

## FOCUSED STUDY ACTIVITY WORK PLAN

### General Information

<b>Work Plan Unique Identifier:</b>	<i>B-PD-12-1718 (Forest Health Program Design Review)</i>																																																																															
<b>Focused Study Activity Title:</b>	Forest Health Monitoring Program Design Review																																																																															
<b>Focused Study Category:</b>	Investigation of Cause or Potential Ecological Impact																																																																															
<b>Geographic Location</b> ( <i>choose from drop-down menu. If Project Location is in more than one area choose from second drop-down</i> )	Athabasca Oil Sands Region	Regional Municipality of Wood Buffalo																																																																														
<b>Monitoring Site(s) Coordinates</b> ( <i>latitude and longitude</i> )	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Site</th> <th style="text-align: left;">Latitude</th> <th style="text-align: left;">Longitude</th> </tr> </thead> <tbody> <tr><td>JP101</td><td>56.539503</td><td>-112.275600</td></tr> <tr><td>JP102</td><td>56.909616</td><td>-111.540720</td></tr> <tr><td>JP103</td><td>57.427494</td><td>-111.572630</td></tr> <tr><td>JP104</td><td>57.119019</td><td>-111.425425</td></tr> <tr><td>JP106</td><td>57.662610</td><td>-111.168812</td></tr> <tr><td>JP107</td><td>57.890264</td><td>-111.435236</td></tr> <tr><td>JP108</td><td>56.705154</td><td>-109.926993</td></tr> <tr><td>JP109</td><td>57.539645</td><td>-111.594417</td></tr> <tr><td>JP201</td><td>57.032109</td><td>-113.735517</td></tr> <tr><td>JP205</td><td>57.837770</td><td>-110.449002</td></tr> <tr><td>JP210</td><td>56.272802</td><td>-110.448742</td></tr> <tr><td>JP212</td><td>57.053691</td><td>-111.409165</td></tr> <tr><td>JP213</td><td>57.047348</td><td>-109.749686</td></tr> <tr><td>JP303</td><td>56.833990</td><td>-111.109017</td></tr> <tr><td>JP304</td><td>57.053223</td><td>-111.375019</td></tr> <tr><td>JP307</td><td>57.358456</td><td>-111.023121</td></tr> <tr><td>JP308</td><td>57.085007</td><td>-112.853495</td></tr> <tr><td>JP310</td><td>56.692592</td><td>-111.795140</td></tr> <tr><td>JP311</td><td>56.564529</td><td>-111.947774</td></tr> <tr><td>JP312</td><td>56.829919</td><td>-110.432767</td></tr> <tr><td>JP313</td><td>56.661405</td><td>-110.065964</td></tr> <tr><td>JP315</td><td>57.106911</td><td>-112.063674</td></tr> <tr><td>JP316</td><td>56.353265</td><td>-110.118498</td></tr> <tr><td>JP318</td><td>57.030737</td><td>-110.348504</td></tr> <tr><td>JP317</td><td>57.076447</td><td>-110.945104</td></tr> </tbody> </table>	Site	Latitude	Longitude	JP101	56.539503	-112.275600	JP102	56.909616	-111.540720	JP103	57.427494	-111.572630	JP104	57.119019	-111.425425	JP106	57.662610	-111.168812	JP107	57.890264	-111.435236	JP108	56.705154	-109.926993	JP109	57.539645	-111.594417	JP201	57.032109	-113.735517	JP205	57.837770	-110.449002	JP210	56.272802	-110.448742	JP212	57.053691	-111.409165	JP213	57.047348	-109.749686	JP303	56.833990	-111.109017	JP304	57.053223	-111.375019	JP307	57.358456	-111.023121	JP308	57.085007	-112.853495	JP310	56.692592	-111.795140	JP311	56.564529	-111.947774	JP312	56.829919	-110.432767	JP313	56.661405	-110.065964	JP315	57.106911	-112.063674	JP316	56.353265	-110.118498	JP318	57.030737	-110.348504	JP317	57.076447	-110.945104	
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<b>Project Leader:</b>	Sanjay Prasad (WBEA) Dan Farr (AEP)																																																																															
<b>Organization and contact</b>	Environmental Monitoring and Science Division Alberta Environment and Parks																																																																															

<b>information:</b>	<p>9th Floor, 9888 Jasper Avenue NW Edmonton, Alberta, T5J 5C6 <a href="mailto:Dan.Farr@gov.ab.ca">Dan.Farr@gov.ab.ca</a>; tel. (780) 229-7251</p> <p>Wood Buffalo Environmental Association 100-330 Thickwood Blvd Fort McMurray AB T9K 1Y1 <a href="mailto:sprasad@wbea.org">sprasad@wbea.org</a>; tel. (780) 799-4420</p>
<b>Date Study initiated:</b>	<b>1991</b>
<b>Monitoring Category:</b> <i>(From OSM long-term plan; choose from drop-down menu)</i>	Biotic Response Monitoring
<b>Strategic Objective of Focused Study:</b> <i>(From OSM long-term plan; choose from drop-down menu)</i>	Objective B1: Detect and report biotic response in relation to Oil Sands Developments
<b>Hypotheses:</b> <i>(Briefly outline the specific hypotheses that your focused study is aiming to address)</i>	<p>The null hypothesis of this study is that the receiving terrestrial environment is unaffected by atmospheric deposition. Based on preliminary data showing effects, the program developed two sub-hypotheses: that acid-sensitive jack pine forests are unaffected by acidifying deposition, and that ombrotrophic bogs are unaffected by eutrophying deposition. Evidence obtained during the twenty years of monitoring suggests that eutrophying deposition may be affecting the terrestrial environment, but that at present acidifying deposition is being neutralized by concomitant base cation deposition. Because some responses may occur over long periods of exposure there is value in continued operation of this long-term biotic response monitoring program. (The most recent measurements were taken in 2011/12.)</p>
<b>Deliverables:</b> <i>What tangible goal (s) and/or product(s) will the monitoring produce and when?</i>	<p>The key outcomes of this study will include:</p> <ul style="list-style-type: none"> <li>• An evaluation of results and data collected to date</li> <li>• An assessment using existing data and results of forest health monitoring</li> <li>• Recommendations of endpoints that should be measured going forward</li> </ul> <p>Specific scientific data and publications to be delivered are listed in the “Reporting and Publications” section.</p>

## 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:

atmospheric deposition, acidification, eutrophication, receptor monitoring, ecological effects, soil, forests

### Overview

Wood Buffalo Environmental Association operates a long-term forest health monitoring (FHM) network to detect any impacts of air contaminants on forest health. WBEA monitors jack pine forest sites that are sensitive to acid deposition, and assesses whether there are changes to soils, vegetation, or the trees. This information informs stakeholders on broader effects, as well as environmental management and monitoring programs, especially water, wildlife and wetland monitoring. **This project plan is for an independent design review for the forest health monitoring program.**

### Background

In 1998, WBEA responded to the concerns of local aboriginal communities regarding the effects of increasing industrial development on air quality, and its potential impacts on Forest Health. WBEA developed the Terrestrial Ecosystem Effects Monitoring (TEEM) program as a rigorous, science-based monitoring approach to detect effects of atmospheric deposition on the receiving environment. This program has since generated 53 publications and has been recognized internationally by the United Nations Economic Commission for Europe (UNECE) International Co-operation Programme on Assessment and Monitoring Effects of Air Pollution Effects on Forests (ICP Forest; <https://www.unece.org/env/lrtap/workinggroups/wge/forests.html>), has provided the foundation for WBEA's receptor modelling program (<http://www.wbea.org/deposition/receptor-modeling>).

Specifically, TEEM's driving question is whether emissions of acidifying compounds such as SO<sub>2</sub> and NO<sub>x</sub> have adverse effects on regional terrestrial environment. The most sensitive receptor to acidification is upland Jack pine (*Pinus banksiana*) ecosystem due to their xeric, nutrient poor, soils with limited buffering capacity. The effects of acid deposition can be observed in a cascading manner from soils to vegetation, impacting individuals then the stand and onward to landscape level impacts.

The original objective of the TEEM program, as stated in 1996, was:

To develop and operate a long-term program to detect and characterize the effects of oil sands emissions on terrestrial and aquatic ecosystems, and on traditional resources and hence on traditional resource users

After much discussion among stakeholders (industry, government, ENGO's, and Aboriginal communities), a long-term program to measure the effects of acidic deposition to sensitive forests (jack pine, aspen) was designed and implemented – this receptor-based monitoring program, and the jack pine component remains

the core of the TEEM program. In addition, (i) trace metal accumulation in soil, vegetation and small mammals, (ii) documenting traditional resource use, and (iii) general surveys of forest stress indicators were also included in the TEEM program at its inception.

Selection of the jack pine system, and establishment monitoring plots in the interior of large pine stands, were deliberate committee decisions that were supported by TEEM's science advisory panel and TEEM's science subcommittee. Fundamentally, a consequential change in the soils and/or health of the jack pine trees resulting from acidic input would be interpreted as indicative of a need for government intervention (policy, regulation, standards) and/or emission abatement by industry. The Canadian Forest Service strongly suggested that the ARNEWS (Acid Rain Network Early Warning System) protocols be used; the TEEM committee agreed and procedures from site selection, plot establishment through to data collection and data forms were adopted.

Trace metal accumulation, traditional resource use, and general forest stress studies were of shorter-term duration, intermittently conducted during the 1996 to 2007 time period.

In 2007, WBEA began what is colloquially termed a 'science build', intended to expand the WBEA's programs (including TEEM) from receptor-based (jack pine) monitoring to an integrated source-to-sink measurement and monitoring system. Several applied research projects were commissioned to support monitoring program enhancements. Trace metal accumulation, traditional resource quality and quantity (e.g., berries), and emission, ambient air and atmospheric deposition research and monitoring programs initiated or expanded. The TEEM objective was expanded to include greater focus on sources, dispersion, deposition measurement, and source apportionment, and rephrased as follows:

To Implement an Approach for Establishing/Determining Cause-Effect Relationships Between  
Air Pollutants and Forest Ecosystem Health in the Oil Sands Region (Percy et al. 2013)

This updated objective speaks to the implementation of approaches for identification of cause (air pollutants)-effect (forest health) relationships, while the objective stated in 1996 is broader in that it focuses on characterizing effects in the receiving terrestrial environment. The original objective remains valid as the overarching TEEM objective, with the 2007 statement to be supportive, focusing on method development, research initiatives, integration of new technologies, and spatial expansion of the monitoring program.

The Assessing Forest Health in the Athabasca Oil Sands Region (Clair and Percy 2015) report provided a substantial consolidation of TEEM program data, and interpretations based on these data. Much of the work conducted within the TEEM program by individual researchers and research groups has been published in peer-reviewed journals, particularly in recent years reflecting the focused study approach implemented in the science build. However, consolidation, interpretation and publication in peer reviewed journal(s) of the extensive forest health dataset acquired by TEEM since 1996 has not been achieved.

This effort is meant to answer the following questions for the TEEM committee:

1. Has the TEEM program objective as stated in 1996 (and as broadened as stated in 2013) been achieved?
2. If yes in part, which part(s)? What are the successes, what is the status of forest health?

<sup>1</sup> Presented at the Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring (JOSM) Air Component Advisory Committee Meeting #6, September 13, 2013

3. If not in whole or part, why not? What limitations are inherent in the program that make achievement of the objective difficult?
4. What recommendations for program improvement are supported by the data and analyses? Should some program components be dropped or modified? Are there any substantive gaps?

These questions would be answered in a series of scientific manuscripts published in a peer reviewed journal. Specifically, the scientific manuscripts will be broadly delivered as:

Manuscript 1 – TEEM Science Introduction – This manuscript will provide much of the history of the industry, emissions over time and the rationale and history of the TEEM and air/deposition programs.

Manuscript 2 – Air Quality and Deposition in the Athabasca Oil Sands 1996 to Present.

Manuscript 3 – Changes in Soil Chemistry and Microbiology in Soils, and Changes in Foliar Chemistry, in Jack Pine Forests related to Deposition in the Athabasca Oil Sands Region

Manuscript 4 - Jack Pine Growth & Health Monitoring and Vegetation Community Composition related to Changes in Deposition in the Athabasca Oil Sands Region

Manuscript 5 - Air Quality and Deposition Effects on Lichen Communities and Chemical Composition

Manuscript 6 - Management Implications and Future Directions in Air, Deposition and Environmental Effects Monitoring in the Athabasca Oil Sands Region.

In the next three years WBEA will integrate all existing datasets and reports, clarify monitoring objectives and assess the utility of various indicators, undertake another forest health campaign, and provide a comprehensive scientific manuscripts on the health of forests in the Athabasca Oil Sands Region. The following deliverables will also be provided as of this workplan:

- To integrate existing, unreported datasets with those presented in the 15-year report, and consolidate data in a comprehensive, secure database with a long-term data management plan,
- To assess and prioritize forest health indicators and ensure that all communities and stakeholders' needs are captured,
- To integrate existing datasets and results the edge plot validation survey into a supplementary report that provides recommendations for the fourth intensive sampling campaign and future direction for the FHM program,
- To conduct the fourth intensive sampling cycle (2018) to determine effects of deposition since the previous cycle (2011/2012),
- To report on 20-years of forest health monitoring in the AOSR using data from four intensive monitoring cycles,
- To develop recommendations to inform source-to-sink terrestrial monitoring, and how TEEM deposition data can inform other AOSR monitoring efforts.
- To develop an integrated knowledge translation plan to foster two-way communication between stakeholders, actively seek engagement and support inclusion of TEK and community priorities in program.

**Methods****Year 1 (2017-18)**

The primary focus of 2017-18 will be the preparation of a technical, externally reviewed summary report to supplement the 15-year FHM report (Clair and Percy, 2015) and provide key recommendations on the design and future direction of the FHM program. Preparation of the report will include cataloguing of existing FHM datasets; synthesis, interpretation, and integration of these datasets; and public availability of these datasets via the WBEA website. The report will incorporate previously unreported data and the results from the forest edge monitoring validation study (see below) as well as assess forest health indicators (soil, microbial communities, lichen communities, understory vegetation, needle composition, cuticular wax, tree height and diameter) to ensure we understand their responses and prioritize for ongoing monitoring

WBEA is a stakeholder driven organization and has recently added several local aboriginal communities and the Regional Municipality of Wood Buffalo as members. In Year 1 WBEA will develop a knowledge translation plan and continue to build relationships with these communities, offering workshops or community meetings. These relationships will foster not only uptake of monitoring information and empowerment of community members to make informed decisions about their local environment, but facilitate the inclusion of traditional ecological and local knowledge, if there is interest from participating communities.

Routine plot maintenance and the annual Forest Health Condition Assessment activities are covered in a separate project plan.

**Year 2 (2018-19)**

The 2018-19 activities will focus on the fourth cycle of the intensive sampling campaign that is key to the FHM program. The campaign design and implementation will be driven by the recommendations of the technical summary report prepared in Year 1. Continuation of efforts to publish the six manuscripts in peer-reviewed journals.

**Year 3 (2019-20)**

The focus of Year 3 will be the reporting of results and outcomes from the intensive sample campaign carried out in Year 2.

**References:**

AMEC. 2000. Monitoring long-term effects of acid emissions in northeast Alberta – 1990 annual report. Wood Buffalo Environmental Association, Fort McMurray, AB.

CEMA. 2004. Recommendations for the Acid Deposition Management Framework for the Oil Sands Region of North-Eastern Alberta. Prepared by the Cumulative Environmental Management Association, NOx/SOx Management Working Group. 39 pp.

Clair, T.A. and K.E. Percy (Editors) 2015. Assessing Forest Health in the Athabasca Oil Sands Region. WBEA Technical Report. 2015-05-25, 180 pp +Appendices

Fenn, M.E., and Poth, M.A. 2004. Monitoring nitrogen deposition in throughfall using ion exchange resin columns: A field test in the San Bernardino Mountains. J. Environ. Qual. 33: 2007-2014.

Foster K.R. 2015. Forest Health Monitoring Program, 2015 Procedures Manual. Prepared for the Wood Buffalo Environmental Association Terrestrial Environmental Effects Monitoring Program, Fort McMurray, AB. 120 pp.

Jaques, D.R., and Legge, A. H. 2012. Ecological analogues for biomonitoring industrial sulfur emissions in the Athabasca Oil Sands Region, Alberta, Canada. Chapter 10. pp 219-241. IN K.E. Percy (Ed.) *Alberta Oil Sands: Energy, Industry and the Environment*. Elsevier, Oxford, UK.

Jones, C.E., Associates 2006. Terrestrial Environmental Effects Monitoring Acidification Monitoring Program: 2004 Sampling Event Report for Soils, Lichen, Understory Vegetation and Forest Health and Productivity. Prepared for Wood Buffalo Environmental Association, Fort McMurray, AB, Canada.

## Data Management

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

WBEA will undertake the following tasks for data management:

WBEA will undertake a data cataloguing task to document and make publicly available data sets from the previous field monitoring periods. WBEA will develop a comprehensive database to manage the information and respond to requests.

Data generated through the FHM program will be openly available to the public via WBEA's website ([www.wbea.org](http://www.wbea.org)).

As outlined in the WBEA Forest Health Procedures Manuals (2011 and revised 2015), data analysis will be completed for existing data set as identified in Objectives section. Additional data analysis will be completed as requested by Science Advisors and reviewers for inputs into program recommendations for 2018 field monitoring program.

Through the data cataloguing, analysis and reporting tasks, development of Standard Operating Procedures for data receiving, handling, management, QA/QC and reporting will be developed and posted publicly.

## 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 Mo/Yr of Publication
Technical Review of WBEA's FHM network	Report to include: supplement to 2015 report (integration of data not yet reported); results from targeted soil and needle sampling to provide validation of early-warning, forest edge sites; recommendations for design and implementation of fourth intensive sampling cycle for 2018-19	2017-12-31
Scientific Manuscripts as outlined	Six scientific peer-reviewed publications	2019-03-31
2017-18 Monitoring Summary	Data report	2018-01-31
2018-19 Monitoring Summary	Data report	2019-01-31
2019-20 Monitoring Summary	Data report	2020-01-31
Report on status of Forest Health in AOSR (20-yrs of monitoring)	Results of fourth intensive sampling cycle integrated with results from previous three cycles	2020-01-31
Recommendations for terrestrial effects monitoring: lessons learned	Conceptual publication and report to EMSD	2018-06-30
Communications to community members on Forest Health	Ongoing outreach and knowledge translation activities	ongoing



## 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	Resource Name/Organization
Program oversight	Oversight of scientific priorities and report, ensuring local and regional stakeholder priorities are met, review and approval of recommendations, budget approval and monitoring	WBEA TEEM Committee
Program Lead	Program oversight, planning, implementation, reporting	WBEA Staff AEP Staff
Scientific Advisors	Program advising and planning	Ken Foster – Owl Moon Environmental Ellen MacDonald – University of Alberta Derek Mackenzie – University of Alberta Carla Davidson – TEEM Committee Chair, Endeavour Scientific Members of WBEA TEEM Technical Committee David Spink – Air Advisor
Field Sampling	Sample collection and analytical results	WBEA Staff External Contractors Analytical Laboratories
Office Work	Data Cataloguing, Collation, Synthesis, Reporting	WBEA Staff Students (Post Grad) Ellen MacDonald, Derek Mackenzie, and Yu-Mei Hsu to provide supervision.

**Deliverables (Year 1)** If your Focus Study is longer than 1 year then complete **Appendix 3** for multi-year deliverables breakdown

Provide a summary of deliverables for each quarter. To the extent possible, please identify deliverables that represent tangible outcomes that directly support the project objective (e.g., draft or final publication, presentation, dataset). For each quarter please also include a 1-page Quarterly Progress Report (which can also include activities in addition to outcomes).

<b>Deliverable(s)</b> (please provide enough information to support status reporting)
<b>Q1 – April to June</b>
No deliverables
<b>Q2 – July to September</b>
Catalogue existing FHM datasets into WBEA data management systems and begin dataset exploration and analysis.
Maintain program management and business support services to ensure deliverables of the workplans are completed.
Maintain a safety program that meets or exceeds provincial or site-specific requirements.
Maintain and conduct financial procedures and policies to meet Alberta Government contract terms and generally accepted accounting principles.
<b>Q3 – October to December</b>
Provide update on results of dataset analysis
Produce draft technical report and initiate process for external review.
Provide public access to FHM data via the WBEA website.
Maintain program management and business support services to ensure deliverables of the workplans are completed.
Maintain a safety program that meets or exceeds provincial or site-specific requirements.
Maintain and conduct financial procedures and policies to meet Alberta Government contract terms and generally accepted accounting principles.
<b>Q4 – January to March</b>
Provide feedback on external review of technical report and recommendations for future direction of the program
Provide public access to FHM report via the WBEA website.
Maintain program management and business support services to ensure deliverables of the workplans are completed.

Maintain a safety program that meets or exceeds provincial or site-specific requirements.
Maintain and conduct financial procedures and policies to meet Alberta Government contract terms and generally accepted accounting principles.

## Detailed Financial Breakdown – Year 1 of 3 (2017-2020)

Also complete **Appendix 2** 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 ( <i>outside JOSM</i> )
<b>O&amp;M - Operations and Maintenance:</b>		
Helicopter Costs	\$	\$
Field Costs	\$	\$
Data Management	\$	\$
Internal Lab Analysis	\$	\$
Consumable Materials & Supplies	\$	\$
<b>Sub-Total</b>	\$	\$
<b>O&amp;M - Travel</b>		
Field Work	\$	\$
Conferences ( <i>identify conference</i> )	\$	\$
Meeting ( <i>identify meeting</i> )	\$	\$
<b>Sub-Total</b>	\$	\$
<b>O&amp;M - External Contracts :</b>		
Goods and Services Contract ( <i>see Appendix 2</i> )	\$265,600 (WBEA)	\$
External Lab Analysis	\$	\$
<b>Sub-Total</b>	\$	\$
<b>Salaries:</b>		
Project Coordinator	\$	\$
Technical / Professional Assistants	\$	\$
Field Staff	\$	\$
<b>Sub-Total</b>	\$	\$
<b>Total Salaries</b>	\$	\$
<b>Total O&amp;M</b>	\$265,600	\$
<b>2017-2018 GRAND TOTAL*</b>	\$265,600	\$

## Appendix 1 - Approvals

<b>Project Submitted by:</b>		
Name:		
Organization:	Signature:	Date:
<b>Project Approved by:</b>		
Dr. Monique Dubé (AEP)		Dr. Kevin Cash (ECCC)
Signature 		Signature 
Date		Date

**APPENDIX 2 – Detailed Multi-year Financial Breakdown** (Complete the following detailed financial breakdown; add or delete categories as required)

Budget requirements	Year 1 (2017- 2018)		Year 2 (2018- 2019)		Year 3 (2019- 2020)	
	OSM	Other	OSM	Other	OSM	Other
1) Salaries and benefits						
a) Percentage allocated from TEEM cost estimate for 4 full time and 1 summer student	\$ 51,262		\$ 284,645		\$ 284,645	
b) Percentage allocated from administrative cost estimate for 7 administrative staff and 2 contractors	\$ 8,925		\$ 195,904		\$ 195,904	
2) Operations and maintenance						
a) Station and site maintenance			\$1,787		\$1,787	
b) Percent allocation of data telemetry costs			\$5,360		\$5,360	
c) Station and facilities Expenses			\$8,602		\$8,602	
d) Building Leases and Occupancy Costs			\$57,365		\$57,365	
e) Safety			\$10,969		\$10,969	
f) Emergent Items	\$4,488		\$22,560		\$22,560	
3) Consumable Materials and supplies						
a) Annual Tree Condition Assessment						
b) Field Materials			\$10,720		\$10,720	

c) Office Equipment			\$2,988		\$2,988	
d)						
4) Travel						
a) Ground transportation (vehicles)			\$12,338		\$12,338	
b) Air Transportation (Helicopter)			\$253,790			
c) Program Work travel, meetings, conferences, development	\$7,097		\$23,780		\$23,780	
d)						
5) Dissemination & Engagement						
a) Data cataloguing, analysis and reporting	\$32,000		\$34,994		\$34,994	
b) Science Advisors, Research Assistants, Reviewers, knowledge translation, manuscript publications	\$147,060		\$499,400		\$50,000	
c) Percent allocation of the WBEA's Data Management System	\$11,615		\$58,392		\$58,392	
d) Stakeholder Honorariums	\$3,153		\$11,125		\$11,125	
6) External Contracts						
a) Field Sampling – Soil (labour)			\$148,500			
b) Soil analysis			\$140,000			
c) Field Sampling – Vegetation (labour)			\$156,000			
d) Vegetation analysis			\$70,000			

e) Field Sampling – Lichen (labour)			\$72,000			
f) Lichen analysis			\$52,500			
g) Financial and Legal			\$7,962		\$7,962	
<b>Grand Total</b>	\$265,600		\$2,141,679		\$799,489	