October 30, 2013 Matrix 8881-523

Mr. Michael Aiton
Regional Compliance Manager
ALBERTA ENVIRONMENT AND SUSTAINABLE RESOURCE DEVELOPMENT
Twin Atria Building
111, 4999 - 98 Avenue
Edmonton, Alberta T6B 2X3

Subject: Wetlands Impact Assessment Under EPO-2013-33/NR

Dear Mr. Aiton:

This letter report serves as a wetlands impact assessment required by Environmental Protection Order No. EPO-2013-33/NR, served to Canadian Natural Resources Limited under the *Environmental Protection and Enhancement Act* on September 24, 2013.

1 BACKGROUND

The Canadian Natural Resources Limited Primrose South in situ oil sands project is located in the Cold Lake Air Weapons Range approximately 65 km north-northeast of Bonnyville, Alberta. Canadian Natural operations staff found a bitumen emulsion flow to surface (FTS) in 09-21-067-04 W4M on June 24, 2013. The FTS area is beneath an unnamed water body within the Canadian Natural Primrose South production zone. At the time of the assessment, the FTS was still occurring beneath the water body but had been contained by booms, X-Tex curtains and a silt fence. The containment area is shown as Basin 2 on Figure 1. In addition, since June 2013, a full-time crew of workers has physically recovered bitumen emulsion from the water body, removing impacted plants from Basins 1 through 3, free bitumen emulsion from Basin 2 and free bitumen emulsion globules from bottom sediments around Basin 1 and the southern portion of Basin 3.

2 INTRODUCTION

Canadian Natural has proposed to drain a portion of the unnamed water body in 09-21-067-04 W4M to expose, delineate and contain the FTS before freeze-up in 2013. All remedial works are anticipated to be completed during winter 2013 to 2014 and a containment berm will be constructed around the FTS before the water body is refilled and restored beginning in spring 2013.

The dewatering program began on September 27, 2013 so that containment, remediation and investigative programs can be completed during frozen ground conditions. The timeline of the dewatering was planned so that bitumen emulsion did not continue to spread and affect aquatic biota during spring runoff in 2014. To ensure that the fissure from which bitumen is escaping is adequately exposed, it was necessary to dewater Basins 1, 2 and 3 of the water body.

3 PROGRAM OBJECTIVES

A wetland impact assessment is required to evaluate potential effects of dewatering on aquatic plant communities in the water body and a fen area that it drains into. Baseline wetland fauna inventory and aquatic vegetation community data were collected during the summer and fall to allow comparison with monitoring data that will be collected following refilling and restoration of the water body. The data will be used to evaluate potential effects on the wetland due to dewatering activities and to develop corresponding mitigation measures.

The following assessment provides a summary of results of the baseline wetlands study conducted before dewatering, an assessment of potential effects, and recommendations for monitoring during the refilling and restoration phases.

4 STUDY OVERVIEW

The following main tasks were completed as a baseline study for the wetlands impact assessment:

- An inventory of aquatic macrophyte species in the water body and fen area was taken during September 19 and 20 and October 9, 2013.
- Wetlands were classified according to the *Alberta Wetland Inventory* (AWI) *Classification System Version 2.1* (Halsey et al. 2004) using information collected during the September 2013 program.
- A desktop delineation of surface area covered by open water, submergent and emergent aquatic macrophyte and fen vegetation zones was conducted.

5 SITE DESCRIPTION

The unnamed water body is classified as shallow open water based on wetland descriptions given in the AWI (Halsey et al. 2004). Shallow open water wetlands are non-peat forming wetlands that are less than 2 m in depth at midsummer and either permanent ecosystems or transitory as a result of flooding (Halsey et al. 2004). The water body is located at the upstream end of a tributary drainage system to the Wolf River located some 5 km to the west. At high water levels, the water body can overflow into the Burnt Lake drainage system located to the east. The water body is fed by a local drainage area of 3.0 km^2 (3,000 ha) and drains through a fen at its southern end to a tributary of the Wolf River. The water body has a surface area of approximately 50 ha, and an average water depth of 1.1 m with a maximum depth of 2.2 m (Figure 2).

The southern end of the water body transitions to a fen, which is included in the impact assessment. The fen wetland study area extended from the southern margin of the water body to immediately south of the main access road located approximately 300 m downstream. The northern half of the wetland is relatively narrow and bordered by forested upland while the southern half opens up to about three times the width, surrounding the pad and a portion of the access road. Beyond the access road the wetland continues southwest into a series of beaver-impounded ponds.

6 BASELINE METHODS

6.1 Vegetation

The main tasks carried out during the 2013 baseline wetland field program included:

- conducting vegetation surveys to record species composition and percent cover in 20 m × 10 m macro plots in the fen and 1 m × 1 m plots in the water body
- conducting vegetation surveys to record species composition along a meander through the fen
- recording vegetation health according to the 4-point scale in the *Ecological Land Survey Site Description Manual (Second Edition)*: Assessments of Vegetation Health (ASRD 2003)
- photographing sites and recording GPS coordinates at each vegetation survey plot location

Plant taxa were identified to species level according to Brayshaw (1985), Burland (1989), Crow and Helquist (2000a and 2000b), Fassett (1957), Hotchkiss (1972), Lahring (2003) and Moss (1959). Detailed methods are described in the following subsections.

6.1.1 Vegetation Plot Surveys

Vegetation plot locations in the water body and fen are shown on Figure 3.

6.1.2 Water Body

Percent cover of rooted aquatic macrophytes was recorded for 34 randomly selected locations in water body Basins 1, 3 and 4 following procedures outlined in *Aquatic Ecosystems Field Sampling Protocols* (AENV 2006). Growth forms of aquatic plants include emergent, submergent and floating-leaved. Emergent taxa are those that have the base of their stem underwater and the remainder of the plant growing above the water surface and are typically found in water depths where sediments are periodically saturated to approximately 1.5 m. Floating-leaved plants are rooted in the bottom sediments in water depths between 0.5 and 2.0 m and have long stems or petioles that connect to broad leaves floating on the water surface. Submergent aquatic plants grow beneath the water surface in water depths that typically range from 1 to 4 m depending on water clarity. A random stratified sampling approach was used to ensure that all life forms, including emergent floating-leaved and submergent taxa, were sampled. At each quadrat, site species presence and relative species dominance were noted, along with estimates of percent cover, general vigor, growth stage and water depth.

6.1.3 Fen

A total of five vegetation plots and three meanders were conducted within the fen wetland area. Vegetation plots were used to capture all species and their percent covers within a 20 m × 10 m area. The intent of doing meanders was to ensure all species within the wetland are accounted for. Meanders involved a field surveyor walking the length of the wetland recording all species until a reasonable length of time had passed with no additional species being identified. The fen area was identified and characterized using the *Alberta Vegetation Inventory* (AVI) *Standards Manual* (Halsey and Vitt 1996) and

the AWI (Halsey et al. 2004) classification system. Site information was recorded at each survey plot and included:

- classification of the site based on the AVI and AWI
- characterization of vegetation health based on the following criteria:
    - healthy (0% to 10% leaves dead)
    - light to moderate decline (11% to 50% leaves dead)
    - severe decline (greater than 50% leaves dead)
    - dead (100% leaves dead)
- GPS coordinates of survey sites
- percent cover of each vegetation strata, water, bryophytes and litter
- nutrient and moisture regime, drainage and structural stage

6.2 Fauna

From June 28, 2013 to present, Eco-Web Wildlife Management and Golder Associates Ltd. have been conducting the wildlife monitoring program. The 24-hour program includes monitoring the impacted area for the presence of birds, mammals and amphibians.

7 BASELINE SURVEY RESULTS

7.1 Aquatic Vegetation

The unnamed water body has well-developed aquatic vegetation communities typical of shallow, soft-bottomed lakes with organic-rich sediments. These include a well-developed emergent zone and dense beds of submergent taxa. Overall average percent cover of aquatic macrophytes in the water body was close to 60%, with average percent cover of less than 45% for emergent communities and 60% for submergent communities. The emergent macrophyte zone covers approximately 29.3 ha along the shoreline while the submergent zone, located at greater water depths, is approximately 23.4 ha (Figure 4). Emergent shoreline communities are dominated by the sedge species water sedge (*Carex aquatilis*) and beaked sedge (*Carex utriculata*) and isolated areas of swamp horsetail (*Equisetum fluviatile*) and softstem bulrush (*Scirpus validus*). Typical emergent communities are shown in Appendix A (Photographs 1 and 2) and softstem bulrush stand in Photograph 3. In water depths greater than 0.5 m, aquatic plant communities consist of homogeneous beds of floating pondweed (*Potamogeton natans*; Photograph 4), Richardson's pondweed (*Potamogeton Richardsonii*) and aquatic moss species (Photograph 5). Detailed plot data for the water body are presented in Appendix B (Tables B1 and B2).

The wetland situated on the south end of the unnamed water body and within the tributary of the Wolf River is characterized as a poor fen. Poor fens are peat accumulating wetlands (greater than 40 cm) that rely on ground and surface water flow. The water is typically rich in minerals making them minerotrophic (NWWG 1997). Their dependence on ground and surface water flow makes them sensitive to changes in the surrounding hydrology and this can be observed in the resulting alteration in their characteristic vegetation communities (Fraser and Miletti 2008; Weltzin et al. 2000). Significant

long-term changes to the hydrology can also affect pH levels and nutrient availability, compounding impacts on wetland vegetation (Bauer et al. 2007; Halsey and Vitt 1996; Vitt and Chee 1990; Zoltai and Vitt 1995). The vegetation community is dominated by black spruce (*Picea mariana*), tamarack (*Larix laricina*), Labrador tea (*Ledum groenlandicum*), dwarf birch (*Betula pumila*) and sphagnum mosses (*Sphagnum* spp.). Detailed plot data for the downstream fen area are presented in Appendix B (Table B3). Typical poor fen community is shown in Appendix A (Photograph 6). The fen has a surface area of approximately 25 ha and its hydrology relies on seepage coming from the unnamed water body (Figure 4). The lack of channels or pooling water suggests the majority of this seepage is subsurface.

Based on the 2013 fall vegetation field program, the dominant vegetation in the downstream fen consists of the following:

- tree layer: black spruce and tamarack
- shrub layer: willows (*Salix* spp.), dwarf birch, Labrador tea and leatherleaf (*Chamaedaphne calyculata)*
- grasses and sedges: blue joint (*Calamagrostis Canadensis*) and water sedge
- forb layer: False Lily-of-the-Valley (*Maianthemum canadense*), horsetail (*Equisetum* spp.) and marsh cinquefoil (*Potentilla palustris*)
- bryophyte layer: golden moss (*Tomenthypnum nitens*) and *Sphagnum* mosses

The majority of the wetland consists of low-lying shrub with a few scattered trees. The southern extent adjacent to the access road contains pockets of tall shrub-dominated communities.

Due to the timing of the assessment, the majority of the vegetation species were well into the stages of senescence when percent covers were recorded. Leaves were discoloured and shedding from the branches. Grasses and sedges were brittle, discoloured and lacked flowering bodies.

No species at risk were encountered during the wetland survey. A separate rare plant survey will be conducted in 2014 and will be timed so that potential rare species are most likely visible and their diagnostic features are most identifiable. The study area should be surveyed a sufficient number of times during the growing season in order to observe ephemeral habitats (e.g., snow beds, ephemeral wetlands and spring seeps) and early and late season perennials and annuals (ANPC 2012).

7.2 Fauna

The water body and surrounding drainage catchment support a variety of bird species that include songbirds, waterfowl and raptors and are summarized in Appendix C (Table C1). Amphibian species documented include the boreal chorus frog (*Pseudacris maculata*) and wood frog (*Rana sylvatica*) and are summarized in Appendix C (Table C2). Typical boreal forest mammal species were recorded including black bear (*Ursus americanus*), moose (*Alces alces*), muskrat (*Ondatra zibethicus*), beaver (*Castor*), snowshoe hare (*Lepus americanus*) and woodland caribou (*Rangifer tarandus*; Appendix C, Table C3).

8 ASSESSMENT OF IMPACTS

8.1 Flow to Surface and Response

Matrix examined potential effects on wetland communities to determine the pathways by which the effects would occur. The potential effects pathways that may occur during the various project phases are listed in Table 1.

Table 1 Potential Effects Pathways

Potential Effect	Project Phase	Effect Pathway
Change in vegetation community abundance or structure	Clean-up	Deposition of the bitumen emulsion on aquatic plants may affect plant health through exposure of plants to toxic constituents and impairment of their photosynthetic function. Indirect effects to plant communities could occur through changes in plant abundance.
		Vegetation removal may change community structure and potentially indirectly change community diversity and function.
		Regular travel of ATVs along the same path may physically damage plants and the substrate that they grow in.
	Dewatering	Temporary reductions of water levels may affect aquatic plants in the water body and downstream fen area.

Wetland vegetation in the water body has been directly affected by the FTS, which has deposited bitumen emulsion directly on leaves and stems of shoreline emergent vegetation and indirectly through shoreline clean-up activities. In addition to removal of the bitumen product, the effected vegetation growing along the shorelines of Basins 1 and 2 has been harvested and disposed of. The sedges and pondweeds that grow along the shoreline are clonal plants, which reproduce prolifically through underground stems (rhizomes) that can spread and persist without aboveground photosynthetic organs over several growing seasons. Since only the aboveground portions of the plants were removed, the original community structure is expected to recover following refilling and restoration.

Reductions of water levels during the dewatering phase are expected to temporarily affect aquatic macrophyte communities in the water body and the downstream fen. The drawdown is expected to begin during fall and end during the spring when plants are typically dormant. The rhizomatous aquatic plants of the water body shoreline can withstand and recover from periodic drawdown and freezing provided that desiccation of rhizomes is prevented (Cooke 1980 and Allan et al. 1989). Given that rhizomes will only be exposed to drawdown for a single dormant season, the original community structure is expected to naturally reestablish following refilling in the spring.

Draining the unnamed water body may cause temporary stress on the fen should the subsurface hydrology be substantially disturbed. Similar to aquatic plants in the water body, conducting the dewatering process during the low flow season (fall and winter), when vegetation becomes dormant, will greatly reduce the severity of any potential impacts to the wetland's integrity. Evidence of senescence was clearly apparent during the fall survey with the majority of shrubs having shed approximately 50% of their leaf mass and the forbs showing discoloration (Appendix A, Photograph 7). Therefore, most of the vegetation will be in a dormant state by the time the dewatering process is

completed. At freshet when vegetation begins to show signs of new growth, refilling the water body will begin, thereby restoring the surface hydrology and minimizing the overall impacts to wetland vegetation. As a result, any potential impacts due to the dewatering process are expected to be minimal.

Since the onset of the spill response, ATVs have been travelling on a frequent basis through the downstream fen to the south shore of the water body to collect samples for the purpose of monitoring water chemistry in the water body and fen. The ATVs path is now nearly void of vegetation as the tracks have removed the majority of vascular plants and overturned the moss layers, thereby exposing the underlying organic material (Appendix A, Photograph 8). As the disturbance is surficial, remains of the seed bank are expected to assist with the restoration of fen vegetation along the ATVs path as long as use of the path by machinery is prevented. Also, the outer fringes of the path are already showing signs of regrowth with several low-laying forb species coming up (Appendix A, Photograph 9). Human manipulation may only be required to facilitate the creation of hummocks. The wide tracks have flattened what is typically a landscape full of hummocks and depressions. Hummocks are small areas of elevated substrate that becomes a preferred habitat for upland species. Depressions are areas between the hummocks and tend to support more hydrophytic species. The extent of the mitigation measures required will be determined after the area has been reassessed.

8.2 Potential Mitigation Strategies

Mitigation measures will be developed based on the types and extent of the various potential disturbances occurring in and around the unnamed water body. At this time, it is recommended that these are monitored on an annual basis. This will provide the necessary information to create effective mitigation and adaptive management plans. Baseline data collected during the fall field program can be used for comparison with data collected in the future to follow the natural restoration process and determine whether hands-on mitigation measures such as restriction of access and diversion of additional water to the fen area are necessary.

8.3 Recommended Restoration and Monitoring

Following refilling of the water body, aquatic and wetland vegetation communities will be monitored to assess recolonization of vegetation in the water body and fen area and the restoration of aquatic habitat. Aquatic macrophyte sampling, as described in Section 6, will be repeated for a period of 4 years annually during the summers of 2014 through 2018 to assess the impact of the Comprehensive Remedial Plan on the aquatic vegetation in the water body and fen.

9 CLOSURE

We trust that this letter report suits your present requirements. If you have any questions or comments, please call either of the undersigned at 403.237.0606.

Yours truly,

MATRIX SOLUTIONS INC.

Aileen Rhodes, M.Sc.
Senior Environmental Scientist

Reviewed by

Henri de Pennart, Ph.D., P. Biol.
Senior Environmental Scientist

Kurt Frederick, M.Sc.
Environmental Scientist

AR/scw
Attachments

copy: Ryan Cameron, Canadian Natural Resources Limited, Calgary, Alberta

DISCLAIMER

We certify that this letter report is accurate and complete and accords with the information available during the site investigation. Information obtained during the site investigation or provided by third parties is believed to be accurate but is not guaranteed. We have exercised reasonable skill, care and diligence in assessing the information obtained during the preparation of this letter report.

This letter report was prepared for Canadian Natural Resources Limited and Alberta Environment and Sustainable Resource Development. The letter report may not be relied upon by any other person or entity without our written consent and that of Canadian Natural Resources Limited and Alberta Environment and Sustainable Resource Development. Any uses of this letter report by a third party, or any reliance on decisions made based on it, are the responsibility of that party. We are not responsible for damages or injuries incurred by any third party, as a result of decisions made or actions taken based on this letter report.

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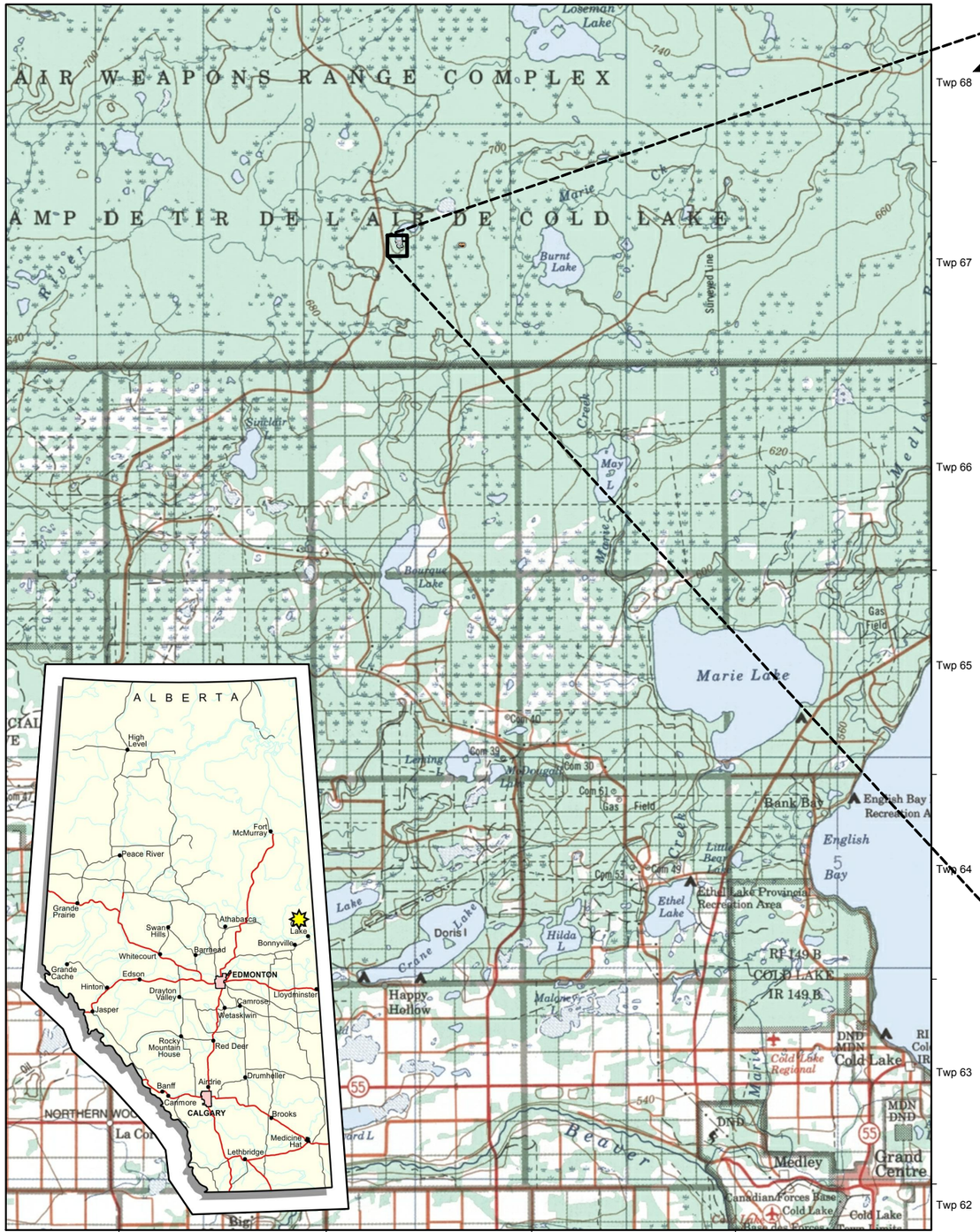
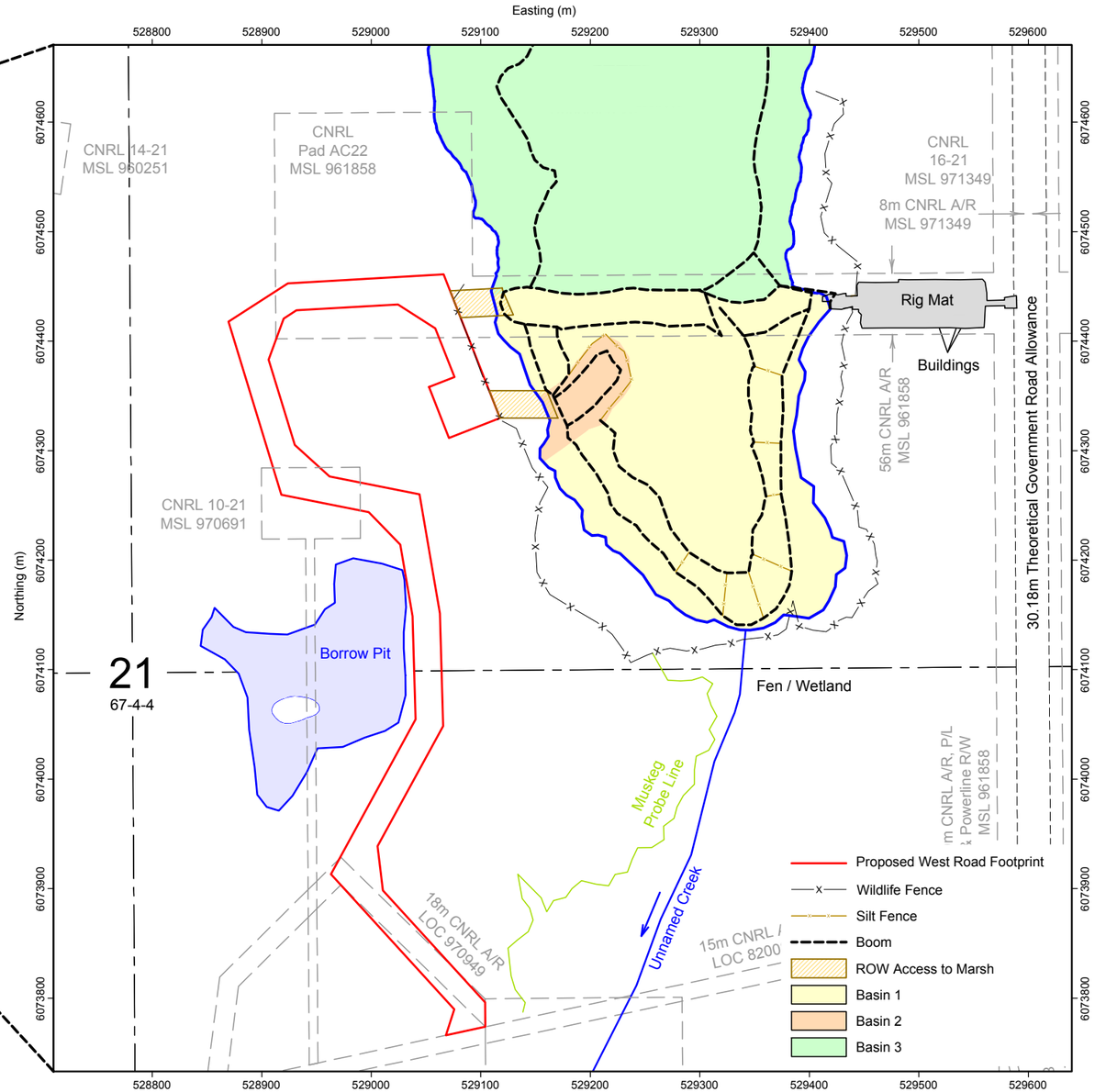


1:250000 metres
2500 0 2500 5000
UTM83-12

Site Location Map
Scale 1:250000



Project Details
Scale 1:5000

1:5000 metres
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UTM83-12

Reference: 1:250000, 73L (Sand River), Edition 4, UTM Zone 12, NAD83, Canada Centre for Mapping, Natural Resources Canada.
Project features taken from Focus File 010044935-CNAB01-R04, dated August 16, 2013.

STAMP	No.	DATE	DESCRIPTION	BY
	4	13/09/25	ISSUED FOR REGULATORY ORDER	DR
	3	13/09/19	RE-ISSUED FOR REGULATORY APPROVAL	DR
PERMIT NUMBER	2	13/09/03	ISSUED FOR REGULATORY APPROVAL	DR
	1	13/08/27	ISSUED FOR DISCUSSION	DR
	0	13/08/16	ISSUED FOR DISCUSSION	SS

Canadian Natural

Primrose 09-21-067-04 W4M

Location Plan

Date: Aug 2013 | Project: 8881-WMSP-13 | Technical: A. Rhodes | Reviewer: H. de Pennart | Drawn: G. Evenson

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Figure 1

F:\8881 CNRL Pad 74\Drafting\2013\8881-WMSP-13.dwg - Site - Wednesday, October 30, 2013 8:48:37 AM - Gary Evenson

Easting (m)

Northing (m)

N

MSL101308

MSL110704

MLL110057

MSL130193

MSL970690

Existing Culvert

North - South Access Road

MSL961858

MSL971349

MSL022227

MLL110059

East - West Access Road Location

MSL964014

PLA970183

Basin 3
Area = 223732 m²
Volume = 220303 m³

Basin 4
Area = 230464 m²
Volume = 256969 m³

Basin 1 & 2
Area = 72877 m²
Volume = 76957 m³

Water Depth (m)

1:5000 metres

50 0 50 100

UTM83-12

Reference:

STAMP	No.	DATE	DESCRIPTION	BY
	4	13/09/25	ISSUED FOR REGULATORY ORDER	DR
	3	13/09/19	RE-ISSUED FOR REGULATORY APPROVAL	DR
PERMIT NUMBER	2	13/09/03	ISSUED FOR REGULATORY APPROVAL	DR
	1	13/08/27	ISSUED FOR DISCUSSION	DR
	0	13/08/16	ISSUED FOR DISCUSSION	SS

Canadian Natural

Primrose 09-21-067-04 W4M

Bathymetry

Date: Aug 2013 | Project: 8881-WMSP-13 | Technical: A. Rhodes | Reviewer: H. de Pennart | Drawn: G. Evenson

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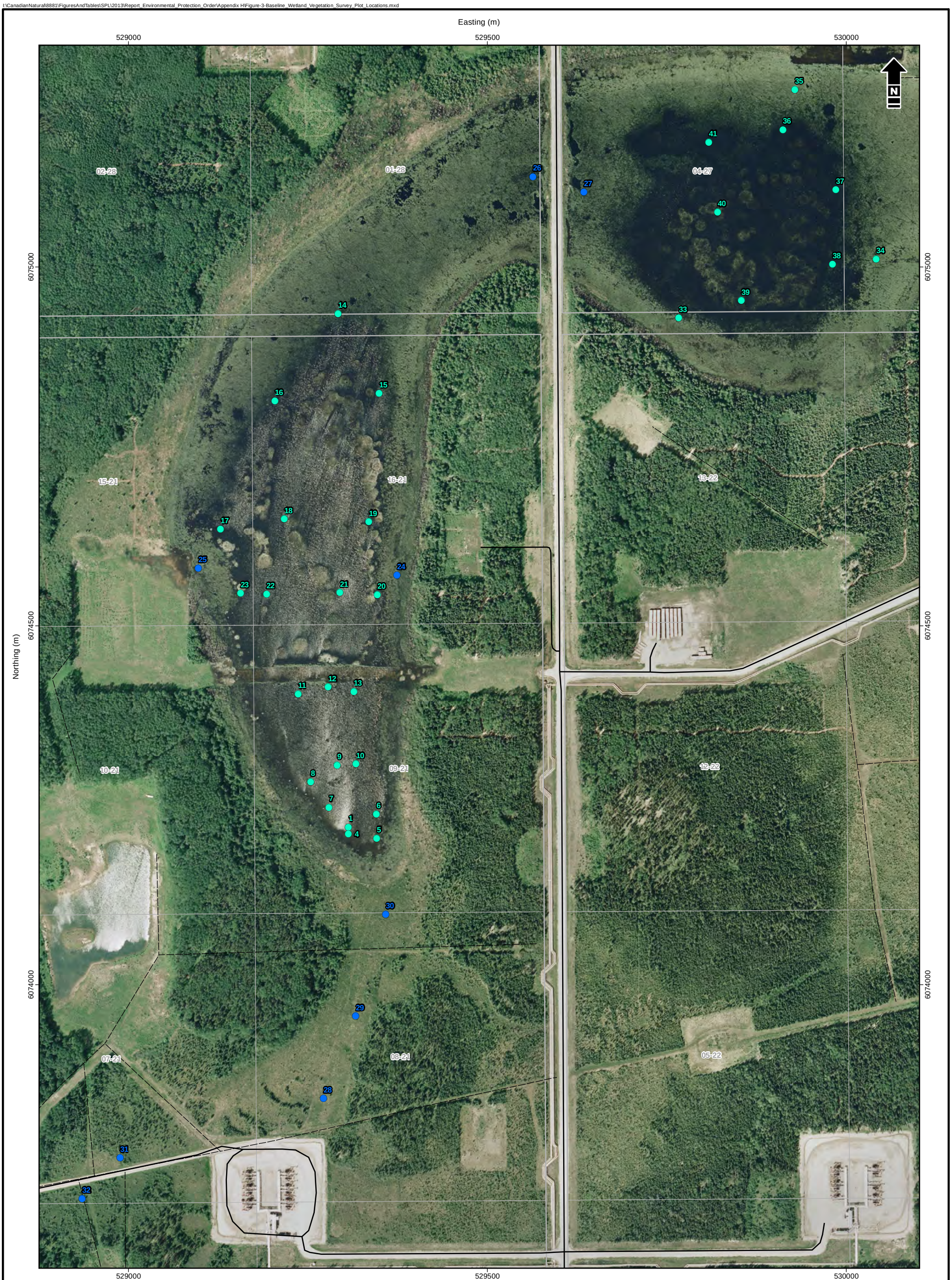
Figure 2

I:\CanadianNatural\8881\FiguresAndTables\SPL\2013\Report_Environmental_Protection_Order\Appendix H\Figure-3-Baseline_Wetland_Vegetation_Survey_Plot_Locations.mxd



Road
Cut Line
1 m^2 plots
10 x 20 m plots

1:5,000
m
50 0 50 100
NAD 1983 UTM Zone 12N

Reference: Data obtained from AltaLIS © Government of Alberta and transportation infrastructure data provided by IHS © 2013 used under license. Imagery obtained from client dated August 2010.

Canadian Natural

Canadian Natural Ltd.
Primrose 09-21-067-04W4M

Baseline Wetland Vegetation Survey Plot Locations

Date:	Project:	Technical:	Reviewer:	Drawn:
30 Oct 2013	8881-523	A. Rhodes	H. de Pennart	R. Keller

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Figure 3

I:\CanadianNatural\8881\FiguresAndTables\SPL\2013\Report_Environmental_Protection_Order\Appendix H\Figure-4-Baseline_Wetland_Zone_Areas.mxd

Easting (m)

528500 529000 529500 530000

Northing (m)

6075500 6075000 6074500 6074000 6073500

Submergent Macrophyte Zone Total Area = 23.4 ha

Emergent Macrophyte Zone Total Area = 29.3 ha

Treed Fen Total Area = 24.9 ha

06-28 07-28 08-28 05-27 03-27

03-28 02-28 01-28 04-27

14-21 15-21 16-21 13-22 14-22

11-21 10-21 09-21 12-22 11-22

2-1 67-4-W4

06-21 07-21 08-21 05-22 06-22

03-21 02-21 01-21 04-22 03-22

14-16 15-16 16-16 13-15 14-15

N

- Emergent Macrophyte Zone
- Submergent Macrophyte Zone
- Treed Fen
- Road
- Cut Line

1:7,500

75 0 75 150 m

NAD 1983 UTM Zone 12N

Reference: Data obtained from AltaLIS © Government of Alberta and transportation infrastructure data provided by IHS © 2013 used under license. Imagery obtained from client dated August 2010.

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Primrose 09-21-067-04W4M

Baseline Wetland Zone Areas

Date:	Project:	Technical:	Reviewer:	Drawn:
30 Oct 2013	8881-523	A. Rhodes	H. de Pennart	R. Keller

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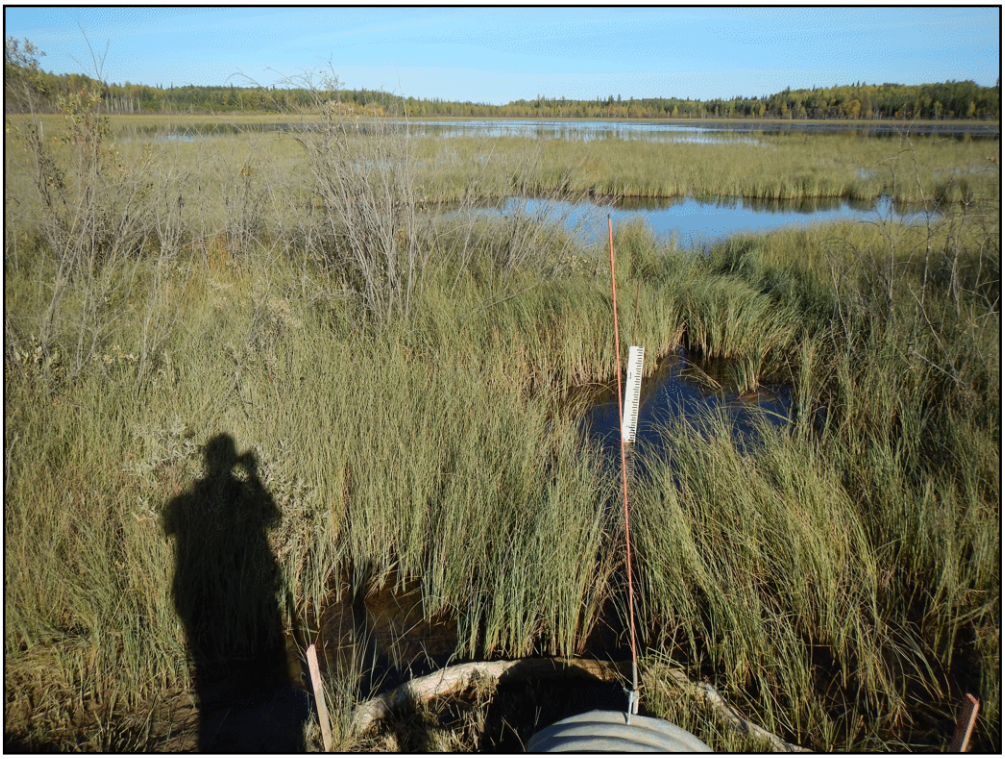
Figure 4

APPENDIX A
SITE PHOTOGRAPHS



1. Facing northeast towards Basin 4 - September 19, 2013.

2. Facing southwest toward Basin 3 - September 19, 2013.

3. Soft-stemmed bulrush (*Scirpus validus*) bed in Basin 4 - October 9, 2013.

4. Floating Pondweed (*Potamogeton natans*) in Basin 3 - September 20, 2013.

5. Aquatic moss in Basin 1 - September 20, 2013.

6. Facing northwest toward Basin 1; typical poor fen vegetation - September 19, 2013.

7. Typical downstream fen area vegetation; showing evidence of senecscence - September 19, 2013.

8. Facing north toward Basin 1; showing argo track - September 19, 2013.

9. Argo track in downstream fen area; showing regrowth of forbs - September 19, 2013.

APPENDIX B

DETAILED VEGETATION PLOT DATA

Table B1 Vegetation Species Percent Cover for Water Body Basins 1 and 3

Plant Species	Plot #																	
	Basin 1											Basin 3						
	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Carex aquatilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex lasiocarpa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carex utriculata	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
Equisetum fluviatile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lemna minor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myriophyllum sibiricum	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
Polygonum amphibium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamogeton Richardsonii	-	-	-	-	30	5	5	90	15	15	80	-	-	-	-	5	-	5
Potamogeton natans	-	-	-	-	-	-	-	-	-	-	-	40	45	15	30	-	5	30
Potamogeton zosteriformis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scirpus validus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sparganum fluctuans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utricularia intermedia	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Utricularia vulgaris	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	1	-
Chara sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryophyte sp.	100	100	100	100	70	95	95	45	15	80	30	-	1	-	-	-	-	-
Water Depth (cm)	100	100	100	100	-	-	138	138	-	-	-	-	140	133	137	160	133.5	107.5
Total Cover	100	100	100	100	100	100	100	135	30	95	110	50	50	15	30	5	6	35

Notes:
- = not present

Table B2 Vegetation Species Percent Cover for Water Body Basins 3 and 4

Plant Species	Plot #															
	Basin 3						Basin 4									
	21	22	23	24	25	26	27	33	34	35	36	37	38	39	40	41
Carex aquatilis	-	-	-	10-25	10-25	25	10-25	20-50	20-50	20-50	-	-	-	-	-	-
Carex lasiocarpa	-	-	-	2-5	< 2	+	-	+	-	-	-	-	-	-	-	-
Carex utriculata	-	-	-	10-25	25-50	25	10-25	20-50	20-50	20-50	-	-	-	-	-	-
Equisetum fluviatile	-	-	-	2-5	-	-	-	-	-	-	-	-	-	-	-	-
Lemna minor	-	-	-	-	-	-	5-10	-	-	-	-	-	-	-	-	-
Myriophyllum sibiricum	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Polygonum amphibium	-	-	-	2-5	-	-	-	-	-	-	-	-	-	-	-	-
Potamogeton natans	5	-	40	-	2-5	+	-	-	-	-	40	35	5	75	80	30
Potamogeton Richardsonii	1	-	40	-	-	+	-	-	-	-	-	-	-	-	-	-
Potamogeton zosteriformis	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scirpus validus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Sparganum fluctuans	-	-	-	< 2	-	-	-	-	-	-	-	-	-	-	-	-
Utricularia vulgaris	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Utricularia intermedia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chara sp.	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryophyte sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Depth (cm)	150	131	126	60	66	80	-	60	50	50	192	191	187	190	190	150
Total Cover	6	16	80	30	47	50	40	40	40	40	40	35	5	75	80	30

Notes:
- = not present

Table B3 Vegetation Species Inventory by Cover Class for the Downstream Fen Area

Species	Strata [a]	Plot # [b]				
		2	3	4	6	8
Larix laricina	T1	1	-	-	2	1
Picea mariana	T1	-	-	-	1	-
Larix laricina	S1	1	-	-	2	2
	S2	-	-	-	-	1
Picea mariana	S1	1	-	-	2	2
	S2	1	1	2	1	1
	S3	1	-	1	-	1
Salix spp.	S1	-	-	-	4	4
	S2	-	-	-	3	1
	S3	-	-	-	2	1
Betula pumila	S2	1	4	3	4	3
	S3	3	2	4	3	3
Andromeda polifolia	S3	2	1	2	-	-
Chamaedaphne calyculata	S2	-	-	2	-	-
	S3	2	-	4	4	3
Salix pedicellaris	S2	-	2	1	-	-
	S3	2	2	1	-	-
Ledum groenlandicum	S2	-	-	1	-	-
	S3	2	1	1	3	2
Potentilla palustris	F	1	-	1	2	2
Maianthemum canadense	F	1	-	-	-	-
Epilobium angustifolium	F	-	2	-	-	-
Equisetum fluviatile	F	-	2	2	1	-
Menyanthes trifoliata	F	-	-	2	-	-
Utriculata intermedia	F	-	-	2	-	-
Petasites sagittatus	F	-	-	-	2	3

Species	Strata [a]	Plot # [b]				
		2	3	4	6	8
Rubus pubescens	F	-	-	-	-	3
Calamagrostis canadensis	G	2	2	-	3	4
Carex aquatilis	G	2	2	2	-	-
Carex tenuiflora	G	2	1	2	-	-
Carex interior	G	2	1	-	-	-
Carex chordorrhiza	G	1	2	-	2	1
Carex limosa	G	-	1	-	-	-
Tomenthypnum nitens	M	4	4	-	-	-
Pleurozium schreberi	M	4	3	-	-	-
Aulacomnium palustre	M	3	3	3	-	-
Sphagnum riparium	M	3	-	3	6	6
Polytrichum strictum	M	-	1	-	-	-
Sphagnum fuscum	M	-	-	3	-	-
Dicranum undulatum	M	-	-	2	-	-
Sphagnum angustifolium	M	-	-	-	5	4

Notes:
- = not present
[a] = T1: Tree, S1: Tall Shrub, S2: Medium Shrub, S3: Low Shrub, F: Forb, G: Graminoid, M: Moss
[b] = Cover classes: 1 = < 2%, 2 = 2 - < 5%, 3 = 5 - < 10%, 4 = 10 - < 25%, 5 = 25 - < 50%, 6 = 50 - < 75%, 7 = 75 - < 95% and 8 = 75 - < 95%

APPENDIX C

FAUNA INVENTORY

Table C1 Bird Species Documented at the 09-21 Site to September 26, 2013

Species	
alder flycatcher	American coot
American crow	American goldfinch
American green-winged teal (AB – sensitive)	American kestrel (AB – sensitive)
American pipet	American robin
American white pelican (AB – sensitive)	American wigeon
bald eagle (AB – sensitive)	barn swallow (AB – sensitive; COSEWIC – threatened)
black tern (AB – sensitive)	black-and-white warbler
black-billed magpie	black-capped chickadee
blue-headed vireo	blue-winged teal
Bonaparte's gull	boreal chickadee
Bufflehead	California gull
Canada goose	canvasback
Cape May warbler (AB – sensitive)	cedar waxwing
chipping sparrow	clay-colored sparrow
common goldeneye	common grackle
common loon	common merganser
common raven	common yellowthroat (AB – sensitive)
Connecticut warbler	crossbill sp.
dark-eyed junco	double-crested cormorant
downy woodpecker	evening grosbeak
gadwall	golden-crowned kinglet
gray jay	great blue heron (AB – sensitive)
greater yellowlegs	greater white-fronted goose
green-winged teal	gull sp.
hairy woodpecker	hermit thrush
horned lark	killdeer
lapland longspur	Le Conte's sparrow
least sandpiper	least flycatcher (AB – sensitive)
lesser yellowlegs	lesser scaup (AB – sensitive)
long-billed dowitcher	Lincoln sparrow
mallard	magnolia warbler
Nashville warbler	merlin
northern flicker	northern shoveler
northern harrier (AB – sensitive)	northern goshawk (AB – sensitive)
orange-crowned warbler	northern waterthrush
palm warbler	ovenbird
pied-billed grebe (AB – sensitive)	Philadelphia vireo
pine grosbeak	pileated woodpecker (AB – sensitive)
purple finch	pine siskin

Species	
red-breasted merganser	red-breasted nuthatch
red-necked grebe	red-eyed vireo
red-winged blackbird	red-tailed hawk
ring-necked duck	Ross's goose
ruffed grouse	ruby-crowned kinglet
sandhill crane (AB – sensitive)	rusty blackbird (AB – sensitive; COSEWIC – special concern; SARA – Schedule 1)
semipalmated plover	savannah sparrow
sharp-shinned hawk	semipalmated sandpiper
snow goose	short-billed dowitcher
song sparrow	solitary sandpiper
spotted sandpiper	sora (AB – sensitive)
swamp sparrow	Swainson's thrush
three-toed woodpecker	Tennessee warbler
warbling vireo	tree swallow
white-throated sparrow	western wood-pewee (AB – sensitive)
woodpecker sp.	white-winged crossbill
Wilson's snipe	winter wren
yellow warbler	yellow-rumped warbler

Notes:
Data from Canadian Natural Resources Limited (2013)
AB: Alberta
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
SARA: *Species at Risk Act*

Table C2 Frog Species Documented at the 09-21 Site to September 26, 2013

Species
boreal chorus frog
wood frog

Notes:
Data from Canadian Natural (2013)

Table C3 Mammal Species Documented at the 09-21 Site to September 26, 2013

Species
American beaver
black bear
Canada lynx (AB – sensitive)
coyote
deer sp.
gray wolf
east chipmunk
meadow vole
moose
mule deer
muskrat
red squirrel
red-backed vole
snowshoe hare
vole sp.
white-tailed deer
woodchuck
woodland caribou (AB – at risk; COSEWIC – threatened; SARA – Schedule 1)

Notes:
Data from Canadian Natural (2013)
AB: Alberta
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
SARA: *Species at Risk Act*