

MONTHLY UPDATE REPORT - PRIMROSE SOUTH 09-21-067-04 W4M

APRIL 21 TO MAY 18, 2015

1 Introduction

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 discovered a bitumen emulsion flow to surface (FTS) area at 09-21-067-04 W4M on June 24, 2013. The bitumen emulsion FTS area is beneath an unnamed water body within the Canadian Natural Primrose South production area.

On September 24, 2013, Alberta Environment and Sustainable Resource Development (ESRD) issued an Environmental Protection Order (EPO No. EPO-2013-33/NR), requesting the preparation of a Comprehensive Remedial Plan (CRP), as well as the preparation of a monthly progress report. This report addresses the requirement of the progress report, summarizes the progress towards the realization of the CRP, and includes data collected and reported between April 21 and May 18, 2015.

2 Summary of Activities to Date

2.1 Individual Plan Submissions

As required by the EPO, the CRP includes the development, submission, and implementation of several specific plans. As of May 18, 2015, the status of these plans has not changed.

3 Water Body Monitoring

In accordance with the Water Body Restoration Plan, an extensive water quality and water quantity monitoring program was implemented on March 19, 2014. This program complements the ongoing water quality and quantity monitoring implemented in June 2013.

Details of the monitoring program are provided in the following subsections.

3.1 Water Quantity Monitoring

3.1.1 Basins 1, 3, and 4, Borrow Pit, and Downstream Fen

Staff gauge and water level monitoring locations are shown on Figure 1. The water levels measured from the staff gauge readings for Basins 3 and 4 are in Appendix A1, and water levels for the downstream fen and the borrow pit are in Appendix A2. The water level within Basin 3 is consistent with readings from June to October 2014 (699.67 +/- 0.1 metres above sea level [masl]); whereas, the water level within Basin 4 is slightly higher compared to 2014 water levels (699.79 m asl) in May, 2015 compared to 699.55 m asl from June to October, 2014). The water levels within the downstream fen have been consistent from June, 2014 to May, 2015 (within +/- 0.1 m asl). Monitoring of water levels from within the centre of Basin 3 (13-SG6) and from within the borrow pit (13-SG13) was discontinued as the staff gauges had been removed in winter 2014.

3.2 Water Quality Monitoring

Water quality was compared to ESRD's *Environmental Quality Guidelines for Alberta Surface Waters* (ESRD 2014). Sampling locations are shown on Figure 2.

3.2.1 Basins 1, 3, and 4 and Downstream Fen

Water quality samples were collected on May 5, 2015 from the surface water sampling sites in Basins 1, 3, and 4, and the downstream fen (Figure 2). The samples were tested to confirm that water quality in the water body remains within applicable guideline levels. Water quality results are provided in Appendix B.

- Laboratory analysis of water samples was carried out for benzene, toluene, ethylbenzene, and xylenes (BTEX); petroleum hydrocarbons (PHCs) fraction 1 (F1; C₆-C₁₀, excluding BTEX); and polycyclic aromatic hydrocarbons (PAHs).
 - ✦ All water quality results were within applicable guidelines.

3.2.2 Within Containment Structure and/or Trench Beneath Access Pad

The containment structure area is now flooded and considered to be part of the water body. Water quality samples were collected from within the flooded containment structure (14-SW81) and from within the water collection trench located beneath the access pad (East Sump, C2). The trench water was tested to confirm that the quality of water seeping into the trench from the water body was adequate to be pumped directly back into the water body (Figure 3). Water quality results are provided in Appendix B.

- Laboratory analysis of water samples was carried out for BTEX, F1, fraction 2 (C_{>10}-C₁₆), fraction 3 (C_{>16}-C₃₄), Fraction 4 (C_{>34}), and PAHs.
 - ✦ All water quality results were within applicable guidelines.

3.3 Aquatic Surveillance

Monitoring for bitumen emulsion and sheen within the water body was discontinued on November 8, 2014 due to freezing conditions and restarted May 13, 2015. Weekly monitoring will be conducted for the first month, and then monthly monitoring will be implemented. One monitoring event was conducted during the reporting period and five occurrences of bitumen emulsion sheen (less than 30 × 30cm [paper towel size] each) and/or pellets (small pea-sized globules) were noted. Over the reporting period, less than 5 mL (1 teaspoon) of bitumen emulsion has been collected from Basins 1 and 3. The sheens were removed using absorbent sheets and the pellets were collected for disposal in the onsite hazardous waste bin. Three occurrences were located beside the containment wall and the other two were near the shore. The specific locations are shown in Figure 4. The source of the sheen and pellets was likely small amounts of material that remained in the water body after the original clean-up in 2013 and 2014.

3.4 Erosion and Sedimentation Prevention

No activities taking place during the reporting period were expected to cause erosion or sedimentation issues and no monitoring activities were completed.

3.5 Bitumen Emulsion Containment

Construction of the fissure containment structure (FCS) is complete and regular monitoring of the bitumen emulsion recovery pipes is ongoing. No bitumen emulsion was recovered during this reporting period; however, some fluid (water) was removed from the FCS and taken to Tervita Lindbergh for disposal. No bitumen emulsion was observed in the recovery sumps of the water collection trench that is located at the base of the access pad or in the shallow monitoring wells screened in the clay soils beneath the access pad during this reporting period.

3.6 Wildlife Management

No injured, distressed, or deceased wildlife were observed within or around the water body during this reporting period.

3.7 Waste Management

The recovery of fluids from the FCSs began on December 19, 2014. A small volume of fluid was recovered from the FCSs during this reporting period.

4 Summary

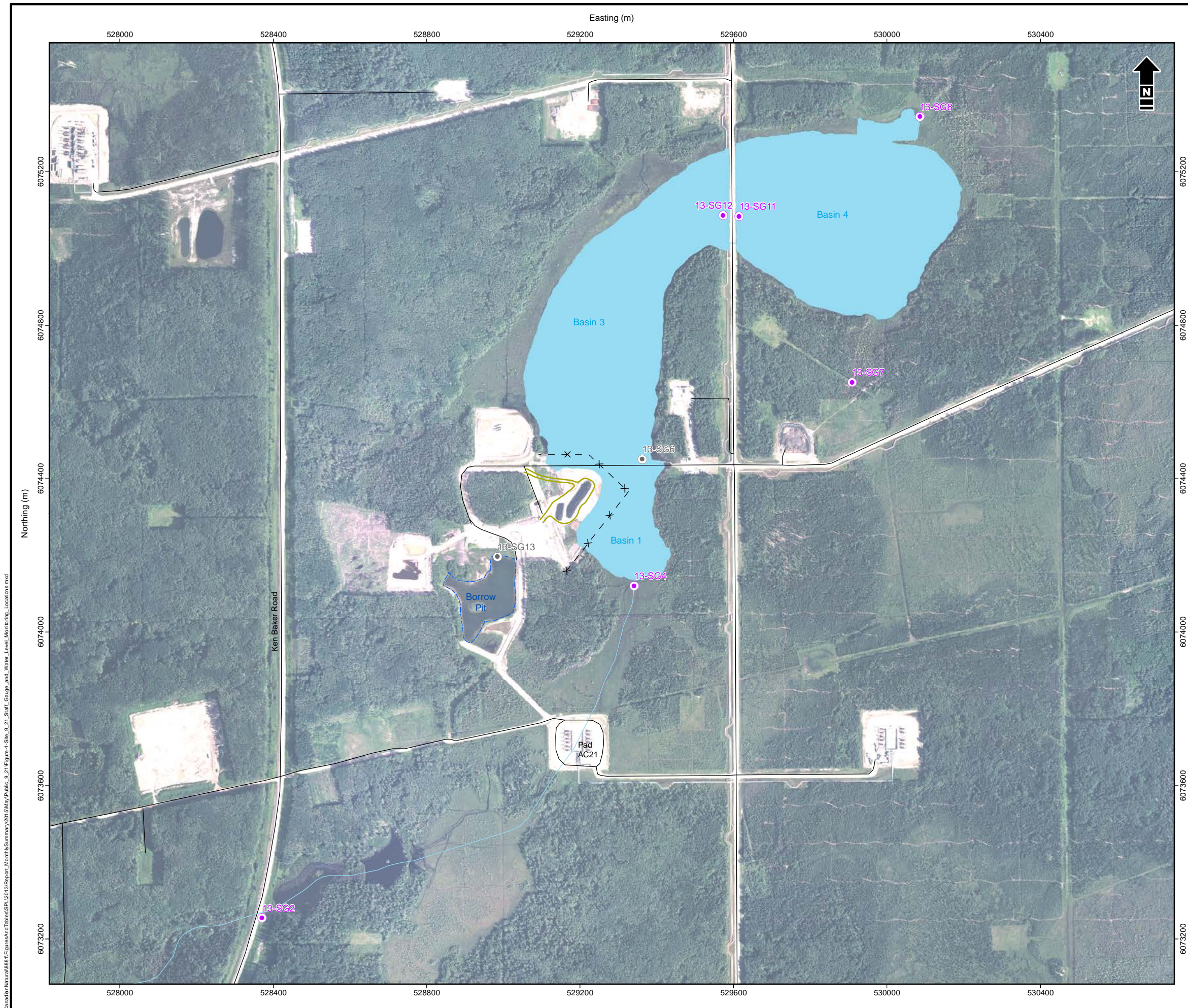
Monthly monitoring was completed at the 9-21 FTS site from April 21 to May 18, 2015. The following additional scheduled activities were also completed over the reporting period:

- surface water sampling in the water body
- water level readings in the water body
- bitumen emulsion monitoring on the water body
- pumping fluids from the FCSs

The work completed at the 9-21 site over this reporting period was routine and scheduled. The findings were as anticipated and were consistent with those for the previous reporting period.

5 Reference

Alberta Environment and Sustainable Resource Development (ESRD). 2014. *Environmental Quality Guidelines for Alberta Surface Waters*. Water Policy Branch, Policy Division. Edmonton, Alberta. July 14, 2014. ISBN: 978-1-4601-1524-4.
<http://esrd.alberta.ca/water/education-guidelines/documents/EnvironmentalQualitySurfaceWaters-Jul14-2014.pdf>



- Borrow Pit
- Water Body
- Watercourse
- Road
- Containment Wall
- Top of Access Pad
- Staff Gauge Location
- Staff Gauges which were removed in Winter 2014

Reference: Data obtained from Atlas LIS © Government of Alberta and GeoBase® used under license. GDM transportation infrastructure data provided by #HS © 2015 used under license. Site features provided through Matrix Solutions Inc. field efforts. Imagery (dated August 2014) obtained from Canadian Natural Resources Limited (September 2014) used under license.

1:10,000

 50 0 50 100
 NAD 1983 UTM Zone 12N



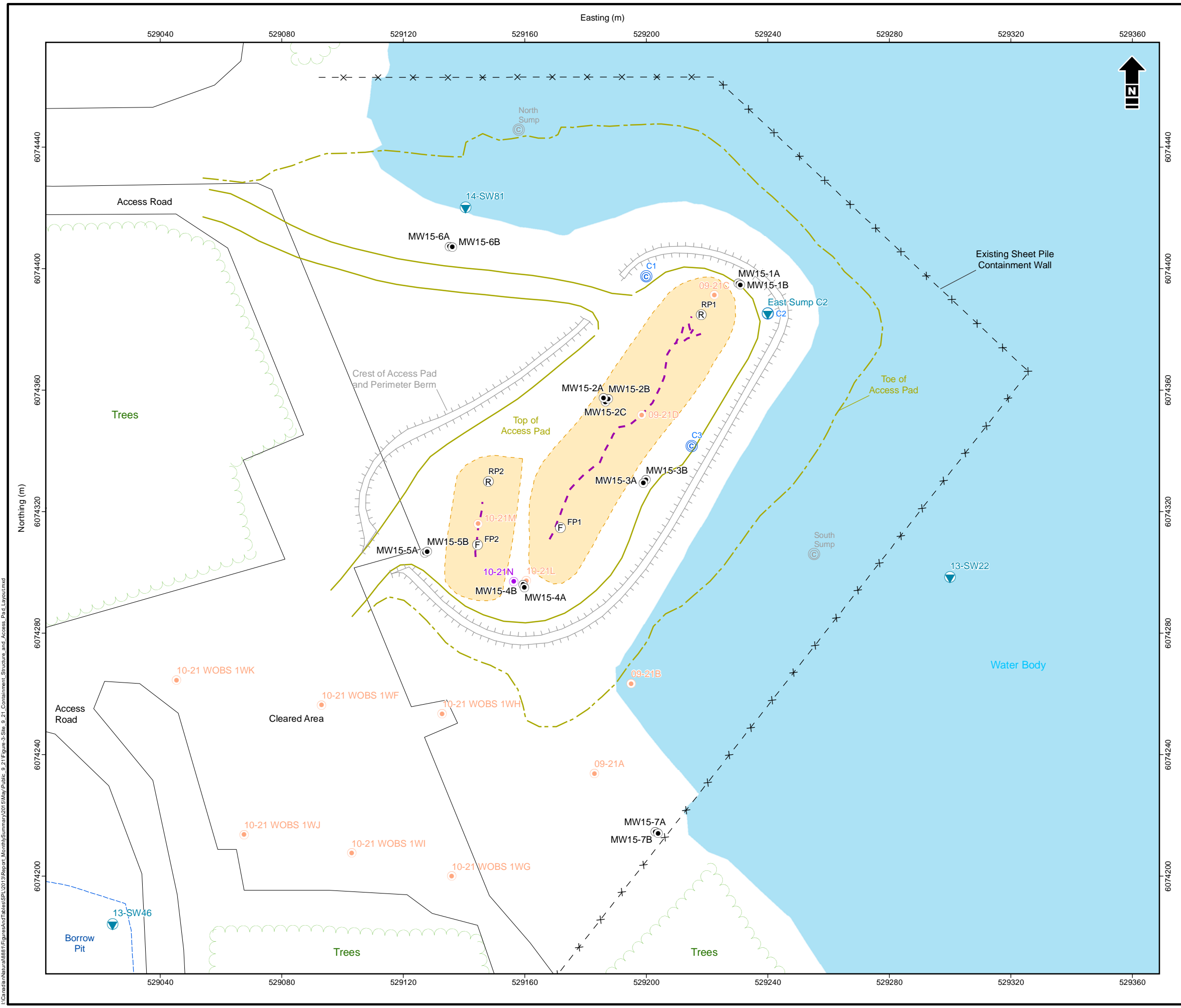
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 Primrose 09-21-067-04 W4M

Site 9-21 Staff Gauge and Water Level Monitoring Locations

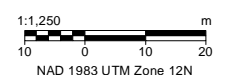
Date: 21 May 2015 Project: 8881-523 Technical: A. Ward Reviewer: P. Hum Drawn: R. Keller

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I:\CanadianNatural\8881\Figures\Figures\Figures\SR\2013\Report_MonthlySummary\2015\May\Public_9-21\Figure 1_Site_9-21_Staff_Gauge_and_Water_Level_Monitoring_Locations.mxd



- Fissure Containment Structure
- Borrow Pit
- Water Body
- Berm
- Containment Wall
- Fissure within Containment Structure
- Top of Access Pad
- Toe of Access Pad
- Bitumen Emulsion Recovery Pipe
- Flush Pipe
- Former Sump with Automated Pump
- Surface Water Sample Location
- Water Collection Trench Recovery Sump
- Phase II Shallow Monitoring Well
- Deep Quaternary Monitoring Well (Screened Formation)
- Ethel Lake Formation Monitoring Well
- Sand River Formation Monitoring Well



Reference: Site features provided through Matrix Solutions Inc. field efforts.



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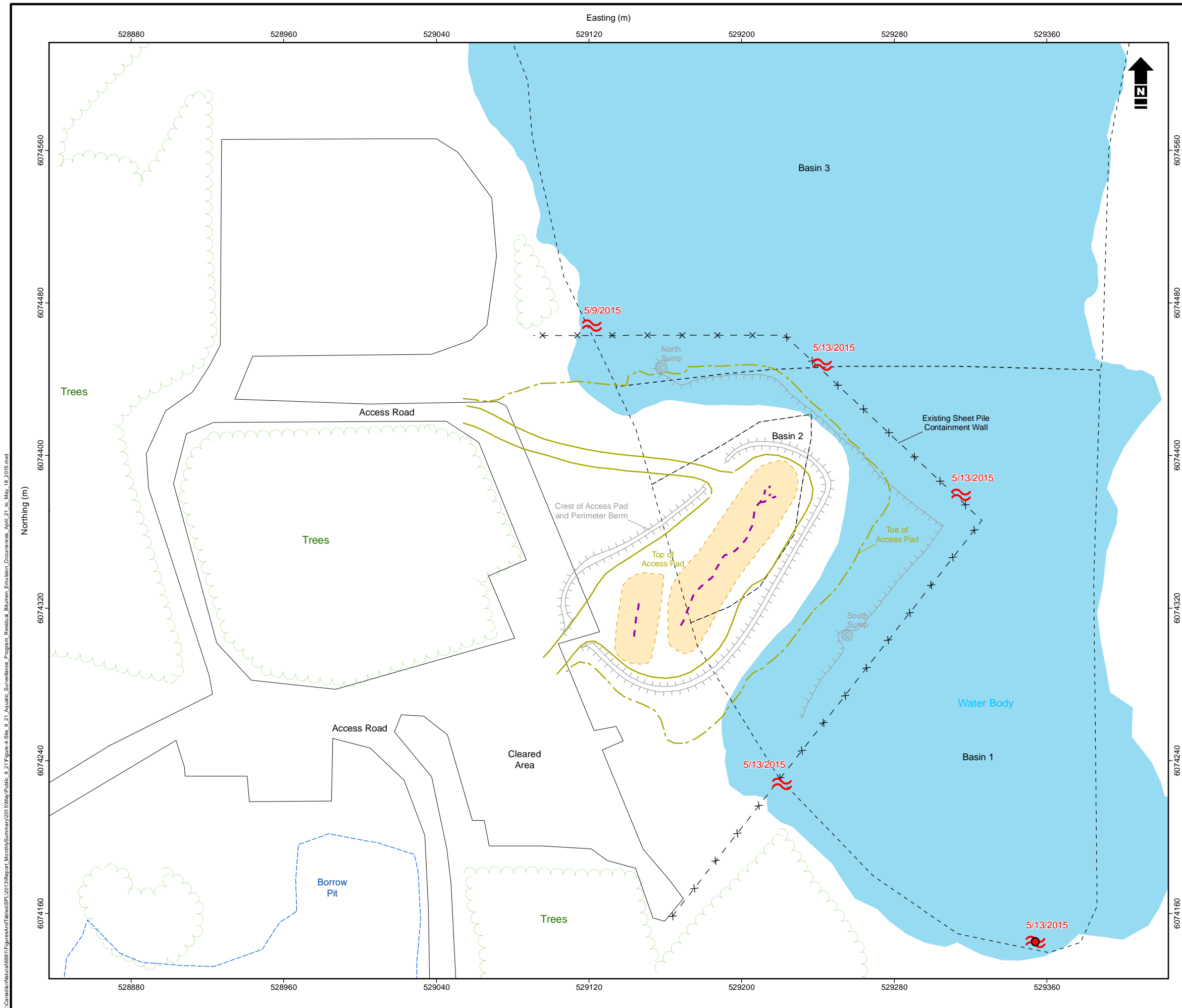
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Primrose 09-21-067-04 W4M

**Site 9-21 Containment Structure
and Access Pad Layout**

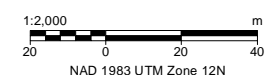
Date: 21 May 2015	Project: 8881-523	Technical: A. Ward	Reviewer: P. Hum	Drawn: R. Keller
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I:\Canadian Natural\8881\Figures\Figures\Figures\2015\May\Public_9_21\Figure 9_Site_9_21_Containment_Structure_and_Access_Pad_Layout.mxd



- Fissure Containment Structure
- Basin Boundary
- Borrow Pit
- Water Body
- Berm
- Containment Wall
- Fissure within Containment Structure
- Top of Access Pad
- Toe of Access Pad
- Former Sump with Automated Pump
- Hydrocarbon Sheen Detected
- Bitumen Emulsion Pellets Detected



Reference: Site features provided through Matrix Solutions Inc. field efforts.

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Primrose 09-21-067-04 W4M

**Site 9-21 Aquatic Surveillance Program:
Residual Bitumen Emulsion Occurrences
(April 21 to May 18, 2015)**

Date: 29 May 2015	Project: 8881-523	Technical: A. Ward	Reviewer: P. Hum	Drawn: R. Keller
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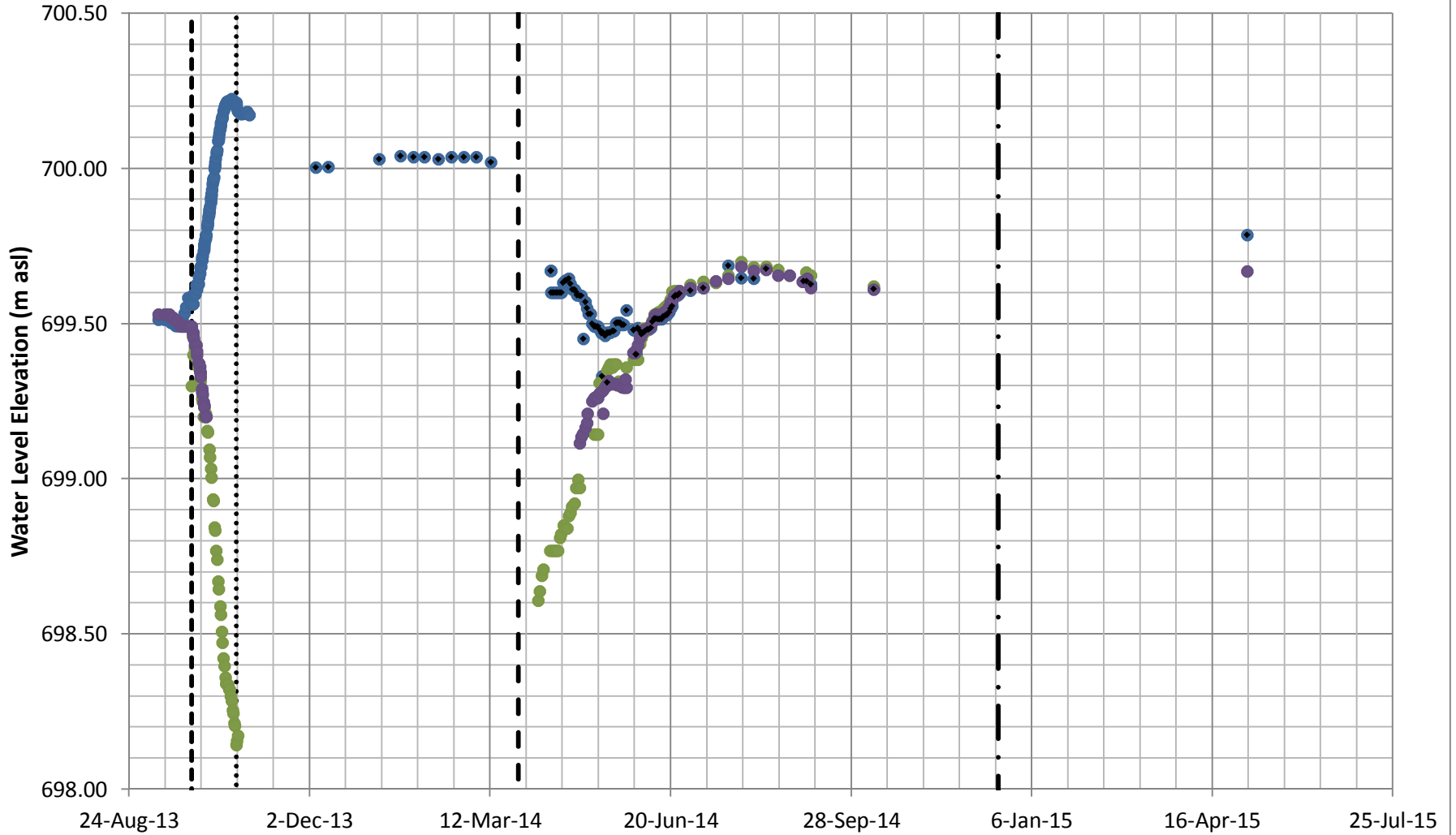
Figure 4

I:\Canadian Natural\8881\Figures and Tables\SR\09-21\Report_MonthlySummary\2015\May\Public_9-21\Figure 4_Site_9-21_Aquatic_Surveillance_Program_Residual_Bitumen_Emulsion_Occurrences_April_21_to_May_18_2015.mxd

APPENDIX A

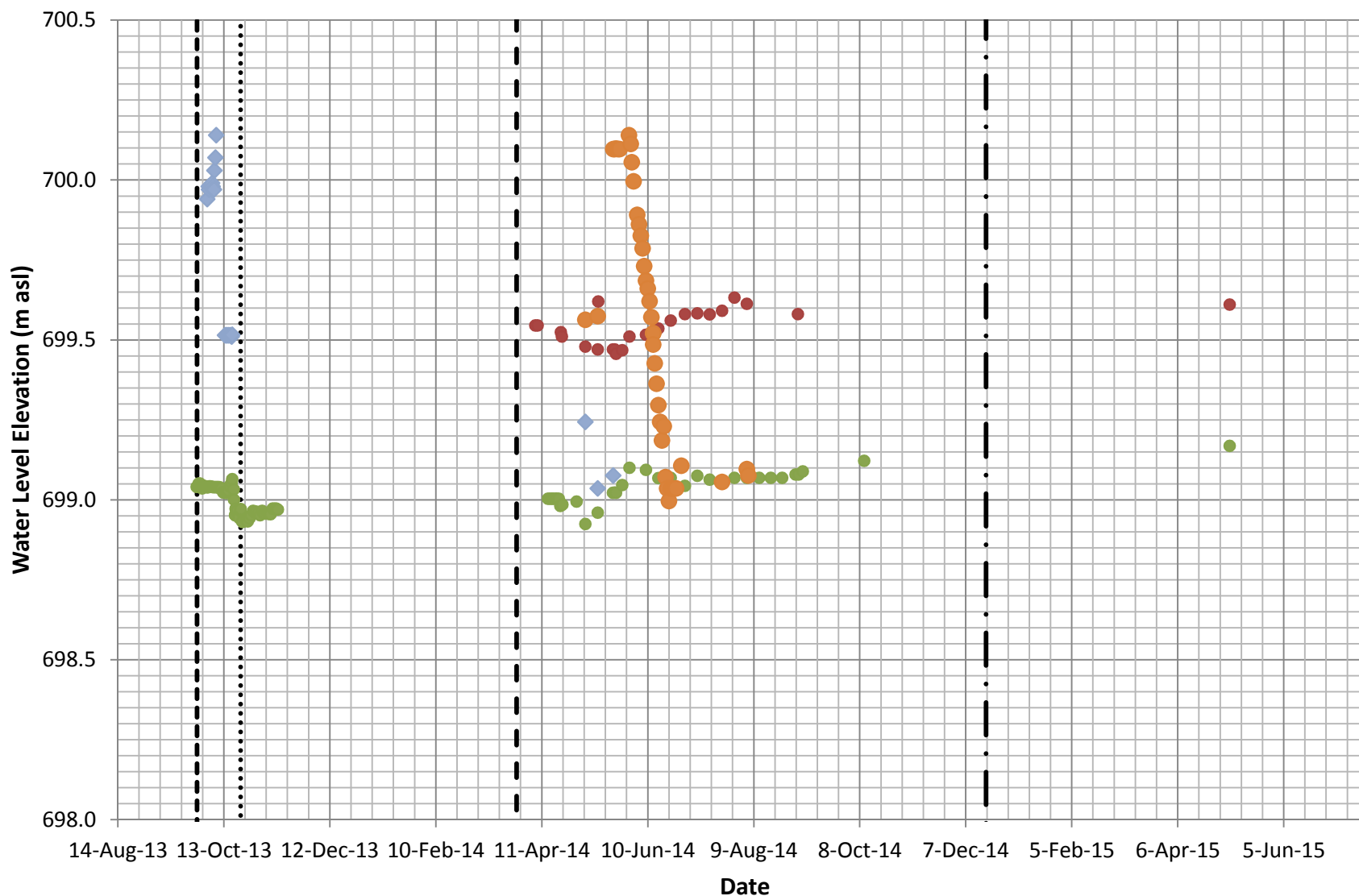
Water Levels

Appendix A1: Water Levels at 9-21 Water Body



- | | |
|--|-------------------------------|
| ● SG11- Basin 4 at East Ladder Rd | ● SG6- Basin 3- Centre |
| ● SG12 N-S East Ladder Road at Basin 3 | --- Dewatering Period - Start |
| Dewatering Period - End | --- Refilling Period- Start |
| — Wall Reinforcement & Containment Wall Flooding - Start | ◆ Basin 4- surveyed level |
| ◆ Basin 3- surveyed level | |

Appendix A2: Water Levels in the Downstream Fen and Borrow Pit



● SG2- Fen at Ken Baker Road (+3m)

◆ Borrow Pit - Surveyed Data (-1 m)

— Refilling Period - Start

● SG4- Fen, South of Basin 1

--- Dewatering Period - Start

— • Wall Reinforcement and Containment Wall Flooding - Start

● SG13- Borrow Pit (-1m)

..... Dewatering Period - End

APPENDIX B

Water Quality Results

APPENDIX B1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 W4M

Sample Point	Sample Date	MSI Sample Number	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	F1 C ₆ -C ₁₀ - BTEX mg/L	F2 C _{>10} -C ₁₆ mg/L	F3 C _{>16} -C ₃₄ mg/L	F4 C _{>34} -C ₅₀ mg/L
Surface Water Samples										
13-SW12	19-Mar-14	08881140319312	<0.0004	0.0044	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12	27-Mar-14	08881140327003	<0.0004	0.0085	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12	01-Apr-14	08881140401001	<0.0004	0.0006	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12	08-Apr-14	08881140408312	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12	15-Apr-14	08881140415312	<0.0004	0.0180	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12	22-Apr-14	08881140422312	<0.0004	0.0040	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12	29-Apr-14	08881140429312	<0.0004	0.0140	<0.0004	<0.0008	<0.1	<0.1	---	---
13-SW12	22-May-14	08881140522001	<0.00040	0.00055	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW12	27-May-14	08881140527312	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW12	02-Jun-14	08881140602312	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW12	09-Jun-14	08881140609312	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW12	16-Jun-14	08881140616312	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW12	23-Jun-14	08881140623312	<0.00040	0.00130	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW12	01-Jul-14	08881140701312	<0.00040	<0.0020	<0.00040	<0.0040	<0.10	<0.10	---	---
13-SW12	08-Jul-14	08881140708312	<0.00040	0.00170	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW12	05-Aug-14	08881140805312	<0.00040	0.00380	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW12	02-Sep-14	08881140902312	<0.00040	0.01100	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW12	09-Oct-14	08881141009312	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	---	---
13-SW12a	06-May-14	08881140506312	<0.0004	0.0060	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW12a	13-May-14	08881140513312	<0.00040	0.00120	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW12a	20-May-14	08881140520312	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW12a	05-May-15	08881150505006	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
13-SW12b	06-May-14	08881140506346	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW12b	13-May-14	08881140513313	<0.00040	0.00096	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW12c	20-May-14	08881140520313	<0.00040	0.00042	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
ESRD Freshwater Aquatic Life*			0.04	0.0005	0.09	0.03	NSST	NSST	NS	NS
ESRD Agriculture - Irrigation*			NS	NS	NS	NS	NS	NS	NS	NS
ESRD Agriculture - Livestock*			NS	0.024	0.0024	NS	NS	NS	NS	NS

APPENDIX B1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 W4M

Sample Point	Sample Date	MSI Sample Number	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	F1 C ₆ -C ₁₀ - BTEX mg/L	F2 C _{>10} -C ₁₆ mg/L	F3 C _{>16} -C ₃₄ mg/L	F4 C _{>34} -C ₅₀ mg/L
Surface Water Samples										
13-SW16	13-May-14	08881140513316	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW16	20-May-14	08881140520316	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW16	27-May-14	08881140527316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW16	02-Jun-14	08881140602316	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW16	09-Jun-14	08881140609316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW16	16-Jun-14	08881140616316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	23-Jun-14	08881140623316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	01-Jul-14	08881140701316	<0.00040	<0.0020	<0.00040	<0.0040	<0.10	<0.10	---	---
13-SW16	08-Jul-14	08881140708316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	15-Jul-14	08881140715316	<0.00040	0.00068	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	22-Jul-14	08881140722316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	29-Jul-14	08881140729316	<0.00040	0.00064	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	05-Aug-14	08881140805316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	12-Aug-14	08881140812316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	18-Aug-14	08881140818316	<0.0004	<0.0004	<0.0004	<0.0008	<0.10	<0.10	---	---
13-SW16 dup	18-Aug-14	08881140818531	<0.0004	<0.0004	<0.0004	<0.0008	<0.10	<0.10	---	---
13-SW16	25-Aug-14	08881140825316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	02-Sep-14	08881140902316	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW16	09-Oct-14	08881141009316	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	---	---
13-SW16	05-May-15	08881150505005	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
13-SW22	01-Apr-14	08881140401002	<0.0004	0.00230	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW22	08-Apr-14	08881140408322	<0.0004	0.00084	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW22	15-Apr-14	08881140415322	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW22	22-Apr-14	08881140422322	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW22	29-Apr-14	08881140429322	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	---	---
13-SW22	06-May-14	08881140506322	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW22	13-May-14	08881140513322	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW22	20-May-14	08881140520322	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW22	27-May-14	08881140527322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW22	02-Jun-14	08881140602322	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW22	09-Jun-14	08881140609322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW22	16-Jun-14	08881140616322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW22	23-Jun-14	08881140623322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW22	01-Jul-14	08881140701322	<0.00040	<0.0020	<0.00040	<0.0040	<0.10	<0.10	---	---
13-SW22	08-Jul-14	08881140708322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW22	05-Aug-14	08881140805322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW22	02-Sep-14	08881140902322	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW22	09-Oct-14	08881141009322	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	---	---
13-SW22	07-May-15	08881150507008	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
ESRD Freshwater Aquatic Life*			0.04	0.0005	0.09	0.03	NSST	NSST	NS	NS
ESRD Agriculture - Irrigation*			NS	NS	NS	NS	NS	NS	NS	NS
ESRD Agriculture - Livestock*			NS	0.024	0.0024	NS	NS	NS	NS	NS

APPENDIX B1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 W4M

Sample Point	Sample Date	MSI Sample Number	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	F1 C ₆ -C ₁₀ - BTEX mg/L	F2 C _{>10} -C ₁₆ mg/L	F3 C _{>16} -C ₃₄ mg/L	F4 C _{>34} -C ₅₀ mg/L
Surface Water Samples										
13-SW26	13-May-14	08881140513326	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	0.23	<0.20
13-SW26	20-May-14	08881140520326	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW26	27-May-14	08881140527326	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW26	02-Jun-14	08881140602326	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW26	09-Jun-14	08881140609326	<0.00040	0.00290	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW26	16-Jun-14	08881140616326	<0.00040	0.00100	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	23-Jun-14	08881140623326	<0.00040	0.00150	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	01-Jul-14	08881140701326	<0.00040	0.00670	<0.00040	<0.0040	<0.10	<0.10	---	---
13-SW26	08-Jul-14	08881140708326	<0.00040	0.00500	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	15-Jul-14	08881140715326	<0.00040	0.00450	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26 dup	15-Jul-14	08881140715426	<0.00040	0.00370	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	22-Jul-14	08881140722326	<0.00040	0.00130	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	29-Jul-14	08881140729326	<0.00040	0.00120	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	05-Aug-14	08881140805326	<0.00040	0.00190	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	12-Aug-14	08881140812326	<0.00040	0.00320	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	18-Aug-14	08881140818326	<0.0004	0.00540	<0.0004	<0.0008	<0.10	<0.10	---	---
13-SW26	19-Aug-14	08881140819326	<0.0004	0.00160	<0.0004	<0.0008	<0.10	---	---	---
13-SW26	25-Aug-14	08881140825326	<0.00040	0.00094	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	02-Sep-14	08881140902326	<0.00040	0.00280	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW26	09-Oct-14	08881141009326	<0.0004	0.00170	<0.0004	<0.0008	<0.1	<0.10	---	---
13-SW26	16-Oct-14	08881141016001	<0.0004	0.01600	<0.0004	<0.0008	<0.1	---	---	---
13-SW26	05-May-15	08881150505004	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
13-SW27	13-May-14	08881140513327	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW27	20-May-14	08881140520327	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW27	27-May-14	08881140527327	<0.00040	0.00100	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW27	02-Jun-14	08881140602327	<0.0004	0.00140	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW27	09-Jun-14	08881140609327	<0.00040	0.00096	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW27	16-Jun-14	08881140616327	<0.00040	0.00100	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	23-Jun-14	08881140623327	<0.00040	0.00270	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	01-Jul-14	08881140701327	<0.00040	0.00210	<0.00040	<0.0040	<0.10	<0.10	---	---
13-SW27	08-Jul-14	08881140708327	<0.00040	0.00170	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	15-Jul-14	08881140715327	<0.00040	0.00250	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	22-Jul-14	08881140722327	<0.00040	0.00170	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	29-Jul-14	08881140729327	<0.00040	0.00270	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	05-Aug-14	08881140805327	<0.00040	0.00110	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	12-Aug-14	08881140812327	<0.00040	0.01100	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW27	18-Aug-14	08881140818327	<0.0004	0.01600	<0.0004	<0.0008	<0.10	<0.10	---	---
13-SW27	19-Aug-14	08881140819327	<0.0004	0.00290	<0.0004	<0.0008	<0.10	---	---	---
13-SW27	25-Aug-14	08881140825327	<0.00040	0.04200	<0.00040	<0.00080	<0.18	<0.18	---	---
13-SW27	05-May-15	08881150505003	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
ESRD Freshwater Aquatic Life*			0.04	0.0005	0.09	0.03	NSST	NSST	NS	NS
ESRD Agriculture - Irrigation*			NS	NS	NS	NS	NS	NS	NS	NS
ESRD Agriculture - Livestock*			NS	0.024	0.0024	NS	NS	NS	NS	NS

APPENDIX B1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 W4M

Sample Point	Sample Date	MSI Sample Number	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	F1 C ₆ -C ₁₀ - BTEX mg/L	F2 C _{>10} -C ₁₆ mg/L	F3 C _{>16} -C ₃₄ mg/L	F4 C _{>34} -C ₅₀ mg/L
Surface Water Samples										
13-SW31	08-Apr-14	08881140408331	<0.0004	0.0011	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW31	15-Apr-14	08881140415331	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW31 dup	15-Apr-14	08881140415531	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW31	22-Apr-14	08881140422331	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW31 dup	22-Apr-14	08881140422531	<0.0004	0.00043	<0.0004	<0.0008	<0.1	<0.1	<0.2	<0.2
13-SW31	29-Apr-14	08881140429331	<0.0004	0.0017	<0.0004	<0.0008	<0.1	<0.1	---	---
13-SW31 dup	29-Apr-14	08881140429531	<0.0004	0.0150	<0.0004	<0.0008	<0.1	<0.1	---	---
13-SW31	06-May-14	08881140506331	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW31 dup	06-May-14	08881140506531	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	0.11	<0.20	<0.20
13-SW31	13-May-14	08881140513331	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW31 dup	13-May-14	08881140513531	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW31	20-May-14	08881140520331	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW31 dup	20-May-14	08881140520531	<0.00040	<0.00040	<0.00040	<0.00080	<0.1	<0.10	<0.20	<0.20
13-SW31	27-May-14	08881140527331	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW31 dup	27-May-14	08881140527531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW31	02-Jun-14	08881140602331	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW31 dup	02-Jun-14	08881140602531	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
13-SW31	09-Jun-14	08881140609531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW31 dup	09-Jun-14	08881140609331	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
13-SW31	16-Jun-14	08881140616331	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31 dup	16-Jun-14	08881140616531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	23-Jun-14	08881140623531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31 dup	23-Jun-14	08881140623331	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	01-Jul-14	08881140701331	<0.00040	<0.0020	<0.00040	<0.0040	<0.10	<0.10	---	---
13-SW31 dup	01-Jul-14	08881140701531	<0.00040	<0.0020	<0.00040	<0.0040	0.11	<0.10	---	---
13-SW31	08-Jul-14	08881140708331	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31 dup	08-Jul-14	08881140708531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	22-Jul-14	08881140722531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	29-Jul-14	08881140729531	<0.00040	0.00042	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	05-Aug-14	08881140805531	<0.00040	0.00520	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	12-Aug-14	08881140812531	<0.00040	0.00710	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	25-Aug-14	08881140825531	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	02-Sep-14	08881140902531	<0.00040	0.00110	<0.00040	<0.00080	<0.10	0.13	---	---
13-SW31 dup	02-Sep-14	08881140902331	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
13-SW31	09-Oct-14	08881141009531	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	---	---
13-SW31 dup	09-Oct-14	08881141009331	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	---	---
13-SW31	07-May-15	08881150507007	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
13-SW31 dup	07-May-15	08881150507009	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	---	---	---
ESRD Freshwater Aquatic Life*			0.04	0.0005	0.09	0.03	NSST	NSST	NS	NS
ESRD Agriculture - Irrigation*			NS	NS	NS	NS	NS	NS	NS	NS
ESRD Agriculture - Livestock*			NS	0.024	0.0024	NS	NS	NS	NS	NS

APPENDIX B1.

WATER QUALITY RESULTS - DISSOLVED HYDROCARBONS

Canadian Natural Resources Limited

09-21-064-04 W4M

Sample Point	Sample Date	MSI Sample Number	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	F1 C ₆ -C ₁₀ - BTEX mg/L	F2 C _{>10} -C ₁₆ mg/L	F3 C _{>16} -C ₃₄ mg/L	F4 C _{>34} -C ₅₀ mg/L
Containment Structure Samples										
14-SW81	02-Jun-14	08881140602381	<0.0004	<0.0004	<0.0004	<0.0008	<0.1	<0.10	<0.20	<0.20
14-SW81	09-Jun-14	08881140609381	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
14-SW81	16-Jun-14	08881140616381	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
14-SW81	23-Jun-14	08881140623381	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
14-SW81	01-Jul-14	08881140701381	<0.00040	<0.0020	<0.00040	<0.0040	<0.10	0.2	---	---
14-SW81	08-Jul-14	08881140708381	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
14-SW81	05-Aug-14	08881140805381	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
14-SW81	09-Oct-14	08881141009381	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
14-SW81	05-May-15	08881150505001	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	---	---
Water Collection Trench Recovery Sumps										
East Sump C2	19-Feb-15	08881150219002	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
East Sump C2	07-May-15	08881150507022	<0.00040	<0.00040	<0.00040	<0.00080	<0.10	<0.10	<0.20	<0.20
Minimal Detection Limit			0.0004	0.0004	0.0004	0.0008	0.1	0.1	0.2	0.2
ESRD Freshwater Aquatic Life*			0.04	0.0005	0.09	0.03	NSST	NSST	NS	NS
ESRD Agriculture - Irrigation*			NS	NS	NS	NS	NS	NS	NS	NS
ESRD Agriculture - Livestock*			NS	0.024	0.0024	NS	NS	NS	NS	NS

Notes:

--- - not analyzed

NS - guideline not specified

ST - see applicable guidelines for short-term exposure guideline

* - *Environmental Quality Guidelines for Alberta Surface Waters* (ESRD 2014)

Italics - indicates values do not meet applicable guidelines

APPENDIX B2.

WATER QUALITY RESULTS - POLYCYCLIC AROMATIC HYDROCARBONS

Canadian Natural Resources Limited
09-21-064-04 W4M

Sample Point	Date	MSI Sample Number	Acenaphthene µg/L	Acenaphthylene µg/L	Acridine µg/L	Anthracene µg/L	Benz[a]anthracene µg/L	Benzo[b+]fluoranthene µg/L	Benzo[k]fluoranthene µg/L	Benzo[g,h,i]perylene µg/L	Benzo[c]phenanthrene µg/L	Benzo[a]pyrene µg/L	Benzo[e]pyrene µg/L	Chrysene µg/L	Dibenz[a,h]anthracene µg/L	Fluoranthene µg/L	Fluorene µg/L	Indeno[1,2,3-cd]pyrene µg/L	Naphthalene µg/L	2-Methylnaphthalene µg/L	Perylene µg/L	Phenanthrene µg/L	Pyrene µg/L	Quinoline µg/L	TOTAL PAH µg/L	
Surface Water Samples																										
13-SW31	05-Aug-14	08881140805531	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31	12-Aug-14	08881140812531	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31	25-Aug-14	08881140825531	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31	02-Sep-14	08881140902531	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31 dup	02-Sep-14	08881140902331	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31	09-Oct-14	08881141009531	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31 dup	09-Oct-14	08881141009331	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31	07-May-15	08881150507007	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
13-SW31 dup	07-May-15	08881150507009	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
Containment Structure Samples																										
14-SW81	02-Jun-14	08881140602381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	09-Jun-14	08881140609381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	16-Jun-14	08881140616381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	23-Jun-14	08881140623381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	01-Jul-14	08881140701381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.020	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	08-Jul-14	08881140708381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	05-Aug-14	08881140805381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	09-Oct-14	08881141009381	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
14-SW81	05-May-15	08881150505001	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
Water Collection Trench Recovery Sumps																										
East Sump C2	19-Feb-15	08881150219002	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
East Sump C2	07-May-15	08881150507022	<0.10	<0.10	<0.20	<0.010	<0.0085	<0.0085	<0.0085	<0.0085	<0.050	<0.0075	<0.050	<0.0085	<0.0075	<0.010	<0.050	<0.0085	<0.10	<0.10	<0.050	<0.050	<0.020	<0.20	ND	
Minimal Detection Limit			0.1	0.1	0.2	0.01	0.0085	0.0085	0.0085	0.0085	0.05	0.0075	0.05	0.0085	0.0075	0.01	0.05	0.0085	0.1	0.1	0.05	0.05	0.02	0.2	-	
ESRD Freshwater Aquatic Life*			5.8	NS	4.4	0.012	0.018	NS	NS	NS	NS	0.015	NS	NS	NS	0.04	3	NS	1	NS	NS	0.4	0.025	3.4	NS	
ESRD Agriculture - Irrigation*			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
ESRD Agriculture - Livestock*			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

Notes:

--- - not analyzed

NS - not specified

ND - not detected

* - Environmental Quality Guidelines for Alberta Surface Waters (ESRD 2014)

Italics - indicates values do not meet applicable guidelines