FOCUSED STUDY ACTIVITY WORK PLAN

General Information

Work Plan Unique Identifier:	*W-IC-22-1718*	
Focused Study Activity Title:	Correlation of Anthropogenic Stressors with Changes in Water Quality (Tributary Systems)	
Focused Study Category:	Monitoring Design and Method Improvement	
Geographic Location (*choose from drop-down menu. If Project Location is in more than one area choose from second drop-down***)**	Athabasca River - Tributaries	Athabasca River - Tributaries
Monitoring Site(s) Coordinates *(latitude and longitude)*		
Project Leader:	Patricia Chambers	
Organization and contact information:	**Environment & Climate Change Canada** **Patricia.Chambers@canada.ca**	
Date Study initiated:	**2016**	
Monitoring Category: *(From OSM long-term plan; choose from drop-down menu)*	Watershed Monitoring	
Strategic Objective of Focused Study: *(From OSM long-term plan; choose from drop-down menu)*	Objective W3: Integration and Synthesis	
Hypotheses: *(Briefly outline the specific hypotheses that your focused study is aiming to address)*	1. Dissolved (versus total) trace metals are a better indicator of anthropogenic inputs and potential ecological effects. 2. Classes of water quality constituents (i.e., metals, major ions, polycyclic aromatic compounds, nutrients) differ in their timing of delivery to the Athabasca River mainstem and, hence, their potential ecological consequences. *3.* Rainfall events represent a significant source of bioavailable contaminants, particularly at sites downstream of mining activities.	
Deliverables: *What tangible goal (s) and/or product(s) will the monitoring produce and when?*	1. New information on the potential for dissolved trace metals to affect ecological condition of tributaries to the Athabasca River. 2. New information to inform the design of the long-term water quality monitoring plan for the OS region, specifically whether	

	rain event sampling is required to adequately describe annual contaminant loads. 3. Geospatial analysis of several classes of water quality constituents (metals, major ions, polycyclic aromatic compounds, nutrients) to identify the quantity and timing of inputs to the Athabasca River. The deliverables listed above will: (a) inform water quality models being run for the Athabasca River mainstem to track the transport and fate of contaminants; (b) establish the environmental conditions for the aquatic biological communities; and (c) explicitly link the data on atmospheric deposition to the snowpack to stream water quality.

Detailed Study Plan

(Please provide detailed information on the specifics of your focused study including – (**keywords, hypothesis and the assumptions and constraints behind your hypothesis**)

Provide a maximum of 10 key words that describe this project. Use commas to separate them:

water quality, long term monitoring design, guidelines, contaminants

Describe how you will test your hypothesis:

Under the Canada-Alberta Joint Oil Sands Monitoring Plan (JOSMP), water chemistry was sampled intensively over three hydrologic years (April 2012-March 2015) at ~14 stations on tributaries flowing through Alberta's oils sands region. Sampling frequency was attuned to hydrologic conditions: high frequency (daily or alternate days) during snowmelt, lower frequency (weekly) during the falling limb of the hydrograph (summer), monthly during fall, and occasionally (3x per year) under ice. Samples were analyzed for anions, cations, metals, nutrients and, in some cases, polycyclic aromatic compounds. In addition, automated samplers collected water samples during rainfall events in 2013 and 2014 for subsequent analysis for total metal and total nutrient concentrations.

To further refine the design of a long-term water quality monitoring plan for the oil sands region, the 2012-2015 data set will be analyzed to answer the broad question "Are human activities affecting the geochemical cycles of potentially toxic trace metals in the oil sands regions?" Under this broad questions, we undertake several specific investigations:

1. <u>Are concentrations of dissolved (versus total) trace metals a better indicator of anthropogenic inputs and potential ecological effects?</u>
    a. We propose to explore with University and other appropriate collaborators and investigation of the dissolved and particulate phases of 11 priority pollutants (Sb, As, Be, Cd, Cr, Cu, Pb, Se, Ag, Tl and Zn), with the goal of assessing whether natural inputs versus anthopogenic inputs predominate in tributaries with varying extent of open-pit and SAGD operations in their watersheds.
    b. To assess potential ecological effects, we propose to test for associations between benthic invertebrate composition (data collected at tributary sites under JOSMP) and dissolved and particulate phases of 11 priority pollutants (Sb, As, Be, Cd, Cr, Cu, Pb, Se, Ag, Tl and Zn).

2. What quantity of contaminants is delivered to the Athabasca River from its tributaries? Do the different classes of water quality constituents (i.e., bioavailable versus total metals as well as major ions, polycyclic aromatic compounds, nutrients) differ in their timing of delivery to the mainstem?

   An integrated data set containing all water quality constituents for all sample dates and years is presently being assembled. This study will use the new integrated dataset to determine the proportion of the total contaminant load in the Athabasca River that is derived from tributary inputs, compare the proportions for the different classes of water quality constituents, and describe seasonal variability in delivery to the Athabasca River in relation to geospatial data (e.g., wetlands, geologic formations, land disturbance).

3. What is the contribution of rainfall events to loading of bioavailable contaminants?

   Although slightly more than half of annual precipitation falls as snow (57% of annual precipitation is snow; data for Fort Chipewyan, 1977-2012), heavy rain storms between mid-July to mid-August deliver, on average, 6% of annual precipitation over a few days. Using the 2012-2015 JOSMP tributary water chemistry database, differences in loads of bioavailable contaminants will be compared when calculated using (a) grab samples only versus (b) grab samples plus automated samples collected during rain events. Such comparisons will allow determination of whether rain events deliver significant quantities of contaminants to tributaries in the oil sands region (particularly at sites downstream of mining activity), and whether the proportion delivered during rain events differs between two major classes of chemical constituents (metals versus nutrients).

Assumptions and Constraints behind the hypothesis and the testing method:

The usual scientific assumptions/constraints when combining data from different sources (AEP and RAMP) and different time periods (e.g., methodology changes) and when performing statistical tests.

References:

Data Management

If this work generates data please summarize your project-level data management plan.

Deliverables	Timeframe
Data Collection Period: *Field work*	Start End
Data Analysis Period: *Laboratory analysis and QA/QC of data, data synthesis & statistical analysis*	Start : 2017-04-01 End: 2019-03-31
Data Release Date: *Metadata and data consistent, complete and meet basic standard format for publication in Open Data; on or linked to JOSM portal*	Metadata and data are already on portal

Reporting and Publications

Provide information on the anticipated reports / publications. (Insert additional rows if needed)

Expected Subject/Titles of Publications or Reports	Short Description of Publication or Report	Expected Year of Publication
Contribution of seasonal events to annual contaminant loads	Assessment of whether rain events deliver significant quantities of contaminants to tributaries in the oil sands region, and whether the proportion delivered during rain events differs between upstream versus downstream sites and between two major classes of chemical constituents (metals versus nutrients).	2018
Dissolved trace metals as an indicator of anthropogenic inputs to oil sands tributaries and potential ecological effects (pending discussions with potential collaborators)	Pending outcome of discussions with Dr. Wm. Shotyk (University of Alberta) and others	2019
Seasonal variability in contaminant loading to the	Assessment of the proportion of the total contaminant load in the Athabasca River that is derived from tributary inputs, and analysis of the	2020

Athabasca River from tributary inputs	seasonal variability in delivery of contaminants to the Athabasca River as related to class of water quality constituents (nutrients, metals, ions, PACs) and watershed geospatial characteristics (e.g., wetlands, geologic formations, land disturbance).	

Technical / Professional Roles and Responsibilities

Identify members of the monitoring team/organization, their roles and responsibilities. Identify monitoring organization leads if different from overall monitoring activity lead. (Insert additional rows if needed)

Role	Responsibilities
Project Lead, ECCC	Provide scientific leadership to the design of the project; provide context for historical and JOSMP data; assist with interpretation of data; assist with drafting manuscripts/reports
Project Co-Lead, ECCC	Provide scientific leadership on elements of the project; supervise term RES or PC; provide statistical direction; assist with interpretation of data; assist with drafting manuscripts/reports
Technical/Professional Support, ECCC	Undertake data analysis and statistical testing; draft manuscripts/reports.

Deliverables (Year 1) If your Focus Study is longer than 1 year then complete **Appendix C** for multi-year deliverables breakdown

Provide a summary of tangible quarterly deliverables. Identify major project areas (deliverables) and results that can be identified as a tangible goal. This could include: field work, lab work/ analysis, evaluation, data, reports, publications, SOPs etc. Do not define process as your Deliverable e.g. 'fly to Ft. McMurray to conduct fieldwork' or 'seek Director approval for report'.

Deliverable(s) (please provide enough information to support status reporting)
Q1 – April to June
Loads calculated for key parameters using (a) grab samples only versus (b) grab samples plus automated samples collected during rain events. Explore potential for collaborative study with Dr. Wm. Shotyk (University of Alberta) on whether natural versus anthopogenic inputs of 11 priority pollutants (Sb, As, Be, Cd, Cr, Cu, Pb, Se, Ag, Tl and Zn) predominate in tributaries with varying extent of open-pit and SAGD operations in their watersheds.
Q2 – July to September
Statistical analyses undertaken to compare loads of key parameters when calculated using (a) grab samples only versus (b) grab samples plus automated samples collected during rain events
Q3 – October to December
Load calculations completed for all parameters (total nutrients and total metals) based on (a) grab samples only, and (b) grab samples plus automated samples collected during rain events. Statistical analyses completed to compare differences in loads for all parameters when calculated using (a) grab samples only versus (b) grab samples plus automated samples collected during rain events
Analysis of variability in contaminant concentrations between reference and impact sites completed.
Concurrently sampled measurements of contaminant concentration and and bioindicator condition (e.g., algae and benthic invertebrate metrics) compiled.
Q4 – January to March
First draft completed of a manuscript on contribution of seasonal events to annual contaminant loads
Assembly of an integrated data set containing all water quality constituents (nutrients, metals, ions, PACs) is completed.

Detailed Financial Breakdown – Year 1 of 2 (2017-2019)

Also complete **Appendix B** for the multi-year financial breakdown

Budget requirements – List areas that require budget expenditures: (ADD OR DELETE BUDGET CATEGORIES AS REQUIRED)	**OS Funding**	**External Funding (*outside JOSM*)**
O&M - Operations and Maintenance:		
Helicopter Costs	$	$
Field Costs	$	$
Data Management (computer/software)	$2,000	$
Internal Lab Analysis	$	$
Consumable Materials & Supplies	$5,086	$
Publication/translation	$4,000	
Mandatory O&M related personnel costs	$8,000	
Sub-Total	**$19,086**	**$**
O&M - Travel		
Field Work	$	$
Conferences (*SETAC x 1 employee; travel + conference fees*)	$4,000	$
Meeting (*meetings between staff in Burlington/Fredericton/Saskatoon/Edmonton*)	$15,000	$
Sub-Total	**$19,000**	**$**
O&M - External Contracts :		
Goods and Services Contract (*GIS support*)	$10,000	$
External Lab Analysis	$	$
Sub-Total	**$10,000**	**$**
Salaries:		
Principal Investigators		**$16,200**
Technical / Professional Assistants	$85,000	**$24,400**
Field Staff		**$**
Sub-Total	**$85,000**	**$40,600**
2017-2018 GRAND TOTAL* (BEFORE OTHER RELATED COSTS	**$133,086**	**$40,600**

Appendix A - Approvals

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

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

APPENDIX B – Detailed Multi-year Financial Breakdown (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 (201X- 201Y)	
	Cash	In-kind	Cash	In-kind	Cash	In-kind
1) Salaries and benefits						
a) Investigators		16,200		16,200		
b) Technical/professional assistants	85,000	24,400	85,000	24,400		
c) Field Staff						
2) Operations and maintenance						
a) Facilities						
b) Equipment						
c) Lab analysis						
d) Data management	2,000		2,000			
e) Field work						
f) Mandatory O&M related personnel costs	8,000		8,000			
3) Consumable Materials and supplies						
a) Software / computer	3,086		3,086			
4) Travel						
a) Conferences	4,000		4,000			
b) Meetings	15,000		15,000			
5) Dissemination & Engagement						

a) Publications/Reports	4,000		4,000			
b) Translation (if required)						
c) Communications						
d) Stakeholder Engagement						
e) Indigenous Peoples Engagement						
6) External Contracts						
a) GIS services	12,000		12,000			
Grand Total *(Before other related costs)	133,086	40,600	133,086	40,600		

The total salary costs for ECCC ($85,000) in 2017-18 with other related costs is $116,892. The total O&M Costs for ECCC ($48,086) with other related costs is $61,108. **The Grand Total for ECCC ($133,086) with other related costs is $178,000.**

APPENDIX C –Years 2 and 3 Deliverables (Complete the following detailed breakdown. Provide a summary of tangible quarterly deliverables. Identify major project areas (deliverables) and results that can be identified as a tangible goal.)

Year 2 (2018- 2019)
Deliverable(s) (please provide enough information to support status reporting)
The following deliverables are based on projected activities at the present time. ECCC will provide updated deliverables and budget estimates as work continues in the next fiscal year. Changes will be made depending on the previous years' progress and new science questions arise.
Q1 – April to June
Dose-response relationships determined between contaminant concentrations and bioindicator status.
Q2 – July to September
Statistical tests completed to identify thresholds or breakpoints indicative of a deleterious change in bioindicator condition in response to increasing contaminant concentrations.
Tributary contributions to the Athabasca River are determined for the different classes of water quality constituents.
Q3 – October to December
First draft completed of a manuscript on approaches for development of regional water targets for tributaries draining the oil sands region
Seasonal variability in contaminant delivery to the Athabasca River is described in relation to geospatial data (e.g., wetlands, geologic formations, land disturbance).
Q4 – January to March
First draft completed of a manuscript on seasonal variability in contaminant loading to the Athabasca River from tributary inputs