5- YEAR LONG-TERM MONITORING OR OPERATIONAL ACTIVITY WORK PLAN

Changes to this Work Plan are only accepted via an Approved Addendum.

General Information		
Monitoring Category: *(From OSM long-term plan; choose from drop-down menu)*	Watershed Monitoring	
Strategic Monitoring Objective: *(From OSM long-term plan; choose from drop-down menu)*	Objective: Detect and report concentration levels and trends of chemical substances of concern in the aquatic environment that are likely to cause adverse human and/or environmental health effects.	
Work Plan Unique Identifier:	W-LTM-S-2-1718	
Monitoring Activity Title:	Surface Water Quality Monitoring	
Geographic Location (*choose from drop-down menu, if Project Location is in more than one area choose from second drop-down***)**	Lower Athabasca River	Peace and Slave Rivers
Monitoring Site(s) Coordinates *(latitude and longitude)*	See Appendix 1	
Monitoring Organization and Responsible Manager:	Alberta Environment and Parks	Colin Cooke
Date Monitoring initiated:	**2012**	
Specific Monitoring Objective: *(State the monitoring objective addressed through this monitoring)*	The establishment of long-term water quality data record that can be used to assess status and trends, to support modelling activities, and the interpretation of aquatic ecosystem based measures. Long-term water quality monitoring will inform assessments of potential impacts related to resource extraction. The design of the program is adaptive in the sense that decision triggers that inform the management of the program will be integral to the program.	
Deliverables (Annual): *What Data Reports will be produced and when?* See the sections listed for details	Field Monitoring Plan Deliverables AEP – EMSD: LAR Mainstem and Tributaries (see Appendix Tables 1A, 2A, 3A and 4A for details) 1) ECCC – WQMS: LAR, PR, SR Mainstem and PAD tributaries Open Water and Winter Season (see Appendix Tables 1B&C, 2B&C, 3B&C and 4B&C for details).	

	Data Acquisition and Deliverables

Monitoring Plan Summary:

Background

Under the Canada-Alberta Joint Oil Sands Monitoring Plan (JOSM; EC and AESRD 2012), a surface water quality monitoring plan was implemented for the lower Athabasca River (LAR), its tributaries, and downstream areas in the Peace Athabasca Delta (PAD), Peace River (PR) and Slave River (SR). The purpose of this monitoring plan was to characterize the current state of the water quality, determine the distribution of contaminants, and to assess the relative importance of natural and man-made inputs. Over the 3-year implementation period of JOSM (April 2012-March 2015), an extensive spatial network of monitoring sites was established representing a significant increase in sampling effort and geographic scope: 10 sites in the LAR mainstem; 11 sites in downstream areas (7 in the PAD, 1 in the PR and 3 in the SR); and 50 sites along tributaries flowing into the LAR. Monthly water quality monitoring occurred at most of these sites, while 14 of the LAR tributary sites were monitored intensively, with sampling frequency attuned to hydrological conditions. Alternative sampling approaches were also evaluated.

Water quality monitoring conducted during JOSM led to identification of:

- strong temporal patterns in water chemistry at all LAR mainstem, tributary and PAD sites, with the majority of the load moving through the system during the high flow period of spring /summer
- higher concentrations and loads of many water quality parameters at downstream (compared to upstream) sites on LAR tributaries
- higher levels of polycyclic aromatic compounds, as measured by semi-permeable membrane devices, at sites within the OS minable area along the LAR mainstem
- little or no change in water chemistry along the LAR mainstem with the exception of increases in concentration of several water quality constituents d/s of Fort McMurray as result of municipal sewage discharge, and influence from the Clearwater River.

Objectives

The goals of long-term water quality monitoring in the Oil Sands region are to: (1) quantify the impact of oil sands mining activities and processing activities on regional water quality; (2) document status and trends in water quality at key sites; and (3) support water quality data requirements for ecosystem health biomonitoring (i.e., benthic invertebrate and fish biomonitoring).

Impacts associated with oil sands mining activities and processing activities would be evidenced as an increase in concentrations or loads (i.e., the total mass of a water quality constituent passing a stream location over a given period) of water quality constituents compared to background (i.e., reference) values. Because of the geographic breadth and complexity of the lower Athabasca watershed, measurement of concentrations and loads is required at three spatial scales:

1. Near-field tributaries (i.e., stream flowing through the oil sands region). Streams are intimately connected to the landscape and respond quickly to changes in weather (snowmelt, storms) and land use activities. Increases in concentrations and loads of certain water quality constituents have been observed at tributary sites downstream of mining operations.
2. Mainstem (i.e., Athabasca River mainstem). The LAR is the collector of tributary inputs and,

itself, flows through the oil sands mineable area. It thus integrates the effects of human activity on the LAR land base. At present, the LAR mainstem is affected by municipal effluent from the Fort McMurray sewage treatment plant as well as industrial inputs in upstream reaches (i.e, pulp mils). Runoff or seepage associated with mining activity is presently not of sufficient volume or concentration to change the quantity of water quality constituents in grab water samples (although this situation could change in future). Hence, use of time-integrated sampling methodologies (i.e., methods that concentrate contaminants over a period of days to weeks) is required under certain circumstances.

3. Far-field (i.e., tributaries and connecting channels in the PAD as well as mainstem locations on the PR and SR). These sites are currently in reference or baseline condition relative to oil sands mining and processing activities.

This nested design allows for detection of both short-term or acute impacts to water quality (evidenced as a change at near-field or mainstem sites) and chronic impacts (identified as change in far-field sites).

Monitoring Design

To detect a change in water quality constituents and be able to attribute this change to a particular human activity requires accurate characterization of the concentration and load measured at both unimpaired sites and those adjacent to or downstream of human activities. Determination of total mass of a water quality constituent passing a stream location over a given period (e.g., a hydrologic period such as freshet, or calendar period such as a year) requires summing the product of concentration and discharge measured at smaller time intervals.

Findings from the 3 year JOSM period are documented in the oil sands water data synthesis reports, which are currently in revision (Chambers et al., in revision, Glozier et al., in revision). In fall of 2016, a water quality monitoring rationalization and optimization workshop was held in Edmonton, Alberta. A major achievement during the workshop was the development of a new decision framework and draft report; Cooke et al. in revision) to guide water quality monitoring activities within the oil sands region. Sites will be monitored if the information provided answers one (or more) of the risk-based questions.

The primary changes include:

- A new decision framework to guide water quality monitoring site selection;
- An annual review process of current water quality monitoring locations based upon the decision framework in conjunction with new results, information from stakeholders, changes on the landscape or updates on planned activities;
- A recommendation to have a minimum standard of monthly sampling where feasible for all active sites which will provide consistency with historic data sets and, more importantly, provide information about seasonal changes in water quality;
- A recommendation to increase water quality sampling frequency at a subset of key monitoring stations to adequately determine loadings (mass). Water quality samples will be collected at high frequency during high flow periods when the greatest load is transported. During periods of decreasing or stable flows, water sampling will taper off until monthly sampling is conducted during fall and under-ice conditions;
- A recommendation that sampling approaches should be used that are designed to capture the majority of the load (i.e., thalweg for large rivers);
- A recommendation to quantify dissolved polycyclic aromatic compounds (PACs), by continuing

to measuring dissolved PACs using semi permeable membrane devices (SPMDs) at a reduced number of (targeted) locations only;
- A recommendation to characterize and quantify sediment-bound contaminants including PACs, by re-initiating suspended sediment sampling at the same sites as the bullet above for SPMDs (to be re-initiated when feasible techniques are confirmed);
- A recommendation that water quality monitoring continue to employ automated water quality multiprobes (sondes) to generate high-frequency water quality information at key monitoring stations. Sondes provide measurements of core water quality parameters (including: dissolved oxygen, pH, turbidity, conductivity, water temperature) at prescribed time intervals (normally every 15 or 30 minutes).

Outcomes of Revised Monitoring Plan

- A comprehensive list of sites with meta data including; site names, station codes, mode of access, current and proposed frequency, active or suspended status, presence/absence of other JOSM activities (i.e., fish or benthic invertebrate collections) as well as monitoring objectives based on results of the decision framework exercise coordinates (Table 1, Cooke et al, and Appendix 1, embedded Table)
- This workplan incorporates the changes recommended within the workshop report. For the first year of the five year (2017-2022) monitoring plan, the active sites identified by the decision framework include:
    - 31 (9 high frequency) of 50 tributary sites;
    - 6 (4 high frequency) of 10 mainstem LAR sites;
    - 10 (0 high frequency) of 11 PR, SR, and PAD sites in open water, and 6 of 11 in winter under ice.
- Ongoing data to establish regional reference conditions for water courses in the LAR region.
- Ongoing data on concentrations of water quality constituents that can be used to identify changes in the magnitude or frequency of exceeding water quality guidelines or regional reference conditions.
- Ongoing data to assist in the interpretation of ecosystem health.
- New information to that will contribute to adaptive management with respect to the design of long-term water quality monitoring for the Oil Sands region.

Field Monitoring Plan Deliverables

1) AEP – EMSD: LAR Mainstem and Tributaries (see Appendix Tables 1A, 2A, 3A and 4A for details)

As per the decision framework and recommendations in the water quality monitoring rationalization and optimization workshop report (Cooke et al., in revision), the following is being implemented in 2017/2018.

- Monitoring at LAR tributary locations identified (31 sites)
- Monitoring at LAR mainstem sites (M0, Grand Rapids, and M2).

2) ECCC – WQMS: LAR, PR, SR Mainstem and PAD tributaries Open Water and Winter Season (see Appendix Tables 1B&C, 2B&C, 3B&C and 4B&C for details).

As per the decision framework and recommendations in the water quality monitoring rationalization and optimization workshop report (Cooke et al., in revision), the following is being implemented in 2017/2018.

- Monitoring at LAR mainstem sites (M2 for SPMDs), M3(east, west, thalweg), M7, M9,
- Monitoring on the mainstem sites on the PR and SR,
- Monitoring at the PAD tributaries sites.

Assumptions and Constraints

- Timely securement of contracts (e.g., external labs) and maintenance of current staffing levels is critical;
- Transition of responsibility for portions of the monitoring plan is ongoing;
- Efficiencies will be discussed regarding transition with possibility of AEP and ECCC crews conducting joint monitoring at some sites were feasible and staff are available;

Data Acquisition and Deliverables

During each year the monitoring work will include the field sampling listed in Appendices 1 and 4, and the resultant laboratory analysis and processing of those samples collected in the current and, in some cases from the previous fiscal year. There are several steps in the process from the collection of the sample to the release of verified and validated data which sets the timelines for data readiness. In brief, these include (in time line order)

In the field: 1) preparation for field work, 2) collection of sample, 3) shipping and submission to designated laboratory,

In the Laboratory: 4) acknowledgement of sample arrival and logging of sample, 5) analysis of sample for requested parameters, 6) laboratory specific quality assurance and quality control, 7) delivery of results to client,

Data Management: 8) data received by client and uploaded to a database, 9) review of results including matching with sample metadata and verification and validation of data, 10) preparation of data release files in machine readable format (e.g., CSV format), 11) review and approval for data release, 12) public data release.

The timelines from step 4 through to step 7 may vary depending on laboratory and parameter type,

such that data is often received with different time lines for the same sampling event. As well, depending on the complexities of the data and verification validation procedures, timelines for the Data Management steps 8 through 12 may vary by parameter and sample type.

Targets for data release are thus based on time from collection, not fiscal or calendar year. Assuming no unexpected delays due to such things as equipment failure, expected timelines from step 4 through to step 12 will range from 6-18 months (provisional data may be released earlier). For example, reporting of data in machine readable formats from samples collected in the open water period of May 2017-October 2017 could expect to be released as follows:

Major Ions, Physicals and Nutrients: 6 months (i.e., April 2018)

Metals: 12 months (i.e., November 2018)

Organics including SPMD data: 18 months (i.e., November 2018 – March 2019)

Progress Reporting

During each year progress reports will be provided semi-annually. Progress reports will include a summary of sites sampled, number of samples collected, challenges encountered, and if necessary, resultant monitoring adaptations made against the planned sampling outlined in Appendices 1 and 4. Additional reporting products (e.g., manuscripts for potential peer-reviewed publication) will be developed primarily through the use of grants and contracts. The awarding of grants will be done strategically to leverage resources at collaborating universities (e.g., University of Alberta, University of Calgary, etc.) while contracts may be awarded to complete discrete products (e.g., statistical analyses, results reports, draft manuscripts) in support of the program.

References:

Environment Canada and Alberta Environment and Sustainable Resource Development. 2012. Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring. Government of Canada, Gatineau, QC, Canada, 27 p.

Cooke et al. (in revision) Rationalizing and optimizing the water quality monitoring network in the oil sands

Glozier et al. (in revision) Surface water quality of Lower Athabasca River Tributaries

Chambers et al. (in revision) Surface Water Quality of the Lower Athabasca River and the Expanded Geographical Area.

Appendix 1 2017–2018 Annual Monitoring Schedule

(Please provide detailed information on the specifics of your monitoring schedule including – **locations, schedule, methods**, **SOPs, QA/QC data release**, **references**) Site names and Site Code table provide in Cooke et al., Site Coordinates provided Appendix 1C

Sampling Locations/Sites	**Sampling Schedule** (*timing/frequency)*	**Compounds to be Analyzed**	**SOPs to be Consulted** (*hyperlinks accepted*)	**QA/QC Complete & Date Data to be Released**
Microsoft Excel 97-2003 Worksheet	See attached worksheet	1) WQ grab: PAHs (unsubstituted and alkylated), CCME F1-F4, Phenol, Metals (TR and Diss), Major Ions, Physicals, Nutrients, Naphthenic Acids 2) WQ passive: PAHs (unsubstituted and alkylated)	ECCC-Draft-SOP_Water_Quality Nov 2016, ECCC-Draft_SOP_SPMD_Field_Procedures_Nov 2016, ECCC-Draft_SOP_Equipment_Nov 2016, ECCC-Draft_SOP_Data Management_Procedures Nov 2016	Parameter Dependent: April 2018-March 2019

Appendix 2A – Detailed Multi-Year Financial Breakdown: if changes are to be made then an Addendum must be Complete and Approved. – AEP, EMSD

(Complete the following detailed financial breakdown; add or delete categories as required)

Budget requirements	Year 1 (2017-2018) APPROVED		Year 2 (2018-2019) NOT APPROVED		Year 3 (2019-2020) NOT APPROVED		Year 4 (2020-2021) NOT APPROVED		Year 5 (2021-2022) NOT APPROVED	
	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
1) Salower ARies and benefits										
a) Appendix 3 - Totals	620,000		620,000		620,000		620,000		620,000	
2) Operations and Maintenance										
a) Vehicles and Transportation										
b) Helicopter	$950,000		$950,000		$950,000		$950,000		$950,000	
c) Lab analysis	$1,207,907		$1,207,907		$1,207,907		$1,207,907		$1,207,907	
d) Data management										
e) Field work	$200,000		$200,000		$200,000		$200,000		$200,000	
3) Consumable Materials and supplies										
a) (*Describe Consumable Supply*)										
4) Travel										
a) Conferences and meetings (*SETAC*)	$7,000		$7,000		$7,000		$7,000		$7,000	

b) Field work – PI travel	$2,000		$2,000		$2,000		$2,000		$2,000	
c) Project-related travel	$3,000		$3,000		$3,000		$3,000		$3,000	
5) External Contracts										
a) Grants (Evaluation & Reporting)	$435,000		$435,000		$435,000		$435,000		$435,000	
Grand Total	**$3,593,917**		**$3,593,917**		**$3,593,917**		**$3,593,917**		**$3,593,917**	

Appendix 2B Open Water – Detailed Multi-Year Financial Breakdown: *if changes are to be made then an Addendum must be Complete and Approved*. – ECCC

Budget requirements	*Year 1 (2017- 2018)*		Year 2 (201X- 201Y)		Year 3 (201X- 201Y)		Year 4 (201X- 201Y)		Year 5 (201X- 201Y)	
	OSM Funding	*External Funding*	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
1) Salaries and benefits										
a) Appendix 3 - Totals	$ 469,000		TBD							
2) 2) Operations and Maintenance										
a) a) Vehicles and Transportation	$ 14,400									
b) b) Helicopter/Float Plane Charter	$ 432,215									
c) c) Lab analysis	$ 146,901									
d) d) Data management	$ 23,809									
e) e) Field work	$ 79,699									
3) 3) Consumable Materials and supplies										
a) Replacement probes, calibration solutions, sample bottles	$ 38,298									
4) 4) Travel										
a) a) Conferences and meetings (CEW, planning meetings and workshops	$ 4000.00 -									

b) b) Field work - travel	$ 152,180									
c) Field work - travel tech ops	$ 28,500									
c) d) Project-related travel	$ 11,840									
5) 5) External Contracts										
b) Flett (hg), Axys (PACs)	$ 91,958									
Grand Total * (Before other related costs)	$ 1,492,500		TBD							

*The total Salary Costs for ECCC ($469,000) in 2017-2018 with other related costs is $644,969. The total O&M Costs for ECCC ($1,023,500) in 2017-2018 with other related costs is $1,126,434. **The Grand Total for ECCC ($1,492,500) in 2014-2018 with other related costs is $1,771,403.**

Appendix 2B Winter - Detailed Multi-Year Financial Breakdown: if changes are to be made then an Addendum must be Complete and Approved. – *ECCC*

Budget requirements	*Year 1 (2017- 2018)*		Year 2 (201X- 201Y)		Year 3 (201X- 201Y)		Year 4 (201X- 201Y)		Year 5 (201X- 201Y)	
	OSM Funding	*External Funding*	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
1) **Grand Total** Salaries and benefits										
a) Appendix 3 - Totals	$ 106,500		TBD							
6) 2) Operations and Maintenance										
f) a) Vehicles and Transportation	$ 2,000									
g) b) Helicopter/Float Plane Charter	$ 82,000									
h) c) Lab analysis	$ 25,000									
i) d) Data management	$ 7,500									
j) e) Field work	$ 25,000									
7) 3) Consumable Materials and supplies										
a) Replacement probes, calibration solutions, sample bottles	$ 13,700									

8) 4) Travel										
d) a) Conferences and meetings (*identify conference/meeting*)	$ -									
e) b) Field work - travel	$ 40,000									
c) Field work - travel tech ops	$ 10,000									
f) d) Project-related travel	$ 3000									
9) 5) External Contracts										
c) Flett (hg), Axys (PACs)	$ 8,000									
Grand Total * (Before other related costs)	$ 312,700		TBD							

*The total Salary Costs for ECCC ($106,500) in 2017-2018 with other related costs is $146,459. The total O&M Costs for ECCC ($216,200) in 2017-2018 with other related costs is $238,909. **The Grand Total for ECCC ($322,700) in 2014-2018 with other related costs is $385,368.**

Appendix 3A – Staffing Plan – AEP, EMSD

(Complete the following detailed staffing plan; add or delete categories as required)

	Year 1 – Budget Allocation		Year 2 – Budget Allocation		Year 3 – Budget Allocation		Year 4 – Budget Allocation		Year 5 – Budget Allocation	
Responsible Role	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
Science Expertise	$240,000		$240,000		$240,000		$240,000		$240,000	
Technical/Field Staff	$300,000		$300,000		$300,000		$300,000		$300,000	
Administrative and Program Coordination	$80,000		$80,000		$80,000		$80,000		$80,000	
Grand Total (*inserted into Appendix 2*)	**$620,000**	**$**	**$620,000**	**$**	**$620,000**	**$**	**$620,000**	**$**	**$620,000**	**$**

Appendix 3B Open Water –Staffing Plan - ECCC

	Year 1 – Budget Allocation		Year 2 – Budget Allocation		Year 3 – Budget Allocation		Year 4 – Budget Allocation		Year 5 – Budget Allocation	
Responsible Role	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
Science Expertise	$15,000									
Technical/Field Staff	$209,160									
Technical/Laboratory Staff	$244,840									
Grand Total (*inserted into Appendix 2*)	**$469,000**	$	$	$	$	$	$	$	$	$

Appendix 3B Winter – Staffing Plan - ECCC

	Year 1 – Budget Allocation		Year 2 – Budget Allocation		Year 3 – Budget Allocation		Year 4 – Budget Allocation		Year 5 – Budget Allocation	
Responsible Role	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding	OSM Funding	External Funding
Science Expertise	$4,900									
Technical/Field Staff	$61,900									
Technical/Laboratory Staff	$39,700									
Grand Total (*inserted into Appendix 2*)	**$106,500**	**$**	**$**	**$**	**$**	**$**	**$**	**$**	**$**	**$**

Appendix 4 - Approvals

Project Submitted by:		
Name:		
Organization:	Signature:	Date:

Project Approved by:	
Dr. Monique Dubé (AEP)	**Dr. Kevin Cash (ECCC)**
Signature 	Signature 
Date	Date