Appendix E Conservation and Reclamation Plan for the CO_2 Pipeline

Quest Carbon Capture and Storage Project

CONSERVATION AND RECLAMATION PLAN FOR THE CO_2 PIPELINE

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Acronyms and Abbreviations

ACCS ..... Alberta Culture and Community Spirit
ACD ..... Alberta Community Development
ACIMS ..... Alberta Conservation Information Management System
AENV ..... Alberta Environment
AEP ..... Alberta Environmental Protection
AIHA ..... Alberta's Industrial Heartland Association
ANHIC ..... Alberta Natural Heritage Information Centre
ASP ..... Area Structure Plan
ASRD ..... Alberta Sustainable Resource Development
C&R Plan ..... Conservation and Reclamation Plan
CCME ..... Canadian Council of Ministers of the Environment
COP ..... Code of Practice
COSEWIC ..... Committee on the Status of Endangered Wildlife in Canada
CP Rail ..... Canadian Pacific Rail
EPEA ..... *Environmental Protection and Enhancement Act*
EPP ..... Pipeline Environmental Protection Plan
ERCB ..... Energy Resources Conservation Board
ESA ..... environmentally sensitive area
FWMIS ..... Fisheries and Wildlife Management Information System
HDD ..... horizontal directional drill
HRIA ..... Historical Resources Impact Assessment
HRV ..... Historical Resource Value
LAA ..... Local Assessment Area
LUB ..... Land Use Bylaw
MDP ..... Municipal Development Plan
NSR ..... North Saskatchewan River
OD ..... outside diameter
PDA ..... Pre-Disturbance Assessment
PLA ..... Pipeline Agreement
RAP ..... Restricted Activity Periods
RDA ..... Restricted Development Area
ROW ..... right-of-way
TWS ..... temporary workspace

1 Introduction

Shell Canada Limited (Shell) is applying to Alberta Environment (AENV) for approval to construct the CO_2 pipeline component of the Quest Carbon Capture and Storage Project (the Project), which is 84 km long (see Figure 1-1). It originates at the CO_2 capture infrastructure site at the Scotford Upgrader, located in northeast and northwest quarters of Section 31 and the northwest quarter of Section 32, Township 55, Range 21, west of the fourth Meridian, and the southeast quarter of Section 6, the northeast and northwest and southwest quarters of Section 5 and the northwest quarter of Section 4, Township 56, Range 21, west of the fourth Meridian in the County of Strathcona. Approximately 28 km of the length of the CO_2 pipeline will be parallel to existing pipelines.

This Conservation and Reclamation (C&R) Plan discusses the CO_2 pipeline component of the Project. Although the pipeline laterals have been assessed qualitatively for the Application, additional information on the pipeline laterals will be provided when the locations are finalized. For C&R plans for 5 of the 3 to 10 potential injection well pads, see Appendix F.

Environmental protection protocols, including contingency planning, are provided in the Pipeline Environmental Protection Plan (EPP) (see Appendix I).

This C&R Plan covers conservation and reclamation considerations associated with the applicable environmental legislation, including the provincial *Environmental Protection and Enhancement Act*, *Water Act and Historical Resources Act,* and the federal *Species at Risk Act* and *Migratory Birds Convention Ac*t.

The C&R Plan is one component of the approval application and is prepared to address environmental concerns and mitigate adverse environmental effects during the construction of the pipeline and to describe the initial phase of reclamation once the pipeline is operational.

This C&R Plan has been compiled with guidance from:

- Information Requirements for Regulated Pipelines (AENV 1988a)
- Environmental Handbook for Pipeline Construction (AENV 1988b)
- Guide for Pipelines (Alberta Environmental Protection 1994)
- Guidelines for Alternative Soil Handling (Pettapiece and Dell 1996)
- Soil Quality Criteria Relative to Disturbance and Reclamation (revised) (Soil Quality Criteria Working Group 1987)
- Salt Contamination Assessment and Remediation Guidelines (AENV 2001a)

1.1 Approval Holder Information

The following is contact information for the approval holder.

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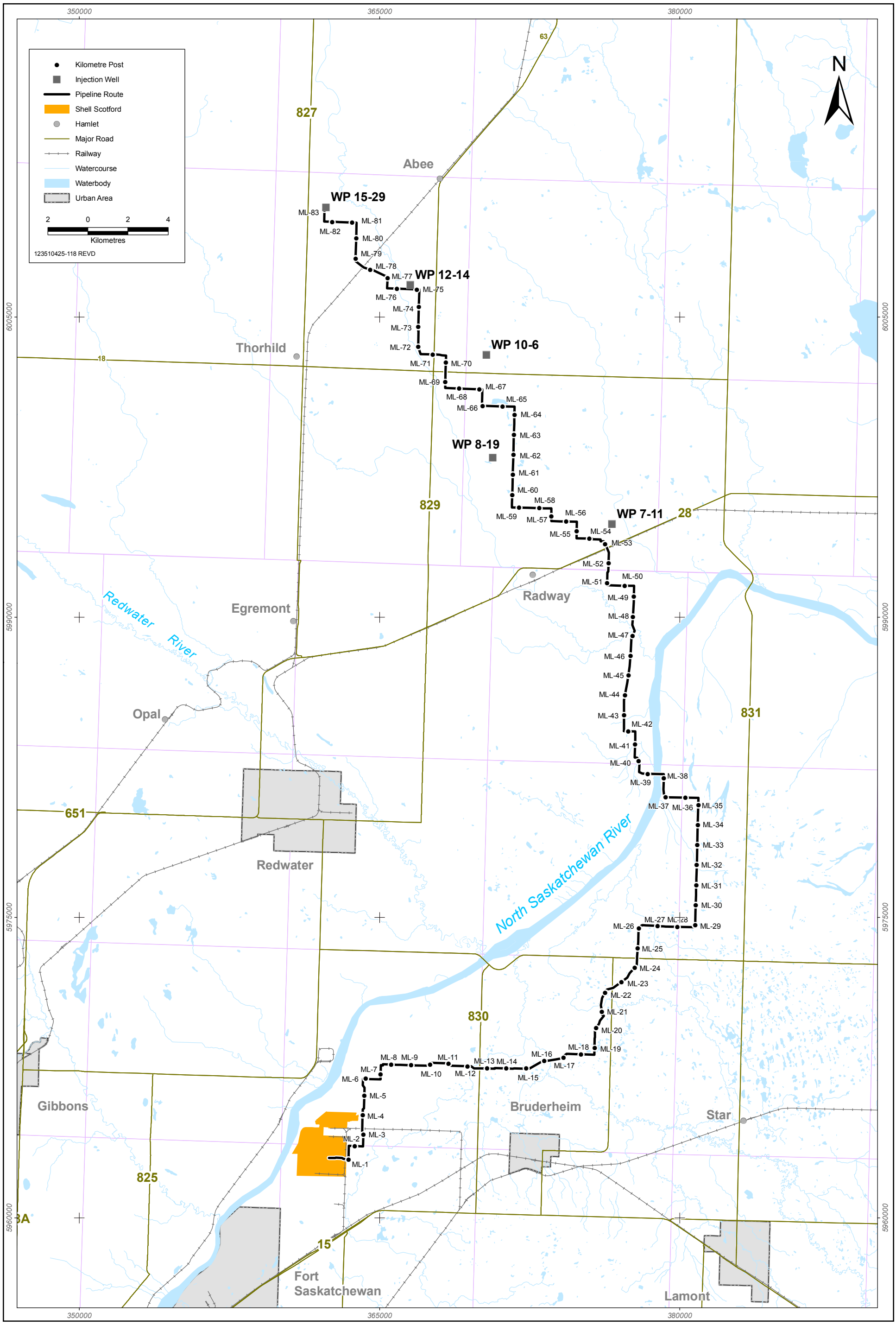

QUEST CARBON CAPTURE AND STORAGE PROJECT

Kilometre Posts along the Quest Pipeline

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010, Wells: Shell August 26, 2010, Basedata: National Road Network, Canvec, Altalis

PREPARED BY Stantec

PREPARED FOR

FIGURE NO. 1-1

Last Modified: Nov. 11, 2010 By: cspyker

2 Project Description

The Project includes a pipeline approximately 84 km in total length, originating at the Scotford Upgrader in Strathcona County and terminating north of Thorhild in Section 29-60-21 W4M (see Figure 1-1).

The pipeline is designed to safely transport dehydrated, compressed, and dense-phase CO_2. The northern end of the pipeline will be located at the end point injection well in Section 29-60-21 W4M. Shell intends to construct between 3 and 10 injection wells; at this time five well locations have been chosen. Smaller diameter pipelines (laterals) will connect the main pipeline to the injection wells. The locations of the laterals have not yet been determined and will be the subject of separate regulatory submissions.

The legal descriptions of five of the injection well pads, from south to north, are:

- LSD 07-11-59-20 W4M
- LSD 08-19-59-20 W4M
- LSD 10-06-60-20 W4M
- LSD 12-14-60-21 W4M
- LSD 15-29-60-21 W4M

Construction of the pipeline will include crossing several named (including the North Saskatchewan River [NSR]) and unnamed water bodies, utilities, roads, highways and railways.

Above-ground emergency shutdown block valves will be spaced at maximum intervals of 15 km along the route and near selected locations, such as watercourse crossings.

2.1 Right-of-Way and Temporary Workspace

The pipeline ROW will be 18 m in width and configured with 7 m temporary workspace (TWS) requirements to provide a 25 m combined width. Additional TWS will likely be required at crossing locations and substantive deflections (i.e., greater than 120° angles); the environmental assessment and mitigation measures are based on these parameters.

The ROW and TWS are located entirely within the White Area (settled area) of Alberta. The pipeline route will traverse Strathcona County, Sturgeon County, Lamont County and terminate in Thorhild County.

The ROW will parallel the Waupisoo Pipeline Project (NW 02-58-20 W4M to SW 35-58-20 W4M and SE 27-56-20 W4M to NE 02-57-20 W4M) and the Inter Pipeline Inc. Corridor Pipeline Expansion Project (NE 14-56-21 W4M to SE 27-56-20 W4M. The length of the ROW that parallels existing linear disturbances is approximately 28 km of the proposed route.

2.2 Technical Pipeline Details

The pipeline has been designed by Shell to accommodate the transport of up to 1.2 million tonnes per year (Mt/a) of CO_2 and is proposed to operate at approximately 9,000 kPa(g) and will have a maximum operating pressure of 14,500 kPa(g). The main portions of the pipeline system are planned to be 323.9 mm (12 inch) outside diameter (OD) mainline from the Scotford Upgrader (Sec 32-55-21 W4M) to the injection well site in LSD 15-29-60-21 W4M.

For a summary of the technical details of the proposed pipeline, see Table 2-1.

Table 2-1 Technical Pipeline Details

Pipe Size (OD)	323.9 mm (12 inches)
Product	dense-phase CO_2
Total ROW Length	84 km
Source	CO_2 capture infrastructure at Scotford: Sec 32-55-21 W4M
Pipeline terminus injection well	Injection well: LSD 15-29-60-21 W4M
Line Pipe Specifications (maximum operating/design pressure)	14,500 kPa(g)
Design Capacity, application	3,300 t/d
Design Capacity, maximum	8,200 t/d
Trench Depth	~1.9 m
Minimum Depth of Cover	1.5 m
Trench Width, Top/Bottom	To be determined/~0.8 m
ROW Width	18 m
Temporary Workspace	7 m
Extra Temporary Workspace	Where required: road, railway, third-party pipeline and utility crossings as well as deflections
Anticipated Construction of the pipeline	Start: Q4 2013 Finish: Q2 2014 Start-up: Q4 2014
Test Medium	Freshwater

2.3 Associated Developments

Temporary surface access requirements for construction will be served by the existing road and highway network, where vehicles and equipment will be able to enter and exit the ROW by existing or temporary approaches. Existing trails or roads will be used wherever available.

Surface facilities associated with the pipeline are aboveground emergency shutdown block valve sites spaced along the ROW at maximum intervals of 15 km to support the safety, operations and maintenance of the pipeline system (see Table 2-2). Each block valve site will be located within the ROW and occupy an area of about 18 m by 36 m. The sites have been located adjacent to existing roads to minimize the need for additional access development.

Table 2-2 Aboveground Shutdown Block Valve Locations

Block Valve Identifier	Kilometer Post	Distance Between Valves	Facilities, Comments
Compressor discharge	0.0	Not applicable	Pig launcher
LBV #1	11.0	11.3	After crossing of Canadian Pacific (CP) Rail lands
LBV #2	24.5	13.5	
LBV #3	36.1	11.6	Pigging station also, east side of NSR
LBV #4	39.8	3.7	NSR crossing
LBV #5	50.1	10.3	
LBV #6	59.5	9.4	
LBV #7	70.9	11.4	North Point Coal location
End point well	84	12.5	Pig receiver

2.4 Schedule

Pending regulatory approval, construction on the pipeline will begin in Q4 2013 with completion anticipated in Q2 2014 under frozen soil conditions. The C&R Plan has been correspondingly developed to cover one season of pipeline construction. If the schedule changes for any reason, and includes non-frozen soil conditions or non-dry soil conditions, additional information will be provided.

The present timing is anticipated to limit interference with land use (such as swathing and combining) and wet soil conditions associated with late spring and early summer. Avoidance of the Restricted Activity Periods (RAP) associated with identified water body crossings and the customary migratory bird nesting window should be achievable based on the proposed timing.

3 Public Consultation

Public consultation began early in the planning phase to allow feedback from stakeholders to be incorporated into the pipeline route selection process. For a comprehensive description of the consultation program, see Volume 1, Section 6.

See Table 3-1 for a list of the stakeholder groups.

Table 3-1 Stakeholder Groups

Stakeholder Group	Stakeholder Subgroups
First Nations and Métis organizations	• Alexander First Nation • Beaver Lake Cree Nation • Saddle Lake Cree Nation • Métis Nation of Alberta, Region 2 and 4
Local communities and organizations	• Grazing rights holders • Landowners, occupants and residents within 5 km of Shell Scotford • Landowners, occupants and residents within the emergency planning zone of the pipeline route • Leaseholders and lease allotment holders
Government agencies	• AENV • Alberta Energy • Alberta Energy Resources Conservation Board (ERCB) • Alberta Health & Wellness • Alberta Infrastructure and Transportation • Alberta Sustainable Resource Development (ASRD) • Alberta Tourism, Parks & Recreation • Canadian Environmental Assessment Agency (CEA Agency) • Environment Canada • Fisheries and Oceans Canada (DFO) • International & Intergovernmental Relations • Natural Resources Canada • Transport Canada
Regional and municipal governments	• County of Lamont • County of Strathcona • County of Sturgeon • Thorhild County • Town of Bruderheim • Town of Redwater
Special interest groups	• Alberta Snowmobile Association • Citizens for Responsible Development • Ducks Unlimited • Environmental Resource Centre • Fort Air Partnership (FAP) • Friends of Lamont County • Northeast Regional Community Awareness Response (NR CAER)

Table 3-1 Stakeholder Groups (cont'd)

Stakeholder Group	Stakeholder Subgroups
Industry and Industry Associations	• Agrium Inc. • Air Liquide • CN Rail • CP Rail • Dow Chemical • Gulf Chemical and Metallurgical Corp. • North West Upgrading Inc. • Statoil • Suncor • Total E & P Canada • Alberta Chamber of Resources • Alberta Industrial Heartland Association (AIHA) • Canadian Association of Petroleum Producers (CAPP) • Integrated CO2 Network (ICO2N) • Northeast Capital Industrial Association (NCIA)

The following government departments or agencies were contacted for feedback on the route, schedule or construction methods:

- AENV
- Alberta Culture and Community Spirit (ACCS)
- Alberta Energy
- Alberta's Industrial Heartland Association (AIHA)
- ASRD
- CEA Agency
- ERCB
- municipal governments of:
  - Athabasca County
  - Lamont County
  - Smoky Lake County
  - Strathcona County
  - Sturgeon County
  - Thornhild County
  - City of Fort Saskatchewan
  - Town of Bruderheim

4 Environmental Setting

See Appendix I, Attachment B for the environmental alignment sheets, which show detailed environmental information in the area to be physically disturbed by the Project.

4.1 Soils and Terrain

4.1.1 Overview

4.1.1.1 Soils

The pipeline route is located in Soil Correlation Areas (SCAs) 10 and 12. The soils underlying most of the pipeline route in SCA 10 are dominated by Black Chernozemic soils, but appreciable extents of less-productive Dark Gray Chernozemic soils and Brunisolic soils are also found. The northern part of the route in SCA 12 has a high proportion of Luvisolic soils, reflecting the climatic transition between parkland to the south and boreal forest to the north.

Parent materials are mainly till and glaciolacustrine. The latter material is often very similar in character to the till, suggesting that it may be re-worked by water. Similar findings were reported for the area by Kjearsgaard (1972).

Orthic and Eluviated Black Chernozems that developed on till and glaciolacustrine sediments, including Beaver Hills and Ponoka units, have 15-45 cm of topsoil and occupy about 19% of the project development area (includes the ROW, associated TWS, well pads and borrow pits, and associated access roads). They are the dominant soils in the south-central portion of route. Topsoil is easily distinguished from subsoil by color in these soils.

Orthic, Gleyed Dark Gray and Gleyed Black Chernozems, developed on till or glaciolacustrine sediments and with 10-35 cm of topsoil occupy about 32% of the route. These soils occur in central part of route near the boundary of SCA 10 and 12, adjacent to the town of Radway. The soil unit of greatest extent in this area is Gleyed Kehiwin. Color differentiation between topsoil and subsoil is also good in these soils.

Soils along the northern portion of the PDA are predominantly Gleyed Dark Gray Luvisols; they occupy about 8.5% of the PDA. These soils are generally imperfectly to moderately well drained and have developed on loam to clay loam textured till or glaciolacustrine material. The soil unit of greatest extent is Gleyed Spedden. Topsoil thickness varies from 20-35 cm and is easily distinguished from subsoil by color.

Orthic Humic Gleysols and Humic Luvic Gleysols developed on till or glaciolacustrine sediments occur in areas of imperfect of poor drainage. The most common soil unit is Onoway (4% of the PDA).

In the very southern portion of the route, soils are formed on aeolian deposits. Soil development on aeolian sands tends to reflect the length of time since these materials were mobile and the dominant vegetation. Where forests have developed on aeolian materials, underlying soils tend towards the Brunisolic Order, represented by the Primula soil series, which has 10 to 20 cm of topsoil. These soils are highly erodible by wind. Where grasslands have been prevalent, Black Chernozems have developed, represented by the Mundare soil series, which has a greater amount of topsoil (15 to 45 cm) and higher organic matter content. The areas of Black Chernozems are now largely cultivated for agriculture. Dark Gray Chernozems (e.g., the Helliwell soil series with 10 to 30 cm of topsoil) are transitional between the Black Chernozemic soils and Brunisolic soils. Helliwell soils are often used as pasture.

A large portion of the route occurs in an area known for Solonetzic soils (Alberta Institute of Pedology 1981). These range from soils classified in the Solonetzic order to intergrades of other orders, such as Solonetzic Gray Luvisols or Solonetzic Black Chernozems. These profiles often have high salt or sodium concentrations. Where not saline, subsoils are usually sodic, (e.g., the Kavanagh and Dnister soil units) found in areas close the Namepi Creek and NSR, where the till is thin and is underlain by strongly sodic weathered bedrock. Profiles are often highly mottled, indicating frequent variation in moisture regimes over time. Based on the extent and intensity of mottling, these soils are sometimes confused with Gleysolic Order soil profiles. However, moisture regimes in these profiles today are not wet enough to support classification in the Gleysolic order.

Organic soils occupy a minor extent of the route. They are found in depressional landscape positions where water tables remain shallow year-round. Organic soils are found in both coarse textured aeolian landscapes and in moderately fine textured till landscapes.

4.1.1.2 Terrain

Physiography

The pipeline will be within the Eastern Alberta Plains Physiographic Region, which in this location is divided into the Thorhild Plain, Redwater Plain and North Saskatchewan Valley Districts (Pettapiece 1986). The Thorhild Plain is the dominant physiographic feature and is characterized by undulating till. The Redwater Plain lies southwest of the Thorhild Plain and borders both sides of the NSR valley. This plain is characterized by undulating glaciofluvial deposits and veneers of glaciofluvial material overlying undulating till (Pettapiece 1986). As implied by their names, the plains are flat to undulating and are cut in places by large and small rivers.

Local Bedrock and Surficial Geology

The pipeline route is underlain by the Upper Cretaceous non-marine Belly River Group, which is characterized by grey to greenish grey bedded feldspathic sandstone, grey clayey siltstone, grey and green mudstone and concretionary ironstone beds (Hamilton et al. 1999).

Overlying bedrock, but underlying the younger glacial deposits, are fluvial gravel and sand of the Empress Formation. These form a buried valley called the Beverly Channel, which trends northeastward between Bruderheim and Redwater, just east of and partly beneath the modern day NSR (Godfrey 1993). The Beverly Channel is an important aquifer for the region (Godfrey 1993).

Pleistocene and Holocene deposits completely mask the underlying bedrock, although exposures of bedrock can be seen on some valley slopes and are sometimes found at the base of soil profiles. North of the NSR crossing, the pipeline route is dominated by glacial till (moraine) deposited under stagnant ice conditions during the last glaciation. The till is composed of an unsorted mixture of clay, silt, sand and gravel with minor amounts of water sorted material (Shetsen 1990). It is of uneven thickness but can be up to 30 m thick, and has created an undulating landscape with local relief of generally less than 3 m (Shetsen 1990). Till deposits adjacent to the NSR tend to be thinner (up to 10 m thick) and drape the underlying bedrock (Shetsen 1990).

Immediately west of Redwater and flanking the NSR northeast of Edmonton are a few small deltaic deposits (St-Onge 1971). Glaciolacustrine and glaciofluvial stream sediments are also found adjacent to the NSR; these consist of gravel, sand, silt and clay (Shetsen 1990). Deposits at the proposed crossing are characterized by fine sand, silt and clay with minor gravel beds (Shetsen 1990).

Aeolian deposits of the Beaverhill Creek Sand Hills are found at the southern end of the pipeline route (Pfeiffer and Wolfe 2002). These dunes are composed of fine- and medium-grained sand and minor silt (Shetsen 1990) and are likely derived from the glaciofluvial and deltaic sediments in the area (Kathol and McPherson 1975).

A large meltwater channel (the Redwater Channel) that once drained Glacial Lake Jarvie runs from northwest to southeast near the town of Redwater and ends at the NSR (St-Onge 1971).

4.1.2 Summary of Results

For a summary of the findings and of soils field work that are pertinent to pipeline construction, see Table 4-1. For a summary of terrain field work, see Table 4-2.

Table 4-1 Summary of Soil Characteristics and their Implications for Pipeline Construction

Soil Symbol	Soil Series Name	Soil Classification (Modal Site)	Parent Material	Drainage Class	Topsoil		Subsoil		Colour Differentiation between Topsoil and Subsoil	Agricultural Capability, Class and Subclass	Reclamation Suitability		Erosion Hazard		Susceptibility to Soil Compaction, Topsoil/Subsoil	Trench stability
					Texture Class	Depth Range (cm)	Texture Class	Depth Range (cm)			Topsoil	Upper Subsoil	Wind	Water		
BVH(2-3)	Beaver Hills, Angus Ridge	O.BL, E.BL, and R.BL (SQ270EV)	Moderately fine textured, non-saline till	Moderately well to well	Loam	15-40	Loam	40-150	Obvious	2HT	F (pH,)	F (pH)	L	L	Low/Low	Stable
BVH(4-5)	Beaver Hills, Angus Ridge	O.BL and R.BL (SQ270EV)	Moderately fine textured, non-saline till	Moderately well to well	Loam	15-40	Loam	40-150	Obvious	4HT	F (pH,)	F (pH)	L	L-M	Low/Low	Stable
CMBsa(2-3)	Columbine	O.HG (SQ094VL)	Moderately fine textured, weakly saline or sodic glaciolacustrine and water sorted till	Imperfect	Silty clay loam to Clay loam	10-35	Loam, Sandy Clay loam below 120 cm	35-150	Not Obvious	4HTNW	F (pH, salinity, sodicity, saturation percentage)	U (sodicity)	L	L	Moderate/Moderate	Potentially unstable
DKN(2)	Daken	R.HG (SQ165VL)	Moderately to very coarse textured glaciofluvial and aeolian sediments	Poor	Sandy loam to Loamy sand	20-45	Sandy loam	50-150	Obvious	4HWI	F (pH)	G	L	L	Moderate/Moderate	Potentially unstable
DL	Disturbed Land	N/A	Variable	Variable	Variable	Variable	Variable	Variable	Variable	NR	NR	NR	NR	NR	NR	NR
DNTgl(2-3)	Gleyed Dnister	SZ.DGL and GLDG.SS (SQ031KD)	Moderately fine textured, till overlying sodic bedrock	Imperfect	Loam	15-30	Clay loam, Sandy clay loam below 120 cm	30-150	Not Obvious	4HDTW	P (sodicity)	U (sodicity)	L	L	Moderate/High	Stable
DRNgl(2-3)	Gleyed Dirleton	GL.DG (SQ424VL)	Moderately coarse glaciofluvial	Imperfect	Sandy loam	15-30	Sandy loam to sandy clay loam	30-100	Not Obvious	3H	G	F (consistence)	M	L	Low/Low	Potentially unstable
HLW(2-3)	Helliwell	O.DG (517[IPF])	Very coarse textured aeolian	Well to rapid	Loamy sand to sand	10-30	Loamy sand	30-210	Obvious	3HMT	P (texture)	P (texture)	H	L	Low/Low	Potentially unstable
HLW(4-5)	Helliwell	O.DG/517 ([IPF]))	Very coarse textured aeolian	Well to rapid	Loamy sand to sand	10-30	Loamy sand	30-210	Obvious	3HMT	P (texture)	P (texture)	H	L-M	Low/Low	Potentially unstable
KHWgl(2-3)	Gleyed Kehiwin	GL.DGC (SQ198KD)	Moderately fine textured, non-saline till	Imperfect	Loam	15-30	Silty clay loam to clay loam	30-100	Obvious	3H	F (saturation percentage)	F (texture)	L	L	Moderate/High	Stable
KVG(2-3)	Kavanagh	BL.SS (SQ161VL)	Moderately fine textured, saline/sodic till over bedrock of the Belly River formation	Moderately well to imperfect	Loam to Clay loam	10-20	Clay	20-150	Not Obvious	3HD	F (pH, sodicity, saturation percentage)	U (consistence)	M	L	Low/Moderate	Stable

Table 4-1 Summary of Soil Characteristics and their Implications for Pipeline Construction (cont'd)

Soil Symbol	Soil Series Name	Soil Classification (Modal Site)	Parent Material	Drainage Class	Topsoil		Subsoil		Colour Differentiation between Topsoil and Subsoil	Agricultural Capability, Class and Subclass	Reclamation Suitability		Erosion Hazard		Susceptibility to Soil Compaction, Topsoil/Subsoil	Trench stability
					Texture Class	Depth Range (cm)	Texture Class	Depth Range (cm)			Topsoil	Upper Subsoil	Wind	Water		
KVG(4-5)	Kavanagh	BL.SS (SQ161VL)	Moderately fine textured, saline/sodic till over bedrock of the Belly River formation	Moderately well to imperfect	Loam to Clay loam	10-20	Clay	20-150	Not Obvious	4HDT	F (pH, sodicity, saturation percentage)	U (consistence)	M	L	Low/Moderate	Stable
MDR(2-3)	Mundare	O.BL (527D1[Waupisoo])	Very coarse textured aeolian	Well to rapid	Loamy sand	10-40	Loamy sand, Silty clay loam below 100 cm	50-180	Obvious	3HMT	P (texture)	P (texture)	H	L	Low/Low	Potentially unstable
MDR(4-5)	Mundare	O.BL (527D1[Waupisoo])	Very coarse textured aeolian	Well to rapid	Loamy sand	10-40	Loamy sand, Silty clay loam below 100 cm	50-180	Obvious	3HMT	P (texture)	P (texture)	H	L-M	Low/Low	Potentially unstable
MNT(1-2)	Manatokan	T.M (SQ237VL)	Organic over coarse textured glaciofluvial or aeolian	Very poor	Organic	40-100+	Silt loam	130+	Obvious	7HBV	NR (organic)	NR (organic)	L	L	High/NR	Potentially unstable
MNTaa-P(1-2)	Manatokan	T.M (SQ237VL)	Organic over moderately fine textured till	Poor	Organic	40-100+	Silt loam	130+	Obvious	7HBV	NR (organic)	NR (organic)	L	L	High/NR	Potentially unstable
MNTaa-VP(1)	Manatokan	T.M (SQ237VL)	Organic over moderately fine textured till	Very poor	Organic	40-100+	Silt loam	130+	Obvious	76HBV	NR (organic)	NR (organic)	L	L	High/NR	Potentially unstable
NRM(2-3)	Norma	SZ.BL (SQ304IW)	Moderately fine textured, weakly-saline till	Moderately well	Loam	15-25	Sandy clay loam	25-100	Not Obvious	2HMT	F (pH)	P (consistence)	L	L	Low/Moderate	Stable
NRMgl(2-3)	Gleyed Norma	GLSZ.BL (SQ306VL)	Moderately fine textured, weakly-saline till	Imperfect	Loam	15-25	Sandy clay loam	25-100	Not Obvious	2HT	F (saturation percentage)	F (soluble conductivity, consistence)	L	L	Moderate/Moderate to High	Stable
ONW(2)	Onoway	O.HG (SQ015VL)	Moderately fine textured, non-saline till	Poor	Loam	15-40	Clay loam	40-100	Obvious	6HOW	NR (organic)	F (texture, consistence)	L	L	High/High	Potentially unstable
ONWaa(2)	Onoway	O.HG (SQ015VL)	Moderately fine textured, non-saline till	Poor	Loam	15-40	Clay loam	40-100	Obvious	6HOW	NR (organic)	F (texture, consistence)	L	L	High/High	Potentially unstable
PHSglxp(2-3)	Gleyed Peace Hills	GL.BLC (SQ152VL)	Moderately coarse textured glaciofluvial/aeolian over bedrock	Imperfect	Sandy loam to Loamy sand	15-40	Clay loam	40-150	Obvious	3HMDT	F (organic carbon)	G	M	L	Low/Low	Potentially unstable

Table 4-1 Summary of Soil Characteristics and their Implications for Pipeline Construction (cont'd)

Soil Symbol	Soil Series Name	Soil Classification (Modal Site)	Parent Material	Drainage Class	Topsoil		Subsoil		Colour Differentiation between Topsoil and Subsoil	Agricultural Capability, Class and Subclass	Reclamation Suitability		Erosion Hazard		Susceptibility to Soil Compaction, Topsoil/Subsoil	Trench stability
					Texture Class	Depth Range (cm)	Texture Class	Depth Range (cm)			Topsoil	Upper Subsoil	Wind	Water		
PHSglxp(3-4)	Gleyed Peace Hills	GL.BLC (SQ152VL)	Moderately coarse textured glaciofluvial/aeolian over bedrock	Imperfect	Sandy loam to Loamy sand	15-40	Clay loam	40-150	Obvious	3HMDT	F (organic carbon)	G	M	L	Low/Low	Potentially unstable
POK(1-2)	Ponoka	O.BLC (SE181[Shell Scotford])	Medium textured glaciolacustrine	Well to moderately well	Loam to Clay loam	15-45	Clay loam to Silt loam	45-120	Obvious	2H	F (pH)	P (texture)	L	L	Low/Moderate	Stable
POK(3-4)	Ponoka	O.BLC (SE181[Shell Scotford])	Medium textured glaciolacustrine	Well to moderately well	Loam to Clay loam	15-45	Clay loam to Silt loam	45-120	Obvious	3HT	F (pH)	P (texture)	L	L-M	Low/Moderate	Stable
PR	Reclaimed Land	N/A	Undifferentiated	Variable	Variable	Variable	Variable	Variable	Variable	NR	NR	NR	NR	NR	NR/NR	NR
PRM(3-4)	Primula	E.EB (SQ221VL)	Very coarse textured aeolian	Well to rapid	Loamy sand	10-20	Sand	20-150	Not Obvious	4HMT	P (texture)	P (texture)	H	L	Low/Low	Potentially unstable
RB(6-7)	Rough Broken	GL.DGC (SQ198KD)	Materials include till, glaciofluvial, and bedrock	Well	Variable	Variable	Variable	Variable	Good-Fair	4HMT	P (stoniness)	P (texture)	L	H	Moderate/Moderate	Stable
RCSaa(2)	Rochester	O.HG (SQ422VL)	Coarse textured glaciofluvial or aeolian	Imperfect	Sandy loam	20-30	Loam, Sand below 80 cm	30-100	Obvious	4HMT	P (pH, saturation percentage)	P (pH)	M	L	Low/Moderate	Potentially unstable
SDN(3-4)[1]	Spedden	D.GL (Site 6[TERA])	Moderately fine textured till	Well to moderately well	Clay loam to Silt loam	10-20	Clay loam	20-120	Obvious	4HMT	P (pH)	P (pH)	L	L-M	Low/Low	Stable
SDNgl(2-3)	Gleyed Spedden	GLD.GL (SQ028VL)	Moderately fine textured till	Imperfect	Clay loam to Silt loam	10-25	Clay loam	25-150	Obvious	4HMT	F (pH, organic carbon)	F (texture, consistence)	L	L	Moderate/High	Stable
ZWA	Water	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4-2 Summary of Terrain Characteristics and their Implications for Pipeline Construction

Terrain Feature	Surficial Geology	Texture	Drainage Class	Dune Damage/ Loss Hazard	Slope Stability Hazard	Trench Stability
NSR Crossing	Fluvial terraces	Clay to fine sand	Moderately well to imperfect	NA	L	Potentially unstable
NSR Crossing	Glaciofluvial terraces	Very fine sand and silty clay	Well to moderately well	NA	L	Potentially unstable
NSR Crossing	Thin colluvium on steep terrace slopes	Very fine sand and silty clay	Well to moderately well	NA	M	Potentially unstable
Namepi Creek River Crossing	Glaciofluvial veneer over till terrace	Silty fine to medium sand over till with a clayey silt matrix and 5-10% clasts	Moderately well to well	NA	L	Stable
Namepi Creek River Crossing	Thin colluvium on steep terrace slopes	Colluvium with a clayey silt matrix and 5-10% clasts	Moderately well to well	NA	H	Potentially unstable
Namepi Creek River Crossing	Glaciofluvial gravel terraces overlying bedrock	Granule to cobble gravel with a fine to coarse sand matrix	Imperfect to poor	NA	L	Potentially unstable
Beaverhill Creek River Crossing	Aeolian and minor fluvial deposits	Fine to medium sand, minor silt	Well to imperfect	NA	L	Potentially unstable
Astotin Creek River Crossing	Aeolian and minor fluvial deposits	Fine to medium sand, minor silt	Well to imperfect	NA	L	Potentially unstable
Beaverhill Creek Sand Hills Dune Field	Aeolian sand dunes	Fine to medium sand, minor silt	Well	M	NA	Potentially unstable

SOURCES:

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Pfeiffer, Z.K. and S.A. Wolfe. 2002. Sand dune orientations in the Prairie Provinces of Canada, Open File 4117. Ottawa: Geological Survey of Canada.

Shetsen, I. 1990. Quaternary Geology, Central Alberta, Map 213. Edmonton: Alberta Geological Survey. 1:500,000.

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4.2 Aquatic Resources

Various sources of information were used to assess the status of fish and fish habitat resources of the watersheds along the pipeline route. Information reviewed included published and unpublished reports, topographic maps, available history, and ASRD's online Fish and Wildlife Management Information System database (FWMIS). Existing information for some of the crossings was also found in Golder (2006).

4.2.1 Overview

The ROW crosses 18 watercourses ranging from ephemeral field drainages to the NSR. All watercourses are part of the NSR drainage basin, and all of the small watercourses crossed by the ROW are direct tributaries of the NSR.

4.2.2 Summary of Results

See Table 4-3 for a list of the 18 watercourses that were assessed and the basic information for each one. Of the 18 crossings identified, field studies found only five crossings on four watercourses had fish habitat potential, these were Astotin, Beaverhill and Namepi Creeks and the NSR.

The NSR LAA contained habitat that may be suitable for lake sturgeon spawning. As lake sturgeon are considered endangered, the NSR is considered important habitat. Lower Namepi Creek contained suitable habitat for spring spawning species, but has limited habitat at other times of the year due to low water levels. The habitat is ranked important. Other crossings had habitat suitable for forage fish and are ranked as marginal habitats.

All watercourse crossings, except the NSR are within DFO's Operational Statements and no HADD is expected.

The preferred crossing method for the majority of the watercourses is open cut and is consistent the winter construction time frame, i.e., frozen to the channel bottom into the bed. An isolated crossing technique is the contingency plan for these crossings.

The NSR will be crossed using an HDD technique with open cut as the contingency. If there is water in any creeks crossed during the winter construction period, DFO Operational Statements will be used.

For a list of the watercourse crossings along the ROW and information relevant for pipeline construction, see Table 4-3. Shell will follow all DFO Operational Statements.

Table 4-3 Watercourse Crossings and Mitigation Measures

Site	Watercourse Name	UTM Location		Quarter Section (W4M)	Code of Practice Class	Restricted Activity Period	Overall Habitat Rating	Proposed Road Crossing Method	Proposed Pipeline Crossing Method
		Easting	Northing						
1	Astotin Creek	369673	5967504	NE-13-056-21	C	April 16 to June 30	Marginal	Ford when dry or frozen. Temporary bridge if flowing water	Open cut when dry or frozen. Trenchless if flowing, as per Operational Statements[2]
2	Beaverhill Creek	373522	5967871	NW-20-056-20	C	April 16 to June 30	Marginal	Ford when dry or frozen. Temporary bridge if flowing water	Open cut when dry or frozen. Trenchless if flowing, as per Operational Statements[2]
3	Unnamed tributary to NSR 1	376055	5970596	SE-27-056-20	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
4	Unnamed tributary to NSR 2	378659	5974602	SE-11-057-20	C	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
5	Unnamed tributary to NSR 3	380845	5977393	NW-18-57-19	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
6	NSR	378912	5982168	NW-36-57-20	C	April 16 to July 31	Important	No vehicle crossing permitted	HDD
7	Drainage 1	377891	5982938	SE-13-56-21	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
8	Unnamed tributary to NSR 4	377761	5983584	NW-15-56-20	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
9	Unnamed tributary to NSR 5	377267	5984890	SW-11-058-20	C	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
10	Unnamed tributary to Namepi Creek	377486	5987102	NW-14-058-20	C	April 16 to June 30	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
11	Unnamed tributary to Namepi Creek	377626	5988737	NW-23-058-20	C	April 16 to June 30	Poor	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
12	Lower Namepi Creek	377780	5989375	SW-26-058-20	C	April 16 to June 30	Important	Ford when dry or frozen. Temporary bridge if flowing water	Open Cut if dry or frozen. Trenchless if flowing, as per Operational Statements[2]
13	Drainage 2	376490	5991595	NE-34-058-20	C	April 16 to June 30	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
14	Unnamed intermittent waterbody	371331	6000531	SE-32-059-20	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
15	Upper Namepi Creek	365883	6006408	NE-15-060-21	C	April 16 to July 31	Marginal	Ford when dry or frozen. Temporary bridge if flowing water	Open Cut if dry or frozen. Trenchless if flowing, as per Operational Statements[2]
16	Drainage 4	365164	6007104	NW-15-060-21	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
17	Drainage 5	363955	6007675	SE-21-060-21	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]
18	Drainage 6	363801	6008349	NE-21-060-21	D[1]	None	None	Ford	Open cut when dry or frozen. Isolated trench if flowing[3]

NOTES:
[1] These drainages had no defined bed or banks and were therefore assigned a class of D.
[2] Open cut is the preferred crossing method when the channel is dry or frozen to (and including) the bed substrate. Trenchless crossing methods are to be used if water flow is present within the channel.
[3] Open cut is the preferred crossing method when the channel is dry or frozen to (and including) the bed substrate. If flowing water is present at the time of construction, an isolation method may be used, as per DFO Operational Statements.

4.2.2.1 Watercourses with Ephemeral or Intermittent Flow

The majority of water bodies surveyed along the pipeline route did not exhibit perennial flow regimes. Although bed and banks may have been defined, flow patterns were considered ephemeral (i.e., flow is only present for short periods following precipitation and melt water events) (see Table 4-4). Channels, where present, were both dry and vegetated or modified by agricultural practices. The crossing locations do not cross fish habitat because of the distance between the crossing location and the nearest fish bearing receiving body. Local aquatic resources are not considered sensitive to pipeline construction activities.

Table 4-4 Watercourses with Ephemeral Flow and Location

Watercourse	Location (W4M)
Crossing 3 - Unnamed tributary to NSR 1	SE-27-056-20
Crossing 4 - Unnamed tributary to NSR 2	SE-11-057-20
Crossing 5 - Unnamed tributary to NSR 3	NW-18-57-19
Crossing 7 - Drainage 1	SE-13-56-21
Crossing 8 - Unnamed tributary to NSR 4	NW-15-56-20
Crossing 9 - Unnamed tributary to NSR 5	SW-11-058-20
Crossing 10 - Unnamed tributary to Namepi Creek	NW-14-058-20
Crossing 11 - Unnamed tributary to Namepi Creek	NW-23-058-20
Crossing 13 - Drainage 2	NE-34-058-20
Crossing 14 - Unnamed intermittent waterbody	SE-32-059-20
Crossing 16 - Drainage 4	NW-15-060-21
Crossing 17 - Drainage 5	SE-21-060-21
Crossing 18 - Drainage 6	NE-21-060-21

4.2.2.2 Watercourses with Perennial Flow

Astotin Creek (NE-13-056-21 W4), Beaverhill Creek (NW-20-056-20 W4M), the NSR (NW-36-57-20 W4M), Lower Namepi Creek (SW-26-058-20 W4M) and Upper Namepi Creek (NE-15-060-21 W4M) all exhibit permanent water flow regimes.

The Astotin Creek crossing is located approximately 4 km upstream of the confluence with Beaverhill Creek and approximately 12 km upstream of the NSR. The channel is located in a narrow valley between cultivated fields. Although the proposed crossing location had a defined channel and water was present, there was no evidence of flow. Immediately downstream of the crossing was an old beaver dam and, starting 100 m downstream, a series of beaver dams. Channel width at the crossing was 7.5 m and wetted width was 1 m. This section of the creek would provide suitable habitat for forage fish species and rearing habitat for coarse fish species. No sport fish habitat was observed within the section.

The Beaverhill Creek crossing is located along an existing ROW approximately 2.4 km upstream of the confluence with Astotin Creek and approximately 10 km upstream of the NSR and is located in a steep, forested valley surrounded by pasture. The proposed crossing location had a well-defined channel and water was present; however, the velocity was too low to be measured. The creek was a continuous series of beaver impoundments within the LAA (1 km upstream and 3 km downstream of the crossing) and the channel width at the crossing was 12 m and wetted width was 4.7 m. This section of the creek would provide suitable habitat for forage fish species and rearing habitat for coarse fish species. No sport fish habitat was observed within the LAA.

The NSR at the proposed crossing location provides cool water habitat for many species and serves as an important migratory pathway for fish moving between habitats. Within this part of the NSR, 30 fish species are known to occur, including 10 sport species, five coarse species, and 15 forage species; only 16 are commonly found in the LAA. One species, lake sturgeon, is known to occur in this part of the river, but low numbers make it unlikely to be captured. At the proposed crossing location, the habitat is classified as entirely deep run. The wetted width is 280 m and the surrounding valley is of low relief with a low degree of confinement, maximum depth along this transect at the time of the fieldwork was 1.7 m. The habitat within the LAA would provide good rearing and foraging opportunities for many of the identified fish species throughout all life stages. Migration potential within the LAA is considered to be excellent. Overwintering potential is good because many run areas are deeper than 1.5 m and provide suitable habitat under ice cover during the winter. However, no areas of prime deep water habitat were identified.

Namepi Creek has been confined and channelled by agricultural activities over much of its length. The proposed crossing, Lower Namepi Creek, is located 3.3 km upstream of the confluence with the NSR. The creek is characterized by an irregular meander pattern and frequently isolated segments of water. The channel is occasionally confined, moderate in gradient, and partially coupled; at the proposed crossing, the channel width is 16 m with a wetted width of 4.7 m. Spawning and rearing habitat is considered to be good overall for coarse and forage fish species but the potential for overwintering is considered to be poor to nil because no deep pools were observed.

The second crossing, Upper Namepi Creek, is located about 32 km upstream of the confluence with the NSR. The channel is characterized by an irregular pattern, confined by agricultural activity, and entirely impounded habitat; the adjacent agricultural land is typically cultivated right to the top of the creek bank. At the proposed crossing, the channel width is 12.5 m and the wetted width is 9.3 m. The habitat is characterized as 100% impoundment with no flow. Spawning habitat in this section of Namepi Creek is considered to be good for forage fish species and northern pike. The availability of rearing habitat is considered to be good overall but the overwintering potential is rated as nil to poor.

4.3 Vegetation

4.3.1 Overview

The ROW crosses two Natural Regions and Subregions: the Central Parkland Natural Subregion of the Parkland Natural Region and the Dry Mixedwood Natural Subregion of the Boreal Forest Natural Region (Natural Regions Committee 2006). Each of these Natural Regions and Subregions is characterized by different assemblages of species.

The Central Parkland Natural Subregion is a transitional region between the drier Grassland Natural Region to the south and the Boreal Forest Natural Region to the north. Native vegetation in the Central Parkland Subregion consists of groves of aspen intermixed with grasslands, with marshes typically found in depressions.

Native vegetation of the Dry Mixedwood Subregion includes upland forests dominated by aspen along with stands of birch and balsam poplar. Coniferous forests can be present with spruce stands typically occurring in more mesic, nutrient rich areas while jack pine stands are found on dry, sandy uplands. Fens replace marshes as the typical wetland type of the Dry Mixedwood Subregion and can be wooded with tamarack and black spruce or, support a canopy of shrubs or sedges. Large parts of the Central Parkland and southern part of the Dry Mixed Subregions have been converted to agricultural, residential and industrial use.

4.3.2 Summary of Results

Agricultural land dominates the LAA, accounting for 73.3% of the land use types. Native vegetation occupies 21.4% and includes upland ecosite phases (8.9%) and wetland ecosite phases (6.3%) and recently burned areas (6.2%). Remaining land units include disturbed areas (4.7%) and water (0.6%). For the distribution of land units across the LAA, see Table 4-5.

Table 4-5 Land Units in the Vegetation Local Assessment Area

Land Units	Area (ha)	Percent of LAA
Upland Ecosite Phases		
a1 lichen/jackpine	3.4	<0.1
b1 blueberry/jackpine-aspen	1.2	<0.1
b3 blueberry/aspen-white spruce	45.4	0.5
b4 blueberry/white spruce-jackpine	1.2	<0.1
d1 low-bush cranberry/aspen	49.2	0.6
d2 low-bush cranberry/aspen-white spruce	85.9	1.0
d3 low-bush cranberry/white spruce	2.5	<0.1
d4 upland tall shrubland alliance	25.5	0.3
e1 dogwood/balsam poplar-aspen	457.2	5.1
e2 dogwood/balsam poplar-white spruce	95.8	1.1
e3 dogwood/white spruce	5.1	0.1

Table 4-5 Land Units in the Vegetation Local Assessment Area (cont'd)

Land Units	Area (ha)	Percent of LAA
Upland Ecosite Phases (cont'd)		
f1 horsetail/balsam poplar-aspen	0.1	<0.1
h1 Labrador tea/horsetail/white spruce-black spruce	5.6	0.1
Upland Subtotal	*778.2*	*8.7*
Wetland Classes		
FTNN – wooded fen	2.7	<0.1
FONS – shrubby fen	3.9	<0.1
FONG – graminoid fen	3.6	<0.1
STNN – wooded swamp	16.4	0.2
SONS – shrubby swamp	186.3	2.1
MONG – ephemeral to temporary marsh	319.5	3.6
MONG – seasonal to semi-permanent marsh	32.0	0.4
Wetland Subtotal	*564.3*	*6.3*
Other Native Vegetation Land Units		
Recent Burn	555.6	6.2
Agricultural Lands		
Pasture Prairie Grassland Alliance	489.4	5.5
Cultivated Land	6075.0	68.0
Highly Modified Woodlot	0.4	<0.1
Agricultural Subtotal	*6564.7*	*73.5*
Other Land Units		
Disturbed Land	416.7	4.7
Water	50.6	0.6
TOTAL	**8930**	**100**

No plant species listed by COSEWIC in SARA Schedules 1 to 3 were identified in the LAA. One rare vascular plant, *Botrychium multifidum* var. *intermedium* identified on the Alberta Conservation Information Management System (ACIMS; formerly Alberta Natural Heritage Information Centre [ANHIC]) watch list was found during field surveys in the LAA. The remainder of rare species occurrences in the LAA are from historical data sources (see Table 4-6).

Table 4-6 Rare Plant Occurrences in the Local Assessment Area

Scientific Name	Common Name	Source	Provincial Rank	Global Rank	Status of Alberta Wild Species 2005	Number of Occurrences
Vascular Plants						
Hedyotis longifolia	long-leaved bluets	May 2010 ACMIS[1]	S2	G4G5	May be at Risk	3
		TERA 2008a; 2008b				1
Botrychium multifidum var. *intermedium*	leather grape fern	Field Surveys (Site SQRP107LM)	S3	G5T4?	May be at Risk	1
Lactuca biennis	tall blue lettuce	May 2010 ACMIS[1]	S2	G5	May be at Risk	1
		TERA 2008a; 2008b				1
Physostegia ledinghamii	false dragonhead	TERA 2008a; 2008b	S3	G3?	May be at Risk	1
Rubus x paracaulis	hybrid dwarf raspberry	May 2010 ACMIS[1]	S1	GNA	Hybrids not listed	2
Bryophytes						
Brachythecium acutum	moss	May 2010 ACMIS[1]	SU	GNRQ	Not listed	1
Bryum uliginosum	moss	May 2010 ACMIS[1]	S2	G3G5	Not listed	4
Conardia compacta	moss	May 2010 ACMIS[1]	S2	G3G5	Not listed	1
Hypnum pallescens	moss	May 2010 ACMIS[1]	S2	G5	Not listed	1
Riccia fluitans	liverwort	May 2010 ACMIS[1]	S2	G5	Not listed	1
Lichens						
Cladonia squamosa	lichen	May 2010 ACMIS[1]	S2	G4G5	Not listed	1
Trapeliopsis flexuosa	mottled-disk lichen	May 2010 ACMIS[1]	S1	G?	Not listed	1

SOURCE:
[1] ACIMS 2010, Internet site

Leather grape fern is a perennial herb in the fern group and typically grows in moist, sandy areas (Moss 1983). Leather grape fern is on ACIMS Watch List (Kemper 2009) and has a rank of S3. It is ranked 'G5T?' globally. The 'G5' indicates that it is common, widespread and abundant and 'T?' is the ranking code for infraspecific taxa (i.e., subspecies, varieties and other designations below the level of the species); in this case, a variety with an inexact numeric rank (?), hence the '?' designation.

4.3.2.1 Rare Ecological Communities

No historical rare ecological communities are present in the LAA. No rare ecological communities were observed in the LAA during the spring or summer rare plant surveys in 2010.

4.3.2.2 Environmentally Significant Areas

One environmentally significant area, the NSR valley, is within the LAA at the point where the pipeline crosses the river (see Table 4-7).

Table 4-7 Environmentally Significant Areas in the Local Assessment Area

Environmentally Significant Area	Ranking	Criterion	Relation to LAA
690 – NSR valley	National	• Supports 56 vegetative elements of conservation concern • Contains rare or unique landforms • Contains habitat for focal wildlife species • Contains important wildlife habitat • Contains riparian areas • Contains large areas of native vegetation • Contains Redwater Natural Area	Bisected by LAA

4.3.2.3 Wetlands

Numerous wetlands were identified during the 2010 field season. For the class and description of these wetlands and their location, see Table 4-8.

Table 4-8 Location of Potentially Affected Wetlands in the LAA

Location (W4M)	Wetland Class	Land Unit Description
Road Allowance	Class II	MONG - ephemeral to temporary marsh
Road Allowance	Class III	MONG - ephemeral to temporary marsh
Road Allowance	Class III	MONG - ephemeral to temporary marsh
Road Allowance	Classes I-III	MONG - ephemeral to temporary marsh
SE-13-056-21	None	SONS - shrubby swamp
NE-27-056-20	None	SONS - shrubby swamp
SE-27-056-20	None	SONS - shrubby swamp
SW-12-057-20	None	SONS - shrubby swamp
NW-36-057-20	None	SONS - shrubby swamp
SW-11-058-20	None	SONS - shrubby swamp
SW-26-058-20	None	SONS - shrubby swamp
SW-26-058-20	None	SONS - shrubby swamp
SW-32-059-20	None	SONS - shrubby swamp
NE-31-059-20	None	SONS - shrubby swamp
NE-15-060-21	None	SONS - shrubby swamp

Table 4-8 Location of Potentially Affected Wetlands in the LAA (cont'd)

Location (W4M)	Wetland Class	Land Unit Description
SW-04-056-21	None	STNN - wooded swamp
SW-04-056-21	None	STNN - wooded swamp
SW-04-056-21	None	STNN - wooded swamp
SW-04-056-21	None	SONS - shrubby swamp
NW-04-056-21	None	SONS - shrubby swamp
NW-09-056-21	None	SONS - shrubby swamp
SE-18-056-20	None	FONG - graminoid fen
NW-33-055-21	Classes I-III	MONG - ephemeral to temporary marsh
NW-33-055-21	Classes I-III	MONG - ephemeral to temporary marsh
NE-27-056-20	Classes I-III	MONG - ephemeral to temporary marsh
SE-22-056-20	Class II	MONG - ephemeral to temporary marsh
NW-19-057-19	Class I	MONG - ephemeral to temporary marsh
NE-03-059-20	Class I	MONG - ephemeral to temporary marsh
NW-14-060-21	Class I	MONG - ephemeral to temporary marsh
NE-35-057-20	Class II	MONG - ephemeral to temporary marsh
SE-20-059-20	Class II	MONG - ephemeral to temporary marsh
NW-15-060-21	Class II	MONG - ephemeral to temporary marsh
NW-15-060-21	Class II	MONG - ephemeral to temporary marsh
SE-21-060-21	Class II	MONG - ephemeral to temporary marsh
NW-30-057-19	Class II	MONG - ephemeral to temporary marsh
NW-02-059-20	Class II	MONG - ephemeral to temporary marsh
NE-03-059-20	Class II	MONG - ephemeral to temporary marsh
SE-29-059-20	Class II	MONG - ephemeral to temporary marsh
SE-29-060-21	Class II	MONG - ephemeral to temporary marsh
NE-29-060-21	Class II	MONG - ephemeral to temporary marsh
NE-17-059-20	Class II	MONG - ephemeral to temporary marsh
SE-20-059-20	Class II	MONG - ephemeral to temporary marsh
SE-32-059-20	Class II	MONG - ephemeral to temporary marsh
NE-15-060-21	Class III	MONG - ephemeral to temporary marsh
NE-08-059-20	Class III	MONG - ephemeral to temporary marsh
SE-31-059-20	Class III	MONG - ephemeral to temporary marsh
NW-14-060-21	Class III	MONG - ephemeral to temporary marsh
NW-15-060-21	Class III	MONG - ephemeral to temporary marsh
NE-22-056-20	Class III	MONG - ephemeral to temporary marsh
SE-22-056-20	Class III	MONG - ephemeral to temporary marsh
NW-17-056-20	Class II	MONG - ephemeral to temporary marsh
NW-17-056-20	Class III	MONG - ephemeral to temporary marsh
NE-17-056-20	Class III	MONG - ephemeral to temporary marsh
NE-35-056-20	Class III	MONG - ephemeral to temporary marsh

Table 4-8 Location of Potentially Affected Wetlands in the LAA (cont'd)

Location (W4M)	Wetland Class	Land Unit Description
SE-12-057-20	Class III	MONG - ephemeral to temporary marsh
SE-12-057-20	Class III	MONG - ephemeral to temporary marsh
SW-12-057-20	Class III	MONG - ephemeral to temporary marsh
NE-35-057-20	Class III	MONG - ephemeral to temporary marsh
NE-02-058-20	Class III	MONG - ephemeral to temporary marsh
NE-34-058-20	Class III	MONG - ephemeral to temporary marsh
SE-29-059-20	Class III	MONG - ephemeral to temporary marsh
NE-15-060-21	Class III	MONG - ephemeral to temporary marsh
NE-21-060-21	Class III	MONG - ephemeral to temporary marsh
SE-21-060-21	Class III	MONG - ephemeral to temporary marsh
NE-21-060-21	Class III	MONG - ephemeral to temporary marsh
NE-29-060-21	Class III	MONG - ephemeral to temporary marsh
NE-29-060-21	Classes III	MONG - ephemeral to temporary marsh
SE-21-060-21	Classes I-III	MONG - ephemeral to temporary marsh
NW-17-056-20	Classes I-III	MONG - ephemeral to temporary marsh
NW-33-055-21	Classes IV-V	MONG - seasonal to semi-permanent marsh
SW-28-060-21	Classes IV-V	MONG - seasonal to semi-permanent marsh
NW-18-057-19	None	MONG - ephemeral to temporary marsh
SE-34-058-20	None	MONG - ephemeral to temporary marsh
NE-21-060-21	None	MONG - ephemeral to temporary marsh

NOTE:
The table is an estimate of wetlands potentially affected by the Project because additional wetlands may be identified following the additional survey of the ROW

4.3.2.4 Non-native and Invasive Species

While no prohibited noxious weeds were identified in the LAA, several noxious and introduced species were identified during vegetation field surveys (see Table 4-9). Several of these species are of concern in the Counties of Strathcona, Sturgeon, Lamont and Thorhild. Non-native and invasive species were typically observed in the interior of native vegetation patches.

The presence of weed infestations along the ROW will be recorded and identified on the environmental alignment sheets. For corresponding mitigation and reclamation monitoring, see Appendix I, the EPP.

Table 4-9 Non-native and Invasive Species Occurrences in the Local Assessment Area

Scientific Name	Common Name	Designation[1]	Vegetation Survey Sites
Cirsium arvense[2, 3, 4, 5]	creeping thistle	Noxious	RP004-SQ, RP012-SQ, RP013-SQ, RP018-SQ, RP020-SQ, RP021-SQ, RP022-SQ, RP023-SQ, RP024-SQ, RP025-SQ, RP027-SQ, SQRP100LM, SQRP101LM, SQRP103LM, SQRP104LM, SQRP107LM, SQRP108LM, SQRP109LM, SQRP112LM
Linaria vulgaris[2, 3, 4, 5]	butter-and-eggs	Noxious	RP002-SQ
Ranunculus acris[3, 5]	tall buttercup	Noxious	RP020-SQ
Sonchus arvensis [5]	perennial sow-thistle	Noxious	RP021-SQ, SQRP100LM, SQRP103LM, SQRP108LM, SQRP109LM, SQRP114LM
Tanacetum vulgare[2, 3, 4, 5]	common tansy	Noxious	SQRP106LM, SQRP108LM, SQRP113LM, SQRP114LM
Agropyron repens	quack grass	Introduced	SQRP100LM, SQRP109LM
Crepis tectorum	annual hawk's - beard	Introduced	SQRP104LM
Descurainia sophia	flixweed	Introduced	RP002-SQ, SQRP109LM
Erysimum cheiranthoides	wormseed mustard	Introduced	SQRP109LM
Galeopsis tetrahit	hemp-nettle	Introduced	RP001-SQ, RP004-SQ, RP008-SQ, RP012-SQ, RP013-SQ, RP018-SQ, RP020-SQ, RP023-SQ, RP024-SQ, SQRP100LM, SQRP105LM, SQRP108LM, SQRP110LM, SQRP112LM
Polygonum convolvulus	wild buckwheat	Introduced	SQRP100LM, SQRP104LM, SQRP109LM
Silene noctiflora	night-flowering catchfly	Introduced	SQRP100LM
Stellaria media	common chickweed	Introduced	RP020-SQ
Taraxacum officinale	common dandelion	Introduced	RP002-SQ, RP003-SQ, RP006-SQ, RP007-SQ, RP008-SQ, RP009-SQ, RP012-SQ, RP013-SQ, RP014-SQ, RP016-SQ, RP017-SQ, RP018-SQ, RP019-SQ, RP020-SQ, RP021-SQ, RP023-SQ, RP024-SQ, RP025-SQ, RP026-SQ, SQRP100LM, SQRP101LM, SQRP104LM, SQRP107LM, SQRP108LM
Thlaspi arvense	stinkweed	Introduced	SQRP100LM, SQRP109LM, SQRP110LM

NOTES:

[1] Designation ranking of noxious is from the *Weed Control Act Regulations*. Designation as introduced follows Moss (1983).

[2] Weed species of concern to the County of Thorhild (Dowhan 2010, pers.comm).

[3] Weed species of concern to the County of Lamont (Lamont County 2010, Internet site).

[4] Weed species of concern to the County of Sturgeon (Sturgeon County 2010, Internet site).

[5] Weed species of concern to the County of Strathcona (Strathcona County 2010, Internet site).

4.3.2.5 Agricultural Pests

Clubroot is a soil-borne disease that affects canola, mustard and other crops in the cabbage family, and cruciferous weeds. It is considered a pest under the *Agricultural Pests Act* and was first detected in a canola field near Edmonton in 2003 (Alberta Clubroot Management Committee 2010, Internet site). While surveys for clubroot were not done, available information from surveys done in 2009 (Alberta Agricultural and Rural Development 2010, Internet site) indicate that clubroot has been found along the ROW in the following areas:

- Strathcona County (10 to 45 fields)
- Sturgeon Count (more than 45 fields)
- Thorhild County (1to 9 fields)

No clubroot has been found in field surveys in Lamont County. Appropriate measures to minimize the potential for spreading of clubroot are in the EPP (see Appendix I), including Shell's clubroot best management practices.

4.4 Wildlife and Wildlife Habitat

4.4.1 Overview

The Project is located in the Dry Mixedwood Natural Subregion of the Boreal Forest Natural Region. The landscape surrounding the Project is dominated by agriculture where wildlife habitats are highly fragmented. Exiting datasets and reports include 158 species of wildlife that could potentially breed or winter on or around the LAA. Four amphibians were detected from 42 of the 50 survey stations (84%). The results of the breeding bird surveys included observations of 82 species. No Yellow Rails were detected. Of the 33 species incidentally recorded during the 2010 field visits, 14 are considered to be species of management concern.

The majority of sightings were classified as auditory (38%) or visual (22%), while there was only one observation each of dens or snags. Ungulate trails and beds were common in shrubby habitats and were mostly attributable to moose.

4.4.2 Summary of Results

See Table 4-10 for the species chosen for the assessment.

Of the species listed, two were recorded during wildlife surveys; western toad and Olive-sided Flycatcher. Only the Olive-sided Flycatcher was detected within the LAA. Olive-sided Flycatchers and western toads are on Schedule 1 of *SARA*.

The baseline conditions for each of the species chosen for the environmental assessment on wildlife and wildlife habitat were determined through field visits and GIS mapping. The availability of key habitat was determined for each assessment species (see Table 4-11).

Table 4-10 Potential Wildlife Species at Risk within the LAA

Species	*SARA*		COSEWIC	Alberta Listings	
	Schedule	Status	Status	ESCC[1]	Rank Status[2]
Birds					
Bobolink	No schedule	No status	Threatened	Not Listed	Sensitive
Canada Warbler	Schedule 1	Threatened	Threatened	Not Listed	Sensitive
Common Nighthawk	Schedule 1	Threatened	Threatened	Not Listed	Sensitive
Horned Grebe	No schedule	No status	Special concern	Not Listed	Sensitive
Loggerhead Shrike	Schedule 1	Threatened	Threatened	Special Concern	Sensitive
Olive-sided Flycatcher	Schedule 1	Threatened	Threatened	Not Listed	Secure
Rusty Blackbird	Schedule 1	Special concern	Special concern	Not Listed	Sensitive
Short-eared Owl	Schedule 3	Special concern	Special concern	Not Listed	May be at risk
Sprague's Pipit	Schedule 1	Threatened	Threatened	Special Concern	Sensitive
Yellow Rail	Schedule 1	Special concern	Special concern	Not Listed	Undetermined
Amphibians					
Western Toad	Schedule 1	Special concern	Special concern	Not Listed	Sensitive

NOTE:
[1] ESCC - Alberta's Endangered Species Conservation Committee
[2] ASRD - General Status of Alberta's Wild Species

Table 4-11 Baseline Habitat Availability for Assessment Species

Species	Baseline Case	
	Key Habitat (ha)	Percent of Total 8930 ha LAA
Western Toad	441.6	4.9%
Bobolink	658.5	7.4%
Canada Warbler	441.6	4.9%
Common Nighthawk	7402.8	82.9%
Horned Grebe	564.3	6.3%
Loggerhead Shrike	430.5	4.8%
Olive-sided Flycatcher	404.7	4.5%
Rusty Blackbird	273.7	3.1%
Short-eared Owl	2794.2	31.3%
Sprague's Pipit	124.2	1.4
Yellow Rail	3.6	0.0

4.4.2.1 Amphibians

Two species of toad were recorded: Canadian toad and western toad. Canadian toads were detected only south of the NSR, and at a distance of 800 m from the pipeline route. Western toads were only found at the northern end of the pipeline, with no observations closer than 8.3 km from the pipeline route.

4.4.2.2 Yellow Rail

No Yellow Rails were detected during field surveys. A preliminary review of aerial photos of the region indicated that highly or moderately suitable sedge wetland habitat for Yellow Rails was particularly limited within the LAA. Similarly, suitable habitat was not noted during field surveys.

4.5 Land Use

4.5.1 Overview

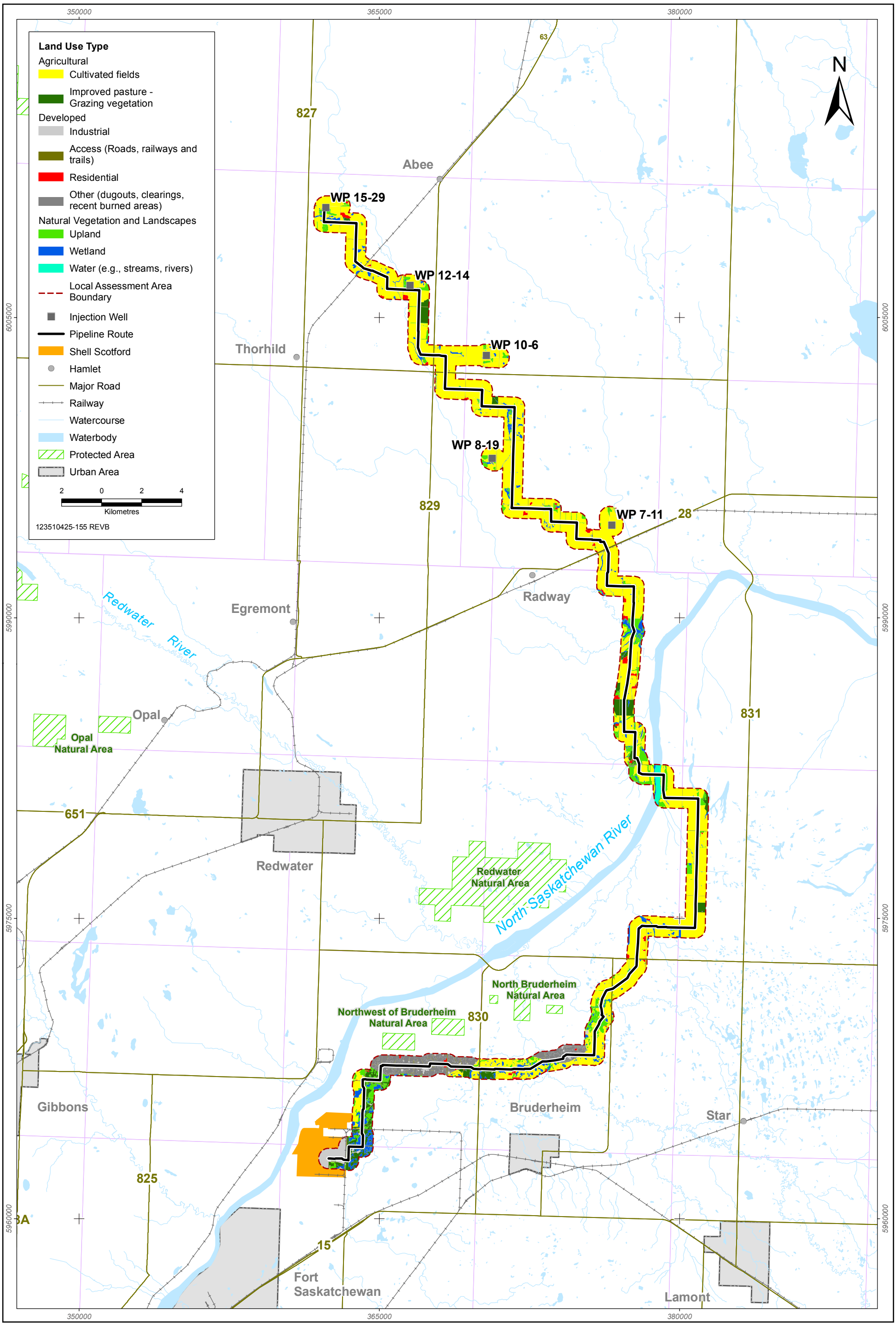
The land use LAA intersects four municipal boundaries: Strathcona County, Lamont County, Sturgeon County and the County of Thorhild. The pipeline route spans the boundaries of all four counties.

4.5.2 Summary of Results

4.5.2.1 Percentages of Land Use Types in the LAA

Approximately 73% of land use in the LAA is agricultural land, making it by far the most dominant land use.

For total areas of the land use types that comprise the LAA, see Table 4-12 and Figure 4-1.



NWT
AB
BC
SK
Area of Interest
USA

QUEST CARBON CAPTURE AND STORAGE PROJECT

Land Use Types in the Local Assessment Area

Acknowledgements: Original Drawing by Stantec
Pipeline: Sunstone Engineering August 11, 2010, Wells: Shell August 26, 2010, Basedata: National Road Network, Canvec, Altalis

PREPARED BY Stantec
PREPARED FOR
FIGURE NO. 4-1

Last Modified: November 11, 2010 By: cspyker

Table 4-12 Land Use Types in the LAA

Land Use Type	Area Occupied (ha)	Proportion of LAA (%)
Agricultural		
Cultivated fields	6,075.0	68.0
Improved pasture – Grazing vegetation	469.2	5.3
Agricultural Subtotal	**6,544.2**	**73.3**
Developed		
Industrial	152.8	1.7
Access (Roads, railways and trails)	145.2	1.6
Residential	114.6	1.3
Recreational	0	0
Other (dugouts, clearings, recent burned areas)	560.1	6.3
Developed Subtotal	**972.7**	**10.9**
Natural Vegetation and Landscapes		
Upland	798.3	8.9
Wetland	564.3	6.3
Water (e.g., streams, rivers)	50.6	0.6
Natural Vegetation Subtotal	**1,413.2**	**15.8**
Total	**8,930.1**	**100**

4.5.2.2 Municipal Land Use Planning Policies and Plans

The pipeline begins at the Scotford Upgrader in Strathcona County and then crosses lands in Lamont County, Sturgeon County (less than 2 km of the pipeline), and the County of Thorhild.

A large portion of the pipeline ROW occurs within Alberta's Industrial Heartland. It encompasses portions of Fort Saskatchewan, Strathcona County, Sturgeon County and Lamont County, which formed the AIHA. Each municipality in cooperation with the AIHA developed complementary Area Structure Plans (ASPs) that covered the portions of their municipalities within the AIHA area.

4.5.2.3 Land Use Planning Framework: Long-Term Planning Policy Areas and Zoning

See Table 4-13 for the municipalities that the pipeline crosses, and the principle municipal land use policies, plans and land use bylaws that are applicable to the pipeline ROW in each municipality.

The pipeline route does not follow any of the recommended pipeline alignments identified on the Strathcona County MDP map (Recommended Pipeline Corridor). About one-half of the pipeline route that is located within the Strathcona County boundaries crosses lands identified as a High Priority PEMA, while the other one-half of the route crosses lands identified as a Medium Priority PEMA.

Table 4-13 Municipalities and Land Use Plans and Bylaws

Municipality	Land Use Plans	Land Use (Zoning) Bylaw and Other Bylaws
Strathcona County	• Strathcona County Municipal Development Plan (MDP) • Strathcona County Alberta's Industrial Heartland (AIH) Area Structure Plan (ASP)	• Strathcona County Land Use Bylaw (LUB)
Lamont County	• Lamont County MDP • Lamont County AIH ASP	• Lamont County LUB
Sturgeon County	• Sturgeon County MDP • Sturgeon County AIH ASP	• Sturgeon County LUB
County of Thorhild	• County of Thorhild MDP	• County of Thorhild LUB

Portions of the pipeline are located within the Medium/Heavy Industrial Policy Area and the Agricultural Policy Area of the Lamont County Heartland ASP. The Lamont County Heartland ASP does not contain any specific policies on oil and gas pipelines.

The County of Thorhild MDP 986-97 (approved in July 1998) recommends that additional residential, commercial and industrial development occur in the urban areas of the County (i.e., hamlets). The MDP encourages limited commercial development near primary highways and secondary highways. The MDP also states that the County does not consider the MDP to be inflexible, and will look at and consider changes proposed from time to time for specific developments.

4.5.2.4 Agriculture

The majority of the pipeline ROW route crosses privately owned agricultural land (mixed cultivation and pasture). Soil conditions for growing crops vary from lands that have few or only moderate limitations to areas unsuitable for crop growth (e.g., wetlands). Most of the pipeline route has been cultivated for annual crops such as barley, canola and wheat.

The pipeline route does not cross any Crown land that is leased for agricultural uses.

Shell has notified landowners and occupants and is negotiating agreements required to enter the respective property, lease the land for both ROW and TWS and install the pipeline.

4.5.3 Industrial Development

Industrial activities in the Strathcona County portion of the AIHA include:

- petrochemical and fertilizer plants
- bitumen upgraders and refineries
- oil and gas product processing plants
- oil and gas pipelines
- oil and gas exploration and development (well sites)
- chemical manufacturing plants
- quarries
- logging

- underground salt storage caverns
- water disposal and injection facilities

Strathcona County is home to over half of Canada's petrochemical industry and is the third-largest petrochemical complex in North America (Strathcona County 2007a, Internet site; Strathcona County 2007b, Internet site).

4.5.4 Recreation

Not including the urban parks and recreational facilities in the City of Fort Saskatchewan, recreational land use opportunities in the RAA exist primarily in the three provincially protected natural areas (Redwater, Northwest of Bruderheim and North of Bruderheim Natural Areas) and the NSR valley area. The three natural areas are available for passive, low-intensity recreational activities, and are used for bird watching, wildlife viewing and photography, horseback riding, hiking and cross-country skiing. Recreational services are limited to staging areas, trails and signs. No formal day use or camping facilities are located in these areas.

Land management objectives for the NSR valley area (i.e., the NSR Environmental Policy Area) are to conserve recreational and educational opportunities while conserving and enhancing the river valley character (Strathcona County 2001). The NSR valley area is available for passive recreation activities such as hiking, biking, bird watching and wildlife viewing, and fishing. It contains a series of recreation trails.

Various outdoor associations and clubs use lands in the RAA for recreation, including the following organizations:

- Fort Saskatchewan Naturalist Society
- Ducks Unlimited
- Fish and Game Association
- Fort Saskatchewan Nordic Ski Club
- Fort Saskatchewan and District Snow Angels (a snowmobile club with 60 km of groomed trails from Fort Saskatchewan to Lamont, via Bruderheim)

4.5.5 Transportation and Road Crossings

Approximately 1.6% of the LAA is land used for roads and railways. Provincial highways that intersect the LAA include Highways 830, 45, 829, 28, 18, and 63.

The pipeline crosses an existing CN railway at two points: the first crossing is located between Warspite and Radway northeast of Radway, and the second crossing is located about halfway between Abee and Thorhild (see Figure 4-1). The pipeline also crosses an existing CP railway north of Scotford.

4.5.6 Environmentally Significant Areas

The Strathcona County landscape is characteristic of the transitional Central Parkland Natural Subregion of the Parkland Natural Region of Alberta. It is located between the drier Grassland Natural Region to the south and the Boreal Forest Natural Region to the north. Many sloughs, lakes, wetlands and rivers, including the NSR, comprise this area's water system. Natural vegetation is dominated by grasslands in the south interspersed with, and gradually replaced by, aspen and balsam poplar forests to the north.

Recognizing the importance of conserving natural landscapes, Strathcona County has identified a number of environmentally significant areas (ESAs) in the region (Saxena 1997; Infotech 1989; Westworth and Knapik 1987). These areas are unique and often contain sensitive natural features and landscapes (Geowest 1996). They are defined as landscape elements or places that are vital to the long-term maintenance of biological diversity, soil, water or other natural processes, both onsite and in a regional context (Jennings and Reganold 1991; Geowest 1996). ESAs are not protected by legislation, unless they are also classified as provincial protected areas (e.g., Natural Areas).

There are three Strathcona County-designated ESAs in the RAA (see Figure 4-1):

- Northwest of Bruderheim Natural Area
- North Bruderheim Natural Area
- NSR valley

Northwest of Bruderheim Natural Area and North Bruderheim Natural Area are also provincially designated protected areas under the Natural Area classification. In addition to any legislation that would apply to provincial natural areas, Strathcona County has set out objectives and guidelines to be followed to conserve these ESAs.

The NSR valley area, in addition to being a county-designated ESA, is also the only provincially designated ESA (Saxena 1997; Infotech 1989; Westworth and Knapik 1987; AIHA 2002). The NSR valley is an interprovincially important waterway that provides diverse riparian and valley habitats and key wintering habitat for white-tailed deer. It also supports various fish populations and is a regionally important nesting area for migratory waterfowl. The NSR valley ESA encompasses the river proper and adjacent river valley in Townships 54 to 57, Ranges 20 to 22-W4M.

The NSR valley area is identified and managed as a conservation policy area in the Strathcona County MDP and as an environmental policy area in the Strathcona County Alberta's Industrial Heartland ASP.

The Strathcona County MDP requires heavy industrial developments to prove that potential risks in these conservation policy areas are managed. The Strathcona County MDP requires a 50-m setback from the top of bank of the NSR and a 30-m setback from the top of banks of all other lakes, waterbodies and watercourses. Conservation policy and environmental policy areas are primarily to be used for long-term conservation, open space and wildlife corridors, passive recreation, environmental education facilities, non-intensive agriculture, sand and gravel extraction and major regional utilities.

The North Bruderheim Natural Area also crosses into Lamont County. Otherwise, there are no provincial or county-designated ESAs in Lamont County and the County of Thorhild that intersect the land use RAA.

There are no nationally or internationally significant ESAs crossed by the ROW.

4.6 Historical Resources

Historical resources are regulated provincially under the Alberta *Historical Resources Act*, which is administered by ACCS. As per ACCS policy, a Schedule of requirements relative to historical resources was issued by ACCS for the Project prior to approval of the archaeological and palaeontological permits (Schedule A, ACCS Project File 4780-10-004). To meet the ACCS requirements, a historical resources impact assessment (HRIA) for archaeology was completed under archaeological permit number 2010-104 (Porter and Tischer 2010).

4.6.1 Characteristics of the Survey Area

4.6.1.1 Overview

During the HRIA field studies, 26 sites were investigated, including 18 precontact archaeological sites and 8 historic sites. Of these sites, 10 are currently located within the PDA, including eight precontact archaeological sites and two historic period sites. Nine of these sites have low heritage value, and no further study is recommended relative to the *Historical Resources Act*. The tenth site (a structure) is determined to have moderate heritage value; however, documentation of the site (mapping, photography, detailed description) has mitigated any effects on the site, and no further study is recommended.

Historical Resources Act clearance is recommended for the Project relative to precontact archaeological and historic sites, except for the east side of the NSR crossing, where a deep testing program will be recommended before Project construction.

4.6.2 Summary of Results

4.6.2.1 Precontact Archaeological Sites

Of the 18 precontact archaeological sites investigated: two were isolated finds, thirteen were artifact scatters, and three were campsites. Of these sites, 17 were identified in disturbed context (cultivated fields, with no undisturbed subsurface remains) and are determined to have low heritage value. A single undisturbed site was identified during shovel testing in an undisturbed (wooded) area; this site has low heritage value within the right-of-way, however, because only two artifacts were recovered.

Of the 18 precontact sites, eight sites are within the PDA and will be affected by the Project. The remaining sites are adjacent to the PDA, or were identified during assessment of Project areas before rerouting, and will not be affected.

All sites likely to be affected by the Project have low heritage value, and no further study is recommended for these sites relative to the *Historical Resources Act*.

4.6.2.2 Historic Sites

Eight historic sites were recorded: one was an isolated find, one was an artifact scatter, and six consisted of structural remains, including three habitation sites associated with farming/ranching, and one religious site (Eldorena Church). Of these sites identified, two sites are within the PDA and will be affected by the Project. This includes the isolated find and one of the farming/ranching structure sites (a granary). The remaining sites are adjacent to the PDA, or were identified during assessment of Project areas that were

subsequently rerouted, and will not be affected. The isolated find site has low heritage value and no further study is recommended for this site relative to the *Historical Resources Act*. The structure (granary) has moderate heritage value, but potential environmental effects on the site has been mitigated by documentation of the site, including mapping, photography and detailed description. No further study has been recommended for this site relative to the *Historical Resources Act*.

4.7 Palaeontological Resources

Historical resources are regulated provincially under the Alberta *Historical Resources Act*, which is administered by ACCS. As per ACCS policy, a Schedule of requirements relative to historical resources was issued by ACCS for the Project prior to approval of the archaeological and palaeontological permits (Schedule A, ACCS Project File 4780-10-004). To meet the ACCS requirements, a historical resources impact assessment (HRIA) for palaeontology was completed under permit number Frampton-2010-002.

4.7.1 Characteristics of the Survey Area

4.7.1.1 Overview

Field surveys found aeolian silt and sand at Beaverhill Creek, but no bedrock or preglacial gravel.

4.7.2 Summary of Results

At the NSR, exposures are minimal, but the survey found a bedrock exposure of the Belly River Group adjacent to the pipeline route. One dinosaur bone fragment was found at this exposure. This indicates that the pipeline will cross a bedrock bench along the middle part of the upper slope, and this bedrock has high palaeontological potential.

There are extensive bedrock exposures of the Belly River Group at Namepi Creek. No fossil sites were recorded along the pipeline route, but several nearby exposures produced dinosaur bone and turtle shell fragments. This indicates that fossiliferous bedrock underlies the pipeline route at Namepi Creek.

Construction monitoring by a professional palaeontologist should be done by the Project palaeontologist for the east side of the NSR valley and the Namepi Creek valley. This monitoring will mitigate any adverse Project effects on palaeontological resources and no other mitigation measures are required.

5 Mitigation to Reduce Environmental Effects

Although the proposed route construction methods have been selected to reduce effects on the environment and existing land users, the potential still exists during Project construction, operation and decommissioning to cause environmental effects. Mitigation measures have been selected to reduce these potential environmental effects. These mitigation measures will be implemented through the EPP. The EPP will be used by contractors when constructing the pipeline and, subsequently, by Shell, the operator of the pipeline.

5.1 Aquatic Environment

5.1.1 Change to Fish Habitat

Best management practices for erosion and sediment control are typically used during all phases of instream or near-stream construction and reclamation. Trenched crossings result in a temporary habitat disturbance, which is restored when construction is complete. Proper grading and reclamation of the banks is the key measure that will be used. Other measures to mitigate changes to fish habitat are as follows:

- A riparian buffer, or minimal disturbance zone (MDZ) will be established for all watercourses, and will be clearly identified before the start of clearing activities. Rights-of-way will be narrowed in these areas to the extent practical. Grubbing and topsoil and duff stripping in the MDZ will be restricted to allow access crossing construction (if required), excavation of the trench and installation of the pipeline. Disturbance inside the MDZ will be limited to the extent practical (access is needed for clearing and construction crews).
- Drainage patterns including channel width and depth will be restored to match pre-disturbance conditions following construction.
- Interim stabilization and final reclamation will be carried out at all crossings. Banks should be graded to stable slopes and covered with erosion-control fabric or matting, as required to maintain slope integrity.
- Disturbed bank areas will be revegetated using native species and cover crops if required for erosion control. If there is insufficient time in the growing season remaining for the seeds to germinate, the site will be stabilized (e.g., exposed areas should be covered with erosion-control blankets). Revegetation will be carried out in the following spring at these locations.
- A qualified expert will be present during construction at all watercourse crossings with water present, to monitor water quality and document compliance with Project plans, commitments and approval conditions (e.g., sediment and erosion control).
- If culverts are used for temporary crossings, they will be removed before the restricted activity period, unless otherwise agreed with DFO.
- All vehicle crossing structures will be designed to meet expected flows during their period of operation. Temporary crossing structures and associated sediment and erosion control structures will be designed to accommodate expected flows during construction and cleanup and will be regularly monitored and maintained.

5.1.1.1 Introduction of Sediment

Potential degradation of water quality can be mitigated by implementing standard best management practices for sediment and erosion control and hazardous materials management. Best management practices will prevent sediment and similar substances from entering watercourses, including those that are fish-bearing, at levels that would be deleterious to fish in the LAA. These measures include the following:

- Time the construction to occur when the watercourse is dry or frozen to the bottom.
- If a watercourse is not dry or frozen, isolate the crossing with clean material free of sediment, and maintain downstream flow.
- Sediment and erosion control measures will be installed after clearing and before or during any construction activities.
- Grading will be delayed on approach slopes to watercourses until immediately before construction of the pipeline crossing. Where this is not practical, appropriate temporary erosion and sediment control structures will be installed immediately when the vegetative mat is initially disturbed and the topsoil or duff is stripped.
- Weather reports and streamflow will be monitored before crossing construction begins, to determine whether a clear window exists for the expected duration of the work. The construction schedule will be modified in accordance with local weather and site conditions.
- Where poor weather conditions and Project activities have the potential to cause increased sedimentation, the construction will be modified or suspended until weather conditions abate, or effective mitigation procedures have been implemented.
- During poor weather conditions, the number of vehicles on access roads or pipeline ROW will be reduced to limit erosion risks. Heavy equipment will be withdrawn from the area. Additional planning of activities might be required to either concentrate, or spread out the work crews, as warranted.
- Contingency plans implemented before shutdown will include considering such measures as installing temporary diversion berms on steep slopes, installing silt fencing and changing equipment (i.e., low-pressure tire or tracked vehicles).
- Fuel and other potentially hazardous materials will not be stored within 100 m of a watercourse.
- Vehicle and mobile construction equipment fuelling will not take place within 100 m of a watercourse, unless the fuelling site is contained within a lined berm.
- Water quality monitoring plans will be implemented at all crossing sites where the potential exists for introducing sediment into surface water. Monitoring and response plans for the inadvertent release of mud will be implemented at all HDD crossing sites.

Once the watercourse crossings are complete, crossing approaches will be graded to stable slopes and reclaimed as quickly as practical to reduce opportunities for erosion. Road ditches will be diverted into stable vegetated areas to prevent runoff from access roads entering watercourses.

5.1.2 Change in Project-Related Fish Mortality

Isolation of the watercourse is considered only as a contingency method in the event that the trenchless method is unsuccessful. Should an isolation technique be required, the following mitigation measures will be implemented and supervised by a fish biologist:

- Fish will be rescued from isolated watercourse sections before dewatering and will be released into an unaffected downstream reach of the watercourse.
- Pumps used during any phase of trenched construction will be fitted with intake screens in compliance with the federal Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995).
- Contingency equipment (e.g., back-up pumps) will be available onsite.
- Instream work on each crossing will be completed rapidly to reduce the *scale of negative effects* on fish populations.

5.2 Soils and Terrain

5.2.1 Soil Loss

The environmental effects of soil loss can be mitigated by:

- following soil stripping requirements and handling techniques as documented in the environmental alignment sheets (Appendix I) and related figures for well pads, access roads and borrow pits
- exercising due care during soil stripping, salvaging and stockpiling

Guidelines and principles of environmental protection for pipeline construction have a long history of successful application in the province. Standards for well pad salvage and reclamation are also defined by Alberta Environment.

The following mitigation measures will limit the environmental effects of soil loss, and are common to the ROW, well pads, access roads and borrow pits:

- salvage topsoil before construction
- apply tackifiers or other covers to reduce the risk of wind or water erosion to stockpiles that are to remain in place for an extended period

Specific for the CO_2 Pipeline

The following mitigation measures will be done for the ROW:

- Strip topsoil where grading is required to install the CO_2 pipeline safely.
- Strip topsoil from under subsoil and spoil piles, in areas recommended for three-lift soil handling.
- Conserve topsoil according to soil handling requirements identified on the Project's environmental alignment sheets.
- Store topsoil and subsoil (i.e., subsoil from three-lift portions of the ROW) according to site-specific soil handling procedures.

- Maintain adequate separation between topsoil and spoil material.
- Replace topsoil as soon as possible after pipe installation to limit the potential for wind and water erosion.

Specific for the Well Pads

Mitigation measures for the well pads include stripping soil in two lifts (topsoil and upper subsoil) before drilling, and storing in separate piles.

Specific for Access Roads

Mitigation measures for the access roads include salvaging topsoil and documenting the location of stored topsoil for use during decommissioning and abandonment.

Specific for Borrow Pits

Mitigation measures for borrow pits include documenting the location of stored topsoil for use during decommissioning and abandonment.

5.2.2 Change in Soil Quality

The quality of the topsoil, subsoil (B horizon) and spoil of the soil profile determines the potential for admixing and the need for mitigation techniques. The subsoil (i.e., B horizon) and spoil are often both of poor quality in comparison to that of the topsoil. In these instances, a standard two-lift procedure is used because separating the subsoil from the spoil would not provide any benefit. Admixing of poorer quality spoil material with higher quality topsoil and subsoil is mitigated using a three-lift technique, whereby the topsoil, subsoil and spoil are salvaged as separate lifts. The chemical and physical characteristics of the B and C horizons that warrant a three-lift soil handling include:

- presence of soluble salts with an electrical conductivity of greater than or equal to 3 dS/m
- presence of sodicity as measured by sodium adsorption ration SAR ≥ 4
- presence of bedrock within the 1.5 m trench depth

In areas of soils prone to trench collapse, a wider stripped area is typically used to build more gently sloping trench wall. This sloped trench wall reduces the potential for collapse and admixing of surface soils with spoil.

The risk of compaction and rutting is mitigated primarily by following procedures documented in the Pipeline Environmental Protection Plan (Appendix I) for wet-weather shutdown conditions. Compaction of topsoil and subsoil may also occur when soils with wetter drainage regimes are salvaged. Salvage operations will consider soil moisture content to ensure that compaction of salvage materials does not occur.

For well pads, handling soil in two lifts, one for topsoil and one for upper subsoil, will be the best mitigation for preventing a change in soil quality.

Borrow pit reclamation will be to provincial standards.

5.2.3 Change in Terrain Stability

Terrain stability on steep slopes can be protected by avoiding placement of access roads on slopes and by applying riprap to areas that are undercut by river flow. If access roads must be placed on these slopes, appropriate drainage must be maintained in order to prevent sliding. Geotechnical investigations are required for areas exhibiting steep slopes with evidence of mass movement.

At the North Saskatchewan River crossing, the areas of steep slopes will require mitigation and a detailed geotechnical assessment. The area of disturbance as a result of the Project is wider on the lower terraces.

A preliminary geotechnical investigation was done to assess the suitability of the proposed North Saskatchewan River pipeline crossing. Based on the results of the investigation, the preferred crossing method for the North Saskatchewan River is by using a horizontal directional drilling (HDD) technique. However, a contingency plan for the crossing will be developed in the event that the HDD method is not successful

Detailed investigation will also be required at Namepi Creek.

5.2.4 Loss of Unique Terrain Features

Mitigation measures for sand dunes include:

- performing construction work in winter when the ground is frozen
- applying erosion control measures to prevent sand from becoming airborne
- revegetating dune field areas in a timely manner after disturbance
- constructing snow fences to catch blowing sand

5.3 Vegetation and Wetlands

Mitigation measures for vegetation and wetlands, which are common to the pipeline ROW, well pads, access roads and borrow pits, include:

- locating the ROW parallel to existing pipeline rights-of-way, as much as feasible
- locating Project components on areas of non-native vegetation (i.e., cultivated land), as much as feasible
- following best management practices for construction including mitigation for areas of saturated lands (i.e., wetlands) and areas with high potential for erosion (i.e., sand dune areas)
- transplanting or seeding of rare plants located within areas of Project disturbance
- implementing the Weed Management Plan
- implementing the Clubroot Management Plan
- protecting wetlands by:
    - using existing stream crossings, where possible
    - limiting removal and disturbance of soil adjacent to wetlands and watercourses leading to wetlands
    - grading away from wetlands to avoid sedimentation

- maintaining natural drainage patterns when storing excavated material
- reclaiming the area, after construction, to the preconstruction profile of wetlands, allowing wetlands to regenerate naturally, monitoring the effectiveness of wetland reclamation, and making adjustments as necessary

5.4 Wildlife and Wildlife Habitat

5.4.1 Limiting Changes in Habitat Availability and Connectivity

The following mitigation strategies will limit the loss of habitat for Species at Risk and other wildlife species:

- using existing roads and rights-of-way to reduce disturbance where possible
- constructing the route parallel to, or overlapping, the ROW of existing linear corridors (roads, seismic lines, pipelines)
- using existing access roads, where available, and coordinating the development of new (temporary) roads with other industrial operators
- avoiding disturbance of suitable habitat for Species at Risk and other wildlife species areas by constructing the pipelines and other infrastructure in disturbed or less sensitive areas, (e.g., avoidance of remnant riparian habitat within and along the slopes of the North Saskatchewan River valley)
- using setbacks if construction interferes with potential habitat for Species at Risk
- following best management practices for construction including mitigation for areas of saturated lands (i.e., wetlands) and areas with high potential for erosion (i.e., sand dune areas)
- protecting wetlands, creeks and the North Saskatchewan River by:
  - use of trenchless techniques for pipeline installation
  - using existing rights-of-way for TWS
  - limiting removal and disturbance of soil adjacent to wetlands and watercourses leading to wetlands
  - grading away from wetlands to avoid sedimentation
  - maintaining natural drainage patterns when storing excavated material
  - reclaiming the area, after construction, to the preconstruction profile of wetlands, allowing wetlands to regenerate naturally, monitoring the effectiveness of wetland reclamation, and making adjustments as necessary
- compensating for wetlands where infilling or removal of wetlands is required following the *Water Act*
- limiting the size of permanent and temporary workspace to the extent possible, and reclaiming work areas immediately following construction

Limiting Changes in Mortality Risk

Pipeline construction planning will take into consideration timing windows and setback distances for Species at Risk and other species of wildlife protected under the *MBCA* and the *Wildlife Act* of Alberta. Where feasible, construction will be scheduled to avoid sensitive timing windows. Timing windows and setback requirements have been developed for some species in the boreal ecoregion, while others have been developed for prairie and parkland species. The guiding principles of the latter are used to mitigate potential Project effects on some species not addressed in the former.

The possibility of western toads (and other wildlife species) being trapped in trenches at contraction sites will be mitigated by following Alberta's best practice guidelines produced for the oil and gas industry, which are as follows:

- Limit the duration and amount of open trench along the ROW.
- If trench is left open overnight or during shutdown, provide 5-m wide pipe, spoil pile and trench breaks.
- Provide (2:1 sloped ramps) every 300 m to allow greater wildlife movement across the ROW and escape.
- Check the trench at least twice daily for trapped wildlife and should any removal be required, contact the local Fish and Wildlife office.
- Prohibit pets, firearms or recreational use of all-terrain vehicles on the ROW.
- Do not harass or feed wildlife.
- Record all wildlife observed within or near trenches for submission to ASRD.

Hazardous materials will be stored securely in an appropriate location to avoid interaction with wildlife. Construction waste and debris, including all waste food products that could potentially attract wildlife, will be routinely collected and disposed in a secure location.

5.5 Historical Resources

The historical resources impact assessment (HRIA) conducted for the Project resulted in the identification of 26 historical resources sites, including 18 precontact archaeological sites and eight historic period sites. The 10 sites identified within the area of physical disturbance are all of low heritage value and/or have been effectively mitigated by documentation during the HRIA studies. The remaining 16 sites were identified outside of the area of physical disturbance, and will not be impacted.

An HRIA report has been prepared for submission to ACCS, as required under the *Historical Resources Act*. *Historical Resources Act* clearance will be required for the Project to proceed relative to historical resources, with the exception of the east side of the NSR crossing, at which a deep testing program should occur prior to construction.

ACCS will review the HRIA report and will issue any requirements for further studies, as well as *Historical Resources Act* clearance for the Project to proceed.

5.6 Paleontological Resources

Construction monitoring will be conducted by the Project palaeontologist in areas of high palaeontological potential at the NSR and Namepi Creek. This is a standard palaeontological mitigation measure.

Any mitigation measures for palaeontological resources will be determined by the Royal Tyrrell Museum of Palaeontology and Alberta Culture and Community Spirit, subsequent to review of the HRIA documents. Shell Canada will meet any issued mitigation requirements.

5.7 Land Use

5.7.1 Direct Loss of Agricultural Land Base

The main mitigation is the successful reclaiming of temporarily disturbed areas (including the pipeline ROW) to an agricultural or native seed mix following construction. This will involve specific mitigation measures by Shell, including:

- completing and implementing an Environmental Protection Plan (EPP) covering the construction and operation phases of the Project
- salvaging topsoil prior to site development and storing topsoil separate from subsoil or using a physical barrier, such as geotextile, where separation of piles is limited by available space (to assist in reclamation of agricultural lands)
- seeding topsoil remaining in storage during operation with a native grass mix or applying a tackifier mix to minimize erosion potential and weed establishment (to assist in reclamation of agricultural lands)
- relieving subsoil compaction prior to replacing topsoil (to assist in reclamation of agricultural lands)
- destroying any restricted weeds observed and controlling any noxious weeds observed (to assist in reclamation of agricultural lands)
- monitoring disturbed sites for weeds and pest species such as clubroot, and developing a weed management plan (to assist in reclamation of agricultural lands)
- re-seeding all disturbed areas to limit the potential for weed and invasive species establishment (to assist in reclamation of agricultural lands)
- consulting with affected landowners about their preferred seed mix for reclamation

5.7.2 Disruption to Transportation Activities

To mitigate potential effects of the Project on railway traffic, the following mitigation will be implemented:

- a railway crossing agreement between Shell and CN will be established
- a railway crossing agreement between Shell and CP will be established
- the only acceptable pipeline crossing method of the railway tracks is a trenchless crossing technique using either a bore or direction drill

5.7.3 Disruption to Industrial Activities

During construction of the pipeline, CO_2 injection wells and their associated infrastructure, Shell will consult with industrial operators in the LAA to identify any interactions between the Project that may interfere with, harm or restrict access to their industrial activities, and then act to avoid conflicts where feasible.

6 Additional Studies

Each of the programs listed in this section will occur in 2011 prior to construction. The results, along with any additional mitigation measures will be reported. For the status of additional studies, see Table A-1 in Attachment A.

6.1 Soils and Terrain Baseline Assessment

Additional work is proposed for areas where either three-lift salvage is to be considered or where shallow bedrock occurs.

Appropriate studies will be conducted for the NSR, Namepi Creek and Beaverhill Creek crossings.

6.2 Aquatic Resources

Winter work is planned to assess the conditions of Astotin, Beaverhill and the two Namepi Creek crossings to insure they will meet the requirements of the operational statements.

6.3 Vegetation

Areas of the route north and south of the NSR crossing point will require additional field inspections. Select parcels of the land along the ROW did not have landowner permission for survey access in 2010; therefore, additional survey work is expected for those areas.

In addition, wetland information on final injection well pad and access road locations will be required for *Water Act* applications for wetland infilling.

6.4 Wildlife and Wildlife Habitat

All of the baseline survey field work was conducted prior to the drafting of the Bruderheim alignment. The result is that approximately 50% of the current route was not included in the field surveys. While Western Toads were recorded during the 2010 field surveys, none of records are located within the LAA of the current pipeline route. One Olive-sided Flycatcher was detected in the LAA in 2010, but the current route now passes through habitat that may support more flycatchers. In addition, over 500 ha of recently burned habitat is included in the LAA of the Bruderheim route, habitat that is considered to be highly suited for Common Nighthawks. Nighthawks require a specialized survey methodology, which was not conducted in 2010 as part of the baseline surveys. Therefore, supplemental surveys are planned for 2011.

Although the results from surveys conducted within the current LAA can be used to extrapolate over the entire Bruderheim route, supplemental surveys will serve multiple purposes:

- The entire Bruderheim alignment will be surveyed to produce a more complete list of wildlife species and wildlife habitat present in the LAA.
- To determine the presence and abundance of Common Nighthawks within the LAA.

- Common Nighthawk surveys conducted at dusk in June would also have the potential to detect the presence of Yellow Rails during a different time period than previously surveyed.
- To provide data for validation of baseline and assessment case wildlife models used in the environmental assessment.

6.5 Land Use

No additional studies are planned.

6.6 Historical Resources

A deep testing program should be conducted for the east side of the NSR crossing due to the nature of the deposits observed during the HRIA studies. This deep testing program will be undertaken in 2011 as part of supplemental HRIA studies for the Project. Prior to undertaking this work, a permit application must be submitted to Alberta Culture and Community Spirit and approved. The results of these supplemental studies will be submitted to ACCS in an HRIA report as required under the *Historical Resources Act*. If any archaeological sites of heritage value are identified during the deep testing program, further studies may be required by ACCS. If no sites with heritage value are identified, ACCS will grant *Historical Resources Act* clearance.

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Attachment A Additional Resource Studies

Table A-1 Status of Completed and Additional Environmental Surveys

Environmental Component	Information to be Collected	Estimated Percent Complete	Primary Reason(s) for Additional Work	Survey Area and Schedule	Description
Soils	Original route was surveyed in 2010, subsequent revisions of the route have produced data gaps.	85%	Areas where three-lift salvage may be indicated	NA	Soils and terrain
Surface Water and Aquatic		100	NA	NA	NA
Vegetation	Original route was surveyed in 2010, subsequent revisions of the route have produced data gaps.	60-70%	Revisions of the route north and south of NSR crossing and limited portions of the ROW did not have landowner permission for survey access	40% of route for spring only rare plant surveys 20% of route for spring & summer rare plant surveys	Rare plant surveys
Wildlife	Original surveys were conducted in early 2010 (spring), subsequent revisions of the route have produced data gaps.	50%	Most of the alignment south of the NSR crossing as ROW location changed since spring 2010	Amphibians in late May 2011 Songbirds in June 2011	Amphibian and songbird surveys
Historical	At areas in which very deep deposits that may contain archaeological resources are encountered, deep testing (backhoe testing) is required by ACCS.	85%	One such area was identified on the east side of the NSR crossing.	The backhoe testing program was not conducted during the current HRIA due to scheduling restrictions, but will be conducted as part of the additional surveys in 2011.	Historic and archaeological sites and artefacts