2022-2023 OSM WORK PLAN APPLICATION

This form will be used to assess the merits of the proposed work plan and its fit with the Oil Sands Monitoring (OSM) Program mandate and strategic priorities. Applicants must complete the form in its entirety. Applicants that fail to use this form and complete all sections in the timeframe will not be considered.

OSM Work Plan Submission Deadline: The deadline for submission of proposed work plans is ***October 5, 2021 at 4:30 PM Mountain Standard time.***	***October 5, 2021*** *4:30 PM MST*
Decision Notification	*Mid to Late January 2022*

The OSM Program is governed by the Freedom of Information and Protection of Privacy Act (FOIP) and may be required to disclose information received under this Application, or other information delivered to the OSM Program in relation to a Project, when an access request is made by anyone in the public. Applicants are encouraged to familiarize themselves with FOIP. All work plans are public documents.

Work Plan Completion

Please ***Enable Macros*** *on the form when prompted.*

The applicant is required to provide information in sufficient detail to allow the evaluation team to assess the work plan. Please follow the requirements/instructions carefully while at the same time being concise in substantiating the project's merits. *The OSM Program is not responsible for the costs incurred by the applicant in the preparation and submission of any proposed work plan.*

When working on this form, please maintain Macros compatibility by always saving your draft and your final submission as a **Microsoft Word Macro-Enabled Document**, failure to do so will result in loss of form functionality. This form was created using Microsoft word 2016 on a PC and may not have functionality on other versions of Microsoft on PC or MACS.

All work plans under the OSM Program require either a government lead or a government coordinator. This will ensure that the financial tables (for Alberta Environment and Parks & Environment and Climate Change Canada) are completed accurately for work plan consideration. ***However,*** if an ***Indigenous community, environmental nongovernmental organization*** *or any other* ***external partner*** *is completing a work plan proposal, they would* ***only*** *complete the* ***grant or contract budget component*** *of the* ***Human Resources & Financials Section*** *for their project. The government coordinator within Alberta Environment & Parks would be responsible for completing the remaining components of the Human Resources and Financial Section of this Work Plan Application, as they are responsible for contract and grant facilitation of successful submissions. All other sections outside of* ***Human Resources & Financials Section*** *of this work plan proposal are to be completed in full by all applicants.*

The OSM Program recognizes that majority of work planning submissions are a result of joint effort and monitoring expertise. Should the applicant wish to submit supplemental materials in addition to their application additional resources are available in the Work Planning Form and Distribution Package, accessible here: **Work Planning Form and Distribution Package**

Should you have any ***questions*** *about completing this work planning form or uploading your final submission documents, please send all inquiries by email to:* **OSM.Info@gov.ab.ca**.

WORK PLAN SUBMISSION

*Upon completion of this application, please submit the appropriately named work plan (**Microsoft Word Macro-Enabled Document**) and all supporting documents to the link provided below. Failure to follow the naming convention provided may result in oversight of your application.*

*Please upload (by drag and dropping) the **WORK PLAN SUBMISSION & ALL SUPPORTING DOCUMENTS** here:*

WORK PLAN SUBMISSION LINK (CTRL+CLICK HERE)

Please use the following file naming convention when submitting your WORK PLAN:

202223_wkpln_WorkPlanTitle_ ProjectLeadLastNameFirstName

Example:

202223_wkpln_OilSandsResiduesinFishTissue_SmithJoe

If applicable, **please use the following file naming convention when submitting your supplementary or supporting files.** Please number them according to the guidance and examples provided:

202223_sup##_WorkPlanTitle_ ProjectLeadLastNameFirstName

Examples:

202223_sup01_OilSandsResiduesinFishTissue_SmithJoe

202223_sup02_OilSandsResiduesinFishTissue_SmithJoe

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202223_sup10_OilSandsResiduesinFishTissue_SmithJoe

Do not resave your work plan or documents under any other naming conventions. *If you need to make revisions and resubmit before the work planning deadline of October 5, 2021, **DO NOT** rename your submission. When resubmitting, simply resubmit with the exact naming convention so that it replaces the original submission. **DO NOT** add any additional components such as versioning or dates to the file naming convention. Please direct any questions regarding the submission or naming of submissions to **OSM.Info@gov.ab.ca**.*

WORK PLAN APPLICATION

PROJECT INFORMATION	
Project Title:	Long-term Groundwater Monitoring
Lead Applicant, Organization, or Community:	Cynthia McClain
Work Plan Identifier Number: *If this is an on-going project please fill the identifier number for 20/21 fiscal by adjusting the last four digits:* ***Example:*** *D-1-2020 would become D-1-**2022***	GW-LTM-3-2022
Project Region(s):	Oil Sands Region
Project Start Year: *First year funding under the OSM program was received for this project (if applicable)*	2015
Project End Year: *Last year funding under the OSM program is requested* ***Example: 2022***	N/A Longterm Monitoring
Total 2022/23 Project Budget: *For the 2022/23 fiscal year*	$2,987,000.00
Requested OSM Program Funding: *For the 2022/23 fiscal year*	$2,818,000.00
Project Type:	Longterm Monitoring
Project Theme:	Groundwater
Anticipated Total Duration of Projects (Core and Focused Study (3 years))	Choose an item.
Current Year	**Focused Study:** Choose an item.
	Core Monitoring: Choose an item.

CONTACT INFORMATION	
Lead Applicant/ Principal Investigator: Every work plan application requires one lead applicant. This lead is accountable for the entire work plan and all deliverables.	Cynthia McClain
Job Title:	Hydrogeologist
Organization:	Alberta Environment and Parks
Address:	3535 Research Rd. NW, Calgary, Alberta T2L 2K8
Phone:	587 226 2551
Email:	cynthia.mcclain@gov.ab.ca

PROJECT SUMMARY

Should your application be successful, The OSM Program reserves the right to publish this work plan application. Please check the box below to acknowledge you have read and understand:

☒ *I acknowledge and understand*

In the space below please provide a summary (300 words max) of the proposed project that includes a brief overview of the project drivers and objectives, the proposed approach/methodology, project deliverables, and how the project will deliver to the OSM Program objectives. The summary should be written in plain language.

The objective of this work plan is to develop and operate a long-term groundwater monitoring program that will provide data to inform the assessment of cumulative effects of oil sands activities on groundwater and groundwater dependent ecosystems (GDEs) and the effectiveness of regulatory and non-regulatory mechanisms. A conceptual model that identifies and prioritizes potential stressors, pathways, and receptors guides the monitoring program design so that monitoring focuses on priority components of the conceptual model. This program improves understanding of baseline conditions and changes in groundwater aquifers, and groundwater discharging to ecosystems (e.g., rivers, wetlands, springs) by conducting field-based monitoring to complement community-based monitoring, publishing groundwater monitoring data, and evaluating and reporting on regional groundwater quality and quantity conditions.

1.0 Merits of the Work Plan

All work plans under the OSM Program must serve the mandate of the program by determining (1) if changes in indicators are occurring in the oil sands region and (2) if the changes are caused by oil sands development activities and (3) the contribution in the context of cumulative effects. In the space below please provide information on the following:

- *Describe the key drivers for the project identifying linkages to the EEM framework particularly as it relates to surveillance, confirmation and limits of change (as per OC approved Key Questions).*
- *Explain the knowledge gap as it relates to the EEM framework that is being addressed along with the context and scope of the problem as well as the Source – pathway – Receptor Conceptual Models .*
- *Describe how the project meets the mandate of the OSM Program*
- *Discuss results of previous monitoring/studies/development and* what has been achieved to date.

Groundwater is an often overlooked but critical component of the hydrological cycle. In the oil sands regions, groundwater contributes to the water balance of rivers (e.g., Steepbank, Muskeg, and Firebag Rivers have >40% groundwater inputs [Gibson et al., 2016; Bickerton et al., 2018]), lakes (small headwater lakes have 5-20% groundwater inputs [Schmidt et al. 2010]) and wetlands (e.g., >50% of peatlands are fens which are sustained by groundwater [Volik et al., 2020]) and their associated ecological health (e.g., temperature, salinity).
A variety of oil sands development stressors may influence the connected groundwater system including mine dewatering, tailings pond seepage, sourcing of groundwater for production, subsurface disposal of wastewater, thermal mobilization of naturally occurring contaminants due to steam injection, and reclamation etc. (Birks et al., submitted; McClain et al., 2021).

The overarching goal of the project is to determine if oil sands activities (mining and in situ) are causing changes in groundwater conditions (quality and quantity) and if these changes are of concern or outside of natural variability. The approach to reach this goal follows the adaptive monitoring framework and work has been sequenced, with input from the OSM Groundwater Technical Advisory Committee (TAC), to reflect this progression. The groundwater monitoring program and Alberta Geological Survey (AGS) have successfully begun to characterize baseline groundwater quality and quantity conditions and changes over time in key aquifers at a regional scale (Manchuk et al., 2021; Nakevska, 2020; Nakevska and Lemay, 2021; Singh and Lemay, 2021). In 2021/2022, the groundwater program also began to characterize baseline groundwater discharge to rivers (baseflow) and wetlands. In 2022/2023, the program will continue work approved in 2021/2022. In addition, in 2022/2023 the program will expand its scope to include groundwater dependent ecosystems (GDEs) by mapping GDEs, evaluating changes in baseflow (quantity and quality) and wetland water balance over time, and synthesizing data on springs. By developing and implementing a long-term oil sands monitoring design, the groundwater program will focus monitoring efforts on stressors, pathways and receptors with the greatest risk of impacts to groundwater and groundwater dependent ecosystems.

Bickerton, G., Roy, J.W., Frank, R.A., Spoelstra, J., Langston, G., Grapentine, L. & L.M. Hewitt (2018) Assessments of Groundwater Influence on Selected River Systems in the Oil Sands Region of Alberta. OilSands Monitoring Program Technical Report Series No. 1.5. 32 p.

Birks, S.J., Gibson, J.J., Fennell, J.W., McClain, C.N., Sayanda, D., Bickerton, G., Yi, Y., Castrillon-Munoz, F. (submitted) Groundwater Condition and Vulnerability in the Oil Sands Region: Gaps, Opportunties and Challenges.

Gibson, J.J., Yi, Y., Birks, S. J., (2016) Isotope-based partitioning of streamflow in the oil sandsregion, northern Alberta: Towards a monitoring strategy forassessing flow sources and water quality controls. Journal of Hydrology: Regional Studies (5) 131-148. https://doi.org/10.1016/j.quascirev.2015.04.013

McClain, C., Sayanda, D., Birks, J., Bickerton, G. (2021) Groundwater Monitoring in the Oil Sands Region of Alberta, Canada. Presentation at GeoNiagara 2021 conference.

Manchuk, J. G., Birks, J. S., McClain, C. N., Bayegnak, G., Gibson, J. J., Deutsch, D. V. (2021) Estimating Stable Measured Values and Detecting Anomalies in Groundwater Geochemistry Time Series Data Across the Athabasca Oil Sands Area, Canada. Natural Resources Research (30), 1755–1779. https://doi.org/10.1007/s11053-020-09801-5

Nakevska N. (2020) Distribution of Hydraulic Head in the Grand Rapids Hydrostratigraphic Unit; Alberta Engergy Regulator / Alberta Geological Survey, AER/AGS Map 597, scale 1:1 250 000.

Nakevska, N., Lemay, T.G. (2021) Distribution of Hydraulic Head in the McMurray Hydrostratigraphic Unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 613, scale 1:1 250 000.

Schmidt, A., Gbson, J.J., Santos, I.R., Schubert, M., Tattrie, K., Weiss, H. (2010) The contribution of groundwater discharge to the overall water budget of two typical Boreal lakes in Alberta/Canada estimated from a radon mass balance. Hydrol. Earth Syst. Sci, 14, 79-89. https://doi.org/10.5194/hess-14-79-2010

Singh, A., Lemay, T.G. (2021) Distribution of Hydraulic Head in the Clearwater Hydrostratigraphic Unit. Alberta Engergy Regulator / Alberta Geological Survey, AER/AGS Map 607, scale 1:1 250 000.

Volik, O., Elmes, M., Petrone, R., Kessel, E., Green, A., Cobbaert D., Price, J. (2020) Wetlands in the Athabasca Oil Sands Region: the nexus between wetland hydrological function and resource extraction. Environmental Reviews 246-261. https://doi.org/10.1002/hyp.14323

2.0 Objectives of the Work Plan

List in point form the Objectives of the 2022/23 work plan below

The objectives are:
1. Long-Term Groundwater Monitoring Design. Develop an adaptive long-term groundwater monitoring program to provide the data required to determine if oil sands activities are causing changes to groundwater conditions that are of concern or outside natural variability.

2. Evaluation and Reporting. Build on the data analysis, synthesis and state of environment reporting from 21/22 on priority groundwater stressors/receptors, including groundwater-dependent ecosystem's (GDEs), to better understand the baseline/current state and variability of groundwater quality and quantity in oil sands regions, and to provide the understanding necessary for change detection and developing limits of change.

3. Groundwater Monitoring. Collect groundwater data from critical sites to (a) maintain a base level of Groundwater Observation Well Network monitoring and maintenance as the OSM Groundwater Monitoring program is being developed, (b) integrate with Air and Wetlands Programs for sampling of water isotopes to facilitate water balance calculations, and (c) expand the scope of monitoring to inclue GDEs and integrating with Community Based Monitoring by monitoring groundwater discharge along key reaches of tributary rivers in

the Lower Athabasca. 4. Publish Groundwater Data. Release 22/23 and historical groundwater monitoring and associated geospatial data (building on data inventory from 21/22) to the public via the OSM Data Portal and OSM Data Catalogue.

3.0 Scope

Evaluation of Scope Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would:

- be in scope of the OSM Program (e.g., regional boundaries, specific to oil sands development, within boundaries of the Oil Sands Environmental Monitoring Program Regulation)
- integrate western science with Indigenous Community-Based Monitoring
- addresses the EEM framework particularly as it relates to surveillance, confirmation and limits of change as per approved Key Questions.

have an experimental design that addresses the Pressure/Stressor, Pathway/Exposure, Response continuum

- produce data/knowledge aligned with OSM Program requirements and is working with Service Alberta
- uses Standard Operating Procedures/ Best Management Practices/ Standard Methods including for Indigenous Community-Based Monitoring

3.1 Sub Theme

Please select from the dropdown menu below the theme(s) your monitoring work plan relates to:

Groundwater

3.2 Core Monitoring or Focused study

Please select from the dropdown menu below if the monitoring in the work plan is "core monitoring" and/or a "focused study". Core monitoring are long term monitoring programs that have been in operation for at least 3 years, have been previously designated by the OSM program as core, and will continue to operate into the future. Focused studies are short term projects 1-2 years that address a specific emerging issue. For the purposes of 2022/23 work planning all Community Based Monitoring Projects are Focused Studies.

Core Monitoring

3.3 Sub Theme Key Questions

Please select from the dropdown menus below the sub-theme(s) your monitoring work plan relates to and address the Key Questions:

3.3.1 Surface Water Theme

3.3.1.1. Sub Themes:

Choose an item.

3.4.1.2 Surface Water Key Questions

Explain how your surface water monitoring program addresses the key questions below.

1. Are changes occurring in water quality, biological health (e.g., benthos, fish) and/or water quantity/flows, to what degree are changes attributable to oil sands activities, and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

2. Are changes in water quality and/or water quantity and/or biological health informing Indigenous key questions and concerns?

Click or tap here to enter text.

3. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

4. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

5. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

6. 7.6. Where does the monitoring fit on the conceptual model within the EEM framework for the theme area and relative to the conceptual model for the OSM Program theme area? How will this work advance understanding transition towards of the conceptual model EEM framework?

Click or tap here to enter text.

7. Is the work plan contributing to Programmatic State of Environment Reporting?

Click or tap here to enter text.

3.3.2 Groundwater Theme

3.3.2.1 Sub Themes:

Cross Cutting

3.3.2.2 Groundwater Key Questions

Explain how your groundwater monitoring program addresses the key questions below.

1.Are changes occurring in groundwater quality and/or quantity, to what degree are changes attributable to oil sands activities, are changes affecting other ecosystems, and what is the contribution in the context of cumulative effects?

Yes (partially), but not all critical elements of the monitoring plan are fully developed and being monitored yet. In the established components of the groundwater monitoring program, changes in groundwater quality over time have recently been statistically identified at specific regional monitoring wells. However, no attribution has currently been made concerning the source of the identified changes but investigations of cause were included in the 2021/2022 and 2022/2023 work plan activities. How these changes may be affecting other ecosystems (e.g. aquatic, terrestrial) remains to be determined pending the development of an interpretation framework (e.g. modeling) and completion of elements of the data synthesis currently in progress. Other groundwater monitoring and modeling components for establishing a reference state and detecting changes in groundwater discharge to surface water ecosystems (e.g. rivers, and wetlands) at various scales are being prioritized and will begin to be tested (e.g. ability and sensitivity to detect change). The cumulative effects of oil sands activities on groundwater have yet to be evaluated. Change detection, attribution and cumulative effects are the core outcomes around which the new adaptive groundwater-monitoring program will be designed (Objective 1).

2. 2. Are changes in groundwater quality and/or quantity informing Indigenous key questions and concerns Indigenous concerns and health?

Yes, but further expansion of Indigenous key questions will continue as the groundwater monitoring program is developed. In general,oil sands groundwater quality data can be compared against water quality guidelines or other benchmarks to inform indigenous concerns and health (e.g. is the water safe to drink?). This may be particularly relevant in the Cold Lake Beaver River region where groundwater may more frequently be used for domestic consumption purposes, and where in-situ mining activities may have the potential to mobilize naturally occurring contaminants of concern (e.g. arsenic).

3. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Yes, the OSM data management systems continue to be configured for groundwater monitoring datasets in collaboration with Service Alberta. Groundwater level data are publically available on the OSM Data Portal and groundwater quality data will be available in 2021/2022.

4. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Standard methods for groundwater monitoring are being used for fieldwork where available. New monitoring approaches being developed/tested to monitor ground water discharge to surface water ecosystems will have new SOPs/guidance developed. A comprehensive groundwater monitoring field manual composed of SOPs is currently under development by AEP (MSDGW1). In the interim we aim to follow Eddington et al. "Guidelines for Groundwater Monitoring Best Practices Regional Municipality of Wood Buffalo" (2012), report prepared for CEMA or other relevant SOPs and guidance.

5. How does the monitoring identify integration amongst projects, themes or with communities?

Phases of this work plan (and the preceding 2020/2021, and 2021/2022 work plans) include specific tasks to inventory, compile and evaluate relevant existing/planned monitoring information for potential integration into the OSM groundwater monitoring. This exercise includes examining data from other OSM themes areas, industry, communities, etc. that may be used directly (in whole or in part) in establishing reference conditions and/or surveillance monitoring for detecting change in groundwater-dependent ecosystems. Attempts will be made to leverage (e.g. repurpose within a groundwater context) existing data and monitoring plans lead by other OSM themes by reinterpreting where possible and supplementing monitoring where needed.

We have also initiated integration among OSM themes through water isotope monitoring in wetlands, surface water, and precipitation (air theme area) to use in refining understanding of where, how much and when surface water-groundwater interaction occur. Groundwater and surface water models, where available, also help integration of this data between OSM themes. Additionally, some of the new methods being examined for watershed-scale monitoring of changes in groundwater discharge (e.g. water balance) use existing surface water data collected under the surface-water monitoring program but examined and interpreted in a groundwater and groundwater modeling context. Integration with the wetland theme is also included in (a) modeling activities (e.g. framework for interpreting observed/expected groundwater changes) in the coupled groundwater-surface water modeling activities included in components of this work plan, and (b) remote sensing of wetland/groundwater interactions. Integration with the terrestrial biological monitoring theme is also included in developing maps of groundwater dependent ecosystems.

6. Where does the monitoring fit within the EEM framework and relative to the theme area? How will this work advance transition towards the EEM framework?

Historically groundwater monitoring in the OS region was not included in previous ecological and water quality monitoring programs (e.g. RAMP), but rather was mainly performed for local compliance objectives or regional planning efforts by the province; neither was particularly well suited on their own for EEM-type design objectives. Previous ECCC work under JOSMP developed new methods and studies to support an EEM approach on monitoring groundwater-surface water interaction but did not advance to including monitoring before JOSMP ended. Consequently, much of the initial work in the OSM groundwater monitoring program has been to compile and synthesize existing groundwater-relevant information, identify/prioritize knowledge gaps, develop conceptual models and rationalize existing infrastructure and programs to align/support the OSM objectives and serve as the foundation for proceeding to an EEM-type framework. Much of this preliminary effort is needed to establish reference conditions and the range of natural variability where possible (e.g. regional groundwater levels and quality) and identify new approaches that could be further tested to provide a surveillance tier of monitoring and establish a reference state for identified OSM monitoring gaps (e.g. watershed-scale temporal changes in groundwater discharge). The use of existing coupled groundwater-surface water models (where available) is being explored to support and evaluate the development of new groundwater surveillance monitoring by providing an interpretive framework from which to determine expected and unexpected changes (and what constitutes a meaningful difference and critical effect levels) from natural and anthropogenic stressors.

Overall, the groundwater-monitoring program is generally in the early-mid stages of its development to an operational EEM-type program with decision frameworks, limits of change, etc. just starting to be developed. The groundwater monitoring program is currently underoing adaptive design and implementation to align with the mandate and scope of the OSM program, including review of indicator parameters. Objective 1 will continue to work towards a rationalized and risk-based monitoring design linked to stressor gradients and the conceptual model. Objective 2 also includes continued compilation, analysis and reporting on historical data to evaluate whether/where indicators parameters are detected and changing.

The groundwater TAC reviewed status of the Key Questions to the EEM Framework in August-September, 2021 and determined that progress has been made in the surveillance category and now the program may be addressing (middle category)the effects questions when aquifers are the “receiving environment” and with the new groundwater dependent ecosystem work in the 22/23 fiscal year.

7. Where does the monitoring fit on the conceptual model for the theme area and relative to the conceptual model for the OSM Program? How will this work advance understanding of the conceptual model?

Current field-based monitoring fits in the receptor categories of groundwater quality, groundwater levels and in 22/23 will also sequence in monitoring groundwater discharge (quantity and quality) in the McKay watershed. Desktop studies in 22/23 also begin to evaluate the potential effects component of the conceptual model by mapping groundwater dependent ecosystems (aquatic and terrestrial) to inform locations of future groundwater effects-based monitoring. This work aims to use the groundwater conceptual model and information on the prioritized groundwater stressors to design an adaptive monitoring program for groundwater to address conceptual model components.

8. Is the work plan contributing to Programmatic State of Environment Reporting?

Yes, a state of the environment report (introduction, indicators) to share with the general public was written and submitted for publication on the OSM website. A companion journal article was submitted in 21/22, and is currently under review, and will be published online. In 21/22 additoinal public reporting content on the 6 priority groundwater stressors, including a research spotlight on tailings pond seepage, is being written for publication in the 22/23 fiscal year.

3.3.3 Wetlands Theme

3.3.3.1 Sub Themes:

Choose an item.

3.3.3.2 Wetland - Key Questions

Explain how your wetland monitoring program addresses the key questions below.

1. Are changes occurring in wetlands due to contaminants and hydrological processes, to what degree are changes attributable to oil sands activities, and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

2. Are changes in wetlands informing Indigenous key questions and concerns?

Click or tap here to enter text.

3. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

4. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

5. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

6. Where does the monitoring fit within the EEM framework and relative to the theme area? How will this work advance transition towards the EEM framework?

Click or tap here to enter text.

7. Where does the monitoring fit on the conceptual model for the theme area and relative to the conceptual model for the OSM Program? How will this work advance understanding of the conceptual model?

Click or tap here to enter text.

8. Is the work plan contributing to Programmatic State of Environment Reporting?

Click or tap here to enter text.

3.3.4 Air Theme

3.3.4.1 Sub Themes:

Choose an item.

3.3.4.2 Air & Deposition - Key Questions

Explain how your air & deposition monitoring program addresses the key questions below.

1. Are changes are occurring in air quality, to what degree are changes attributable to oil sands emissions, and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

2. Are changes informing Indigenous key questions and concerns?

Click or tap here to enter text.

3. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

4. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

5. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

6. Where does the monitoring fit within the EEM framework and relative to the theme area? How will this work advance transition towards the EEM framework?

Click or tap here to enter text.

7. Where does the monitoring fit on the conceptual model for the theme area and relative to the conceptual model for the OSM Program? How will this work advance understanding of the conceptual model?

Click or tap here to enter text.

8. Is the work plan contributing to Programmatic State of Environment Reporting? (Answer Box)

Click or tap here to enter text.

3.3.5 Terrestrial Biology Theme

3.3.5.1 Sub Themes:

Choose an item.

3.3.5.2 Terrestrial Biology - Key Questions

Explain how your terrestrial biological monitoring program addresses the key questions below.

1. Are changes occurring in terrestrial ecosystems due to contaminants and landscape alteration, to what degree are changes attributable to oil sands activities, and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

2. Are changes in terrestrial ecosystems informing Indigenous key questions and concerns?

Click or tap here to enter text.

3. Are data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

4. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

5. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

6. Where does the monitoring fit within the EEM framework and relative to the theme area? How will this work advance transition towards the EEM framework?

Click or tap here to enter text.

7. Where does the monitoring fit on the conceptual model for the theme area and relative to the conceptual model for the OSM Program? How will this work advance understanding of the conceptual model?

Click or tap here to enter text.

8. Is the work plan contributing to Programmatic State of Environment Reporting?

Click or tap here to enter text.

3.3.6 Cross-Cutting Across Theme Areas

3.3.6.1 Sub Themes:

Choose an item.

If "Other" was selected from the drop down list above please describe below:

Click or tap here to enter text.

3.3.6.2 Cross-Cutting - Key Questions

Explain how your cross-cutting monitoring program addresses the key questions below.

1. Is data produced following OSM Program requirements and provided into the OSM Program data management system?

Click or tap here to enter text.

2. Do methodologies use relevant Standard Operating Procedures/ Best Management Practices/ Standard Methods?

Click or tap here to enter text.

3. How does the monitoring identify integration amongst projects, themes or with communities?

Click or tap here to enter text.

4. Where does the monitoring fit within the EEM framework and relative to the theme area? How will this work advance transition towards the EEM framework?

Click or tap here to enter text.

5. Where does the monitoring fit on the conceptual model for the theme area and relative to the conceptual model for the OSM Program? How will this work advance understanding of the conceptual model?

Click or tap here to enter text.

6. Is the work plan contributing to Programmatic State of Environment Reporting?

Click or tap here to enter text.

4.0 Mitigation

Evaluation of Mitigation Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially inform:

- efficacy of an existing regulation or policy
- an EPEA approval condition
- a regional framework (i.e., LARP)
- an emerging issue

Explain how your monitoring program informs management, policy and regulatory compliance. As relevant give consideration for the EEM framework and the approved Key Questions.

Groundwater monitoring, particularly the work outlined to address objective 2 (evaluation and reporting), will directly inform development of the Lower Athabasca Region Groundwater Management Framework and other water management plans (e.g., plans overseen by WPACs).

In addition, information generated from the groundwater monitoring program (especially once the new design focused on the assessment of cumulative effects is implemented) could be used to:

1. evaluate the efficacy of multiple policies, frameworks, guidelines and directives (i.e., directive for the Assessment of Thermally-Mobilized Constituents in Groundwater for Thermal In Situ Operations, draft directive for Assessment of Non-saline Groundwater in Direct Contact with Bitumen for In Situ Operations, LAR Groundwater Management Framework, Water Conservation Policy for Upstream Oil and Gas Operations, etc.);

2. evaluate regional scale cumulative effects associated with regulatory approvals and licences in the area (i.e., EPEA approved facilities, Water Act approvals and licences, disposal scheme approvals, etc.); and

3. evaluate, verify or validate predictions of impacts to groundwater at the regional scale (i.e., predictions made in EIAs).

As a part of developing the adaptive monitoring design there is the potential to leverage regional monitoring programs operators are implementing pursuant to EPEA and Water Act approval conditions to improve the OSM regional groundwater monitoring network. Operator involvement and support will inform regulatory compliance with EPEA approval conditions to participate in regional initiatives under LARP and OSM.

Objective 3, groundwater monitoring, supports transboundary agreements with the Northwest Territories for the Mckenzie River Basin

5.0 Indigenous Issues

Evaluation of Indigenous Issues Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially:

- Investigate Indigenous communities key questions and concerns
- Includes culturally relevant receptor(s) and indicator(s)
- Include or be driven by Indigenous communities (participatory or collaborative)
- Develop capacity in Indigenous communities
- Include a Council Resolution or Letter of Support from one or more Indigenous communities
- Describe how ethics protocols and best practices regarding involvement of Indigenous peoples will be adhered to
- Provide information on how Indigenous Knowledge will be collected, interpreted, validated, and used in a way that meets community Indigenous Knowledge protocols

Explain how your monitoring activities are inclusive and respond to Indigenous key questions and concerns and inform the ability to understand impacts on concerns and inform Section 35 Rights

Two indigenous community based monitoring groundwater pilot projects were successfully completed in 2020/2021 under the groundwater work plan to investigate indigenous community key questions and concerns on water levels and quality in rivers, and the potential role of groundwater activities associated with oil sands mining. One of these has now scaled up and is a stand alone work plan from Fort McKay Metis Nation in 2021/2022 and 2022/2023. Separate EOI's were submitted by communities in 2022/23 and were not integrated into the core groundwater monitoring work plan.

Groundwater discharge monitoring fieldwork and evaluation and reporting in the Mckay River watershed (Tasks 3.2.3 and 3.3.1) provide western science data and interpretations of baseline conditions and change that can be used by Fort McKay Metis Nation in their investigation of cause to addressed confirmed community concerns.

Objective 1, refining the new long-term monitoring design will incorporate recommendations for opportunities for traditional knowledge and community-based groundwater monitoring that is relevant to and inclusive of Indigenous communities over a 5-year period and include culturally relevant receptors/indicators. The plan will also adhere to reference standards for ethical research practices.

Does this project include an Integrated Community Based Monitoring Component?

No

6.0 Measuring Change

Evaluation of Measuring Change Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially:

- assess changes in environmental conditions compared to baseline (e.g., validation of EIA predictions)
- report uncertainty in estimates and monitoring is of sufficient power to detect change due to oil sands development on reasonable temporal or spatial scales
- include indicators along the spectrum of response (e.g., individual, population, community)
- focus on areas of highest risk (where change is detected, where change is greater than expected, where development is expected to expand (collection of baseline)
- measure change along a stressor gradient or a stressor/reference comparison

Explain how your monitoring identifies environmental changes and can be assessed against a baseline condition. As relevant give consideration for the EEM framework and the approved Key Questions.

The groundwater monitoring program is generally in the stage of identifying/establishing baseline and reference conditions (quality and quantity/discharge), spatial and temporal ranges of natural variability in groundwater quality and quantity/discharge, and whether changes occur outside of these ranges in the oil sands regions. In addition, new integrated approaches are still being evaluated and considered for monitoring of groundwater-depended ecosystems within an EEM-type framework. Field-based monitoring (Objective 3) includes confirmation monitoring in wells where temporal changes in water quality were identified, strategic monitoring of regional baseline, and surveillance monitoring. Evaluation and reporting on groundwater monitoring data and indicators continues (Objective 2) to work towards answering the core questions of the OSM program, including baseline conditions and change.

Monitoring stable isotopes as routine parameters in the OSM surface water quality program permits an evaluation of hydrograph separation as a potential surveillance-tier method to detect changes in groundwater discharge at the watershed-scale (e.g., water balance) and will be further evaluated in the Lower Athabasca River where previous research data and groundwater-surface water models exists.

EIA and model predictions of groundwater stressors (e.g., drawdown due to groundwater extraction by oil sands operations) will be used to compare against observed changes in environmental conditions (e.g., hydraulic head), to develop groundwater stressor gradient maps, and inform risk-based long-term groundwater monitoring design. The long-term groundwater monitoring design began in 20/21 and 21/22 with a workshop series and will continue in 22/23 including making specific recommendations for indicators to monitor, linked to the conceptual model components, and methods that will be used to evaluate change and uncertainty in groundwater quality and quantity/discharge over space and time.

7.0 Accounting for Scale

Evaluation of Accounting for Scale Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially be:

- appropriate to the key question and indicator of interest
- relevant to sub-regional and regional questions
- relevant to organism, population and/or community levels of biological organization
- where modelled results are validated with monitored data
- where monitoring informs on environmental processes that occur at a regional scale. e.g. Characterizing individual sources to gain a regional estimate of acid deposition and understand signal from individual contributing sources.

Explain how your monitoring tracks regional and sub-regional state of the environment, including cumulative effects. As relevant give consideration for the EEM framework and the approved Key Questions.

The groundwater monitoring program extends from the Cold Lake Beaver Region to the Lower Athabasca Region and Peace Region. In the current monitoring well network, groundwater wells monitor quality and quantity conditions in both deeper regional aquifers as well as shallow local-scale groundwater systems. Approaches for monitoring groundwater dependent ecosystems at various scales is still under development through testing and evaluation. In 2020/2021 conceptual models of stressors, pathways and effects for oil sands impacts to groundwater were developed and used as the basis for a data inventory, stressor prioritization, and data gap workshop. These activities identified baseline data and monitoring of the quantity and quality of groundwater discharge to dependent ecosystems (wetlands, rivers and lakes) as a key data and monitoring gap. In addition, some of the highest priority stressors identified during the workshops were local in scale and monitored as part of compliance monitoring. The 2021/22 work plan initiated a new focus of addressing priority gaps related to developing baseline groundwater and groundwater discharge quantity as well as synthesis of selected local compliance data that can contribute to regional baselines and assist in evaluating the sensitivity and consistency of watershed-scale monitoring that is intended to integrate the effects of local stressors, and this work will continue in 2022/23. In 2022/23 work on the priority gap of groundwater discharge quality will be sequenced in by interpreting surface water quality data from a groundwater lens in areas where changes in the quantity of groundwater discharge to surface water were found, as well as by conducting a desktop study synthesizing spring data to identify appropriate locations for regional monitoring and monitoring of groundwater dependent ecosystems.

The 2022/23 workplan will continue to work towards completing a rationalized and adaptive long-term monitoring plan (Objective 1) to align with the core OSM outcomes including identification of key questions, indicators, limits of change and assessment of cumulative effects of oil sands development on groundwater and connected ecosystems (e.g., groundwater dependent aquatic and terrestrial ecosystems) at multiple scales (i.e. local, watershed and regional scale). The adaptive monitoring plan will also make recommendations for how numerical modelling can provide an interpretive framework to integrate groundwater monitoring with other OSM themes and inform monitoring (and vice versa).

8.0 Transparency

Evaluation of Transparency Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would potentially include:

- a plan for dissemination of monitoring data, including appropriate timing, format, and aligns with OSM program data management plan
- demonstrated transparency in past performance
- identified an annual progress report as a deliverable
- reporting of monitoring results occurs at timing and format that is appropriate for recipient audience.

Explain how your monitoring generates data and reporting that is accessible, credible and useful. As relevant give consideration for the EEM framework and the approved Key Questions.

Monitoring data generated by the groundwater program are targeted for dissemination as per the OSM program data management plan and the identified groundwater data assets (e.g., quality and quantity data). The configuration of the public OSM Data Portal for groundwater data is complete for groundwater levels and nearly complete for groundwater quality (as of October 2021). 2022/2023 groundwater quality data from the GOWN network will be automatically uploaded from the labs, validated and posted to the OSM Data Portal. Historical groundwater moniotirng datasets are also being prepared for release on the OSM Data Catalogue. For a subset of groundwater monitoring wells, water level data are available in near-real time on the AEP GOWN and RiverBasins websites.

A communication plan was presented to the Groundwater TAC in September 2021. In 2021 the groundwater sections of the SoE website and report report were completed, a conference presentation was given, and a community presentation will be given in Q3. Public communication pieces on the 6 priority groundwater stressors are being prepared in 21/22 for publication in 22/23. One peer reviewed paper on regional groundwater quality was published, two additional manuscripts were submitted. Multiple OSM technical documents summarizing contractor/grantee work have been drafted. Section 14.0 identifies a variety of deliverables for scientific and lay audiences, including a progress report.

9.0 Efficiency

Evaluation of Efficiency Criteria (Information Box Only- No action required)
Your workplan will be evaluated against the criteria below. A successful workplan would include:

- appropriately addressed a risk-informed allocation of resources
- identified the role and justification for each staff member on the proposed work plan
- identified in-kind and leveraged resources (e.g., resources and approaches are appropriately shared with other OSM projects where possible)
- established partnerships (value-added) and demonstrated examples of coordinated efficiencies (e.g., field, analytical)
- identified co-location of monitoring effort
- demonstrated monitoring activities and information collected are not duplicative
- considered sampling/measurement/methods compatibility to other data sources (e.g., AER)

Explain how your monitoring is integrated with other OSM projects and incorporates community-based participation and/or engagement in proposed monitoring activities. As relevant give consideration for the EEM framework and the approved Key Questions.

In 20/21 and 21/22 monitoring was integrated with multiple other OSM projects, all of which will continue in the 22/23 plan. The 22/23 work plan includes further integration with the terrestrial biological monitoring work plan (B-LTM-TB-1-2223). To support the groundwater monitoring program the wetlands program (WL-PD-10-2223) includes water isotopes (oxygen-18, deuterium) as a new parameter at wetland sites (and the piezometers installed at wetland sites) for a second year at request of the groundwater TAC. The wetlands-geospatial program and groundwater program collaborate on evaluating use of remote sensing techniques for use in identifying wetland/groundwater interactions. The integrated atmospheric deposition monitoring work plan (A-PD-6-2223) supports groundwater monitoring: collection of water isotopes in precipitation at 3 monitoring locations along a latitudinal gradient (co-located with existing air monitoring). This monitoring work supplements the isotopic records for surface water, which will also be expanded to 7 new locations in the South Athabasca Oil Sands area co-located with Water Survey Canada stations, and groundwater allowing for better characterization of surface water – groundwater interaction which has been identified as a priority for the OSM program across theme areas. New integration will include working with the terrestrial biological monitoring program to map groundwater dependent ecosystems that can be used to identify locations for monitoring potential biological effects from groundwater stressors/pathways/responses.

This work plan uses historical monitoring data from a variety of sources (e.g., industry, government etc.) and theme areas (e.g., AEH, wetlands) to ensure that the long-term monitoring activities in the new adaptive design are not duplicative and that the program utilizes available information to address the core OSM outcomes.

This work plan includes collaboration with other TACs to share approaches for monitoring design (e.g., risk-based on stressor gradients).

10.0 Work Plan Approach/Methods

10.1 List the Key Project Phases and Provide Bullets for Each Major Task under Each Project Phase *

Note on Changes: The initial stages of developing an adaptive long-term groundwater monitoring plan for OSM was originally envisioned in four phases (conceptual model, data synthesis, monitoring, long-term program design). Significant progress has been made in all phases despite the disruption by COVID-19 impacts. Phase 1 conceptual model was completed in 2021 which included consensus based decision making by the OSM Groundwater TAC to define 6 priority stressors and knowledge gaps that have guided the sequencing of subsequent work. The 2022/2023 work plan includes reorganization of the 4 phases into tasks associated with the 5 objectives, recognizing the long-term nature of the work. Each task indicates whether it is continued from 2021/2022 or new in 2022/2023.

Note on Interdependencies: Geospatial tasks include: 1.2, 2.2.2, 2.2.4.1(delivered by AEP, ABMI, InnoTech and UNB grant), and 4.3.4 (dependent on geospatial data portal). Tasks integrated with the Wetlands work plan: 2.2.4.2, 3.2.3, 3.3.2, and 3.3.3 (delivered by AEP, U Waterloo grant and UNB grant). Tasks integrated with the Terrestrial Biological Monitoring work plan: 2.2.2 (delivered by InnoTech contract and ABMI grant). Tasks integrated with the Air work plan: 3.2.1. Tasks interdependent/coordinated with groundwater community based monitoring work include: 1.3 and 3.3.1.

1. Long Term Groundwater Monitoring Design (continued from 2021/2022)
1.1 Monitoring Network Design
1.2 Geospatial Analysis of Groundwater Stressors
1.3 Opportunities for Focused Studies and Community Based Monitoring
1.4 Data Evaluation, Modelling, and Reporting Recommendations
1.5 Planning for Implementation

2. Evaluation & Reporting (E&R)
2.1 Plain Language Reporting (continued from 2021/2022)
2.2 Groundwater Quantity Evaluation & Reporting (continued from 2021/2022)
2.2.1 Aquifers- Hydraulic Head Baseline and Change (continued from 2021/2022)
2.2.2 Groundwater Dependent Ecosystems Mapping (new in 2022/2023)
2.2.3 Discharge to Rivers- Baseflow Baseline and Change (continued from 2021/2022)
2.2.4 Discharge to Wetlands- Baseline and Change (continued from 2021/2022)
2.2.4.1 Remote Sensing of Wetland/Groundwater Interaction in the McKay Watershed (continued from 2021/2022)
2.2.4.2 Groundwater/Wetland Modelling in the Poplar Creek Watershed (continued from 2021/2022)
2.3 Groundwater Quality Evaluation & Reporting (continued from 2021/2022)
2.3.1 Aquifers- Geochemical Interpretation and Investigation of Temporal Anomalies (continued from 2021/2022)
2.3.2 Discharge to Rivers- Baseflow Baseline Water Quality and Changes (focus where changes in discharge quantity observed- task 2.2.3) (new in 2022/2023)
2.3.3 Discharge via Springs- Data Compilation and Synthesis (new in 2022/2023)

3. Groundwater Monitoring
3.1 Regional Core Groundwater Observation Well (GOWN) Monitoring and Maintenance (continued from 2021/2022)
3.1.1 Fieldwork at Selected Wells and Lab Analysis of Samples (continued from 2021/2022)

3.2 Integrated Isotope Sampling to Inform Regional Water Balance (continued from 2021/2022)
3.2.1 Precipitation Water Isotopes at 3 Stations along a Latitudinal Gradient (continued from 2021/2022)
3.2.2 South Athabasca River Tributary Water Isotopes at 7 ECCC/Water Survey Stations (new in 2022/2023)
3.2.3 Wetland Surface Water and Groundwater Isotope Sampling (continued from 2021/2022)
3.3 Groundwater Dependent Ecosystem Fieldwork
3.3.1 Groundwater Discharge along Reaches of the McKay River (extension of OSM funded ECCC work in 2012-2013; new in 2022/2023)
3.3.2 Wetland Fieldwork in the McKay Watershed to support Validation of Remote Sensing of Wetland Groundwater Interactions (continued from 2021/2022)
3.3.3 Validation of Poplar Creek Wetland-Groundwater Model (continued from 2021/2022)
3.4 Standard Operating Procedure Development (continued from 2021/2022)

4. Publish Groundwater Data (continued from 2021/2022)
4.1 OSM KISTERS Database, Data Portal and Data Catalogue Configuration for Groundwater Data
4.2 Publish 22/23 Groundwater Monitoring Field Data (from tasks 3.1-3.3) via the OSM Data Catalogue
4.3 Publish Historical Groundwater Data via the OSM Data Catalogue
4.3.1 Historical GOWN Water Level and Quality Data
4.3.2 Operator Data Request Water Level, Quality, and Metadata
4.3.3 OSM Groundwater Data Compilation (from InnoTech data compilation in 2020-22)
4.3.4 Groundwater Geodatabase (from InnoTech data inventory in 2020-22)

5. Project Management (continued from 2021/2022)
5.1 Strategic/Implementation Plan Preparation (new in 2022/2023)
5.2 23/24 Work Plan Preparation
5.3 Quarterly OSM Program Office Reports on Fiscal Status & Deliverables
5.4 Annual OSM Program Office Report

10.2 Describe how changes in environmental Condition will be assessed *

The groundwater conceptual model identified four main groundwater responses: changes in groundwater quality, change in groundwater quantity, changes in groundwater discharge quality, and change in groundwater discharge quantity.

Baselines for groundwater quality have been developed for most of the key aquifers in the oil sands region. Temporal anomalies in baseline groundwater quality have been identified in previous studies published in 2021, and the 22/23 work plan will continue to use geochemical and water level data to interpret and investigate the cause of regional groundwater quality changes.

The 22/23 workplan will develop baseline estimates for groundwater quantity in Quaternary aquifers (hydraulic head distribution), and publish results of Cretaceous aquifer water level changes.

Data synthesis and modeling that can be used to develop baseline and natural variability estimates of groundwater discharge will continue in the 22/23 workplan, and new work on groundwater discharge quality conditions in river baseflow (where changes in discharge quantity have been observed) will be conducted.

Groundwater levels and quality are measured over space and time as a part of this monitoring program, and may be compared to historical data to identify whether there have been changes in environmental condition.

10.3 Are There Benchmarks Being Used to Assess Changes in Environmental Condition? If So, Please Describe, If Not, State "NONE" *****

Triggers exist for certain water quality indicator parameters as specified in the LARP Groundwater Management Framework, however these are drafts and are currently under revision. Surface water quality (Canadian Water Quality Guideline) or Guidelines for Canadian Drinking Water Quality can also be used for aquatic groundwater dependent ecosystems and domestic well water, respectively. In some cases, comparison to Tier 1 and Tier 2 guidelines under Alberta's contaminated sites management framework may be relevant.

(e.g., objectives, tiers, triggers, limits, reference conditions, thresholds, etc.)

10.4 Provide a Brief Description of the Western Science or Community-Based Monitoring Indigenous Community-Based Monitoring Methods by Project Phase *

1. Long Term Groundwater Monitoring Design
The groundwater monitoring program design will be based on the conceptual model, stressor prioritization, and data gap analyses that were completed in 2021 to identify future monitoring needs. The groundwater monitoring design may include an adaptive monitoring decision framework based on EEM concepts, which were discussed during TAC workshops in 2021. We aim to use geospatial groundwater stressor mapping to support monitoring site selection and allow for future analysis with respect to response variables. Opportunities for focused studies, traditional land use studies, and community-based monitoring will be recommended. At least one two-day design workshop will be convened to get input on the program design from the groundwater TAC, indicators, and to discuss timing, requirements, and strategy for phased implementation.

2. Evaluation & Reporting (E&R)
Task 2.1 Plain language reporting will continue with publication of short public communication pieces on the priority stressors that were developed in 21/22, and developing additional content such as a groundwater quantity indicator based on the hydraulic head change mapping conducted by the Alberta Geological Survey for Cretaceous aquifers in 2021/2022.

Task 2.2 Groundwater quantity evaluation and reporting focuses on addressing key data gaps for aquifers and groundwater discharge by: (1) continuing to compile, QA/QC, analyze, and map baseline and changes in hydraulic head in Cretaceous and Quaternary aquifers, including supporting on Quaternary hydrostratigraphy; (2) developing an approach, evaluating data availability, and mapping groundwater dependent ecosystems (GDEs) inclusive of GDE's that support aquatic, wildlife, and vegetation communities used for indigenous harvesting that could be considered for groundwater effects-based monitoring; (3) continuing to define ranges of groundwater discharge to surface water under baseline and future climate/development scenarios using isotope-enabled modelling of baseflow separation in the lower Athabasca River basin; (4.1) continuing to evaluating how remote sensing can be used to infer groundwater contributions to wetlands by developing wetland temperature maps using Landsat 8 thermal imagery in the McKay River watershed, and validating the supporting wetland land cover maps developed in 2021/2022 using publically available multi-date Sentinel-2 optical and Sentinel-1 SAR imagery combined with LiDAR; (4.2) further developing, refining and validating the existing integrated groundwater-surface water model (GSFLOW) in the Poplar Creek watershed to assess the cumulative effects of oil sands development stressors including surface water and groundwater dewatering and diversions and various land disturbances on groundwater levels and the hydrological conditions of wetland ecosystems. The outcomes will be used to fill knowledge gaps that cannot be addressed by surveillance monitoring and to refine the monitoring program designs to focus in areas where ecological effects are predicted to be at highest risk.

Task 2.3 Groundwater quality evaluation and reporting focuses on addressing key data gaps for aquifers and groundwater discharge by: (1) Continuing to compile, QA/QC, analyze, and interpret groundwater quality data for improved understanding and communication of potential groundwater quality impacts from priority oil sands stressors and how local stressors are being monitored and reported through compliance monitoring, to fill in spatial data gaps in regional baseline conditions, and investigate geochemical changes (temporal anomalies from Manchuk et al., 2021); (2) Reviewing time-series river water quality data from OSM Surface Water Quality monitoring, from a groundwater lens, focusing on baseflow data and in areas/tributaries with known/larger groundwater influence and where changes in discharge quantity were observed (task 2.2.3; e.g., Steepbank, Muskeg, Firebag, Christina Rivers) to begin to evaluate how groundwater influences surface water quality; (3) Compiling and synthesizing spring data that was inventoried in 2020/2021 (and new data from the AGS [Stewart, 2021]) to identify whether time-series data are available to identify changes in quantity or quality of discharge and locations suitable for continued monitoring with respect to Indigenous Knowledge or GDEs.

3. Groundwater Monitoring
Task 3.1 Regional core Groundwater Observation Well (GOWN) monitoring (water levels, temperature) and maintenance will continue at approximately 120 wells (including ~30 water quality wells) in the Cold Lake Beaver River, Peace and Lower Athabasca Regions, with fieldwork being conducted by AEP from April-December. Stations for baseline, surveillance and confirmation monitoring will be the focus for 22/23 and station selection will be finalized after results from 21/22 monitoring come in. Monitoring follows standard methods as described in section 3.3.2.2- 4. Additional SOPs are also being written in Task 3.4. Laboratory methods are provided by contracted labs and reviewed by AEP to ensure they are appropriate for the parameters measured.

Task 3.2 Integrated isotope sampling to inform regional water balance will continue as a point of integration with other theme areas and to help constrain groundwater inputs to surface water systems using isotope mass balance methods. (1) Precipitation samples will be collected for water isotopes (d18O, d2H) analysis at three locations across a latitudinal gradient. (2) River water samples will be collected for water isotope analysis at 7 ECCC/Water Survey Stations Water in the South Athabasca Oil Sands Area to supplement (but not duplicate) the OSM Surface Water Quality program. (3) Water isotopes in wetlands and groundwater piezometers at wetland sites will be continue to be collected under the 22/23 wetlands program for understanding of baseline water-balance conditions (and groundwater contributions) over time and relations to disturbance. The inclusion of water isotopes in precipitation, groundwater wetlands and surface water monitoring across TACs is a significant step towards developing isotopes as a synoptic surveillance monitoring indicator across all sites.

Task 3.3 Additional groundwater dependent ecosystem (GDE) fieldwork, to supplement the refinement of water balances using isotopic monitoring as described above, will be conducted as the program transitions within the adaptive monitoring framework to focus on GDEs. (1) Monitoring groundwater discharge (quantity and quality) along select reaches of the McKay River will be initiated as guided by previous data, model outputs and community concerns, to supplement community based monitoring in the watershed (2017-2021), and as a next step in the sequence of ECCC work funded by OSM in 2012-2013. (2) Wetland fieldwork will be conducted in the McKay Watershed to confirm wetland type and monitor water temperature by U Waterloo and UNB to support validation of remote sensing of wetland groundwater interactions (Task 2.2.4.1). (3) Wetland fieldwork (e.g., peat thickness, water table depth, new wetland monitoring sites in western) will also be in the Poplar Creek watershed by U Waterloo to provide data for validation of Poplar Creek wetland-groundwater model (Task 2.2.4.2).

Task 3.4 Standard Operating Procedures (SOPs) will be written and revised for new field methods for sampling GDE's as required (e.g., drivepoint piezometer, RAD7 operation for radon monitoring) and AEP will write SOPs for groundwater quantity and quality monitoring and data QA/QC.

4. Publish Groundwater Data
Task 4.1 Configuration of the OSM KISTERS database, Data Portal, and Data Catalogue for groundwater data will be coordinated with the Data Management work plan for additional parameters (e.g., temperature), stations, and metadata to ensure that the supporting information necessary for use of groundwater monitoring data will be publically available.

Task 4.2 Groundwater monitoring field data (from tasks 3.1-3.3) collected during the 22/23 fiscal year will be published via the OSM Data Catalogue.

Task 4.3 Historical groundwater data and geospatial data collected and/or compiled as a part of previous year's approved OSM groundwater work plans will be prepared and published via the OSM Data Catalogue. For example, in 2021/2022 operator data workshops and requests will identify regional monitoring wells and data that can best contribute to the monitoring network.

5. Project Management
Effectively coordinate work plan execution and project reporting for the OSM program office among AEP, ECCC, contractors, sub-contractors, and grantees by using project management tools and strategies for monitoring and reporting. Special attention will be paid to communication and delivery of interdependent tasks with other theme areas.

10.5 List the Key Indicators Measured, If Not Applicable, State N/A *****

Indicators of changes to groundwater quantity (e.g., water levels, discharge) and changes in groundwater quality (routine parameters and major ions, nutrients, organic and dissolved inorganic carbon, total and dissolved trace elements, BTEXS, F1-4, PAHs, water isotopes). Additional gas, isotope, arsenic speciation or NA parameters may also be analyzed.

11.0 Knowledge Translation

In the space below, please provide the following:

- *Describe the plan for knowledge transfer and distribution of learnings from the project. This could include workshops, publications, best practice documentation, marketing plan, etc.*
- *Demonstrate that the knowledge transfer plan is appropriate for the intended end-users.*

A variety of workshops, presentations, peer-reviewed publications, public communication content, and technical reports will be used to transfer knowledge on the condition of the groundwater environment in the oil sands area to a variety of end users and stakeholders (e.g., general public, scientists, communities, industry etc.) as listed in the deliverables section 14.0.

12.0 External Partners

List by project or project phase each component that will be delivered by an external party (including analytical laboratories) and name the party. Describe and name the associate work plan/grant/contract for these services. * state none if not required

Objective 3 laboratory analysis contracts: ALS (22RSD849), InnoTech (22RSD852; 18AEM818-02), BV (22RSD851), AXYS (22RSD853). Fieldwork is partially conducted using helicopter access by contract to various vendors, and groundwater monitoring well enhancement by various vendors.

Tasks to support objectives 1-4 are partially delivered by InnoTech Alberta contract for "oil sands long term groundwater monitoring" (20AEM841) as described in supplement 03: Task 1 Long Term Groundwater Monitoring Design, Task 2 Evaluation and Reporting (2.1 Plain Language Reporting, 2.2 Groundwater Quantity, 2.3 Groundwater Quality), Task 3 Groundwater Monitoring (3.3.1 Groundwater Discharge along Reaches of the McKay River, 3.4 Standard Operating Procedure Development), Task 4 Publish Groundwater Data (4.3.3 Groundwater Data Compilation and 4.3.4 Groundwater Geodatabase), Task 5 Project Management

Tasks to support objective 2- evaluation and reporting are partially delivered by grant to:

University of Calgary for "Oil Sands Monitoring Program: Science Program Reporting and Integration Support" (20GRAEM01) as described in supplement 04: Task 2.3.2 Evaluation and Reporting (Groundwater Quality): Aquifers- Geochemical Interpretation and Investigation of Temporal Anomalies, and supplement 05: Tasks 2.2.3 and 3.2.2 Evaluation and Reporting (Groundwater Quantity) and Groundwater Monitoring: Discharge to Rivers- Baseflow Baseline and Change, and supporting fieldwork for validation

The Alberta Geological Survey for "Groundwater quantity indicators for oil sands monitoring" (22GRRSD24) as described in supplement 06: Task 2.2.1 Evaluation and Reporting (Groundwater Quantity): Aquifers- Hydraulic Head Baseline and Change

The University of Waterloo for "Wetland hydrology monitoring and watershed modelling project" (22GRRSD26) as described in supplement 07: Tasks 2.2.4.2 Evaluation and Reporting (Groundwater Quantity) and Groundwater Monitoring: Groundwater/Wetland Modelling in the Poplar Creek Watershed, and supporting fieldwork for validation

The University of New Brunswick for "Remote sensing of groundwater dependent ecosystems" (22GRRSD27) as described in supplement 08: Tasks 2.2.4.1 and 3.3.2 Evaluation and Reporting (Groundwater Quantity) and Groundwater Monitoring: Remote Sensing of Wetland/Groundwater Interactions in the McKay Watershed, and supporting fieldwork for validation

The Alberta Biologial Monitoring Institute for "OSM Program: Terrestrial Biological Monitoring" (22GRRSD07) as described in supplement 09: Task 2.2.2 Evaluation and Reporting (Groundwater Quantity): Groundwater Dependent Ecosystem Mapping

Precipitation monitoring will be partially delivered in coordination with the Air TAC and Dr. Greg Wentworth under work plan A-PD-6-2122 "Integrated Atmospheric Deposition Monitoring" by airsheds LICA and WBEA.

*To ensure complete work plan proposal submission, all grants and contracts listed in this section should also be captured in Grants & Contracts.

13.0 Data Sharing and Data Management

For 2022-23 the following approach will be taken by the OSM Program related to data sharing.

For all work plans of a **western science** nature funded under the OSM Program, data sharing is a condition of funding and must align with the principle of **"Open by Default"**. In this case, all data is to be shared with the OSM Program as directed by the OSM Program Data Management work plan.

For all work plans involving **Indigenous Knowledge** as defined below and funded under the OSM Program, data sharing is a condition of funding and the Indigenous Knowledge components of the work plan must align with the principle of **"Protected by Default".** In this case, all data as defined as Indigenous Knowledge, are to be retained by the Indigenous community to which the Indigenous Knowledge is held.

Indigenous Knowledge is defined as:

"The knowledge held by First Nations, Inuit and Métis peoples, the Aboriginal peoples of Canada. Traditional knowledge is specific to place, usually transmitted orally, and rooted in the experience of multiple generations. It is determined by an Aboriginal community's land, environment, region, culture and language. Traditional knowledge is usually described by Aboriginal peoples as holistic, involving body, mind, feelings and spirit. Knowledge may be expressed in symbols, arts, ceremonial and everyday practices, narratives and, especially, in relationships. The word tradition is not necessarily synonymous with old. Traditional knowledge is held collectively by all members of a community, although some members may have particular responsibility for its transmission. It includes preserved knowledge created by, and received from, past generations and innovations and new knowledge transmitted to subsequent generations. In international or scholarly discourse, the terms traditional knowledge and Indigenous knowledge are sometimes used interchangeably."

This definition was taken from the Canadian Government's Tri-council Policy Statement for Ethical Research involving Humans (Chapter 9, pg. 113) and is an interim definition specific to the Oil Sands Monitoring Program.

Data Sharing and Data Management Continued

13.1 Has there, or will there be, a Data Sharing Agreement established through this Project? *

YES

13.2 Type of Quantitative Data Variables:

Both

13.3 Frequency of Collection:

Other

13.4 Estimated Data Collection Start Date:

2022-06-01

13.5 Estimated Data Collection End Date:

2022-11-30

13.6 Estimated Timeline For Upload Start Date:

2022-06-01

13.7 Estimated Timeline For Upload End Date:

2023-02-28

13.8 Will the data Include traditional knowledge as defined by and provided by an Indigenous representative, Community or Organization?

NO

TABLE 13.9 Please describe below the Location of Data and Data Type:

Add a Data Source by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table

Name of Dataset	Location of Dataset (E.g.: Path, Website, Database, etc.)	Data File Formats (E.g.: csv, txt, API, accdb, xlsx, etc.)	Security Classification
AEP Groundwater Levels and Temperature	AEP and OSM WISKI; M:\EMSD\Monitoring\Groundwater__Obs-wells; or OSM Catalogue	.wsl .csv	Open by Default
AEP Groundwater Quality; precipitation isotope; wetland isotope; surface water (SAOS) isotopes	AEP WDS or OSM KiWQM or OSM Catalogue	database	Open by Default

Operator Data Request Groundwater Levels, Temperature and Quality data	M:\EMSD\Science\Watershed\Programs\Oil Sands\Groundwater\AOS\OSM Groundwater Operator Data	.xls	Open by Default

Groundwater Geodatabase	OSM Geospatial Data Portal	shapefiles	Open by Default

AGS quaternary aquifer water level data	AGS website	csv	Open by Default

Hydrological data from western part of Poplar Creek watershed	TBD, OSM Catalogue	TBD, xls or csv	Open by Default

Spring data compilation	TBD, OSM Catalogue	TBD, xls or csv Click or tap here to enter text.	Open by Default

Groundwater quantity and quality data from McKay River discharge study	TBD, OSM Catalogue	TBD, xls or csv Click or tap here to enter text.	Open by Default

14.0 2022/23 Deliverables

Add an additional deliverable by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table.

Type of Deliverable	Delivery Date	Description
Technical Report	Q4	Long Term Groundwater Monitoring, Evaluation, and Reporting Plan
Other (Describe in Description Section)	Q1	Short plain language communication pieces on conceptual model components
Other (Describe in Description Section)	Q4	Community presentation by InnoTech Alberta on temporal water quality anomalies investigation- integration of water level and water quality data
Technical Report	Q4	Activity report from Univeristy of Calgary (Mayer) on geochemical interpretation of groundwater quality trends in oil sands regions, including compiled datasets
Technical Report	Q4	Activity report summarizing work completed by Alberta Geological Survey, including: i) digital datasets of NAOS Quaternary unit pics and modelled geobodies, ii) SAOS surficial geology maps, iii) figures showing availability of Quaternary water level data in NAOS, iv) water level digital dataset for NAOS Quaternary aquifers, v) SAOS geological characterization of bedrock topography and overlying Quaternary sediments, vi) water level change detection in Cretaceous aquifers.
Technical Report	Q4	Activity report from University of Calgary (Stadnyk) on defining ranges of groundwater quantity contributing to surface waters under baseline and development scenarios including water isotope data (d18O, d2H) from monthly sampling of 7 SAOS tributaries

Peer-reviewed Journal Publication	Q1	Baseline baseflow partitioning and natural variability of groundwater discharge to surface waters
Peer-reviewed Journal Publication	Q4	Production ensemble of variability of groundwater quantity contributing to surface waters from hydrogeologic and hydrologic models comparing pre- and post-development scenarios of oil sands mining
Peer-reviewed Journal Publication	Q4	Wetlands as integral parts of surface-groundwater interactions in the AOSR: a synthesis review
Technical Report	Q4	Activity report from U of Waterloo summarizing results on modelling groundwater-wetland interactions, including hydrological data from western parts of Poplar Creek watershed
Peer-reviewed Journal Publication	Q4	Wetland Class, Water Extent, and Temperature Mapping with Landsat 8, Sentinel-1 SAR, Sentinel-2 Optical and LiDAR Data in the Oil Sands Region to support Regional Wetland and Groundwater Monitoring
Technical Report	Q4	Activity report from University of New Brunswick including i) validation accuracy of the wetland/land cover map of the McKay watershed, ii) shapefiles of McKay watershed wetland/land cover maps, high low water extent, and wetland temperature, iii) georeferenced photographs and field data from validation fieldwork
Technical Report	Q4	Progress report from InnoTech and ABMI on developing an approach for identifying GDEs in the oil sands - literature review of groundwater and biological indicators, data review, and method/rule selection, in cluding initial GDE watershed map shapefiles

Technical Report	Q4	Activity report summarizing work completed by InnoTech Alberta including 22/23 Data Compilation Activities and Progress on Baseline i) spring discharge data compilation, ii) temporal water quality anomalies investigation-integration of water level and water quality data, and iii) baseflow water quality); 22/23 McKay River Field Monitoring Program summary and groundwater quantity and quality discharge data
Other (Describe in Description Section)	Q4	Community presentation on 22/23 McKay River Field Monitoring Program
Other (Describe in Description Section)	Q2	SOP for drivepoint monitoring of groundwater discharge
Other (Describe in Description Section)	Q1	SOP for monitoring radon using a RAD7
Other (Describe in Description Section)	Q4	SOPs for groundwater well level and quality monitoring and data QA/QC
Other (Describe in Description Section)	Q4	22/23 GOWN groundwater quantity and quality data
Other (Describe in Description Section)	Q4	22/23 precipitation isotope data
Other (Describe in Description Section)	Q4	22/23 wetland isotope data
OSM Program Annual Progress Report (required)	Q4	OSM Program Annual Progress Report
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15.0 Project Team & Partners

In the space below please provide information on the following:

- *Describe key members of the project team, including roles, responsibilities and expertise relevant to the proposed project.*
- *Describe the competency of this team to complete the project.*
- *Identify any personnel or expertise gaps for successful completion of the project relative to the OSM Program mandate and discuss how these gaps will be addressed.*
- *Describe the project management approach and the management structure.*

The project team is composed of multiple senior hydrogeologists, scientists, and monitoring technologists who will jointly deliver the tasks within the groundwater monitoring work plan under advisory by the groundwater TAC. With expertise in field-based monitoring, evaluation and reporting as well as monitoring program design the team is well poised for successful completion of the project. Key team members include Cynthia McClain, AEP hydrogeologist, TAC co-lead and contributor to design, evaluation and reporting; Jean Birks, InnoTech Alberta principal researcher, and lead of evaluation and reporting activities and long-term monitoring program design/development; and Greg Bickerton, ECCC senior hydrogeologist, TAC co-lead, and program advisor contributing to design, evaluation and reporting. Roles/responsibilities of other team members are described below.

With respect to project management, AEP-OSM aims to hire an experienced professional who may use formal project management tools (e.g. MS Project) for scheduling, monitoring and controlling while coordinating execution among government staff, contractors, sub-contractors and grantees.

One key personnel gap for successful completion of the project is in groundwater database development, metadata, database management, and qa/qc. We aim to address this gap by working with OSM aquatic scientists, having advisors at Service Alberta, and having data delivered from grantees/contrctors in final OSM template/formats, however hiring a dedicated and experienced groundwater data manager would be recommended.

Key Team Members:
-OSM Groundwater Monitoring Technologists, AEP; Conduct fieldwork and support data systems
-AEP groundwater science data analyst; data systems and evaluation & reporting
-Service Alberta; groundwater data services
-Neal Tanna, InnoTech: Project management
-Francisco Castrillon, InnoTech: Hydrogeochemistry
-John Gibson, InnoTech: Isotope Hydrology
-Jon Fennell, Integrated Sustainability: Hydrogeologist
-Mina Nasr, AEP; Geospatial groundwater data compilation, geodatabases, (e.g., stressor gradient maps) and data/knowledge transfer from contractor to AEP
-AEP aquatic scientists; Data systems and evaluation & reporting on surface water/groundwater data
-Vanessa de Koninck, AEP: OSM Interdisciplinary Social Scientist; Knowledge co-production advisor, advise on methodologies for design and implementation of CBM and bicultural indicator development

- Executive Director WBEA; coordinate sampling for water isotopes in precipitation at Fort McKay Bertha Ganter station and Fort Chipewyan station
- Executive Director LICA; coordinate sampling for water isotopes in precipitation at Cold Lake Maskwa station
- Dan Palombi, AGS; coordinate AGS work on groundwater level indicators for Cretaceous and Quaternary aquifers and
-Brigitte Leblon (UNB)- remote sensing data to evaluate its use to identify GW SW interactions in wetlands
-Matthew Elmes (U of Waterloo)- wetland hydrology monitoring and watershed modelling project
-Bernhard Mayer (U of Calgary)- geochemical interpretation of groundwater quality
-Trica Stadnyk (U of Calgary)- defining ranges of groundwater discharge quantity contributing to surface waters under baseline and development scenarios
-Monica Kohler (ABMI)- mapping groundwater dependent ecosystems

-EarthFx, Aquanty, Advisian and Matrix will be subcontracted to continue with groundwater data compilation, evaluation and reporting

16.0 Project Human Resources & Financing

Section 16.1 Human Resource Estimates

Building off of the competencies listed in the previous section, please complete the table below. Add additional rows as necessary. This table must include **ALL staff involved** in the project, their role and the % of that staff's time allocated to this work plan. The AEP calculated amount is based on an estimate of $120,000/year for FTEs. This number cannot be changed. The OSM program recognizes that this is an estimate.

Table 16.1.1 AEP

Add an additional AEP Staff member by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. The total FTE (Full Time Equivalent) is Auto Summed (in Table 16.2.1) and converted to a dollar amount.

Name (Last, First)	Role	% Time Allocated to Project
Hydrogeologist	Principal Investigator	40%
Senior Groundwater Technologist	Monitoring & Data Systems	100%
Groundwater Technologist	Monitoring & Data Systems	100%
Groundwater Technologist	Monitoring & Data Systems	100%
Groundwater Science Data Analyst	Data Systems, Evaluation & Reporing	90%
Quality Assurance Coordinator	Data Systems	50%
Geospatial Scientist	Evaluation & Reporting	30%
TBA	Evaluation & Reporting, Project Management	50%
Click or tap here to enter text.	Click or tap here to enter text.	0%
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Table 16.1.2 ECCC

Add an additional ECCC Staff member by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. The total FTE (Full Time Equivalent) is Auto Summed in Table 16.2.2

Name (Last, First)	Role	% Time Allocated to Project
Bickerton, Greg	Senior Hydrogeologist	50%
Roy, Jim	Research Scientist	10%
Spolestra, John	Research Scientist	10%

The tables below are the financial tables for Alberta Environment & Parks (AEP) and Environment & Climate Change Canada. All work plans under the OSM Program require either a government lead or a government coordinator.

Section 16.2 Financing

The OSM Program recognizes that many of these submissions are a result of joint effort and monitoring initiatives. A detailed "PROJECT FINANCE BREAKDOWN" must be provided using the Project Finance Breakdown Template provided, accessible here (ctrl + click the link below). Please note that completion of this Project Finance Breakdown Template is mandatory and must be submitted along with each workplan.

PROJECT FINANCE BREAKDOWN TEMPLATE (CTRL+CLICK HERE)

Table 16.2.1 Funding Requested BY ALBERTA ENVIRONMENT & PARKS

Organization – Alberta Environment & Parks ONLY	Total % time allocated to project for AEP staff	Total Funding Requested from OSM
Salaries and Benefits *(Calculated from Table 16.1.1 above)*	**560.00%**	**$672,000.00**
Operations and Maintenance		
Consumable materials and supplies		$91,000.00
Conferences and meetings travel		$2,000.00
Project-related travel		$93,000.00
Engagement		$0.00
Reporting		$0.00
Overhead		$48,000.00
Total All Grants *(Calculated from Table 16.4 below)*		**$810,000.00**
Total All Contracts *(Calculated from Table 16.5 below)*		**$1,068,000.00**
Sub- TOTAL *(Calculated)*		**$2,784,000.00**
Capital*		$15,000.00
AEP TOTAL *(Calculated)*		**$2,799,000.00**

* The Government of Alberta Financial Policies (*Policy # A600*) requires that all **capital asset** purchases comply with governmental and departmental legislation, policies, procedures, directives and guidelines. **Capital assets** (*Financial Policy # A100*, Government of Alberta, January 2014) are tangible assets that: have economic life greater than one year; are acquired, constructed, or developed for use on a continuing basis; are not held for sale in ordinary course of operations; are recorded and tracked centrally; have a cost greater than $5,000.

Some **examples of capital asset equipment include:** laboratory equipment, appliances, boats, motors, field equipment, ATV's/snowmobiles, stationary equipment (pier/sign/weather), fire/safety equipment, pumps/tanks, heavy equipment, irrigation systems, furniture, trailers, vehicles, etc. (*Financial Policy # A100*, Government of Alberta, January 2014).

Table 16.2.2 Funding Requested BY ENVIRONMENT & CLIMATE CHANGE CANADA

Organization – Environment & Climate Change Canada ONLY	Total % time allocated to project for ECCC staff	Total Funding Requested from OSM
Salaries and Benefits FTE *(Please manually provide the number in the space below)*		
Salaries and Benefits		$0.00
Operations and Maintenance		
Consumable materials and supplies		$0.00
Conferences and meetings travel		$0.00
Project-related travel		$15,000.00
Engagement		$0.00
Reporting		$3,000.00
Overhead		$1,000.00
ECCC TOTAL *(Calculated)*		**$19,000.00**

* ECCC cannot request capital under the OSM program. Any capital requirements to support long-term monitoring under the OSM program should be procured by Alberta and captured in that budget table.

Table 16.3

Complete ONE table per Grant recipient.

Add a Recipient by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. The total of all Grants is Auto Summed in Table 16.2.1

GRANT RECIPIENT – ONLY: Click or tap here to enter text.	20GRAEM01 Oil Sands Monitoring Program: Science Program Reporting and Integration Support
GRANT RECIPIENT - ONLY:	University of Calgary
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$223,000.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	$0.00
Project-related travel	$0.00
Engagement	$0.00
Reporting	$0.00
Overhead	$0.00
GRANT TOTAL *(Calculated)*	**$223,000.00**
GRANT RECIPIENT - ONLY: Name	22GRRSD24 Groundwater quality indicators for oil sands monitoring
GRANT RECIPIENT - ONLY: Organization	Alberta Geological Survey
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$383,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	0
Overhead	0
GRANT TOTAL *(Calculated)*	**$383,000.00**
GRANT RECIPIENT - ONLY: Name	22GRRSD26 Wetland hydrology monitoring and watershed modelling project – Budget accounted for in wetlands workplan
GRANT RECIPIENT - ONLY: Organization	University of Waterloo
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$0.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	0
Project-related travel	$0.00

Engagement	$0.00
Reporting	0
Overhead	0
GRANT TOTAL *(Calculated)*	**$0.00**
GRANT RECIPIENT - ONLY: Name	22GRRSD27 Remote sensing of groundwater dependent ecosystems
GRANT RECIPIENT - ONLY: Organization	University of New Brunswick
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$110,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	$0.00
Overhead	0
GRANT TOTAL *(Calculated)*	**$110,000.00**
GRANT RECIPIENT - ONLY: Name	22GRRSD07 OSM Program: Terrestrial Biological Monitoring
GRANT RECIPIENT - ONLY: Organization	ABMI
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$94,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	0
Overhead	0
GRANT TOTAL *(Calculated)*	**$94,000.00**

Table 16.4

Complete ONE table per Contract recipient.

Add a Recipient by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table. This section is only to be completed should the applicant intend to contract components or stages of the project out to external organizations. The total of all Contracts is Auto Summed in Table 16.2.1

CONTRACT RECIPIENT - ONLY: Name	18AEM818-02 Laboratory analysis of water isotopes
CONTRACT RECIPIENT - ONLY: Organization	InnoTech Victoria
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$2,000.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	$0.00
Project-related travel	$0.00
Engagement	$0.00
Reporting	$0.00
Overhead	$0.00
CONTRACT TOTAL *(Calculated)*	**$2,000.00**
CONTRACT RECIPIENT - ONLY: Name	22RSD849 Laboratory analysis of water - Routines, nutrients, and organics
CONTRACT RECIPIENT - ONLY: Organization	ALS Canada
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$23,000.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	$0.00
Project-related travel	0
Engagement	0
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$23,000.00**
CONTRACT RECIPIENT - ONLY: Name	22RSD851 Laboratory analysis of water – Routines, nutrients, organics
CONTRACT RECIPIENT - ONLY: Organization	Bureau Veritas
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$110,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0

Engagement	0
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$110,000.00**
CONTRACT RECIPIENT - ONLY: Name	22RSD852 Laboratory analysis of water – Trace elements, rare earth elements, napthenic acids
CONTRACT RECIPIENT - ONLY: Organization	Innotech Alberta
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$70,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	$0.00
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$70,000.00**
CONTRACT RECIPIENT - ONLY: Name	22RSD853 Laboratory analysis of water – Polycyclic aromatic compounds
CONTRACT RECIPIENT - ONLY: Organization	SGS AXYS
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$45,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	$0.00
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$45,000.00**
CONTRACT RECIPIENT - ONLY: Name	Various – Helicopter transport
CONTRACT RECIPIENT - ONLY: Organization	Various
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$45,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	0
Overhead	0
CONTRACT TOTAL	**$45,000.00**

(Calculated)	
CONTRACT RECIPIENT - ONLY: Name	20AEM841 Oil sands long term groundwater monitoring
CONTRACT RECIPIENT - ONLY: Organization	InnoTech Alberta
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$673,000.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	$0.00
Project-related travel	0
Engagement	0
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$673,000.00**
CONTRACT RECIPIENT - ONLY: Name	Various- Groundwater Observation Well Network Improvements
CONTRACT RECIPIENT - ONLY: Organization	Various
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$100,000.00
Operations and Maintenance	
Consumable materials and supplies	$0.00
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	0
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$100,000.00**

Table 16.5 GRAND TOTAL Project Funding Requested from OSM Program

The table below is auto calculated, please do not try to manually manipulate these contents.

Category	Total Funding Requested from OSM
Salaries and Benefits ***Sums totals for salaries and benefits from AEP and ECCC ONLY***	$672,000.00
Operations and Maintenance	
Consumable materials and supplies *Sums totals for AEP and ECCC ONLY*	$91,000.00
Conferences and meetings travel *Sums totals for AEP and ECCC ONLY*	$2,000.00
Project-related travel *Sums totals for AEP and ECCC ONLY*	$108,000.00
Engagement *Sums totals for AEP and ECCC ONLY*	$0.00
Reporting *Sums totals for AEP and ECCC ONLY*	$3,000.00
Overhead *Sums totals for AEP and ECCC ONLY*	$49,000.00
Total All Grants (from table 16.2.1 above) *Sums totals for AEP Tables ONLY*	$810,000.00
Total All Contracts (from table 16.2.1 above) *Sums totals for AEP Tables ONLY*	$1,068,000.00
Sub- TOTAL	$2,803,000.00
Capital* *Sums total for AEP*	$15,000.00
GRAND PROJECT TOTAL	$2,818,000.00

Some **examples of capital asset equipment include:** laboratory equipment, appliances, boats, motors, field equipment, ATV's/snowmobiles, stationary equipment (pier/sign/weather), fire/safety equipment, pumps/tanks, heavy equipment, irrigation systems, furniture, trailers, vehicles, etc. (*Financial Policy # A100*, Government of Alberta, January 2014).

17.0 FINANCIAL MANAGEMENT

The OSM Program reserves the right to reallocate project funding during the current fiscal year on the basis of project performance and financial overspend or underspend.

☒ *Please check this box to acknowledge you have read and understand*

In the space below please describe the following:

- *Discuss how potential cost overruns and cost underruns will be managed.*
- *If this is a continuing project from last year, identify if this project was overspent or underspent in the previous year and explain why.*
- *Describe what risks and/or barriers may affect this project.*

The increase in budget of this 2022/23 work plan, compared to 2021/22, is primarily due to the increased amount of evaluation and reporting on historical data (which will be delivered via contracts and grants due to provincial human resource constraints), inclusion of 0.5 FTE for AEP project management, inclusion of groundwater well maintenance, and groundwater dependent ecosystem fieldwork and mapping as the program transitions to adaptive monitoring to enable cumulative effects assessment.

Quarterly budget reviews and forecasts will be conducted. A work plan amendment may be submitted should significant cost overruns be projected. In 22/23 this project was forecast to be on-budget.

Support with groundwater data and geospatial data services from Service Alberta is required to streamline data management, availability and access.

Support from AEP for managing the 13 grants/contracts is required. Grants span multiple work plans and will be coordinated with wetlands, TBM, air, and the program office. Because a significant portion of the work for this project will be completed under contract/grant, there is a risk that if contracts and grants are not quickly initiated and approved in Q1 of 22/23 FY that multiple objectivves/tasks/deliverables may be delayed or not completed in entirety within the fiscal year.

18.0 Alternate Sources of Project Financing – In-Kind Contributions

Table 18.1 In-kind Contributions

Add an In Kind Contribution by clicking on the table and then clicking on the blue "+" symbol on the bottom right side of table.

DESCRIPTION	SOURCE	EQUIVALENT AMOUNT ($CAD)
Scientist Salaries (program coordination, expertise)	ECCC	$84,000.00
Salaries, O&M (Evaluation and Reporting)	University of Calgary	$55,000.00
Salaries (Evaluation and Reporting)	Mitacs- University of Waterloo	$30,000.00
	TOTAL	**$169,000.00**

19.0 Consent & Declaration of Completion

Lead Applicant Name

Cynthia McClain

Title/Organization

Hydrogeologist, Alberta Environment and Parks

Signature

Cynthia McClain

Date

2021-10-05

Government Lead / Government Coordinator Name (if different from lead applicant)

Click or tap here to enter text.

Title/Organization

Click or tap here to enter text.

Signature

Click or tap here to enter text.

Date

Click or tap to enter a date.

PROGRAM OFFICE USE ONLY

Governance Review & Decision Process

this phase follows submission and triggers the Governance Review

TAC Review (Date):

Click or tap to enter a date.

ICBMAC Review (Date):

Click or tap to enter a date.

SIKIC Review (Date):

Click or tap to enter a date.

OC Review (Date):

Click or tap to enter a date.

Final Recommendations:

Decision Pool:

Choose an item.

Notes:

Click or tap here to enter text.

Post Decision: Submission Work Plan Revisions Follow-up Process

This phase will only be implemented if the final recommendation requires revisions and follow-up from governance

ICBMAC Review (Date):

Click or tap to enter a date.

SIKIC Review (Date):

Click or tap to enter a date.

OC Review (Date):

Click or tap to enter a date.

Comments:

Decision Pool:

Choose an item.

Notes & Additional Actions for Successful Work Plan Implementation:

Click or tap here to enter text.