


SOUTHERN LIGHTS PROJECT

APPLICATIONS BY ENBRIDGE SOUTHERN LIGHTS GP INC., ON BEHALF OF ENBRIDGE SOUTHERN LIGHTS LP, AND ENBRIDGE PIPELINES INC.

VOLUME III

REPORT ON ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT

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ACRONYMS AND ABBREVIATIONS

AAR	Applied Aquatic Research Ltd.
AB	Alberta
ACI	ACI Acoustical Consultants Inc.
AENV	Alberta Environment
ammocoetes (lamprey)	Small larval form of lamprey.
ANHIC	Alberta Natural Heritage Information Centre
asl	above sea level
bbl/d	barrels per day
benthic	occurring at the bottom of a body of water or in the substrate of the water body
bivalve	animal such as a clam or mussel with a shell composed of two separate parts that open and shut
CA	Conservation Agreements
CAPP	Canadian Association of Petroleum Producers
CCME	Canadian Council of Ministers of the Environment
CDC	Conservation Data Centre
CEA	Canadian Environmental Assessment (applies to Act and Agency)
CEAR	Canadian Environmental Assessment Registry
channel (bankfull) width	The horizontal distance between the tops of the streambanks, usually indicated by a definite change in vegetation and sediment texture.
CLI	Canada Land Inventory
CN	Canadian National (Railway)
ConocoPhillips	ConocoPhillips Canada Limited
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CP	Canadian Pacific (Railway)
CPUE	catch-per-unit-effort
CSA	Canadian Standards Association
DFO	Department of Fisheries and Oceans Canada
discharge	The volume of water passing through the channel per unit time.
DO	Dissolved Oxygen Concentration
EGC	Environmental Guidelines for Construction
Enbridge	Enbridge Pipelines Inc.
eolian	surficial deposits or soils deposited by wind
ESA	Environmental and Socio-Economic Assessment
ESLGP	Enbridge Southern Lights GP
ESLLP	Enbridge Southern Lights LP
Fisheries Act	Federal Act enacted to protect fish, fish habitat, water frequented by fish, and to provide for “sustainable fisheries” in Canada.
fluvial	surficial deposits arising from deposition or sorting by a watercourse
FNA	Flora of North America
forage fish	Small, schooling fish which serve as an important source of food for other fish species.
fork length	length measurement of a fish (*i.e.*, from the tip of the mouth of a fish to the notch in the tail (caudal fin)
glaciofluvial	formed by meltwater streams from a glacier
glaciolacustrine	sediments deposited on the floor of a glacial lake
HADD	harmful alteration, disruption or destruction
HDD	horizontal directional drill
HRIA	Heritage Resources Impact Assessment
IBA	Important Bird Area
INAC	Indian and Northern Affairs Canada
KP	Kilometre Post
KPS	locations along Souris reroute

life-history stage (fish)	Stages of a fish’s life cycle, including egg, fry, juvenile, sub-adult and mature adult.
LSA	Local Study Area
LSr	light sour pipeline
MB	Manitoba
Mentiga	Mentiga Pedology Consultants Ltd.
N/A	not applicable, not available
navigable waterway	As defined by the Canadian Coast Guard “*any body of water capable, in its natural state, of being navigated by floating vessels of any description for the purpose of transportation, recreation or commerce, and may also be a man-made feature such as a canal or reservoir.*”
NAWMP	North American Waterfowl Management Plan
NEB	National Energy Board
No Net Loss	a Fisheries and Oceans Canada guiding principal that requires activities in water bodies that provide habitat for fish to either avoid adversely effecting fish habitat or to compensate for adverse effects on fish habitat such that an equal or greater amount of fish habitat remains
NPS	nominal pipe size
NRC	Natural Resources Canada
NWPA	*Navigable Waters Protection Act*
O&MPs	Operating & Maintenance Procedures
O.D.	outside diameter
Operational Statements	guiding procedures and mitigative measures issued by Fisheries and Oceans Canada to direct various activities in and near water bodies that support fish or provide fish habitat
PCMP	Post-Construction Monitoring Program
pugging	To make footprints in the substrate, especially in reference to an animal.
QAES	Qualified Aquatic Environment Specialist
RAP	restricted activity period indicating time of year when instream activity in watercourses is to be avoided
riparian zone	Zone immediately adjacent to a water body containing vegetation that is influenced through its proximity to water, and hence, is distinctly different from the vegetation of adjacent upland areas.
riverine	Of or pertaining to a river.
RL&L	RL&L Environmental Consulting Services Ltd.
RM	rural municipality
ROW	right-of-way
RSA	Regional Study Area
S1	A Conservation Data Centre ranking where a species is very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.
S2	A Conservation Data Centre ranking where a species is rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.
S3	A Conservation Data Centre ranking where a species is uncommon throughout its range or in the province (21 to 100 occurrences).
S4	A Conservation Data Centre ranking where a species is widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).
saline	soils with an electrical conductivity level due to the presence of salts that reduces the capability of the soil (*i.e.*, greater than 3-5 dS/m)
SARA	*Species at Risk Act*
SENV	Saskatchewan Environment
SK	Saskatchewan
sodic	soils with a sodium absorption ratio (SAR) that reduces that capability of the soil (*i.e.*, greater than 4-8)

species at risk	A species listed under Schedule I of the *Species at Risk Act*
species of special concern	A species listed on provincial tracking and watch lists
substrate	upper stream bed material
swale	Shallow, trough-like depression without defined bed and banks that carries water mainly during rainstorms, floods or snow melts (not considered a watercourse).
TERA	TERA Environmental Consultants
the Project	the Southern Lights Project
timing window	Period when no in-water work is to occur and is intended to protect sensitive life-history stages of fishes (e.g., spawning, egg incubation, fry emergence).
TN	total nitrogen
TP	total phosphorous
TSS	total suspended solids – measure of particles (sediment and algae) suspended (i.e. not dissolved) in a water column.
TSS	total suspended sediment
turbidity	A measure quantifying the degree to which light is scattered and absorbed by particles (sediment and algae) suspended in the water column.
undefined drainage	Shallow, trough-like depression without defined bed and banks that carries water mainly during rainstorms, floods or snow melts (not considered a watercourse).
ungulate	hoofed animal *e.g.*, deer
US	United States
watercourse	Waterbody with defined bed and banks, whether or not water is continuously present.
wetted width	Width of the water surface measured at right angles to the direction of flow.
zone of influence	area at and downstream of a watercourse crossing where the potential exists for adverse effects from instream construction

FISH POPULATION AND RIVERINE HABITAT INVENTORIES AT WATERCOURSE CROSSINGS PROPOSED Enbridge Southern Lights Project

Submitted to:

TERA Environmental Consultants
Calgary, Alberta

for:

Enbridge Pipelines Inc.
Enbridge Southern Lights GP
On behalf of
Enbridge Southern Lights LP
Edmonton, Alberta

Submitted by:

Applied Aquatic Research Ltd.
Calgary, Alberta

February 2007
File: AAR06-109

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1.0 INTRODUCTION

1.1 Project Overview

Enbridge Pipelines Inc. (Enbridge) is applying to the National Energy Board (NEB) to construct and operate a new 2867 km long, 508.0 mm O.D. (20") pipeline (LSr pipeline) from Cromer, Manitoba to the US border crossing near Gretna, Manitoba (Figure 1). The proposed LSr pipeline will transport crude oil from Cromer to the US.

The LSr pipeline proposed will be installed within a 40 m wide construction right-of-way (ROW) to maximize use of the existing ROW and work space from previous construction programs. The pipeline will be installed adjacent to the south side of the existing Enbridge pipeline corridor for most of its length; however, it will be installed on the north side of the existing pipeline corridor for 5 km in the vicinity of the Souris River crossing from KP1070.87 to KP 1074.4 and near KP 1195.6. In addition, a new alignment will be required for approximately 7.9 km on the east side of the Souris River valley (Souris re-route) (KP 1074.4 to KP 1081.5) (KPS 0.0 to KPS 7.9) will be required to avoid land use constraints and areas of limited workspace.

In Manitoba, federal and provincial regulations state requirements to reduce disturbance to aquatic resources that may result from instream activity associated with linear development. Firstly, Manitoba fish populations and aquatic habitat protection comes under the jurisdiction of the Federal government, through the Department of Fisheries and Oceans Canada (DFO) and the *Fisheries Act.* *W*atercourses that may be affected temporarily or permanently by pipeline and/or road crossing construction are governed by the *Fisheries Act.* The *Act* prohibits the destruction of fish; harmful alteration, disruption, or destruction of fish habitat; and deposition of deleterious substances into water frequented by fish, or into places that may result in the deposition of deleterious substances into other water frequented by fish (sections 32, 35, and 36 of the *Act*, respectively). The *Fisheries Act* is a wide body of legislation that can, in principle, account for landscape-level disturbance resulting from cumulative stressors distributed across the watershed. That is, the protection of fishes and their habitat (e.g., stream morphology and hydrology) necessitates an understanding of processes occurring across a watershed.

It is important to recognize that only DFO can determine whether the *Fisheries Act* has been, or could be, contravened. It is the responsibility of Enbridge to provide sufficient data and information with respect to the watercourse such that DFO can issue a Letter of Advice stating whether violation of the *Fisheries Act* is likely to occur given works proposed. If violation is likely, then Enbridge must obtain Ministerial approval to proceed with the works and remain in compliance with the *Act*. Part of this approval process requires that any harmful alteration, disruption, or destruction (HADD) of fish habitat be mitigated through enhancement and improvement of that already existing to satisfy the “No Net Loss” guiding principle (DFO 1998). In addition, compensation to meet HADD Authorization is necessary to permit construction to proceed in such instances. HADD compensation requires long-term monitoring (up to 10 years) to ensure measures installed are functional.

DFO has simplified its review and approval process as part of its Environmental Process Modernization Plan (DFO 2006). This initiative enables routine reviews of lower risk projects to be replaced by clear guidelines in the form of Operational Statements. The Operational Statements provide guidelines on how to protect fish and fish habitat and comply with the *Fisheries Act* through "bottom line" advice for different types of low risk activities. They also describe the conditions to reduce disturbance to aquatic resources that may result from instream activity associated with linear development, including preferred construction methods and timing windows. Timing windows are when no in-water work is to occur and intended to protect sensitive life-history stages of fishes (e.g., spawning, egg incubation, fry emergence).

Manitoba fisheries are also protected provincially through the Water Stewardship Fisheries Branch of Manitoba Conservation. While the Government of Canada retains ultimate legal authority and responsibility for fishes and their habitat through the *Fisheries Act*, day-to-day management and administration of federal fisheries regulations has effectively been delegated to this provincial office (Manitoba Conservation 2006). With respect to pipeline and vehicle watercourse crossing construction, local regulators endorse the use of guidelines provided by the Canadian Association of Petroleum Producers (CAPP) - “Pipeline Associated Watercourse Crossings” (2005) outlining “best practices” for construction techniques and available environmental protection methods. These recommended measures meet Provincial regulatory requirements to minimize associated fisheries habitat impact. “Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat” (Manitoba Natural Resources 1996) is another often referenced guideline that provides practical advice and information on mitigation and measures to protect fishes and their habitat, with a greater focus on bridges than pipelines. Applications for construction are reviewed by the Environmental Approvals and the Water Stewardship divisions of Manitoba Conservation. Environmental Approvals will authorize an Environmental Act License, outlining specific conditions of the approval for construction to proceed. Work on Crown Land will also require a conditional permit from the district Manitoba Conservation office, and water withdraws associated with construction will require a water license from the Water Stewardship division.

Finally, the Federal government, through Transport Canada and the *Navigable Waters Protection Act* (NWPA), provides for uninterrupted navigation of Canada’s waterways. The *Navigable Waters Protection Act* ensures the protection of navigable waters in Canada by forbidding building or replacement works on, over, under, through or across any navigable waters, unless those works and the site and plans thereof have been approved prior to commencement of construction. All proposed pipelines regulated by the National Energy Board (NEB) crossing navigable waters are subject to review and approval by the Navigable Waters Protection program under section 108 of the NEBA (administered by Transport Canada – NWP) (Drummond 2004). In addition, temporary bridges are also subject to review and approval under the NWPA. Only Transport Canada has the authority to declare a watercourse as “navigable” and it is Enbridge’s’ responsibility to seek Ministerial approval before crossing construction if navigation of the watercourses crossed is thought to be possible (Transport Canada 2005).

To meet provincial and federal regulatory requirements, TERA Environmental Consultants (TERA) retained Applied Aquatic Research Ltd. (AAR), on behalf of Enbridge, to complete detailed fish and aquatic habitat inventories at watercourse crossings proposed. Information about fish species composition, relative abundance and distribution, the nature and extent of riverine habitat, and its potential to support individual species and life-history stages at each watercourse crossing will be used to comply with regulatory requirements for habitat protection.

Specifically, information was gathered so that:

- appropriate crossing construction methods and timing windows can be developed to protect aquatic habitat;
- a Letter of Advice can be issued by DFO stating whether works proposed are likely to contravene the *Fisheries Act*; and
- Transport Canada can assess the navigability for the watercourses investigated.

Data collected help determine the nature, extent, and relative importance of aquatic habitat for fishes at each crossing at the time of construction and whether methods proposed for crossing construction

comply with DFO Operational Statements. In turn, best construction and mitigation practices can then be developed by a fish biologist for application by the proponent. As per the Manitoba Operational Statement for Timing Windows (DFO 2006), all watercourses along the route fall within the Southern Manitoba Management Area with timing windows based on species' spawning seasons, as summarized in Tables 1 and 2.

TABLE 1
Timing Windows when no instream work is to occur

Region	Spring Spawning Fish	Summer Spawning Fish	Fall Spawning Fish
Southern Manitoba	April 1 – June 15	May 1 – June 30	September 15 – April 30

TABLE 2
Common spring- summer- and fall- spawning fishes of Manitoba

Spring-Spawning Fish	Summer-Spawning Fish	Fall-Spawning Fish
Northern pike	Channel catfish	Brook trout
Walleye	Lake sturgeon	Lake trout
Sauger	Goldeye	Arctic char
Yellow perch	Mooneye	Lake whitefish
Suckers (various species)	White bass	
Smallmouth bass	Freshwater drum	
Arctic grayling	Carmine shiner	

1.2 Study Area

The LSr pipeline proposed will traverse the Aspen Parkland eco-region of Manitoba (Environment Canada 2006a). Most of this eco-region is now farmland containing a fragmented mosaic of trembling aspen, oak groves, mixed tall shrubs, and intermittent fescue grasslands. The climate is marked by short, warm summers and long, cold winters with continuous snow cover. The mean summer temperature is 15ºC and mean winter temperature is -12.5 ºC. Annual precipitation averages about 400-500 mm.

1.3 Known Distribution of Fishes and Their Habitat

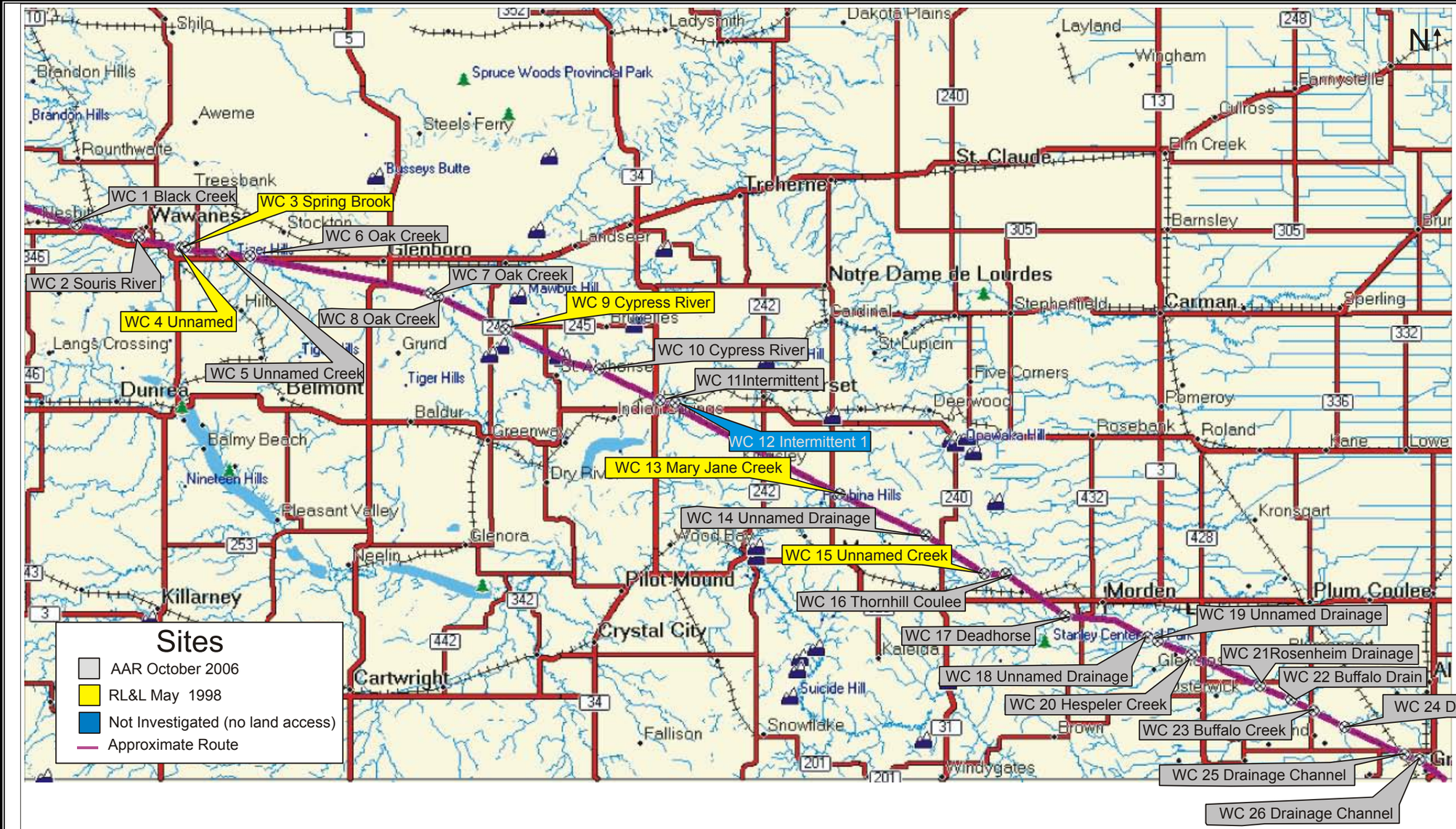
Manitoba has 95 species of freshwater fishes, 30 of which are considered sports fish. Watercourses investigated for the LSr pipeline are part the Assiniboine River and Red River watersheds in southern Manitoba, where channels typically have shallow gradients, low to moderate water velocities and meandering courses. The Assiniboine River and Red River watersheds support 65 and 70 species, respectively, including lake sturgeon (*Acipenser fulvescens*), goldeye (*Hiodon alosoides*), mooneye (*H. tergisus*), black bullhead (*Ameiurus melas*), brown bullhead (*A. nebulosus*), channel catfish (*Ictalurus punctatus*), stonecat (*Noturus flavus*), northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), burbot (*Lota lota*), white bass (*Morone chrysops*) - introduced into the Red River only, rock bass (*Ambloplites rupestris*), smallmouth and largemouth bass recently introduced into the Red River (*Micropterus dolomieu* and *M. salmoides,* respectively), black and white crappie in the Red River only (*Pomoxis nigromaculatus* and *P. annularis,* respectively), yellow perch (*Perca flavescens*), sauger (*Sander canadensis*), and walleye (*Sander vitreus*) (Stewart and Watkinson 2004). This list represents sports fish that may be present in the vicinity of the crossing locations proposed.

Within the Assiniboine River and Red River watersheds, there are five species with special conservation status as a result of low population numbers. Lake sturgeon is rare in the Red River watershed and extirpated from the Assiniboine River watershed (Stewart and Watkinson 2004). COSEWIC lists it as endangered and it is ranked provincially as S2S3. Silver chub (*Macrhybopsis storeriana*) is a species of special concern as per SARA and COSEWIC, and is listed provincially as S3. Bigmouth shiner (*Notropis dorsalis*) is listed S3 provincially, and chestnut lamprey (*Ichthyomyzon castaneus*) is designated by COSEWIC to be "at risk" and listed S3S4 provincially. Pumpkinseed (*Lepomis gibbosus*) is found in the Red River watershed and is considered rare in Manitoba as this is the northern extent of their range. Even though it has a suggested classification provincially as S 1 (Conservation Data Centre 2001), Manitoba Conservation does not manage for pumpkinseed (L. Janusz, Fisheries Branch, Manitoba Conservation pers. comm.). In addition, it has not been assessed as a species at risk by COSEWIC and is not a listed species under SARA (F. Hyntka, SARA Project, DFO pers. comm.).

1.4 Study Objectives

The specific objectives of this study were to:

- Determine whether crossings proposed are on waterbodies as defined by DFO;
- Determine fish presence in the vicinity of each watercourse crossing;
- Describe aquatic habitat at, and next to, each crossing in terms of type, quantity, area, quality, and potential to support individual species and life-history stages;
- Identify appropriate pipeline and vehicle crossing methods and timing windows for the watercourses;
- Assess the potential for the harmful alteration, destruction, or disruption (HADD) of fish habitat given resident populations, habitat available, construction timing, and crossing methods proposed; and
- Identify restoration and mitigation measures to reduce adverse effects of instream activity on aquatic resources.



APPLIED AQUATIC RESEARCH Ltd.	ENBRIDGE	**Enbridge Pipelines Inc.**
		Figure 1 Watercourse crossings proposed (Source: DMTI Spatial 2004)
		AAR06-109 | February 2007

2.0 APPROACH

2.1 Literature Review

A review of the literature and interviews with regional fish biologists (Manitoba Conservation) were undertaken to determine the extent of knowledge about fishes and their habitat within the zone of influence. This zone represents the area of the water body where 90% of the sediment discharged as a result of the works will be deposited. Since the pipeline proposed will loop an existing ROW, inventories about fishes and their habitat already undertaken describing select crossings were also reviewed. These data are described and previous sampling locations are mapped in this report.

2.2 Riverine Habitat Inventory

From October 12-17, 2006, a biologist and field assistant investigated riverine habitat in watercourses to be crossed by the LSr pipeline. The section of channel sampled encompassed that which may be affected by construction, also known as the zone of influence. The extent of this zone depends on various parameters that include channel gradient, width, depth, morphology (shape and roughness), water velocity, discharge, and instream vegetation. Professional judgment, based on experience and an understanding of these factors, is used to determine the extent of the zone of influence downstream from the crossings. In general, 300 m downstream and 100 m upstream from each crossing proposed were visited for channels approximately 5 m wide. Typically, distances sampled were adjusted with corresponding increases/decreases in channel width, as needed.

Physical parameters including channel bankfull and wetted widths, bank height and water depth were quantified across transects spaced throughout the zone of influence. Channel width, bank height, and water depth were measured to the nearest 0.01 m. Water velocity was measured with a Swoffer™ digital current meter and wading rod at vertical stations across a single transect to calculate discharge. Discharge was calculated using a mid-section method (Orth 1983). Water temperature, pH, conductivity, and dissolved oxygen concentration (DO) were measured at the crossing locations proposed with a Multiline P4™ multi-meter. Bank stability and shape were described qualitatively, and dominant and sub-dominant substrate and embeddedness were assessed.

Watercourse and riparian vegetation characteristics that affect fish habitat potential were described. These included substrate composition, instream and overhead cover, riparian vegetation composition, and canopy closure. A modified Wentworth particle scale was used to assign substrate type to diameter of particle present (Orth 1983). The presence of limiting factors or unique features such as beaver dams and ground water intrusion were mapped, photographed, and described. Fish habitat was rated as high, moderate, or low according to its potential to support spawning, rearing, wintering, and migration of fish species present or documented previously. Additionally, photographic records of sites were compiled.

2.3 Fish Population Inventory

Fish communities were sampled using backpack electrofishing (BPEF) (Smith-Root, Type LR-24, pulsed DC) and baited “Gee-type” minnow traps (MNTR). Sampling effort was apportioned evenly across each habitat type throughout the zone of influence of each crossing. At the Souris River location (WC 2), a float electrofisher (FLEF) (Smith-Root, GPP 2.5, pulsed DC) mounted in a 3.5 m inflatable boat powered by a 15 Hp outboard engine was used to sample for fish given the depth and breadth of the channel.

Fish immobilized by the electrofisher were retrieved with a dip net and placed in a live-well at bankside to recover. All fish captured were identified to species, measured to the nearest millimeter and had their sex and life-history stage determined (if discernable externally). Sport fish captured were weighed to the nearest gram. After sampling, all fish were returned unharmed to the watercourses from where they were captured. Catch-per-unit-effort (CPUE) was described as the number of fish caught per 100 seconds electrofished, or as the number of fishes caught per trap-hour set. Scientific nomenclature of fishes follows Nelson et al. (2004) and abbreviations (from Mackay *et al*. 1990) have been used to code fish species (Table 3).

3.0 RESULTS AND DISCUSSION

Findings from field investigations of crossing locations proposed are summarized on atlas pages and grouped into three appendices to facilitate interpretation and presentation of recommendations. Appendix A describes crossings that have channel widths of > 5 m, and Appendix B describes those that have channel widths of < 5 m. Atlas pages contain water quality data, channel characteristics, fish captured, habitat potential, photographs and recommendations for crossing methods and restoration. Watercourses with channel widths > 5 m, appreciable fish habitat potential and/or special concerns for construction are discussed in further detail in Section 3.2.

Supplementing AAR's 2006 fieldwork is a fish and aquatic habitat study completed previously by RL&L Environmental Services Ltd. – "Fisheries Assessment for the IPL Terrace Phase I Expansion Program" (1998). Six of the watercourse crossings proposed for the LSr pipeline are described in detail by this study and are also referenced in the atlas pages. These watercourses include - Spring Brook (2 crossings), Cypress River (I of 2 crossings), Mary Jane Creek, Thornhill Coulee and one unnamed creek.

A number of the drainages investigated had undefined channels and little potential to support fishes. Consequently, no attempt was made to sample for fish, water quality or habitat parameters. A photographic record of non-fish bearing drainages is compiled in Appendix C.

Sport and forage fish species that were observed during investigations are outlined in Table 3. A detailed fish record for each crossing investigated providing life history stage and fork length is in Appendix D. Finally, a list of undefined drainages and swales that were not investigated during the course of this study is included in Appendix E.

TABLE 3
Fishes Captured from Watercourses Sampled

Code	Species	Scientific Name	Code	Species	Scientific Name
BLBL	Black bullhead	*Ameiurus melas*	LKCH	Lake chub	*Couesius plumbeus*
BLDC	Western blacknose dace	*Rhinichthys obtusus*	LNDC	Longnose dace	*Rhinichthys cataractae*
BLDR	Blacksided darter	*Percina maculate*	CNMD	Central mudminnow	*Umbra limi*
BRST	Brook stickleback	*Culaea inconstans*	NRPK	Northern pike	*Esox lucius*
CMSH	Common shiner	*Luxilus cornutus*	PRDC	Pearl dace	*Margariscus margarita*
CRCH	Creek chub	*Semotilus atromaculatus*	PUMP	Pumpkinseed	*Lepomis gibbosus*
EMSH	Emerald shiner	*Notropis atherinoides*	SNSH	Sand shiner	*Notropis stramineus*
FTMN	Fathead minnow	*Pimephales promelas*	SHRD	Shorthead redhorse Sucker	*Moxostoma macrolepidotum*
FNDC	Finescale dace	*Phoxinus neogaeus*	TRPR	Trout-perch	*Percopsis omiscomaycus*
JHDR	Johnny darter	*Etheostoma nigrum*	WALL	Walleye	*Sander vitreus*
IWDR	Iowa darter	*Etheostoma exile*	WHSC	White sucker	*Catostomus commersonii*

3.1 General Pipeline and Vehicle Crossing Recommendations

Recommendations for crossing construction are made in accordance with DFO Manitoba Operational Statements and CAPP Pipeline Associated Watercourse Crossings, Edition 3 (CAPP 2005). Regardless of fish presence or absence, construction and restoration measures proposed are based on the potential of riverine habitat to support different life-history stages of representative fish species that could reside in the watercourse. Construction timing was not defined at the time of the writing of this atlas. Therefore, crossing recommendations are considered for each season and are the minimum required for the protection of fish habitat and compliance with regulations. Generally, northern pike, walleye and white sucker were chosen as indicator species for habitat protection and construction method considerations given their prevalence in the watersheds sampled. Upon completion of the works, the quantity and productive capacity of the aquatic environment (including fish habitat) through and downstream from the watercourse crossing site must be equivalent to or exceed that which existed before the works instream.

Based on fish population and riverine habitat inventories completed, watercourses documented in this report may be crossed using a trenchless method during the restricted activity window (RAP), and isolated or open-cut trenched technique outside of the RAP depending on the presence of water. Details of crossing recommendations for all watercourses are summarized in Table 4 and Appendices A and B, as are fish presence, crossing channel morphology, and flow data to support the recommendations.

For watercourses where isolated trenched crossings are proposed, the following is recommended:

- Isolation with dams to prevent sediment-laden water from compromising riverine habitat and water quality downstream;
- Salvage of any fish trapped between the isolation dams is required before de-watering and digging of the trench;
- Upper substrate from the channel be salvaged and stock-piled separately to cap the trench once it is back-filled; alternatively, material of the same quality may be used; and
- Upon completion of construction, the channel should be reconstructed and stabilized with salvaged substrate. The trench must be capped with 0.5 m of clean granular material where granular material is encountered during excavation.

Open-cut crossings where channels are dry or frozen to bottom require that:

- The trench be backfilled with native material or imported granular material as soon as possible after lowering in, and
- The streambed be returned to appropriate pre-construction profile to ensure that flow patterns are unaltered.

Water quality monitoring is recommended when a crossing is constructed during the RAP on watercourses and/or where there is appreciable fish habitat potential. Monitoring aims to ensure that sediment concentration, measured as total suspended solids (TSS) does not exceed 25 mg/L above background over a 24-hour period as recommended by CCME (2001) guidelines. These guidelines are in place to protect all aquatic life in Canadian waters from the adverse effects of suspended sediment. In addition, the monitoring program will allow for the magnitude and duration of any sediment disturbance during construction to be quantified. Outside of the RAP, this monitoring is generally not necessary.

General recommendations for bank restoration are:

- Banks must be restored to their original contour and height;
- Restoration prescriptions must be tied into that which is adjacent on either bank;
- Banks should be recontoured with salvaged duff if it can be removed intact. When salvaged duff is placed in position it should be protected with coconut matting or equivalent, if necessary to stabilize. Reseeding of riparian areas with native grasses is recommended.
- In instances where banks are high, it may be necessary to use soil wraps as a method to restore them,
- Where shrubbery is present on the banks, it may be restored with transplanted or staked willows; and
- Where bio-engineered restorative prescriptions have been installed to stabilize bank and reclaim benches, a post-construction audit of each crossing will be required to determine the relative success of the works installed to ensure prescriptions built are functioning properly and meet DFO criteria for successful vegetative regeneration along the channel (85% of stems planted are alive).

Temporary access for vehicles and equipment may be by several methods (Table 4). Existing roads near some watercourse may provide the most convenient access, but single-span bridges may also be installed. Where channels are dry or if ice is thick enough to support traffic, ice or snow-fill bridges or fords with swamp mats may be used. All fill material is to be removed before spring. For watercourses with low fish habitat potential or undefined channels, a culvert may be installed following specific authorization from DFO.

Drainages presented in Appendix C are not defined as watercourses because of the absence of defined bed and banks, and therefore, may be constructed using simple open-cut techniques and any type of vehicle crossing.

3.2 Recommendations for Watercourses with Potential Fish Habitat Concerns

WC 2 Souris River (KP 1073.4, 10-22-7-17 WPM, see page A-2)

The Souris River originates in north-central North Dakota, USA and flows north into Manitoba, Canada where it drains into the Assiniboine River just southeast from the City of Brandon, Manitoba. The crossing proposed is located 13 km upstream from the confluence with the Assiniboine River. The Souris River is known for its recreational fishing potential. Walleye, northern pike, rock bass, white sucker, and shorthead redhorse sucker occur in the Souris River, as well as numerous minnow species (B. Bruederlin, Fisheries Branch, Manitoba Conservation pers. comm.). Additionally, there are known occurrences of chestnut lamprey upstream and downstream from the Wawanesa dam 4 km downstream from the crossing proposed (L. Janusz, Fisheries Branch, Manitoba Conservation pers. comm.). Spring sampling resulted in capture of six white sucker and six shorthead redhorse sucker near the crossing proposed (RL&L 1998).

Channel Characteristics

On October 17, 2006, the Souris River was surveyed from 200 m upstream to 400 m downstream from the ROW proposed. The river flows in an irregularly meandering, occasionally confined channel with average channel and wetted widths of 44.2 m and 30.9 m, respectively. Banks are vegetated predominantly with grasses and deciduous cover, 0.5 m high on average, and only moderately stable.

Areas of instability caused by cattle pugging, sloughing, and undercutting are present and comprise 64% of the distance sampled. Water levels were low at the time of investigation, resulting in average depths of 0.4 m (range 0.08 – 0.9 m). Run and riffle units dominated habitat within the area surveyed (82% and 18%, respectively), and bed material consisted predominantly of fines (65%), and smaller proportions of small (25%) and large gravel (8%), cobble (1%) and boulder (1%). Substrate was moderately embedded throughout the channel sampled. Water temperature was cool (3.2 °C), pH near neutral (7.2), DO concentration near saturation (11.7 mg/L), and conductivity high (1438 µS/cm) on the date sampled.

Discharge	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean Monthly	0.922	0.855	4.09	39.2	38.5	24.2	13.4	6.58	3.30	2.99	2.74	1.40
Max. Monthly	9.01	7.47	25.2	488	286	195	141	76.4	27.3	26.8	24.9	12.2
Min. Monthly	0.00	0.00	0.00	0.714	0.274	0.058	0.016	0.00	0.00	0.00	0.00	0.00

Years of Streamflow Record: 1912 to 2005
Maximum Daily Discharge: 742 m^3/s (April 11, 1976) (extreme recorded for the period of record)
Minimum Daily Discharge: 0.00 m^3/s (multiple dates)
Drainage Area: 61,100 km^2

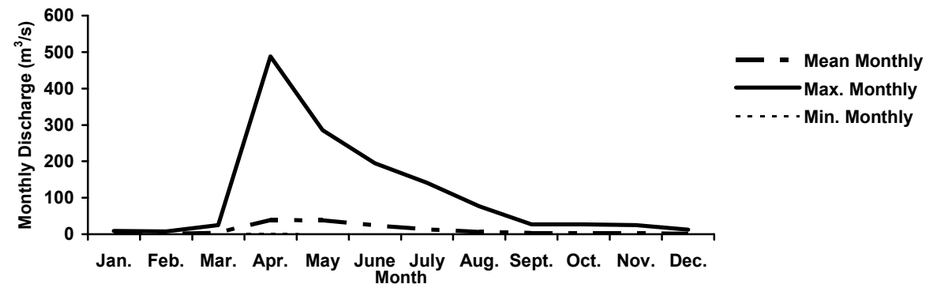


Figure 2 Historical Mean Monthly Streamflow (m3/s) Summary for the Souris River Near Wawanesa, Manitoba (NW 26-7-17 WPM) (Environment Canada 2006b).

Figure 2 indicates historical streamflows with the highest mean discharge in April of 39.2 m^3/s (Environment Canada 2006b). A spring survey of the same stretch of the Souris River conducted by RL&L in May 1998 found warm water temperature (14.5 °C), pH of 8.6, and conductivity of 720 µS/cm. At that time, the river contained moderate amounts of suspended sediment resulting in a Secchi depth of 0.38 m (visibility was low to moderate).

On October 17, 2006, flow at the crossing proposed was divided evenly by a gravel bar midstream. Wetted widths were 13.0 m (northwest) and 28.0 m (southeast), respectively for each channel. Average water depth was 0.35 m, with a discharge of 0.988 m^3/s. Channel width at the crossing proposed was 45.5 m and substrate was dominated by fines, with some moderately embedded small gravel in the right channel (20%). Banks at the crossing proposed were sloping to vertical, and only moderately stable because of cattle activity. Average bank height was 0.4 m.

Fish Populations

Fish populations of the Souris River were sampled on October 18, 2006 over a distance of 400 m with a float electrofisher (90 volts, 30 Hz). A total of 58 fish were captured, including a single adult northern pike, 10 juvenile walleye, and numerous forage and coarse fishes (blacknose and longnose dace, black-sided darter, sand shiner, shorthead redhorse sucker, and trout-perch) (Appendix D). Total CPUE was 3.7 fish per 100 seconds electrofished (includes those individuals sampled and observed). RL&L (1998) reported a lower spring CPUE of 0.28 fish per 100 seconds.

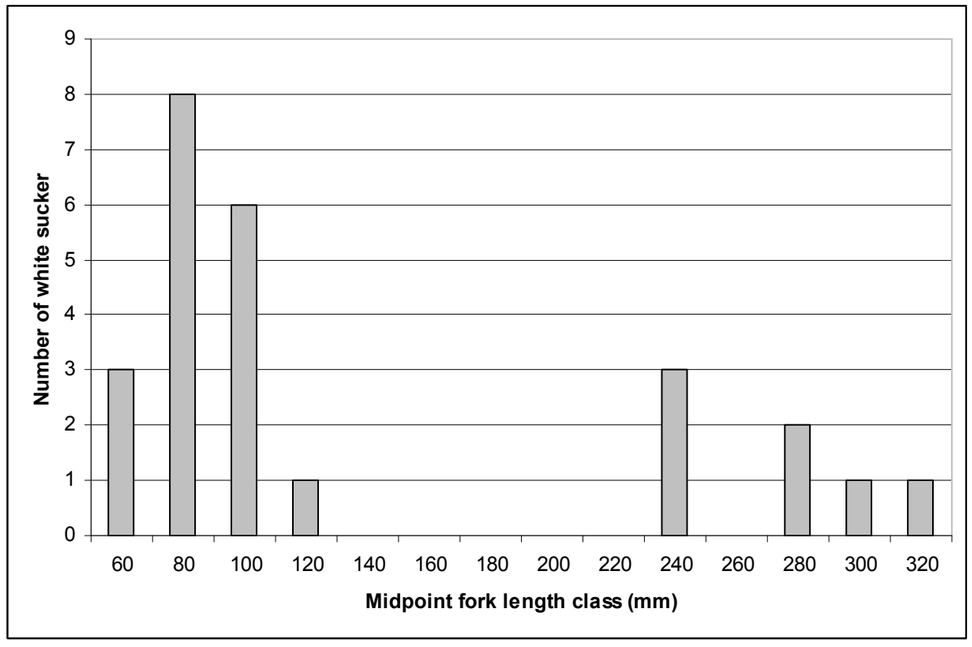


Figure 3 Fork length frequency histogram for white sucker in the Souris River

Fish Habitat Potential

The Souris River in the vicinity of the crossing proposed has low potential for spawning and rearing by northern pike given little instream vegetation. Spawning potential is low to moderate for walleye and white sucker since suitable gravel or cobble substrate is limited through the crossing proposed. Rearing habitat is good for walleye and white sucker. Different age classes of white sucker, as evidenced by fork length distribution (Figure 3), were present which indicates that fish are over-wintering in the Souris River. Wintering potential is moderate and limited by shallow depth of water (0.08 – 0.85 m) in early winter which may freeze to bottom by late winter. The reservoir/dam 4 km downstream near the village of Wawanesa, has a weir that impedes fish movement (RL&L 1998). Migration potential is, therefore, rated as low.

Although chestnut lamprey is known to occur in the Souris River, none were observed during AAR investigations in October 2006 or during RL&L investigations in May 1998. Given its “at risk” COSEWIC status, the habitat potential for chestnut lamprey in the vicinity of the crossing needs to be considered. Adult chestnut lamprey appear to inhabit the main course of moderate-sized rivers and are not found in smaller tributaries. Spawning occurs in rivers from early to mid-June but possibly as late as early July. The peak of activity is mid-June (Scott and Crossman 1973). A school of spawning lamprey will build a communal nest in gravel substrate (Stewart and Watkinson 2004), and adults die soon after egg laying is completed. Two weeks after spawning, lamprey eggs hatch into small larvae known as ammocoetes. Ammocoetes burrow into habitats with swift current and stable sand / silt substrates, or quiet backwater areas with a softer bottom and dense vegetation, presumably near the site where they were hatched. Filter-feeding larvae live for five to seven years, with metamorphosis beginning in August or September of their final ammocoete year, and completing in January (Scott and Crossman 1973). Adults live a parasitic life; however, little is known about preferred substrates, water depths, or velocities for non-spawning adults. Presumably, the presence of suitable host species is the most important factor in determining habitat suitability (Stewart and Watkinson 2004). Fishes reported to be attacked by this species include brook trout, brown trout, rainbow trout, northern pike, chain pickerel, carp, creek chub, white sucker, smallmouth buffalo, channel catfsh, burbot, green sunfish, largemouth bass and smallmouth bass (Scott and Crossman 1973). Suitable habitats for spawning and rearing of larvae, and species’ hosts for adults may be present in the vicinity of the crossing proposed.

Crossing Recommendations

Unless otherwise approved by provincial and federal authorities, a trenchless crossing is recommended for the Souris River year-round in order to protect potential chestnut lamprey spawning habitat and ammocoete rearing habitat in the vicinity of the crossing proposed. Should a trenchless crossing be geotechnically unfeasible, an isolated crossing would be recommended as a contingency, constructed outside of a RAP from April 1 to July 31 to account for spring spawning of northern pike and walleye, and chestnut lamprey spawning and hatching of eggs. If the gravel bar mid-stream is elevated sufficiently above the channel, a diversion method to isolate crossing activities may be considered. This would require that streamflow be diverted to one side of the gravel bar while the isolated crossing occurs on the opposite side.

To ensure aquatic resources are protected, it is recommended that water quality (turbidity and concentration of total suspended solids) be monitored throughout the zone of influence during construction of either a trenchless or trenched crossing. Should an isolated contingency crossing occur, fish must be salvaged from the ROW once the workspace is isolated.

Access for vehicles and equipment across the Souris River can be facilitated by existing roads and bridges, or a temporary single span bridge. An ice bridge could be constructed if ice of sufficient thickness exists.

Restoration

Upon completion of a trenched crossing, the streambed and banks must be recontoured to their natural state and left in a condition that will prevent scouring of the bed and banks and erosion of the stream channel. The channel is wide at the crossing proposed with a mid-channel gravel bar. This exposed substrate should be restored with stockpiled material. Restoration of the banks may require soil wraps to restore bank height and further stabilization with coconut mats and willow staking (Drawings 1 and 2). Reseeding with native grasses and fencing out cattle may be required to initiate riparian revegetation and channel restoration.

<u>Oak Creek</u>

Oak Creek is crossed three times by the alignment proposed, and each is described in separate detail below. Oak Creek originates near Pelican Lake in southern Manitoba, flowing through Glenboro Marsh before joining the Souris River downstream of the village of Wawanesa (RL&L 1998). The lower reaches of Oak Creek could be used by spring spawners from the Souris River, while the upper reach east from Glenboro Marsh supports forage fish like fathead minnow and creek chub (B. Bruederlin, Fisheries Branch, Manitoba Conservation pers. comm.).

WC6 Oak Creek (KP 1087.0, 1-13-7-16 WPM, see page A-3)

Channel Characteristics

WC6 is the most westerly crossing of Oak Creek and located 10 km from the Souris River. Investigations over a distance of 500 m of Oak Creek on October 12, 2006 found a defined occasionally confined watercourse that meanders irregularly with a gradient of 1%. Average channel and wetted widths were 11.0 m and 6.3 m, respectively. Banks were on average 1.6 m high, sloping to vertical and moderately stable except where cattle had affected stability negatively at the crossing proposed and 100 m downstream. Grasses and deciduous trees covered riparian habitats; however, bank vegetation only provided minor canopy closure in some areas (5% or less). Stream habitat was comprised of a repeated run-riffle sequence over the length walked, with no discernible discharge. Cover for fishes was dominated by instream vegetation and depth. Substrate was 93% fines and 7% gravel. Water temperature was cool (4.3 ^{o}C), conductivity high (968 µS/cm), pH near neutral (7.8), and dissolved oxygen near saturation (10 mg.L).

Channel width at the crossing proposed was 12.4 m, with gentle sloping banks 2.3 m (left bank) and 2.1 m (right bank) high. Bank instability was evident for 10-12 m on both sides as a result of cattle activity. Wetted width was 5.6 m, with an average channel depth of 0.1 m. Substrate composition was entirely fines.

Fish Populations

Fish populations were sampled on October 12, 2006 using a backpack electrofisher (100 V., 30 Hz) for a distance of 400 m. In total, 1 juvenile northern pike, 6 adult and 14 juvenile white sucker, 3 black dace, 7 emerald shiner, 8 johnny darter, and 20 pearl dace were captured (Appendix D). CPUE by electrofishing was 5.41 fish per 100 seconds. Additionally, abundant pearl dace (approximately 500), 40 juvenile white sucker, and a northern leopard frog (*Rana pipiens*) were also observed.

Fish Habitat Potential

Spawning and rearing potential for northern pike was high given the presence of instream vegetation and abundant forage. Flood sign was evidence of high spring flow given grasses trapped on the top wire of a streamside fence. This sign indicates that riparian grasses would provide additional spring spawning substrate for northern pike. Spawning potential for white sucker was low given only minor presence of highly embedded gravels; rearing is high given suitable habitat. Walleye spawning potential is also low given minimal gravels and no cobble. Given the proximity to the Souris River and adequate cover, Oak Creek could be used by walleye for rearing. Even though early winter depths are shallow (0.05 m – 0.4 m), the presence of multiple age classes of white sucker (Figure 4) indicates that wintering does occur on Oak Creek. Wintering potential for all is moderate and limited by negligible streamflow and shallow depths. This segment of Oak Creek may freeze to bottom by late winter. Migration potential is high for all species given the absence of barriers encountered.

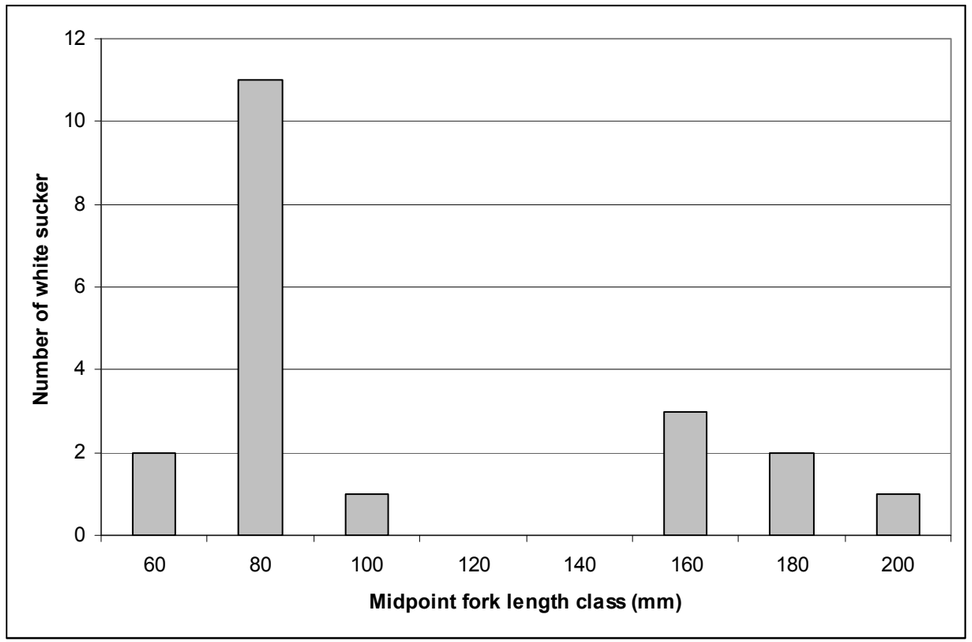


Figure 4 Fork length frequency histogram for white sucker in Oak Creek (WC6)

Crossing Recommendations

Stream discharge information in proximity to this crossing of Oak Creek (WC6) was not available; however, mean discharge would be at its peek in April, as evidenced by historical streamflows of Oak Creek near Glenboro (see Figure 5 at WC7 Oak Creek) (Environment Canada, 2006b). The observed presence of spring spawners (i.e. northern pike, white sucker) confirms a timing window restricting instream activity from April 1 to June 15. A trenchless crossing would be required to protect spring spawning / migration activity and incubating eggs if pipeline construction occurs at this time. Since discharge is typically < 1 m^3/s by June, summer construction (outside the RAP) may be completed with an isolated crossing. If the watercourse is frozen to bottom or dry during winter construction, an open cut crossing is recommended.

To ensure water quality for aquatic resources is maintained, it is recommended that turbidity and concentration of TSS be monitored throughout the zone of influence during construction of a trenched crossing, if water is present and construction timing occurs outside of the RAP.

Access for vehicles and equipment across Oak Creek (WC6) can be facilitated by use of a temporary single -span bridge or existing bridges, if water is present. An ice bridge can be constructed if ice of sufficient thickness exists, or a ford with swamp mats if the streambed is dry.

Restoration

Restoration of the banks requires rebuilding both to their pre-construction profile using layered soil wraps and coconut matting. Willow stakes should be planted to anchor coconut matting (Drawings 1 and 2). The area should be reseeded with native grasses and fenced off from cattle use until grass is well established.

WC7 Oak Creek (KP 1109.3, 7-31-6-13 WPM, see page A-4)
The 7-31 crossing proposed of Oak Creek is located 22 km east from WC6. It is near the entrance of Glenboro Marsh, near Glenboro, Manitoba.

Channel Characteristics
On October 13, 2006, 500 m of Oak Creek was investigated. This section flows in an unconfined, irregular manner through a hayfield. The well-defined channel has an average width of 12.8 m and bank height of 0.5 m. Banks were sloping, highly stable and well-vegetated with grasses. The average wetted width was 6.8 m. Water depth ranged from 0 m to 0.4 m (average 0.2 m), and had no discernible flow. The downstream end of the watercourse surveyed was dry. Substrate was entirely fines for the length investigated. The surface of the stream was frozen, where present water temperature was 0.2 ^{o}C, basic pH (9.3), DO near saturation (10.9 mg/L), and high conductivity (1306 µS/cm).

RL&L (1998) at this location in May found warm water temperature (17.5 ^{o}C), pH lower (8.9), conductivity 810 µS/cm, and discharge 0.63 m^3/s. Figure 3 shows mean discharge to be the highest in April at a volume of 1.07 m^3/s (Environment Canada 2006b).

At the ROW proposed, channel and wetted widths were 12.0 m and 7.0 m, respectively. The average water depth was 0.3 m, with substrate composed entirely of fines. Sloping banks were highly stable with both left and right banks 0.6 m high.

Discharge	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean Monthly	-	-	0.475	1.07	0.285	0.182	0.189	0.113	0.018	0.012	-	-
Max. Monthly	-	-	1.38	2.76	1.73	0.459	0.645	0.544	0.136	0.061	-	-
Min. Monthly	-	-	0.000	0.023	0.018	0.001	0.000	0.000	0.000	0.000	-	-

Years of Streamflow Record: 1986 to 1994 (during nonfrozen conditions only)
Maximum Daily Discharge: 8.28m^3/s (March 30, 1992) (extreme recorded for the period of record)
Minimum Daily Discharge: 0.00 m^3/s (multiple dates each year of record)
Drainage Area: 493 km^2

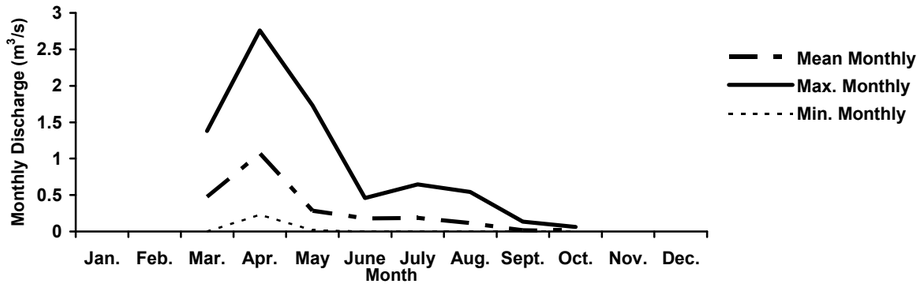


Figure 5 Historical Mean Monthly Streamflow (m3/s) Summary for Oak Creek Near Glenboro, Manitoba (SW 21-6-13 WPM) (Environment Canada 2006b).

Fish Populations
This portion of Oak Creek (WC7) was not electrofished as the stream surface was frozen. Given the maximum depth of 0.3 m, the watercourse is expected to freeze to bottom. A spring survey in 1998 captured 25 white sucker, with an overall CPUE of 0.87 fish/100 seconds. The mean fork length of the white sucker captured was 361 mm, ranging in length from 268 mm to 445 mm (RL&L 1998), indicating multiple age classes. Freshwater mussel shells were observed on exposed stream substrates.

Fish Habitat Potential
The presence of multiple age classes of WHSC implies that Oak Creek can winter fish (RL&L 1998); however, given the lack of depth through the section investigated, it is unlikely that fish can remain here year round. Consequently, wintering potential for all fish is low in this section. Northern pike spawning potential is high given the abundance of flooded, emergent vegetation (riparian grasses and cat tails) present during high spring flows. Spawning potential is low for walleye and white sucker, since suitable substrate is not present (entirely fines). Rearing potential is affected by seasonal flow; good in the spring and low as flow declines. No barriers to migration were evident.

Crossing Recommendations
Even though northern pike was not observed in this section of Oak Creek (WC7), they are known to reside in this watercourse (as observed at the 1-13-7-16 WPM location of Oak Creek (WC6) 22 km downstream). Therefore, a timing window restricting instream activity to protect spring spawners exists from April 1 to June 15, requiring a trenchless crossing if pipeline construction occurs at this time. As discharge is typically < 1 m^3/s by June, summer construction may be done with an isolated crossing. If the watercourse is frozen to bottom or dry during winter construction, an open cut crossing is recommended.

To ensure water quality for aquatic resources is maintained, it is recommended that turbidity and concentration of TSS be monitored throughout the zone of influence during construction of a trenched crossing, if water is present and construction timing occurs outside of the RAP.

Access for vehicles and equipment across Oak Creek (WC7) can be facilitated with a temporary single-span bridge, if water is present. An ice bridge can be constructed if sufficient ice exists or a ford with swamp mats if the streambed is dry.

Restoration
It is recommended that native substrate be replaced and banks be recontoured to their original shape. Healthy cattails rhizomes should be transplanted from undisturbed ROW areas to reclaimed banks. Cattail rhizomes can simply be dug, spread onto the substrate and watered. When proper conditions exist, they will take root and grow. They are best transplanted in the winter before new growth starts (Simeral 2006).

WC8 Oak Creek (KP 1110.3, 4-32-6-13 WPM, see page A-5)

Channel Characteristics
WC8 of Oak Creek is the most easterly crossing, located approximately 1 km upstream of WC7. On October 13, 2006, 500 m of Oak Creek was investigated. Channel morphology was irregular and unconfined within a prairie pasture. Water was present within the well-defined channel, but there was no discernible discharge. The watercourse was completely dry 600 m upstream from the crossing proposed. Banks were sloping and riparian vegetation was well-grazed. Mean bank height is 0.8 m. Bank stability was high, for the most part, with instability located 100 m upstream and 300 m downstream from the ROW proposed as a result of cattle pugging. Average channel and wetted widths were 23.9 m and 14.7 m, respectively, and water depth varied from 0.1 m to 0.6 m. Habitat for the stretch investigated consisted entirely of a run, with 100% fines for substrate. Water temperature was cold (1 ^{o}C), pH basic (9.12), dissolved oxygen near saturation (13.5 mg/L), and conductivity at 1149 µS/cm. A survey completed in May

1998 at this same site found water temperature to be warm (16 ^{o}C), pH near neutral (pH 7.5), conductivity at 890 µS/cm, and discharge to be above average for May (0.71 m^3/s) (RL&L 1998).

Channel width at the ROW proposed was 48.0 m with sloping, stable banks 1.0 m high. Wetted width was 17.0 m, with an average water depth of 0.3 m. Substrate was 100% fines.

Fish Populations

Fish populations were sampled using baited Gee-type minnow traps set over a distance of 300 m on October 12, 2006. These were removed the following morning after a period of approximately 21 hours, resulting in a sampling effort of 225.5 trap hours. Fish recovered included 9 juvenile white sucker, 249 creek chub, 82 brook stickleback, and 2 Iowa darter (Appendix D). Backpack electrofishing was not conducted because of soft-bottom substrate and wide channel. RL&L (1998) captured 38 white sucker, with an overall CPUE of 1.05 fish per 100 seconds in the spring. The main fork length captured was 374 mm, ranging in length from 304 mm to 490 mm.

Fish Habitat Potential

Spawning potential for white sucker and walleye is low given the absence of course substrate. Pike spawning potential is also low given the lack of instream vegetation, and inadequate native riparian vegetation for high flood events. Furthermore, high pH during low flow would minimize egg viability for northern pike (Inskip 1982). Moderate rearing potential exists for all species given the presence of benthic invertebrates and forage fish; however, the lack of sufficient water depth or flow minimizes the potential for fish to survive here over the winter. Barriers to spring migration during high flows were not evident.

Crossing Recommendations

Even though northern pike was not observed in this section of Oak Creek (WC8), they are known to reside downstream and barriers to migration were not identified. Consequently, a timing window restricting instream activity to protect spring spawners exists from April 1 to June 15, requiring a trenchless crossing if pipeline construction occurs at this time. Construction during summer, when flow is typically less than 1.0 m^3/s, may be completed with an isolated crossing. If the watercourse is frozen to bottom or dry during winter construction, an open cut crossing is recommended.

Access for vehicles and equipment across Oak Creek (WC8) can be facilitated with a temporary single span bridge or an existing temporary access on north side, if water is present, or a ford with swamp mats if the streambed is dry or frozen to bottom.

Restoration

It is recommended that native substrate be replaced, banks be recontoured to their original shape and reseeded with native grasses. If possible, the disturbed area should be fenced to keep cattle off until vegetation is re-established.

<u>WC 10 Cypress River</u> (KP 1131.5, 16-31-5-11 W1M, see page A-6)

The Cypress River originates from the Tiger Hills just north of the Town of Somerset, Manitoba, and flows north from this crossing location 25 km to join the Assiniboine River. During periods of high water, large body fish species such as northern pike and white sucker may use the lower reaches of the Cypress River (B. Bruederlin, Fisheries Branch, Manitoba Conservation pers. comm.). The presence of white sucker at this location was confirmed with an earlier investigation in May 1998, where common shiner, creek chub, fathead minnow, longnose dace, sand shiner, lake chub and finescale dace were also sampled (RL&L 1998). A landowner commented that a northern pike was caught at the bridge upstream from the crossing proposed in years past (Gord Delichte pers. comm.).

Channel Characteristics

On October 14, 2006, the Cypress River was investigated for 200 m upstream and 300 m downstream from the crossing proposed. At this location, the river channel is confined occasionally as it meanders irregularly through a shallow valley bottom. Numerous beaver dams exist along the channel investigated, creating deeper pools of standing water. Banks are sloping to vertical and highly stable, except in the vicinity of the crossing proposed where cattle have been active, or downstream where vertical banks have been undercut. Average channel width was 7.4 m with bank heights ranging from 0 to 1.2 m. Remnant pools separated by dry channel (45% of the length surveyed) were representative of late season water levels; however, there was evidence of high flow previously. Average wetted width was 4.6 m and average depth was 0.3 m with no flow. Substrate consisted almost entirely of fines (97%), and any small gravel beds were highly embedded. Fish cover was provided by channel depth and overhanging vegetation, with the occasional large woody debris. Riparian vegetation was grass predominantly. Water temperature was cool (2.5 ^{o}C), pH slightly basic (8.5), DO concentration near saturation (12.4 mg/L), and conductivity moderately high (800 µS/cm). At the ROW proposed, channel width was 11.4 m with gradually sloping banks of low stability as a result of cattle activity. Standing water was present, with a wetted width of 7.3 m and an average depth of 0.3 m. Substrate was composed of mostly fines (96%), with highly embedded cobble (2%) and boulders (2%).

Figure 6 indicates historical streamflows for the Cypress River with the highest mean discharge in April of 4.03 m^3/s (Environment Canada 2006b). RL&L (1998) reported warm water temperature (16.5 ^{o}C), pH of 8.3, and conductivity of 650 µS/cm during May at WC10. Discharge was 0.23 m^3/s, which was below average for this time of year.

Discharge	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean Monthly	-	-	0.574	4.03	0.708	0.161	0.285	0.115	0.058	0.040	-	-
Max. Monthly	-	-	3.81	12.2	5.25	1.34	4.22	1.73	1.04	0.508	-	-
Min. Monthly	-	-	0.000	0.022	0.038	0.000	0.000	0.000	0.000	0.000	-	-

Years of Streamflow Record: 1965 to 2005 (during nonfrozen conditions only)
Maximum Daily Discharge: 72.5 m^3/s (April 12, 1969) (extreme recorded for the period of record)
Minimum Daily Discharge: 0.00 m^3/s (multiple dates)
Drainage Area: 276 km^2

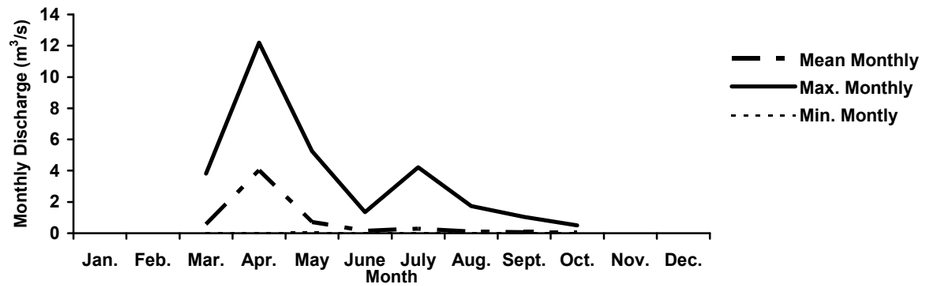


Figure 6 Historical Mean Monthly Streamflow (m3/s) Summary for the Cypress River near Bruxelles, Manitoba (SW 4-6-11 WPM) (Environment Canada 2006b).

Fish Populations
The fish population was sampled on October 14, 2006 with a backpack electrofisher (90 V., 30 Hz) for a distance of 300 m. In total, 43 white sucker, 1 black bullhead, 15 johnny darter, 1 fathead minnow, 111 emerald shiner, 82 creek chub, 3 blacksided darter, and 13 black dace were captured (Appendix D). Multiple age classes of white sucker, creek chub and emerald shiner were observed. Electrofishing CPUE was high at 58.4 fish per 100 seconds of effort. A northern leopard frog and crayfish were also observed.

Fish Habitat Potential
Spawning potential for white sucker and walleye is low given the absence of suitable, unembedded course substrate. It is low, as well, for northern pike given the absence of significant instream vegetation. Rearing potential is high for white sucker and northern pike given the abundance of forage and cover present. Based on fork length distributions (Appendix D), wintering potential is high for forage fish; however, it is not suitable wintering habitat for large bodied forage fish and sport fish. Migration for all species would be possible during higher spring and summer flows.

Black bullhead spawning potential is high given suitable soft substrate for nest excavation, and undercut banks and woody debris for cover. Bullheads are opportunistic predators and scavengers who feed on snails, leeches, crayfish, northern leopard frogs and various minnows (Stewart and Watkinson 2004), many of which were found during the investigation. Potential for rearing and survival of young is high.

Crossing Recommendations
Northern pike have been reported from this reach of the Cypress River. Consequently, a timing window restricting instream activity from April 1 to June 15 is warranted. A trenchless crossing would be required for pipeline construction at this time. The river is narrow enough for an isolated crossing during summer construction when flows are generally less than 1.0 m^3/s. If the watercourse is dry or frozen to bottom, an open cut crossing is recommended. If water is present, a temporary single span bridge or an existing local bridges are recommended for vehicle and equipment crossings. An icebridge would be constructed if the watercourse was sufficiently frozen.

To ensure water quality for aquatic resources is maintained, it is recommended that turbidity and concentration of TSS be monitored throughout the zone of influence during construction of a trenched crossing, if water is present and construction timing occurs outside of the RAP.

Restoration
Natural substrate should be replaced, and banks recontoured and reseeded with native grasses. If possible, disturbed areas should be fenced to keep cattle off until vegetation is re-established.

WC17A Deadhorse Creek (KP 1196.2, 6-6-3-5 WPM, see page A-7)

Deadhorse Creek originates in the Pembina Hills of Manitoba and flows east into Plum Creek, a tributary to the Red River. The pipeline crossing proposed is 50 km upstream from the Red River. This creek is the headwaters of Lake Minnewasta which supports white sucker and numerous cyprinids (e.g. fathead minnow, brook stickleback), as well as a stocked walleye, black crappie and northern pike fishery. Pumpkinseed is also found in the lake, possibly a result of a “pan-size” fish release (B. Bruederlin, Fisheries Branch, Manitoba Conservation, pers. comm.). It is not certain how far upstream some of these fish species can and would migrate.

At the time of the AAR field study (October 2006), an alternate crossing location 10 km upstream was considered on Deadhorse Creek (KPM 2.5 at 16-35-2-6 WPM). Subsequently, the crossing proposed has been moved to the original alignment - KP 1196.2 at 6-6-3-5 WPM. This location was investigated by RL&L on May 13, 1998 and the following crossing description is adapted from their work (see Appendix A, WC17A). AAR information from the 2006 study has been incorporated where appropriate and is summarized in Appendix A as site WC17B.

Channel Characteristics
On May 13, 1998, stream habitat was sampled from 30 m upstream to 225 m downstream from the crossing proposed. The creek has a well-defined channel that flows in an unconfined, irregular manner. At the time of investigation, water levels were low with exposed gravel bars and boulders. Wetted width at the ROW was 0.6 m, with average wetted widths over the length studied of 4.2 m. Average channel depth was 0.5 m, with maximum depth recorded among all transect lines of 1.5 m. Mean depth at the ROW was 0.08 m. ROW bank heights were 0.4 and 1.6, with bank slopes of 2^o and 20^o (left and right banks, respectively). The left bank was primarily exposed soil, whereas the right bank was vegetated with grasses. The upper banks were steeper than the lower banks, however, both were stabilized with grass vegetation, trees and shrubs. Channel substrate was composed of mostly fines (98%), with some cobble (1%) and boulder (1%). Instream habitats were classified mainly as shallow flats with instream fish cover primarily boulder and cobble. Water temperature was warm (18 ^oC), pH slightly basic (7.9), with discharge of 0.005 m^3/s. Water quality, as measured in late fall (October 16, 2006) 10 km upstream, found water temperature cool (4.9 ^oC), pH slightly basic (8.0), and DO high (9.0 mg/L).

Figure 7 indicates historical streamflow with the highest mean discharge in April of 1.32 m^3/s (Environment Canada 2006b).

Discharge	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean Monthly	-	-	0.380	1.32	0.302	0.116	0.125	0.094	0.029	0.007	-	-
Max. Monthly	-	-	2.42	5.4	1.29	0.949	1.10	1.14	0.373	0.029	-	-
Min. Monthly	-	-	0.004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-

Years of Streamflow Record: 1966 to 1996 (during nonfrozen conditions only)
Maximum Daily Discharge: 288 m^3/s (April 20, 1979) (extreme recorded for the period of record)
Minimum Daily Discharge: 0.00 m^3/s (multiple dates)
Drainage Area: 159 km^2

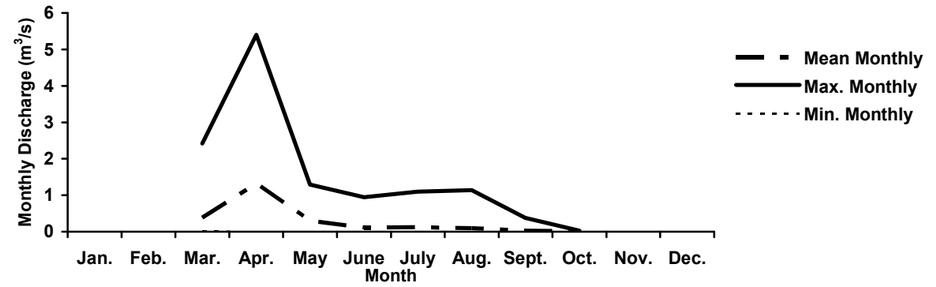


Figure 7 Historical Mean Monthly Streamflow (m3/s) Summary for Deadhorse Creek at Morden, Manitoba (SW 8-3-5 WPM) (Environment Canada 2006b).

Fish Populations
Fish were sampled May 13, 1998 using a backpack electrofisher for 786 seconds over a distance of 593 m. A total of 5 species were captured, including a walleye, white sucker, fathead minnow, creek chub and lake chub (Electrofishing CPUE of 0.64 fish per 100 seconds).

At WC17B location 10 km upstream, fish stranded in a series of isolated pools were sampled on October 16, 2006 using baited Gee-type minnow traps fished overnight, set over a distance of 284 m. These were removed the following morning after a period of approximately 19 hours, resulting in a sampling effort of 209 trap hours. Fish recovered included 6 juvenile white sucker, 21 pumpkinseed, and 20 creek chub (Appendix D). Bivalve shells and burrows were also observed at this watercourse.

Fish Habitat Potential
Spawning potential for walleye and white sucker is low, limited by extensive silty substrates. Rearing potential is high in spring and summer when water levels are highest, and cover is accessible. Potential declines by late season as water levels drop, creating intermittent stream conditions with isolated pools.

Even though northern pike were not observed in either sampling event (May 1998 or October 2006), they reside in Lake Minnewasta 400 m upstream from the ROW proposed and could move into Deadhorse Creek to spawn and rear. Spawning potential is high as abundant bank vegetation becomes accessible during spring flood events. Rearing is also high given the presence of abundant forage fish and cover.

Pumpkinseed is a rare fish in Manitoba as this is generally the extreme northern limit of their range (Manitoba Conservation 2006). Spawning occurs from late spring to early summer, although nests are occupied as late as July or August. Hatching takes place in as little as three days and young leave the male-guarded nest after a period of 11 days (Scott and Crossman 1979). Spawning and rearing potentials in Deadhorse Creek are moderate to high given access to quiet submerged vegetation during higher water events in June and suitable soft substrates.

Even though early winter conditions still support various life history stages of fish (Appendix D), it is likely that remnant pools will freeze to bottom; therefore, wintering potential is rated as low. Migration potential is high for all species during higher flow events and likely given the close proximity of Lake Minnewasta.

Crossing Recommendations
Pumpkinseed has a suggested classification of S1 in Manitoba; however, it is not a managed species in the province (Janusz, Manitoba Conservation and Hnytka, DFO SARA Project pers. comm.). Its lack of recognized status is a result of its introduction into the region (i.e. not a “natural” population) (G. Franzin, DFO, pers. comm.). Therefore, a restricted activity period for pumpkinseed has not been considered for Deadhorse Creek; however, a timing window for northern pike exists from April 1 to June 15. A trenchless crossing is recommended for pipeline construction occurring within the RAP. An isolated crossing may be done in the fall when water is present, or it may be open cut if the watercourse is frozen to bottom or dry during winter construction.

To ensure water quality for aquatic resources is maintained, it is recommended that turbidity and concentration of TSS be monitored throughout the zone of influence during construction of a trenched crossing, if water is present and construction timing occurs outside of the RAP.

Access for vehicles and equipment across Deadhorse Creek can be facilitated by a temporary single span bridge if water is present. An ice bridge can be constructed if ice of sufficient thickness exists or a ford with swamp mats if the streambed is dry.

Restoration
Banks must be recontoured and stabilized with geotextile material, as needed. Re-seeding with native grasses will aid in the establishment of vegetation for additional stabilization and maintenance of pike spawning habitat.

TABLE 4
Watercourse Crossing Summary for the LSr Pipeline

ID	Watercourse	KP	Location (W1M)	Sampled Fish Presence --- Fish Habitat Potential	Timing Window	ROW Channel Morphology (m) (Sample date)	Pipeline Crossing**	Vehicle Crossing	Restoration
WC1	Black Creek (Tributary to Souris River)	1065.8	5-25-7-18 WPM	None --- Low	No restricted activity window	Dry Channel 0.54 m wide 0.15 m deep (Oct 12/06)	Spring/Summer/fall- isolate if water present Winter - open cut if dry or frozen to bottom	Temporary single span bridge or existing bridge if water present, ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Recontour appnach slopes & stabilize with coconut mats, reseed with native grasses
WC2	Souris River[2] (Tributary to Assiniboine River)	1073.4	10-22-7-17 WPM	NRPK, WALL, WHSC, BLDC, BLDR, LNDC, SHRD, SNSH, TRPR Bivalves --- Low to High	April 1 – July 31	Channel width – 45.5 Wetted width – 41.0 Depth – 0.35 (Oct 17/06)	Year-round HDD (Isolated contingency crossing)	Temporary single span bridge or existing bridge crossings or snow/ice fill if sufficient ice thickness exists	Restoration for contingency crossing - Restore mid-channel gravel bar. Restabilize banks with soil wraps, coconut mats, and willow staking. Reseed with native grasses.
WC3	Spring Brook[1] (Tributary to Oak Creek)	KPS 5.1	NW 18-7-16 WPM	NRPK, LKCH, CRCH, FTMN, PRDC, BRST --- Habitat potential TBD	April 1 – June 15	Channel width - TBD Wetted width – TBD Depth – TBD	Spring – HDD Summer/fall- isolate if water present Winter - open cut if dry or frozen to bottom	Temporary single-span if water present, or snow/ice fill if sufficient ice thickness exists	Recontour banks using geotextiles as needed, and reseed with native grasses
WC4	Unnamed Creek (Tributary to Spring Brook)	KPS 6.1	NE 18-7-16 WPM	BRST --- Habitat potential TBD	No restricted activity window	Channel width - TBD Wetted width – TBD Depth – TBD	Spring / summer / fall - isolate if water present Winter - open cut if dry or frozen to bottom	Ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Recontour banks, using geotextiles to stabilize as necessary, reseed with native grasses
WC5	Unnamed Creek	1083.6	8-15-7-16 WPM	No Fish Habitat Potential	No restricted activity window	No Defined Channel (Oct 12/06)	Open cut anytime	Ford or culvert, as needed	Reseed with native grasses
WC6	Oak Creek (Tributary to Souris River)	1087.0	1-13-7-16 WPM	NRPK, WHSC, PRDC, BLDC, EMSH, JHDR Northern leopard frog --- Low to High	April 1 – June 15	Channel width – 12.4 Wetted width – 5.6 Depth – 0.1 (Oct 12/06)	Spring – HDD Summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single span bridge or existing bridge crossings or ford with swamp mats if dry or snow/ice fill if sufficient ice thickness exists	Restabilize banks with layered soil wraps & coconut mats. Reseed with native grasses; fence off from cattle until re-established.
WC7	Oak Creek[2] (Tributary to Souris River)	1109.3	7-31-6-13 WPM	WHSC Bivalves --- Low to High	April 1 – June 15	Channel width – 12.0 Wetted width – 7.0 Depth – 0.3 (Oct 13/06)	Spring – HDD Summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single span if water present, or ford with swamp mats if dry or snow/ice fill if sufficient ice thickness exists	Transplant cattail rhizomes. Reseed with native grasses
WC8	Oak Creek[2] (Tributary to Souris River)	1110.3	4-32-6-13 WPM	WHSC, BRST, CRCH, IWDR --- Low to High	April 1 – June 15	Channel width – 48.0 Wetted width – 17.0 Depth – 0.3 (Oct 13/06)	Spring – HDD Summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single span bridge or existing bridge crossings or ford with swamp mats or snow/ice fill if sufficient ice thickness exists	Reseed with native grasses. Fence off from cattle until vegetation re-established.

TABLE 4 continued

ID	Watercourse	KP	Location (W1M)	Sampled Fish Presence --- Fish Habitat Potential	Timing Window	ROW Channel Morphology (m) (Sample date)	Pipeline Crossing**	Vehicle Crossing	Restoration
WC9	Cypress River[1] (Tributary to Assiniboine River)	1120.1	15-18-6-12 WPM	WHSC, CMSH, LNDC, CRCH, SNSH, FNDC,CNMD, FTMN, JHDR --- Low to Moderate	April 1 – June 15	Wetted width – 3.2 Depth – 0.2 (May 16/98)	Spring – HDD Summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single-span if water present, ford with swamp mats if dry, snow/ice fill if sufficient ice thickness exists	Recontour approach slopes and seed with native grasses
WC10	Cypress River[2] (Tributary to Assiniboine River)	1131.5	16-31-5-11 WPM	WHSC, BLDC, CMSH, LNDC, SNSH, LKCH, BLDR, BLBL, , PRDC, CRCH, EMSH, JHDR,FNBC, FTMN, Northern leopard frog --- Low to High	April 1 – June 15	Channel width – 11.4 Wetted width – 7.3 Depth – 0.3 (Oct 14/06)	Spring – HDD Summer/fall – isolate if water present Winter - open cut if frozen to bottom.	Temporary single span bridge or existing bridge if water is present, or snow/ice fill if sufficient ice thickness exists	Reseed with native grasses. Fence off from cattle until vegetation re-established.
WC11	Intermittent Creek	1139.9	11-24-5-11 WPM	No Fish Habitat Potential	No restricted activity window	Intermittent channel (Oct 13/06)	Spring / summer / fall - isolate if water present Winter - open cut if dry or frozen to bottom	Ford with swamp mats if dry or frozen, culvert in summer	Recontour banks, reseed with native grasses
WC12	Intermittent Creek	1141.3	SW 19-5-10 WPM	NOT SAMPLED, NO LAND ACCESS	??	??	??	??	??
WC13	Mary Jane Creek[1] (Approx. 15 km from confluence with Pembina River)	1164.0	14-18-4-8 WPM	No Fish Found --- Nil to Low	No restricted activity window	*ROW morphology not available, average channel morphology:* Wetted width – 2.1 Depth – 0.1 (May 15/98)	Spring / summer / fall - isolate if water present Winter - open cut if dry or frozen to bottom	Ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Recontour banks, use geotextiles to stabilize as necessary, reseed with native grasses
WC14	Unnamed Drainages	1175.7	16-31-3-7 WPM	No Fish Habitat Potential	No restricted activity window	No Defined Channel (Oct 15/06)	Open cut anytime	Ford or culvert, as needed	Reseed with native grasses
WC15	Unnamed Creek[1] (Tributary to Thornhill Coulee)	1183.5	13-24-3-7 WPM	FTMN, LKCH (suspected to have come from nearby dugout during precipitation event) --- Low	No restricted activity window	No Defined Channel at ROW (May 14/06)	Spring / summer / fall - isolate if water present Winter - open cut if dry or frozen to bottom	Ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Recontour, use geotextiles to stabilize as necessary, reseed with native grasses

TABLE 4 continued

ID	Watercourse	KP	Location (W1M)	Sampled Fish Presence --- Fish Habitat Potential	Timing Window	ROW Channel Morphology (m) (Sample date)	Pipeline Crossing**	Vehicle Crossing	Restoration
WC16	Thornhill Coulee[1] (Tributary to Shannon Creek)	1186.3	2-19-3-6 WPM	FTMN, BRST --- Low to High	April 1 – June 15	Wetted width – 4.0 Depth – 0.1 (May 14/98)	Spring – HDD Summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single-span if water present, ford with swamp mats if dry, snow/ice fill if sufficient ice thickness exists	Restore/stabilize banks with layered soil wraps & coconut mats as needed; reseed with native grasses. Silt fencing on approach slopes.
WC17A	Deadhorse Creek[2] (Tributary to Plum Creek)	1196.2	6-6-3-5 WPM	CRCH, WHSC, WALL, FTMN, LKCH, PUMP Bivalves --- Low to High	April 1 – June 15	Wetted width – 0.6 Depth – 0.08 (May 13, 1998)	Spring – HDD Summer/ Fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single span or ford with swamp mats if dry or snow/ice fill if sufficient ice thickness exists	Recontour banks, using geotextiles to stabilize as necessary, reseed with native grasses
WC18	Unnamed Drainage	1205.4	1-26-2-5 WPM	No Fish Habitat Potential	No restricted activity window	No Defined Channel (Oct 15/06)	Open cut anytime	Ford or culvert, as needed	Reseed with native grasses
WC19	Unnamed Drainage	1206.5	15-24-2-5 WPM	No Fish Habitat Potential	No restricted activity window	No Defined Channel (Oct 15/06)	Open cut anytime	Ford or culvert, as needed	Reseed with native grasses
WC20	Hespeler Creek (Tributary to Deadhorse Creek)	1211.1	13-16-2-4 WPM	No Fish Found --- Low to High	No restricted activity window	Channel width – 2.8 m Wetted width - 0 Depth - 0 (Oct 15/06)	Spring/summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single span bridge or drive around to south side of residential properties, snow/ice fill if sufficient ice thickness exists	Restore/stabilize banks with coconut mats; reseed with native grasses.
WC21	Rosenheim Drain (Tributary to Red River)	1220.1	12-5-2-3 WPM	No fish found --- Nil to Low	No restricted activity window	Dry Seasonal Drainage (Oct 15/06)	Spring / summer / fall - isolate if water present Winter - open cut if dry or frozen to bottom	Ford or snow/ice fill if sufficient ice thickness exists	Reseed with native grasses, fence off from cattle until re-established
WC22	Buffalo Drain (Tributary to Buffalo Creek)	1224.4	10-34-1-3 WPM	No Fish Habitat Potential	No restricted activity window	No Defined Channel (Oct 15/06)	Isolate if water present Open cut when dry	Ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Reseed with native grasses
WC23	Buffalo Creek (Tributary to Red River)	1227.4	13-25-1-3 WPM	BLBL, CRCH Crayfish, northern leopard frog --- Low for sportsfish	No restricted activity window	Channel width – 2.3 Wetted width – 2.0 Depth – 0.2 (Oct 15/06)	Spring / summer / fall - isolate if water present Winter - open cut if dry or frozen to bottom	Culvert, ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Recontour, reseed with native grasses, fence off from cattle until vegetation re-established.

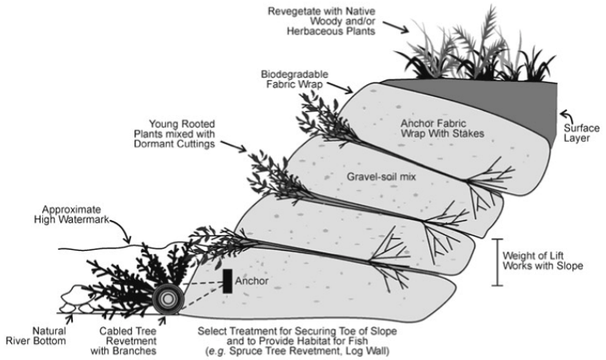
TABLE 4 continued

ID	Watercourse	KP	Location (W1M)	Sampled Fish Presence --- Fish Habitat Potential	Timing Window	ROW Channel Morphology (m) (Sample date)	Pipeline Crossing**	Vehicle Crossing	Restoration
WC24	Drainage Channel (Tributary to Buffalo Creek)	1231.6	10-20-1-2 WPM	BLBL, CRCH, WHSC --- Low to High	No restricted activity window	Channel width – 7.5 Wetted width – 4.8 Depth – 0.2 (Oct 15/06)	Spring/summer/fall – isolate if water present Winter – open cut if dry or frozen to bottom	Temporary single span bridge or existing bridge 800 m to the south, culvert, ford with swamp mats, or snow/ice fill if sufficient ice thickness exists	Recontour, reseed with native grasses
WC25	Drainage Channel (Tributary to Buffalo Creek)	1239.5	9-12-1-2 WPM	No Fish Habitat Potential	No restricted activity window	Dry Undefined Channel (Oct 16/06)	Open cut anytime	Ford or culvert, as needed	Reseed with native grasses
WC26	Drainage Channel (Tributary to Buffalo Creek)	1241.4	8-7-1-1 WPM	No Fish Habitat Potential	No restricted activity window	Dry undefined Channel (Oct 16/06)	Open cut anytime	Ford or culvert, as needed	Reseed with native grasses

** Seasonal definitions – spring April 1 to June 15, summer June 16 to September 15, fall September 16 to October 31, and winter November 1 to March 30.

1. Data from RL&L 1998
2. Data from AAR 2006 and RL&L 1998 investigations

4.0 DRAWINGS



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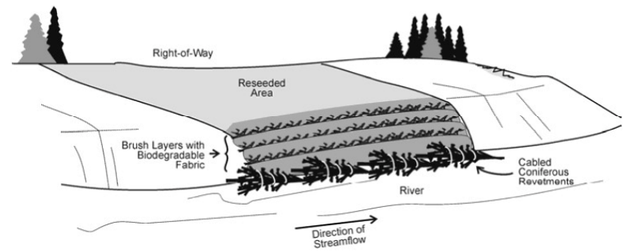


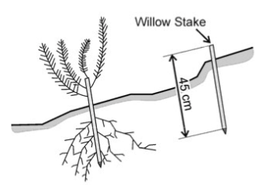
Oblique View
(Not to Scale)

Notes:

1. Proper placement and design is critical and qualified specialists should be involved.
2. Secure the toe of the slope with appropriate technique (coniferous tree revetments, log wall, riprap, etc.).
3. Begin layering at the bottom of slope with first hedge/brush layer situated at the approximate high water mark or lower. Select plant species suitable for site conditions.
4. Excavate the first bench 0.5-1.0 m deep, ensuring not to damage the pipeline, angled slightly down into the slope. Lay branches and transplants on the bench, slightly criss-crossing, with shoots extending beyond the edge of the bench by approximately 20% of their length.
5. Plant 18-25 stems per metre, using higher densities for more erosive sites or if the cutting's diameter is small. Cover with 5-10 cm of soil and tamp into place.
6. Continue building layers with damp soil and cuttings until bank height is reached. Vary spacing between layers based on erosion potential.
7. For best results dig transplants in spring or late summer and plant the same day. Keep transplants moist. A mixture of plant species can mimic adjacent undisturbed vegetation.

Source: Canadian Association of Petroleum Producers, Canadian Energy Pipeline Association and Canadian Gas Association 2005

APPLIED AQUATIC RESEARCH Ltd.	**Enbridge Pipelines Inc.**	
	Drawing 1 Soil wraps	
	AAR06-109	February 2007



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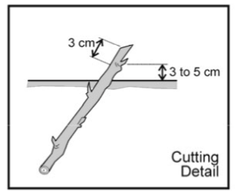

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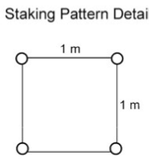
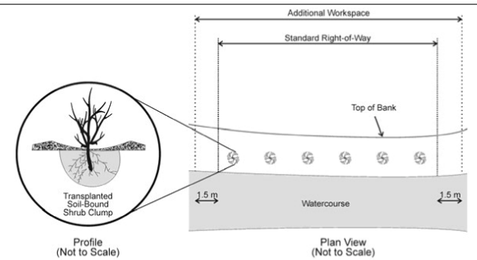


Plan View
(Not to Scale)

Notes:

1. Install stakes of suitable species (*e.g.* willow, dogwood) on watercourse banks.
2. Make clean cuts with unsplit ends using pruning shears, hand saw or chain saw.
3. Select stock from bottom of branches not tips.
4. Mark basal ends to ensure correct installation.
5. Ensure at least one lateral bud above surface and three below. Plant cutting at an angle.
6. Protect material from drying out. Install as quickly as practical.
7. Trim side shoots close to main stock.
8. Use frost pin to make pilot hole. Minimize damage to stake when driving by using a neoprene lined post hole pounder or rubber mallet.
9. Install live stakes on banks and 1.5 m (approximately) back from banks for entire disturbed width of right-of-way.



Profile
(Not to Scale)

Plan View
(Not to Scale)

Notes:

1. Salvage and replace shrubs on all watercourse banks where shrubs are present on the right-of-way.
2. Salvage whole bushes from the right-of-way during grading of banks. Ensure bulk of root mass is surrounded by soil.
3. Store salvaged shrubs on edge of right-of-way, cover with soil and do not let dry out.
4. Transplant as quickly as practical when reconstructing watercourse banks.
5. Soak the ground around the transplant with water.

Source: Canadian Association of Petroleum Producers, Canadian Energy Pipeline Association and Canadian Gas Association 2005

APPLIED AQUATIC RESEARCH Ltd.	**Enbridge Pipelines Inc.**	
	Drawing 2 Streambank Protection - Willow and Shrub Transplant	
	AAR06-109	February 2007

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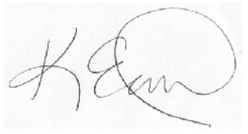
6.0 CLOSURE

The statements and conclusions reported are accurate and address requirements of the *Fisheries Act.*



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