorina spongiosa	fringed chocolate chip lichen	LF	S2	NNR	G4G5
Usnea ceratina	warty beard lichen	LF	S1	NNR	G4G5
Usnea scabiosa	beard lichen	LF	S1S2	NNR	GNR
Varicellaria rhodocarpa	red-fruited pox lichen	UF	S2	NNR	G3G5
Vulpicida canadensis	brown-eyed sunshine lichen	UF	S2	NNR	G3G5
Xanthomendoza fulva	bare-bottomed sunburst lichen	UF	S1	NNR	G5
Xylographa parallela	black woodscript lichen	UF	S2S4	NNR	G5
Xylographa vitiligo	white-spotted woodscript lichen	UF	S2	NNR	G4G5
Plants - Vascular					
Agrostis exarata	spike redtop	LF UF	S2	N5	G5
Anemone quinquefolia	wood anemone	LF UF	S1	NNR	G5
Arnica louiseana	Lake Louise arnica	UF	S1S2	N3	G3
Artemisia borealis	northern wormwood	UF	S2	N5?	G5T5?
Blindia acuta	sharp-pointed weissia	LF UF	S2	NNR	G5
Botrychium ascendens	ascending grape fern	UF	S2	N2N3	G3
Botrychium crenulatum	scalloped grapefern	LF	S1	N2N3	G3
Botrychium lanceolatum	lance-leaved grape fern	LF UF	S2	N4	G5
Botrychium pinnatum	northwestern grapefern	LF UF	S3	N4	G4?
Botrychium spathulatum	spatulate grape fern	UF	S2	N2N3	G3
Boykinia heucheriformis	telesonix	UF	S2	N2	G4
Calamagrostis lapponica	Lapland reed grass	LF	S1	N5	G5
Carex adusta	browned sedge	LF	S1	NNR	G5
Carex arcta	narrow sedge	LF	S1	N5	G5
Carex heleonastes	Hudson Bay sedge	LF UF	S2	N3	G4
Carex incurviformis var. incurviformis	seaside sedge	LF UF	S2	NNR	G4G5T4T5Q
Carex lacustris	lakeshore sedge	LF	S2	N5	G5
Carex mertensii	purple sedge	UF	S2	NNR	G5
Carex podocarpa	alpine sedge	LF	S2	NNR	G4G5
Carex umbellata	umbellate sedge	LF	S2	N5	G5
Chrysosplenium iowense	golden saxifrage	LF	S3?	N3	G3?
Cystopteris montana	mountain bladder fern	LF UF	S2	N3N4	G5
Deschampsia elongata	slender hair grass	LF	S1	NNR	G5
Diphasiastrum sitchense	ground-fir	UF	S2	N5	G5
Draba porsildii	Porsild's whitlow-grass	UF	S1S2	N3N4	G3G4
Eleocharis elliptica	slender spikerush	LF	S2?	N5	G5
Epilobium clavatum	willowherb	UF	S2	N5	G5
Epilobium lactiflorum	willowherb	UF	S2	NNR	G5
Epilobium leptocarpum	willowherb	UF	S1	N2N3	G5
Epilobium saximontanum	Rocky Mountain willowherb	UF	S1	N1N3	G5
Festuca altaica	northern rough fescue	UF	S2	N5	G5
Glyceria elata	tufted tall manna grass	LF UF	S2	NNR	G4G5
Gymnocarpium disjunctum	western oak fern	UF	S1	N5	G5
Juncus brevicaudatus	short-tail rush	UF	S2	N5	G5
Juncus stygius var. americanus	marsh rush	LF UF	S2	NNR	G5T5
Koenigia islandica	koenigia	UF	S1	N4	G4
Lactuca biennis	tall blue lettuce	LF	S2	N5	G5
Lomatogonium rotatum	marsh felwort	UF	S2S3	N5?	G5
Luzula acuminata	wood-rush	LF UF	S1	N5	G5

Scientific Name	Common Name		Conservation Rank*		
			AB	Canada	Global
Luzula rufescens	reddish wood-rush	LF	S1	N2N3	G5
Mimulus guttatus	yellow monkeyflower	LF	S2S3	N5	G5
Monotropa hypopithys	pinesap	LF	S2	NNR	G5
Oxytropis campestris var. davisii	northern locoweed	LF UF	S2?	N3	G5T3
Phegopteris connectilis	northern beech fern	LF UF	S2	N5	G5
Pinus albicaulis	whitebark pine	UF	S2	N3	G3G4
Pinus flexilis	limber pine	UF	S2	N3	G4
Potamogeton foliosus	leafy pondweed	LF	S2	N5	G5
Potamogeton obtusifolius	blunt-leaved pondweed	LF	S2	N4N5	G5
Potentilla multisecta	smooth-leaved cinquefoil	UF	S2	N2	GNR
Prenanthes alata	white lettuce	UF	S1	NNR	G5
Primula egaliksensis	primrose	LF UF	S2	NNR	G4
Sagittaria latifolia	broad-leaved arrowhead	LF	S2	N5	G5
Salix alaxensis var. alaxensis	Alaska willow	UF	S2S3	NNR	G5T4T5
Salix commutata	changeable willow	UF	S2	NNR	G5
Salix raupii	Raup's willow	LF	S1	N2	G2
Saxifraga odontoloma	saxifrage	UF	S1S2	NNR	G5
Sisyrinchium septentrionale	pale blue-eyed grass	UF	S3	N3N4	G3G4
Sparganium hyperboreum	northern bur-reed	UF	S1	NNR	G5
Sphenopholis obtusata	prairie wedge grass	LF	S2	NNR	G5
Stellaria crispa	wavy-leaved chickweed	LF UF	S2	NNR	G5
Streptopus roseus	rose mandarin	LF UF	S1	N5	G5
Streptopus streptopoides	twisted-stalk	UF	S1	NNR	G5
Trichophorum clintonii	Clinton's bulrush	LF	S1	NNR	G4
Trisetum montanum	mountain trisetum	UF	S1	N2	G4G5
Viola pallens	Macloskey's violet	LF	S2S3	NNR	G5T5

Conservation Status Rankings - Federal and Provincial

The Fish and Wildlife Division of Alberta Sustainable Resource Development ranks species into categories reflecting the perceived level of risk to their populations in Alberta in the General Status of Alberta Wild Species. The general status evaluation process that is used in Alberta provides an initial assessment of wild species as to whether they are: "At Risk" of extinction / "May Be At Risk" of extinction / "Sensitive" to human activities or natural events / Considered "Secure" or "Undetermined". An "At Risk" species is any species known to be at risk after formal detailed status assessment and legal designation as Endangered or Threatened in Alberta. "May Be At Risk" is any species that may be at risk of extinction or extirpation, and is therefore a candidate for detailed risk assessment. "Sensitive" is any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk. "Undetermined" is any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.

SRANK- Standard Subnational (Provincial) Conservation Status Rank: **SX**-Taxon is believed to be extirpated from the province / Not located despite intensive searches of historical sites and other appropriate habitat / virtually no likelihood that it will be rediscovered. **SH**- Known from only historical records but still some hope of rediscovery / Evidence that the taxon may no longer be present but not enough to state this with certainty. **S1**- Known from five or fewer occurrences or especially vulnerable to extirpation because of other factor(s). **S2**- Known from twenty or fewer occurrences or vulnerable to extirpation because of other factors. **S3**- Known from 100 or fewer occurrences, or somewhat vulnerable due to other factors, such as restricted range, relatively small population sizes, or other factors. **S4**- Apparently secure, Taxon is uncommon but not rare, Potentially some cause for long term concern due to declines or other factors. **S5**- Secure - taxon is common, widespread, and abundant. **S#S#**- A numeric range rank is used to indicate any range of uncertainty about the status of the taxon. Example - S2S3 or S1S3. Ranges cannot skip more than two ranks. Example - SU is used rather than S1S4. **SU**- Taxon is currently

unrankable due to lack of information or substantially conflicting information. Example - native versus non-native status not resolved.

GRANK- Global Conservation Status Rank: **GX-** Presumed Extinct (species)—Not located despite intensive searches and virtually no likelihood of rediscovery. **GH-** Possibly Extinct (species)- Known from only historical occurrences but still some hope of rediscovery. Examples of evidence include (1) that a species has not been documented in approximately 20–40 years despite some searching and/or some evidence of significant habitat loss or degradation / (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is extinct or eliminated throughout its range. **G1-** Critically Imperiled—At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors. **G2-** Imperiled—At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors. **G3-** Vulnerable—At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors. **G4-** Apparently Secure—At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors. **G5-** Secure—At very low risk of extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats. **T#**- Infraspecific Taxon (trinomial)—The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T subrank cannot imply the subspecies or variety is more abundant than the species . For example, a G1T2 subrank should not occur. A vertebrate animal population, (e.g., listed under the U.S. Endangered Species Act or assigned candidate status) may be tracked as an infraspecific taxon and given a T-rank / in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada)- Extinct (X) - A wildlife species that no longer exists. Extirpated (XT) - A wildlife species that no longer exists in the wild in Canada, but exists elsewhere. Endangered (E) - A wildlife species facing imminent extirpation or extinction. Threatened (T) - A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction. Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats. Data Deficient (DD) - A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction. Not At Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

SARA (Species at Risk Act)- Schedule 1, is the official list of wildlife species at risk. It classifies those species as being either extirpated, endangered, threatened, or a special concern. Once listed, the measures to protect and recover a listed wildlife species are implemented. COSEWIC has been assessing species since 1977. In October 1999 COSEWIC adopted new assessment criteria. When SARA was proclaimed, only those species that had been assessed according to these new criteria were included on Schedule 1. To ensure that the remaining species at risk would be re-assessed within an appropriate timeframe, they were all included in SARA with the addition of Schedule 2 (endangered and threatened species) and Schedule 3 (species of special concern) (SARA, 2013).

Appendix 14. Watersheds with Stream Crossings

Highway 947 Watersheds with Stream Crossings

N

1 0 1 2 3

Kilometers

Scale: 1:100,000

LEGEND

- Contours
- Streams
- Proposed Highway 947 Alignment
- Stream Crossing
- Wetlands
- Lakes & Rivers
- Watershed Subbasin Boundary

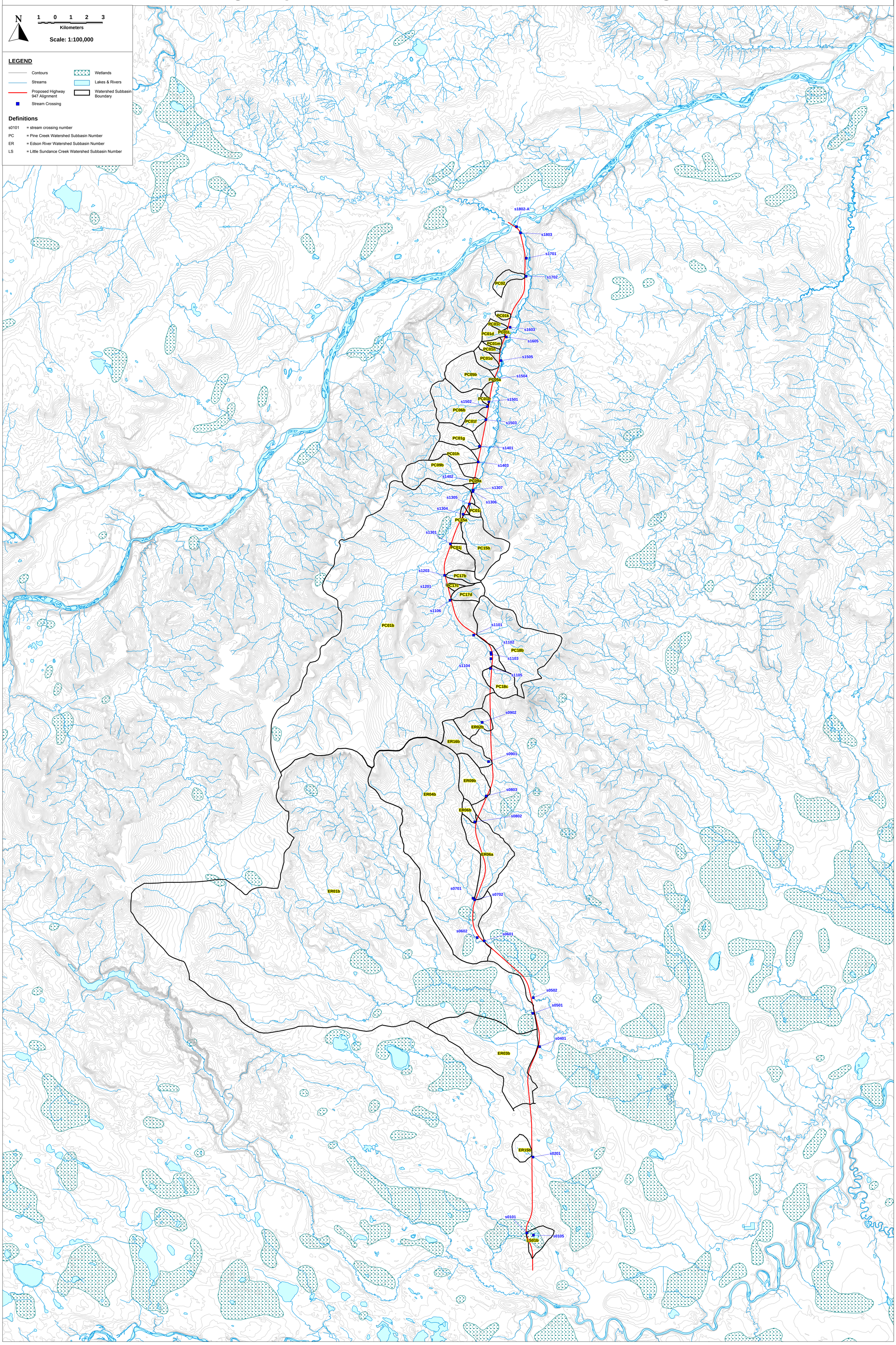
Definitions

s0101 = stream crossing number

PC = Pine Creek Watershed Subbasin Number

ER = Edson River Watershed Subbasin Number

LS = Little Sundance Creek Watershed Subbasin Number



Appendix 15. Heritage Assessment

HIGHWAY 947

Highway 16 to Silver Summit Access
(Km 0.000 to Km 37.711)
Silver Summit Access to Athabasca River
(Km 0.000 to Km 35.511)

Environmental Assessment Report

Cultural Resources - Draft

27 February 2013

Submitted To:

ALBERTA TRANSPORTATION
North Central Region

Prepared For

ARA Engineering Ltd
Suite 101, 110 Country Hills Landing NW
Calgary, Alberta
T3K 5P3

Prepared By

Ecofor Consulting Ltd
9940 – 104th Ave
Fort St. John, BC
V1J 2K3
(250) 787-6009

ECOFOR
natural and cultural resource consultants

EPN: 2011-2136

DRAFT

1 Cultural Resources

1.1 Methods

The methods are discussed below for background research, the Statement of Justification, and the fieldwork. Due to their sensitivity, the exact locations of the historical resources are not provided here. The details are provided in separate archaeological Historical Resources Impact Assessment (HRIA) and paleontological HRIA reports submitted to Alberta Culture for review and inclusion in their records as per permit requirements.

1.1.1 Background Research Methods

Initial Cultural Resources background review included a site file search for previously recorded archaeological sites, historic structures (Heritage Survey records), and past permitted assessment work in and near the proposed Highway 947 alignment. Following this review, a Statement of Justification (SOJ) (summarized below) was prepared and submitted for review by Alberta Culture. As a result of their review, Alberta Culture indicated there was a need for both archaeological and paleontological HRIAs for this project. In addition, Ecofor biological staff had identified one possible historic structure and begun to document stream crossings along the proposed alignment. This information was included in background research in preparation of the Statement of Justification.

1.1.2 Statement of Justification

The majority of the proposed development is located in relatively undisturbed forested crown land. There is some previously disturbed ground within existing secondary roads, agricultural fields, utility developments and corridors. Ecofor began environmental baseline studies along the proposed Highway 947 right-of-way (ROW) in the summer of 2012, and at that time biology field crews documented 59 stream crossings ranging from large rivers to small non-classified drainages (NCDs) and a single pond. Approximately two-thirds of these streams and drainages were thought to be, or were likely to be, fish bearing. Photographs of the stream crossing sites were inspected by heritage staff, who estimated that approximately one-third of the banks and benches associated with these crossings had potential for buried cultural resources. Some of these crossings, as well as a few other locations, were identified as areas of heritage resources interest.

Heritage staff recommended that an archaeological HRIA be conducted for areas that were located immediately adjacent to both major and minor stream crossings (included in the areas of interest), as well as within areas associated with the single historical structure, HSS 74802. In the case of the HSS 74802, additional local background research and informant interviews were recommended, to learn the probable location of the post. Moreover, pedestrian transects in the areas of least prior disturbance

DRAFT

were recommended to determine the presence/absence of micro-topographic features, such as knolls, ridges, or breaks in slope that are indicative of moderate or higher archaeological potential. Subsurface testing was recommended for areas assessed in the field to possess archaeological potential.

Surface inspection, coupled with a subsurface testing program, was strongly recommended for areas slated for development near the larger stream and river crossings including the Edson River, tributaries to Pine Creek, Pine Creek, and the approach to the south side of the Athabasca River.

It was also recommended that any historical resources that will be impacted by the construction of the proposed development, which have not been previously documented in the Provincial Historical Resources Inventory, be photographed and recorded with a completed Heritage Survey Site Form.

This SOJ was submitted to Alberta Culture. Their office reviewed the SOJ and issued a *Schedule A Requirements* that directed the completion of an archaeological HRIA with recording of historic structures, as well as a paleontological HRIA.

The Schedule A requirements stated that all areas of high archaeological potential as outlined in the Statement of Justification must be included in the archaeological HRIA, and that additional salvage, protection or preservation measures may be required. The Schedule A requirements also stated that the assessment be carried out prior to land surface disturbance under snow-free, unfrozen ground conditions, and that if warranted a deep testing program may be required in areas of significant sedimentation.

1.1.3 Fieldwork Methods

The field methods employed for the archaeological HRIA efforts were outlined in the permit application submitted to Alberta Culture through the Online Permitting and Clearance (OPaC) system. These methods were based on the following two-part strategy. The first part consisted of background record checks and review of previous HRIAs in and near the project area. The second part consisted of field reconnaissance and sub-surface testing in areas of moderate to high archaeological potential.

Field reconnaissance of the proposed Highway 947 project was conducted under snow-free, unfrozen conditions. The assessment consisted of surface inspection undertaken by means of pedestrian traverse of each parcel with landowner approved access, as well as concentrated efforts on areas exhibiting moderate to high archaeological potential. Typically, areas exhibiting the greatest archaeological potential include stream crossings, significant breaks-in-slope, distinct topographic features such as ridges, knolls and depressions, well drained, elevated terrain adjacent to wetlands and locations within or in close proximity to previously recorded archaeological or historic sites. During pedestrian traverse, a visual inspection of exposures was undertaken to identify surface cultural materials. Subsurface testing was conducted in areas deemed to exhibit moderate to high archaeological potential but lacking sufficient surface exposure for adequate assessment. Subsurface tests were a minimum of 35 cm x 35 cm in dimension and were excavated to a depth of 70 cm where possible. All sediments were screened

through 0.64 cm mesh and/or hand sorted to ensure the recovery of cultural materials. Sediment characteristics were documented for each shovel test location. Areas of interest identified in the SOJ and permit application, and any additional high potential landforms identified in the field, were also surveyed using similar methods.

In circumstances where surface or subsurface artifacts were identified, the location of each artifact was photographed and recorded. The Universal Transverse Mercator (UTM) coordinates were determined using a recreational-grade Garmin GPS unit, and the locations were noted on 1:50,000 scale National Topographic Survey (NTS) maps. Site assessment included collection and/or documentation of a representative sample of any cultural materials identified on the surface of the development or within shovel tests. When a site was identified, shovel testing was conducted at three to five meter intervals as required in order to determine the extent of the site boundary. The results of the testing was recorded and site sketches were made.

Artifact analysis was conducted in accordance with standard archaeological practice: measurements were taken, morphology recorded and cultural associations made when possible. If present, faunal materials were assigned to class, genus or species, element, and if possible, sided[1]. Diagnostic artifacts were photographed and/or illustrated.

Archaeological site significance was assessed for all identified heritage resources. Information on site size, depth, stratigraphic quality/integrity, site type, density of archaeological materials, and the presence/absence of cultural features was collected to determine a site's significance in order to ensure that appropriate recommendations are made. Established significance criteria includes scientific importance, public interest, ethnic meaning, historic and economic relevance.

Historic structures located within or near the proposed alignment were assessed and recorded as per the Alberta Culture guidelines entitled *Requirements for recording and reporting historic structures within the context of archaeological HRIAs – revised February 2012*[2]. This includes collecting black and white and digital photographs of each facade and corner view, completing a Heritage Survey Site Form, a site sketch map, and a follow-up historic title search. The results of this historic structure assessment was included in the archaeological HRIA reporting as required.

Paleontological HRIA field methods employed were focused on the water crossings as directed in the Schedule A provided by Alberta Culture. Information and recent photographs of each water/stream crossing were reviewed and an initial field survey was conducted. Only those streams that had exposed outcrops of soil to evaluate, were chosen for closer inspection. The majority of the streams had water

[1] "Elements" are the part of the faunal remains, such as the type of bone; "sided" is whether the remains came from the right or left side of an animal.

[2] Alberta Culture. 2012. *Requirements for recording and reporting historic structures within the context of archaeological HRIAs* (October 2008, revised February 2012) available at: http://culture.alberta.ca/heritage/resourcemanagement/archaeologyhistory/researchpermitmanagementsystem/pdf/recording-historic-structures.pdf.

DRAFT

present that was less than 0.5 m across and less than 0.1 m deep at the time of survey, and had little to no outcrop to examine. Those stream crossings with exposed outcrops were evaluated 100 m east and west of the highway alignment centerline where possible. The width and depth of each stream crossing was recorded, the sediments were described, and the area's depositional environment was evaluated and noted. The stream crossings were inspected for fossil remains and materials and suggested management actions were recommended.

1.2 Existing Conditions

1.2.1 Archaeological Resources Background

The heritage resources background research revealed many previous Historical Resources Impact Assessment efforts which partially overlapped segments of the proposed alignment of Highway 947, but no archaeological sites were previously recorded within the planned alignment. One previously recorded archaeological site (FjQd-13) is located approximately 3.5 km from the proposed alignment. Fourteen additional sites have been recorded within approximately 7 km of the proposed alignment, but none of these will be impacted by the construction of the project.

Table 1. Previous Historical Resource Impact Assessment efforts near the Highway 947 Project

PERMIT NUMBER(S)	RELATIONSHIP TO PROPOSED DEVELOPMENT FOOTPRINT
00-005	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T055 S09 and W5 R18 T059 S03, S10. Sites recorded included FjQd-6, 9, and 11; these are approximately 5 - 7 km southeast of the current project, in similar contexts near small tributaries.
01-162	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T058.
01-194	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S09, S10, S15.
02-132	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; and W5 R18 T055.
02-133	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059 S10, S14, S23, S25, S26, S35.
02-176	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059.
03-117	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056; W5 R18 T057.
03-299	An HRIA was conducted within the following lands that overlap with the

PERMIT NUMBER(S)	RELATIONSHIP TO PROPOSED DEVELOPMENT FOOTPRINT
	proposed project area: W5 R18 T058 and W5 R18 T059.
04-213	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056; and W5 R18 T057.
04-411	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059.
05-206	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056; and W5 R18 T057.
06-107	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S03, and S04.
06-201	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S09, and S10. Sites recorded included site FjQd-13 which is approximately 4 km southeast of the current project, located in similar contexts near a small tributary.
06-264	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056; and W5 R18 T057.
06-693	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057 S30.
06-722	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057 S30.
07-019	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S09, and S10.
07-217	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056; and W5 R18 T057.
08-253	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059.
08-266	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057; W5 R18 T058; and W5 R18 T059.
08-317	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054 S16, and S21.
08-363	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057; W5 R18 T058; and W5 R18 T059.
09-151	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056; and

DRAFT

PERMIT NUMBER(S)	RELATIONSHIP TO PROPOSED DEVELOPMENT FOOTPRINT
	W5 R18 T057.
09-159	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057; W5 R18 T058; and W5 R18 T059.
10-047	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S14 and S15.
10-102	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059.
10-138	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057 and W5 R18 T058.
10-167	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T057; W5 R18 T058 and W5 R18 T059.
10-229	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056 and W5 R18 T057.
11-093	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059.
11-147	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056 and W5 R18 T057.
11-148	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S14, S15, S21, and S22.
12-089	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T058 and W5 R18 T059. Sites recorded include GaQd-1, located approximately 4.5 km east of the alignment and will not be impacted.
12-140	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054; W5 R18 T055; W5 R18 T056 and W5 R18 T057.
75-022	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T055; W5 R18 T058 and W5 R18 T059.
76-076	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S10.
77-009	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T054 S16.
77-045	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T058 S08, S16, S17, S21, S28, S33; W5 R18 T059 S03, S10, S11, S14, S23, S26 and S35. This work included assessment for road improvements from the south side of the Athabasca

PERMIT NUMBER(S)	RELATIONSHIP TO PROPOSED DEVELOPMENT FOOTPRINT
	River along Pine Creek for approximately 10 miles. Areas of potential were inspected and subjected to a total of 11 shovel tests and no new sites were recorded near the current project.
81-041	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059 S35.
85-075	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S10.
85-090	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S09 and S10.
89-026	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S09. Sites recorded included FjQd-3 located approximately 2.7 km west of the current project; it will not be impacted.
91-067	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059 S03.
92-059	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059 S10, S14 and S23.
93-100	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S14, S21, S22 and S28.
93-102	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053.
94-112	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059 S10.
96-063	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T053 S14, S15, S21, S22, S28, S33; W5 R18 T055 S09, S16, S28, S33; W5 R18 T056 S04, S08, S09, S16, S21, S28, S33; W5 R18 T057 S04, S09, S16, S17, S19, S30, S31; W5 R18 T058 S05, S06, S08, S16, S21, S33, W5 R18 T059 S03, and S10. Sites recorded included FjQd-10 and 11 located to the south and southeast respectively, of the proposed project area; they will not be impacted.
96-074	An HRIA was conducted within the following lands that overlap with the proposed project area: W5 R18 T059 S03.

DRAFT

1.2.2 Historical Resources Background

No previously recorded historic structures were known to be within the proposed alignment of Highway 947. One historic structure was said to be near (or south of) the southern terminus of the project -- a RNWMP Post from 1911 was recorded to be within LSD 2 and 3, 9-53-18-W5M). However, no existing structure was previously recorded in the area. The historical significance notes on the heritage survey form stated that by 1911 'G' Division had established a one-man detachment (const WGF Wells) at Bickerdike in quarters rented from D. McMillan until January 1912.

Table 2. Previously recorded Historic Structures listed near the Highway 947 Project

HISTORIC STRUCTURE(S)	RELATIONSHIP TO ACTIVITY AND ANTICIPATED IMPACTS
74802 R.N.W.M.P. Post	An historic RNWMP Post from 1911 was recorded as within LSD 2 and 3, 9-53-18-W5M and no photographs or detailed location information were recorded with the structure. Since the proposed Highway 947 would impact the northeast 1/4, of the northeast 1/4, of the northeast 1/4 of section 3, it is uncertain, but unlikely, that the remains of this structure would be impacted.

1.2.3 Palaeontological Resources Background

Dan Spivak of the Royal Tyrrell Museum and Dr. Chris Jass of the Royal Alberta Museum noted (pers. comm. September 24, 2012) that no Quaternary fossils are currently known from project area. Given that the proposed project will cross numerous watercourses and channels, they stated that there is potential for impacting Quaternary (most likely post-glacial) faunal remains. An increasing number of microfauna sites containing both pre- and post-glacial remains (e.g., Sturgeon River, Pine Creek) have been recognized across the province in fluvial channels. Because the project will include watercourse crossings, there is a greater likelihood that Quaternary fossil resources might be impacted. Therefore a paleontological HRIA was requested, which was to focus on areas where water crossings will be impacted, as those are the most likely sites for paleontological resources.

1.2.4 Field Assessment

The archaeological HRIA field assessment was conducted between September 30 and October 12, 2012. The field crew consisted of James Mooney, Jen Herkes, Greg Holland, and Devon Yacura of Ecofor Consulting Ltd (Ecofor). The areas of interest identified in the SOJ were inspected in the field and other areas along the proposed alignment were reviewed. Field mapping with stream crossings and points of access previously identified by Ecofor biological staff were used for access and recording purposes. A total of 42 locations were assessed in the field and of these, 22 locations were selected for sub-surface shovel testing. A total of 192 shovel tests were excavated and 19 (10%) of these were found to contain

DRAFT

cultural resources. As a result of this HRIA six previously unrecorded prehistoric archaeological sites were recorded (FjQd-15, FkQd-2, FjQd-3, FjQd-4, FjQd-5, and GaQd-2). Each of these sites contained prehistoric lithic materials which represent a prehistoric use area. No areas were identified as warranting deep testing and therefore no deep testing was conducted.

No evidence was identified that supported the location of the McMillan residence in which the one-man police detachment was said to have been temporarily established from 1911 into 1912. It appears that D. McMillan could have been A. D. McMillan, the first Mayor of Edson, as per communication with the Edson Public Library. However no standing historic structures were identified within the proposed alignment of the project in this area. The structure in question, if still standing, may be located on private land to the east of the proposed alignment.

A single historic structure was identified within the proposed alignment. This structure was identified very near the centerline of the proposed alignment, and appears to have been a chicken coop built in the mid 1900's that was converted into a horse shed in the mid to late 1900's. This structure was recorded and photographed by James Mooney on October 4, 2012 as per Alberta Culture guidelines. No other historic structures were noted in or near the proposed alignment.

The paleontological HRIA field assessment was conducted by Ecofor October 9 - 11, 2012, concurrently with the archaeological assessment. The paleontological field assessment was conducted by Dr. Neil Beaven assisted by Devon Yacura. A total of 16 locations were assessed. No paleontological evidence was discovered during the survey at stream crossings along the proposed alignment. One location within the proposed alignment and one location to the east of the alignment were found to contain fragments of petrified wood.

1.3 Impacts

Each of the six identified archaeological sites will be directly impacted by the proposed highway alignment. Four of the sites (FjQd-15, FjQd-4, FjQd-5, and GaQd-2) represent small, low density, lithic scatters which reflect short term lithic deduction workshops (sites of limited stone tool manufacture) that are unlikely to contain materials that would significantly add to the understanding of the past use of the area. Two sites (FkQd-2 and FkQd-3) each contain higher densities of prehistoric materials which reflect a more significant use. Each of these two sites was evaluated as possessing a moderate potential to add to the understanding of the past use of the area. No further work is recommended for the four smaller sites (FjQd-15, FjQd-4, FjQd-5, and GaQd-2).

No evidence was identified for the previously recorded historic structure, the HS74802 temporary RNWMP post, and it is very unlikely that it, or the remains of the structure, will be impacted by the proposed project. No further work is recommended. A single historic structure (horse shed) was recorded within the proposed alignment. This structure was evaluated as not likely to add significant understanding to the past use of the area, and it will be impacted by the proposed alignment.

No known paleontological remains will be impacted by this project. However five locations were identified as possessing depositional environments that are conducive to preserving paleontological remains. These five locations would be impacted by the proposed alignment.

1.4 Mitigation Measures

1.4.1 Protection Measures

No archaeological protection measures are recommended for archaeological sites FjQd-15, FjQd-4, FjQd-5, and GaQd-2. Archaeological sites FkQd-2 and FkQd-3 are recommended for protection by means of avoidance or data recovery mitigation (see below). Any changes to the currently proposed alignment should be assessed for need for additional archaeological HRIA efforts, to ensure that additional archaeological resources are not impacted.

No further work is recommended for the previously recorded historic structure, the HS74802 temporary RNWMP post in the McMillan residence of 1911-1912, as it appears that no structure exists that matches that description within the southern end of the project area.

No protection measures are recommended for the single historic structure (horse shed) recorded within the proposed alignment. This structure does not possess sufficiently significant heritage values to warrant protection. This structure has been photographed and recorded as per Alberta Culture guidelines and this recording serves to record a sample of the mid 1900s use of the area.

Five locations within the right-of-way identified by paleontological HRIA efforts, including one with petrified wood, have been recommended for construction monitoring.

1.4.2 Mitigation Measures

Archaeological sites FkQd-2 and FkQd-3 are recommended for avoidance (see above), or mitigation by means of data recovery excavations, prior to construction disturbance.

The five locations identified as possessing depositional environments that are conducive to preserving paleontological remains are recommended for construction monitoring. In the event that paleontological remains are discovered during construction, then additional efforts will be made to record, temporarily protect, then excavate the remains as per the paleontological HRIA report.

1.4.3 Chance Find Procedures

Developers are required to comply with Section 31 of the Historical Resources Act, which reads:

> A person who discovers an historic resource in the course of making an excavation for a purpose other than for the purpose of seeking historic resources shall forthwith notify the Minister of the discovery. Where there will be little or no further impact from the excavation activity on the historic resource, applicants reporting a chance discovery will not

DRAFT

be responsible for conducting Historic Resources Impact Assessments or other studies to clarify the nature and extent of the historic resource.

When reporting the discovery of a historic resource, Alberta Culture should be provided UTM coordinates recorded by GPS and as much descriptive information as possible. Therefore in the event that archaeological, paleontological, or historic remains are identified during the construction process, the crew should stop work immediately, protect the remains with a tarp, record their location, and consult Alberta Culture. If archaeological remains are identified then a professional archaeologist should be consulted.

In the event that paleontological remains are uncovered then a paleontologist should be contacted for immediate inspection, identification and removal of the remains before construction at that location continues.

If human remains are identified then work in the area should cease, the remains should be protected from further impacts, and the RCMP and local coroner should be notified.

1.5 Residual Effects

1.5.1 Positive and Negative Residual Effects

This project has had a positive effect on historical resources in that six new archaeological sites and one historic structure have been recorded and many other locations have been reviewed and tested. If the project continues to development as planned, and the two sites recommended for avoidance or mitigation are avoided, that will also be a positive effect. However if the two sites are impacted without mitigation data recovery, they will be lost forever and their loss will be a negative effect. However if mitigation data recovery efforts are conducted, they will provide a better understanding of the past use of this area and there will be a positive effect in recording some of the past use of this area. The single historic structure identified in the proposed alignment is evaluated as not possessing significant data to warrant protection in place, but the recording of the structure has provided a positive effect.

1.5.2 Consequences Relevant to Management Objectives

The mission of Alberta Culture is to promote, develop and preserve Alberta's culture and heritage in support of vibrant and inclusive communities. Historic resource management in Alberta protects designated historic places, archaeological and paleontological sites, and historic buildings while regulating development to preserve significant historical resources. These resources are protected under the *Historical Resources Act*, and impacts to historical resources are evaluated through the HRIAs which are regulated through the archaeological and paleontological fieldwork permit system. The

objectives of the historical resources management by Alberta Culture are being met by the review and implementation of recommendations of archaeological and paleontological HRIA[3].

1.6 Monitoring

The five locations identified by the paleontological HRIA report are recommended for construction monitoring by a qualified paleontologist. Depending on the results of the monitoring, additional salvage, protection or preservative measures and efforts may be required.

1.7 Regulatory Requirements

1.7.1 Historical Resources Act and Definitions

In the province of Alberta, Historical Resources are recognized as nonrenewable resources and are protected under the *Historical Resources Act* (Province of Alberta 1987). *The Historical Resources Act* defines a historical resource as follows:

> …any work of nature or of man that is primarily of value for its palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific or aesthetic interest including but not limited to, a paleontological, archaeological, prehistoric, historic, or natural site, structure or object…. (Province of Alberta 1987).

Historical Resources are separated into three categories -- Archaeological, Historical and Palaeontological:

> **Archaeological Resources** include any work of humans that are of value for their prehistoric, historic, cultural or scientific significance and is or was, buried or partially buried in land in Alberta or submerged beneath the surface of any watercourse or permanent body of water in Alberta. No written record exists for these resources;
>
> **Historical Resources** include any work of nature or of humans that is primarily of value for its palaeontological, archaeological, prehistoric, historic, cultural, natural, scientific of esthetic interest including, but not limited to a palaeontological, archaeological, prehistoric or natural site, structure or object. Historic sites include, or consist of, an historical resource of an immovable nature or that cannot be disassociated from its context without destroying some or all of its value as an historical resource and includes prehistoric, historic or natural sites or structures. Typically, historic documents exist for these resources;

[3] At the time of writing this draft report, Alberta Culture has not reviewed either the archaeological or the paleontological HRIA report and recommendations. However, following their review of the reports and recommendations and implementation of their recommendations, then the management objectives will be met.

Palaeontological Resources refer to works of nature consisting of or containing evidence of extinct multicellular beings and include those works of nature or classes of works of nature designated by the regulations as palaeontological resources. These are typically referred to as fossils and include such things as dinosaur bones or track ways.

DRAFT