2023-2024 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 31, 2022 at 4:30 PM Mountain Standard time.*** *Late submissions will not be accepted.*	***October 31, 2022*** *4:30 PM MST*
Decision Notification	*Mid to Late March 2023*

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.*

Privacy: *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.*

Technical Requirements: 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.

Government Lead/Coordinator: 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.*

Supplemental Materials: *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 Package accessible here:* **2023-24 Work Planning Package (Ctrl+CLICK)**

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:

202324_wkpln_WorkPlanTitle_ ProjectLeadLastNameFirstName

Example:

202324_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:

202324_sup##_WorkPlanTitle_ ProjectLeadLastNameFirstName

Examples:

202324_sup01_OilSandsResiduesinFishTissue_SmithJoe

202324_sup02_OilSandsResiduesinFishTissue_SmithJoe

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202324_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 31, 2022, **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:	Groundwater Monitoring
Lead Applicant, Organization, or Community:	Yemi Ilesanmi
Work Plan Identifier Number: *If this is an on-going project please fill the identifier number for 22/23 fiscal by adjusting the last four digits:* ***Example:*** *D-1-2223 would become D-1-****2324***	GW-LTM-3-2324
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: 2024***	N/A
Total 2023/24 Project Budget: *For the 2023/24 fiscal year*	$1,953,820.00
Requested OSM Program Funding: *For the 2023/24 fiscal year*	$2,386,723.00
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.	Yemi Ilesanmi (Acting PI)
Job Title:	Science Program Manager
Organization:	AEPA
Address:	9888 Jasper Building
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Email:	yemi.llesanmi@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 continue and improve the groundwater OSM program. Previously developed conceptual models depicting the Pressure-Stressor-Pathway-Response-Effect by identifying activities (Pressures) that may potentially cause local changes in groundwater systems (Stressors), which in turn may translate into broader changes in groundwater systems (Pathways), and ultimately affect ecosystems that depend on groundwater systems (Effects), and are a fundamental reference for the OSM groundwater workplan.

The work proposed for delivery in the 2023-24 groundwater work plan includes the following: 1) Continuation of operational work to evaluate the current well network and explore possibilities for its expansion, as well as continuing ongoing sub-projects that aim to: a) better understand the temporal changes in groundwater chemistry; b) identify baseline and change of groundwater discharge and baseflow; and c) define baseline and temporal changes in quaternary aquifers.

2) New work directed at improving the understanding of groundwater systems at the watershed scale, and focusing on linking surface water parameter changes with changes in groundwater systems in tributaries with high baseflows. Another new item is a focused study that aims to confirm if groundwater quality should be a concern in in situ monitoring.

This core groundwater work plan complements community-based monitoring efforts. The work proposed will result in publishing groundwater monitoring data in the data catalogue available via the OSM Portal, as well as the evaluation 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 Adaptive Monitoring 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 Adaptive Monitoring 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 or areas of limited knowledge is the work being designed to answer with consideration for the TAC specific Scope of Work Document (attached) and the Key Questions (attached)?*
- *Discuss results of previous monitoring/studies/development and* what has been achieved to date. Please identify potential linkages to relevant sections of the State of Environment Report.

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: 1) if oil sands activities (mining and in situ) are causing changes in groundwater conditions (quality and quantity); 2) if these changes are of concern or outside of natural variability and affects ecological receptors. The approach to reach this goal follows the adaptive monitoring framework and considers input from the OSM Groundwater Technical Advisory Committee (TAC).

For 2020/2021 and 2022/2023, the groundwater monitoring program and Alberta Geological Survey (AGS) successfully began implementing efforts to characterize baseline groundwater quality and quantity conditions and changes over time in Cretaceous (completed) and Quaternary (ongoing) aquifers at a regional scale (Manchuk et al., 2021; Nakevska, 2020; Nakevska and Lemay, 2021; Singh and Lemay, 2021). This work will be concluded in 2023-24.

Work on the characterization of baseline groundwater discharge to rivers and springs and wetlands supported for delivery in 2021/2022 and 2022/2023, will be continued under the workplan approved for 2023-24. Further, the program will also be requesting for operator data from baseline wells located in areas that correspond to spatial gaps in AEPA's monitoring network to support long-term monitoring design.

For 2021-2022, the program provided support to the Alberta Geological Survey for a pre-development baseline study for Cretaceous aquifers hydraulic head. This work was expanded to Quaternary aquifers in 2022-23, and will continue in 2023-24 with the finalization of the pre-development baseline and change in Quaternary and Cretaceous aquifers. It is expected

that this work will improve aquifer geological mapping and the knowledge of the aquifers at the Athabasca and Cold Lake Oil Sands Designated Areas and inform the long-term groundwater program design.

New items for the year of 2023-2024 are as follows:
a) Initiating the analysis of groundwater quality at discharge areas;
b) Initiating comparisons between groundwater and surface water parameters to detect surface water quality changes associated with changes in groundwater quality in tributaries with high baseflow;
c) analyzing groundwater parameters at the watershed scale to characterize and improve understanding of watersheds' variability; and d) a focused study that aims to evaluate if water quality monitoring should be a concern at in situ operations.

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 for assessing 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 Energy 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 2023/24 work plan below

For the fiscal year of 2023-2024 the objectives are:

1. Continue designing a long-Term groundwater monitoring plan.
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, and results from groundwater program activities.
Result synthesis and state of environment reporting from 2021/2022 and 2022/2023 using available groundwater data stressors/receptors to:
a) better understand the current state of data
b) assess groundwater quality and quantity patterns of variability in oil sands regions and,
c) increase knowledge of groundwater systems at the watershed/aquifer scale and initiate water quality monitoring at groundwater discharges and comparing with surface water quality data collected from tributaries with high baseflow.

3. Groundwater Core Monitoring.
Collect groundwater data to:
a) maintain surveillance monitoring of Groundwater Observation Well Network monitoring and continue building groundwater level and quality data bases 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) evaluate if there is enough data to expand the scope of monitoring to include available aquatic ecosystems indicators' data and d) integrate with Community Based Monitoring by monitoring groundwater discharge along key reaches of tributary rivers in the Lower Athabasca.

4. Publish Groundwater Data.
Ensure public release of data collected in 2022-23 and other associated data (building on data inventory from 2021-22 and 2022-23) to the public via the 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)
- consider the TAC-specific Scope of Work document and the key questions
- integrate western science with Indigenous Community-Based Monitoring)
- address the Adaptive Monitoring 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 2023/24 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. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in water quality, biological health (e.g., benthos, fish) and/or water quantity/flows relative to baseline? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

4. 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.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

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. Has baseline been established? Have thresholds or limits of change been identified?

Baseline has been partially established, however, not all critical elements of the monitoring program have been fully developed or monitored at present.

Baseline and changes are being assessed for groundwater quantity: Cretaceous and Quaternary aquifers and for groundwater discharge, baseflow and springs.

Limits of change have not been identified for groundwater parameters, as some fundamental elements are presently missing that hinder defining the confines of acceptable/normal change for groundwater parameters.

2. Are changes occurring in groundwater quality and/or quantity relative to baseline? If yes, is there evidence that the observed change is attributable to oil sands development? *(Describe source-pathway-receptor and/or conceptual models)* and what is the contribution in the context of cumulative effects?

Yes. Temporal trends have been identified for the concentration of several chemical parameters measured by the program, but the interpretation of the observed changes is still ongoing. Attribution of cause and the role of oil sands industrial activity in groundwater change is presently not conclusive and may not be due to heterogeneity of the geological environment.

At present, it is not possible to assess ecological effects associated with changes in groundwater quality and quantity. Ongoing groundwater OSM sub-projects (supplements 03 to 06) will provide further information on drivers of change in groundwater. Specifically the supplemental documents attached to this workplan address:
- groundwater chemistry change (see Supplement 03)
- location of groundwater discharges and contribution to baseflow and springs (see Supplement 04)
- aquifer baseline and change (see Supplement 05)

The information above will assist with refining the groundwater monitoring program design to include sampling locations for integrated monitoring (including surface water and at least aquatic ecosystems health indicators), and with data evaluation and interpretation, as well as partially separating natural vs anthropogenic causes for groundwater chemistry and quantity changes.

Although work continues to define baselines for groundwater quality and quantity, it is premature to identify cumulative effects of industrial activity in groundwater. However, work proposed under the geospatial workplan on the collection and analysis of data on water use may provide relevant and useful information to support the assessment of cumulative effects of oil sands activities on groundwater over time and space.

The focus on addressing Indigenous key questions will continue. In general, the oil sands

groundwater quality data can be compared against water quality guidelines or other benchmarks to inform indigenous questions and concerns (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).

Indigenous concerns are supported by specific workplans that are being submitted to the OSM program. For this workplan specifically, Supplement 06 supports work to address indigenous concerns with groundwater.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

It is premature to launch an investigation of cause as the interpretation of observed changes is still underway. However, evaluation of the data on the chemical composition of groundwater will allow for better understanding of the solute heterogeneity, concentrations, and temporal variability. Results from the studies on baseline and change of groundwater discharge, and Cretaceous and Quaternary aquifers are expected to improve knowledge regarding their evolution over time and the drivers of change. Also, analysis of temporal trends in groundwater quality and quantity parameters will also improve knowledge about the evolution of groundwater quantity and quality in the oil sands region.

Task 2.4 in the geospatial workplan also includes the mapping of groundwater dependent ecosystems, which will be useful in studying the effects of groundwater changes (quality and quantity) on ecological receptors.

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

Yes. Currently all data on groundwater quality is compared with Canadian Drinking Water Quality guidelines. There is an ongoing project with the Fort MacKay that focusses on indigenous concerns, part of this project is covered in Supplement 06 of this workplan.

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

Yes. All groundwater field monitoring data is uploaded into OSM Data Systems (KiWQM). Historical data in older data bases have been quality assessed, analyzed and transferred to the same data base. Historical data that has been collected under groundwater OSM subprojects has been aggregated and recompiled into readable and editable data tables, assessed for quality and will be published in the OSM data catalog publicly available through the OSM Portal.

Data collected in 2023-24 by AEPA and under the various grant and contract supporting the delivery of this workplan will also be compiled and made available through the OSM data catalog on the OSM Portal.

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

Standard methods for groundwater monitoring are being used for fieldwork where available. SOPs/guidance documents will be developed for any new monitoring approach implemented in the delivery of this workplan. A comprehensive groundwater monitoring field manual/SOP is currently under development by AEPA. 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 documents. In 2023-24 SOPs will also be revised or adapted to support community based monitoring as required.

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

Phases of this workplan include specific tasks and subprojects that address or support integration, e.g., the baseflow and groundwater discharge study will assist in defining areas where groundwater discharges are more likely to exist. These locations can then be used as references for integrated monitoring among groundwater, surface water and aquatic and riparian ecology.

Task 2.4 in the geospatial work plan focuses on mapping groundwater dependent ecosystems (GDE). This work will assist in defining multi-theme integrated monitoring including groundwater and aquatic ecosystems.

The groundwater program includes a sub-project that focusses on Fort MacKay's indigenous communities concerns. SOPs currently in development will be adapted and potentially adopted for use by community based monitoring projects, thus ensuring standardization of the sample collection procedures.

Other ongoing work that includes integration among OSM themes is water isotope monitoring in wetlands, surface water, and precipitation (air theme area). This work supports better understanding of where, when and how much surface water-groundwater interaction occurs.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

The current groundwater field-based monitoring fits in the category of surveillance monitoring under the adaptive monitoring framework. Water quality samples and water level measurements are being collected from wells distributed across the Oil Sands Region. When applicable, the data is compared to drinking water quality guidelines and uploaded into OSM data catalog. Temporal variability in the data is also being assessed with the aim of detecting change and potential association with oil sands development activities. Groundwater discharge (quantity and quality) in the McKay watershed is also being measured to support CBM. The results from sub-projects associated with the groundwater OSM program, namely the project on baseflow and groundwater discharge, will also provide information on the most likely areas of groundwater discharge, which then allows adapting the program sampling design to accommodate areas with surface water-groundwater interactions.

9. How will this work advance understanding transition towards adaptive monitoring?

Detecting patterns of variability in the data that are potentially associated with oil sands development activities will allow for better understanding of how local changes are translated into broader context. Such results indicate the contributions of affected aquifers to local ecosystems and potential environmental impacts on biological indicators at groundwater discharge areas.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

Yes. The outcomes of the data evaluation under this workplan is relevant to the State of the Environment Report. A chapter on groundwater quantity is being prepared to be added to the current groundwater State of the Environment report in 2023-24.

3.3.3 Wetlands Theme

3.3.3.1 Sub Themes:

Choose an item.

3.3.3.2 Wetlands - Key Questions

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

1. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in wetlands due to contaminants and hydrological processes? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models) and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

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. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in air quality? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models) and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies

Click or tap here to enter text.

4. Are changes in air quality informing Indigenous key questions and concerns?

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

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. Has baseline been established? Have thresholds or limits of change been identified?

Click or tap here to enter text.

2. Are changes occurring in terrestrial ecosystems due to contaminants and landscape alteration? If yes, is there evidence that the observed change is attributable to oil sands development? (Describe source-pathway-receptor and/or conceptual models) and what is the contribution in the context of cumulative effects?

Click or tap here to enter text.

3. Are there unanticipated results in the data? If yes, is there need for investigation of cause studies?

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

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

Click or tap here to enter text.

8. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

9. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

10. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

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. With consideration for adaptive monitoring, where does the proposed monitoring fit on the conceptual model for the theme area relative to the conceptual model for the OSM Program?

Click or tap here to enter text.

5. How will this work advance understanding transition towards adaptive monitoring?

Click or tap here to enter text.

6. Is the work plan contributing to Programmatic State of Environment Reporting? If yes, please identify potential linkages to relevant sections of the State of Environment Report.

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 consider adaptive monitoring and the approved Key Questions in your response.

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). Part of the findings developed through groundwater OSM sub-projects and the analysis of compiled data will published in peer-review journals and summarized in chapters to be added to the State of the Environment report.

Internal reports on the state of groundwater, monitoring parameters, data, sampling design and workplan implementation progress will be produced and provided to the program to support defining next steps for the OSM groundwater monitoring program. Results from data analysis indicating deviations from relevant drinking water quality guidelines observed at aquifers used for human consumption will also be reported.

The information generated from the groundwater monitoring program will be publicly available through the OSM Portal and may be used by interested parties including governments, Indigenous Communities, industry, and the general public. Potential applications for such data and information include:

1. Evaluating 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. Evaluating regional scale cumulative effects associated with regulatory approvals and licenses in the area (i.e., EPEA approved facilities, Water Act approvals and licenses, disposal scheme approvals, etc.); and,
3. Improving environmental impact assessment and monitoring procedures by comparing observed data with predictions made in environmental procedures, evaluating particular sample collection procedures and developing SOPs that may be used as standard procedures.

As a part of developing an adaptive monitoring design and filling spatiotemporal gaps in the present groundwater OSM well network, there is the potential to leverage regional monitoring programs operators are implementing, pursuant to EPEA and Water Act approval conditions. Operator involvement and data will inform regulatory compliance with EPEA approval conditions to participate in regional initiatives under LARP and OSM. Groundwater monitoring, supports transboundary agreements with the Northwest Territories for the Mckenzie River Basin and may contribute for refining existing agreements taking into consideration aquifers and groundwater uses.

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 to investigate Indigenous key questions and concerns on water levels and quality in rivers, and the potential role of groundwater activities associated with oil sands activities were successfully completed in 2020-21 under the groundwater workplan. One of these pilots was scaled up and is presently a standalone workplan implemented by Fort MacKay Metis Nation in 2021-22, 2022/2023 and has also been submitted for consideration in 2023/2024. Other communities have also submitted standalone work proposals under the Expression of Interest entry into the OSM Program.

Groundwater discharge monitoring fieldwork and evaluation and reporting in the MacKay River watershed provide data/information on baseline conditions and change that can be used by Fort McKay Metis Nation in addressing relevant community questions and concerns. The 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

If YES, please complete the ICBM Abbreviated Work Plan Forms and submit using the link below

ICBM WORK PLAN SUBMISSION LINK (CTRL+CLICK HERE)

5.1 Alignment with Interim Ethical Guidelines for ICBM in the OSM Program

1. Are there any community specific protocols that will be followed?

Click or tap here to enter text.

2. Does the work plan involve methods for Indigenous participants to share information or knowledge (e.g. interview, focus group, survey/structured interview), or any other Indigenous participation? If yes, describe how risks and harms will be assessed, and the consent process that will be used.

Click or tap here to enter text.

3. Do the activities include any other collecting/sharing, interpreting, or applying Indigenous knowledge? Please describe how these activities will be conducted in alignment with the Interim Ethical Guidelines, and any community-based protocols and/or guidelines that may also apply.

Click or tap here to enter text.

4. Indicate how Indigenous communities / Indigenous knowledge holders will be involved to ensure appropriate analysis, interpretation and application of data and knowledge.

Click or tap here to enter text.

5. How are Indigenous communities involved in identifying or confirming the appropriateness of approach, methods, and/or indicators?

Click or tap here to enter text.

6. How does this work plan directly benefit your community? How does it support capacity building in your community?

Click or tap here to enter text.

7. How is the information from this work plan going to be reported back to your community in a way that is accessible, transparent and easy to understand?

Click or tap here to enter text.

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 how can be assessed against a baseline condition. As relevant, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

The groundwater monitoring program is continuing to identify/establish baseline and reference conditions including spatial and temporal ranges of natural variability in groundwater quality, quantity and discharge, and whether changes occur outside of these ranges in the oil sands regions.

In 2021-22 and 2022-23 baseline conditions were established for Cretaceous and Quaternary aquifers, models on baseflow and groundwater discharges tested, and baseline/temporal trends in chemical parameters were also assessed. Work to expand and conclude the establishment of baselines and develop on detection of change groundwater quality and quantity will continue in 2023-24. This work will focus on estimating contributions of groundwater to baseflow and identifying groundwater discharges to springs and main flow in a more holistic spatial scale in the Oil Sands Region.

The analysis of relationships between spatiotemporal evolution of groundwater parameters, and aquifer data, and industrial activity will allow to get a better perception of: 1)the relationship between local changes and industrial activity; 2) the spatial magnitude of the observed changes; and, 3) the connectivity among aquifers and the resilience of the systems potentially impacted by anthropogenic activities.

Future work on groundwater discharges will inform focused studies aimed at: 1) determining changes in base flow associated with industrial groundwater uses; 2) understanding of the dynamics of aquatic and riparian ecosystems and its relationship with the oil sands industrial activity; 3) analyzing bioaccumulation of Oil Sands Process Water contaminants by ecological indicators within the local context.

In addition, operator's groundwater quality and quantity data will be requested and compiled to fill spatiotemporal gaps in the current ground water sampling network, and gain better resolution at a regional level to inform improved understanding of temporal variability in groundwater quantity and quality patterns as well as connectivity among groundwater systems/aquifers.

Data collection from wells where temporal changes in water quality were identified will continue under the field-based monitoring (Objective 3) component of this workplan. These data are valuable to detect and validate observed temporal trends. It is expected that this will inform the future resolution of uncertainties associated with data gaps and extreme variability sometimes observed in several parameters. Evaluation and reporting on groundwater monitoring data and indicators (Objective 2) will continue and support work to answer the OSM program's core questions as it relates to groundwater monitoring, including baseline conditions and change.

Monitoring stable isotopes as routine parameters in the OSM surface water quality program will allow for 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). This will be further evaluated in the Lower Athabasca River where data and groundwater-surface water models presently exists. The current work plan extends the isotope work done in previous years.

The long-term groundwater monitoring design was initiated in 2020-21, and has continued through 2021-22 and 2022-23 with a workshop series delivered as outcomes for those years. The work is proposed to continue in 2023-24 including making specific recommendations for indicators to monitor, linkages to 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, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

The groundwater monitoring program includes the Cold Lake Beaver Region, the Lower and Northern Athabasca Regions and the Peace Region.

The current work plan proposal includes three main sub-projects with sub-regional (2020/2021, 2021/2022 and 2022/2023) and regional components (2022/2023 and 2023/2024) related to aquifer, baseflow and groundwater chemistry baseline and change, and on locating groundwater discharge areas.

Data and information from these sub-projects and field monitoring contribute to advancing the knowledge on answering the three (3) key program questions adapted for the groundwater theme:

1. Has aquifer groundwater quality (e.g. water chemistry) and quantity (groundwater levels, groundwater flow patterns, groundwater discharge/recharge relationships) changed at various geographical and temporal scales?

2. Where are the significant areas (e.g. groundwater dependent ecosystems) of groundwater connectivity (i.e. groundwater discharge/recharge) to surface waters such as streams, wetlands, springs and lakes?

3. Has the quality and quantity of groundwater discharge to groundwater dependent ecosystems (GDEs), or other surface waters of interest, changed?

A request for operator groundwater quality and quantity data was made in 2021-22 to support assessing background well data and increasing data representativeness at the Northern and Southern Athabasca and Cold Lake regions. Operator data provided to the program and those collected from other sources in 2020-21, 2021-22 and 2022-23 will be added to the existing data bases and subsequently analyzed.

The program will make a request to obtain data from areas outside AEPA sampling network but within the designated oil sands areas will follow in March 2023. These data will provide information to address spatiotemporal data gaps in the AEPA well network and support

additional analysis at a regional scale and address sub-regional representation for the Peace River Oil Sands Designated Region, which is currently underrepresented. Further, identifying likely discharge areas in the OSR surface water systems may inform studies on mapping groundwater dependent ecosystems (see Task 2.4 in the geospatial workplan) and an integrated focused studies on GW-SW interactions and ecological responses in future years. Work on the well infrastructure condition initiated in 2020-21 to evaluate the state of the well network infrastructure and the possibility of expanding the current active monitoring well network is underway and will continue in 2023-24.

The work proposed for 2023-24 will continue efforts towards completing a rationalized and adaptive long-term monitoring plan aligned with the core OSM outcomes including identification or confirmation 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, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

Monitoring data (quality and quantity) generated by the groundwater program are disseminated as per the OSM program data management plan. In 2023-24 groundwater quality data from the GOWN network will be validated and subsequently uploaded to the data catalogue on the OSM Portal. Relevant groundwater monitoring datasets from the data inventory and data compilation from EIAs, and other compliance monitoring will be recompiled into structures and format compliant with the OSM data catalogue.

Groundwater quantity data from 2021-22 is currently being uploaded into the AEPA data systems. Data from groundwater quantity measurements taken in 2022-23 and 2023-24 will also be validated and subsequently uploaded into AEPA data systems.

Evaluation results will inform the preparation of technical reports, peer-reviewed scientific papers as well as the OSM State of the Environment Report (SoE) and any accompanying knowledge translation products for the general public. In addition, the various technical reports summarizing work delivered to the program under various contracts and grants documents and internal reports will inform decision on relevant aspects of the monitoring work in 2023-24 and beyond.

Section 14.0 of this workplan identifies a variety of deliverables for scientific and lay audiences, including the annual progress report provided to the program at fiscal year-end.

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, consider adaptive monitoring, the TAC specific Scope of Work document and the Key Questions in your response.

In 2020-21, 2021-22 and 2022-23 monitoring was integrated with other OSM projects, all of which will continue in the 2023-24 plan.

To support the groundwater monitoring program the wetlands and atmospheric deposition monitoring programs include water isotopes (oxygen-18, deuterium) as a monitoring parameter at several sampling sites. 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.

Piezometers were also installed at wetland sites to measure SW-GW interactions.

Both the geospatial and groundwater programs have collaborated on evaluating use of remote sensing techniques for use in identifying wetland/groundwater interactions.

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, and mapping groundwater dependent ecosystems). Expected outcomes in 2023-24 from the sub-project on the identification of potential groundwater discharges will assist in defining areas for future focused studies on groundwater dependent ecosystems.

10.0 Work Plan Approach/Methods

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

Similar to previous years, the 2023-24 workplan includes: a) an operational monitoring component; b) data compilation and publication through AEPA data systems; c) data analysis; and, d) interim and external reporting/scientific publications by AEPA and sub-projects managed by AEPA. The grant proponents for the year of 2023-24 are the research groups led by:

- Bernhard Mayer (University of Calgary) - Groundwater quality and the impact on surface water groundwater interactions on environmental health of the Oil Sands Region (see '202324_sup03_GrouindwaterMonitoring_IlesanmiYemi.pdf');

- Dan Palombi (Alberta Geological Survey) - Groundwater Quantity – Determination of Baseline Hydraulic Head and Degree of Variability (see 'sup05_GroundwaterMonitoring_IlesanmiYemi.pdf')

- InnoTech Alberta suggests the following work to be included in a contract to support the 2023/2024 work plan (see 'sup06_GroundwaterMonitoring_IlesanmiYemi.pdf') which includes:
a) Data collection compilation and delivery for the projects covered by the grants led by AGS and researchers from the University of Calgary. Support and coordinate work, and coauthor associated deliverables;
b) Support in developing the design for the long-term groundwater program;
c) Support on the identification of areas that are more likely to be affected by the Oil Sands Industry and that are adequate targets for monitoring;
d) Develop aquifer change detection studies to compare current simulated data with EIAs' predictions;
e) Improve mapping of aquifers in the NAOS region by coordinating data collection and modeling work with AGS, Matrix and Advisian;
f) Study decreases in the flow identified in the hydrology state of the environment report by AEPA with input from the results of past work by T. Stadnyk;
g) Initiate monitoring surface and groundwater quality at groundwater discharge areas with input from the results of past work by T. Stadnyk;
h) Stratify simulated data, by aquifers that will be mapped by AGS, and improve knowledge and understanding of groundwater quality and quantity at the aquifer level;
i) Assist AEPA with fieldwork planning, by using the results that will come from topic c) and the well infrastructure condition report, which compiles the work developed by APEA with other infrastructure data collected by Innotech;
j) Continue the MacKay River groundwater field program to investigate community concerns;
k) Review impacts to groundwater quality from in situ operations to verify if these are local, and justify whether regional groundwater quality monitoring in the vicinity of in situ operations is required;
l) Ensure the completion and publication of peer-review and technical publications pending from previous years;
m) Contribute to the State of the Environment report.

The tasks listed below for 2023-24 will be delivered by Alberta Environment and Protected Areas, as well as through grants to University of Calgary and Alberta Geological Survey, and under contract with Innotech.

1. Long Term Groundwater Monitoring Design (continued from 2022-23)
1.1 Evaluate the monitoring network with potential for expansion
- With consideration for the AEPA and Innotech infrastructure condition report
- Identify areas that are likely affected by the oil sands development activity as potential targets for future monitoring
1.2 Groundwater data analysis including quality, quantity and temporal variability, as well as numerical model predictions, aquifer maps in NAOS, groundwater discharge and baseflow predictions
1.3 Collaborate with Indigenous communities to explore 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 State of Environment Report and related plain language summary (continued from 2022/2023)
2.2 Groundwater quantity data evaluation and reporting (continued from 2022/2023)
- Aquifers: Hydraulic Head Baseline and Change (continued from 2022/2023)
- Development of a new Quaternary geological framework and improve knowledge of the Quaternary aquifers in the CLOS (Clear Water Oil Sands) area.
- Generate maps of pre-development water level conditions in Quaternary aquifers within NAOS and SAOS
- Produce datasets providing a compilation of water levels for Quaternary aquifers
- Stratify simulated data by aquifers that have been and will be mapped by AGS, improve knowledge and understanding of groundwater quality and quantity at the aquifer level
- Discharge to Rivers – Baseflow Baseline and Change (continued from 2022/2023)
- Identify and increase focus on areas where changes in discharge quantity were observed –
- Aquifers- Geochemical Interpretation and Investigation of Temporal Anomalies (continued from 2022/2023)
- Finalize investigation of temporal anomaly zones and identify potential geochemical processes explaining temporal, or spatial, distributions of water quality patterns in 5 target areas
- Use geochemical models to further refine information on potential geochemical processes affecting key dissolved constituents and their temporal variabilities
- Use water level, pressure, and geological data to further refine information on sources and transportation pathways of dissolved constituents and, where appropriate, contaminants
- Quantify to what extent natural versus anthropogenic drivers of change are responsible for observed anomalies
- Review and QA/QC groundwater quality data collected and compiled from EIAs EPEAs and other compliance monitoring. Evaluate whether these data can be incorporated to improve baseline water quality assessments
2.3 Ensure publication of the condition of the environment report, associated peer-review paper and other pending deliverables form previous years

3. Groundwater Monitoring
3.1 Regional Groundwater Observation Well (GOWN) monitoring and maintenance (continued from 2022/2023)
-Sampling at selected wells (~35) and laboratory analysis of samples
3.2 Integrated Isotope Sampling to Inform Regional Water Balance (continued from 2022/2023)
- Precipitation water isotopes at 3 Stations along a Latitudinal Gradient
- South Athabasca River Tributary water isotopes at 7 ECCC/Water Survey Stations

- Wetland, Surface Water and Groundwater isotope sampling
3.3 Groundwater discharge along Reaches of the McKay River (extension of OSM funded ECCC work in 2012-2013; continued from 2022/2023)
3.4 Standard Operating Procedure development (continued from 2022/2023)

4. Publish Groundwater Data (continued from 2021/2022)
4.1 Publish 2023/2024 Groundwater Monitoring Field Data (from tasks 3.1-3.3) via AEPA data systems
4.2 Publish Third party Groundwater Data via AEPA data systems
- Request operator data - water level, quality, and metadata
- OSM groundwater data compilation (from Innotech data compilation in 2022-24)
- Groundwater geodatabase (from Innotech data inventory in 2020-24)
- Prepare and publish data received from AGS (Dan Palombi), University of Calgary (Dr. B. Mayer and Dr. T. Stadnyk)

5. Project Management (ongoing)
5.1 2024-25 Workplan Preparation
5.2 Quarterly reporting on the status of project deliverables and expenditure
5.3 Annual Progress 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.

Significant progress has been made in defining baselines for Cretaceous aquifers groundwater discharges and baseflow and in assessing temporal variability of groundwater chemical parameters. The approaches to detect changes on groundwater environment are basically two: one that uses mechanistic models to compare observed vs predicted estimates of parameters like groundwater discharge and solute concentration using models that account for climate change, and another approach that analyzes the temporal variability of groundwater parameters. The first approach centered on the interpretation of the differences between observed and predicted values find changes associated with oil sands development activities, or uses simulated data from models that account for groundwater uses under different climate change scenarios. The second approach identifies associations between oil sands activities and the temporal variation of groundwater parameters.

In 2023-24, the program will continue developing baseline estimates for groundwater quantity in Quaternary aquifers (hydraulic head distribution), improve the baseflow baseline and change knowledge as well as the location of groundwater discharge areas to a broader spatial scope. This will contribute to better understanding of pre-industry conditions, and changes associated with industrial activity, and provide valuable information for future focused studies.

Data evaluation and synthesis will continue in the 2023-24 work plan to support the geochemical interpretation of groundwater chemistry, and the projects associated with aquifer and groundwater discharge baselines and change.

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 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 quantity and quality analyses and well infrastructure condition completed in 2020-21, 2021-22 and 2022-23 to identify future monitoring needs, which may include an adaptive monitoring decision framework. We aim to use the geospatial groundwater stressor mapping and modeling to identify areas that may reflect change and include data on stressors. Opportunities for focused studies, traditional land use studies, and community-based monitoring will be recommended. At least one two-day long-term monitoring program design workshop will be convened to get input 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 and state of the environment reporting will continue with publication of short public communication pieces on priority stressors and results from the modeling, data analysis and on the sub-projects included with the 2023/2024 groundwater work plan submission (CONFIRM). Task 2.2: Groundwater quantity evaluation and reporting focuses on addressing key data gaps for monitoring data, aquifers and groundwater discharge by: (1) continuing to compile, QA/QC, analyze, and map baseline and changes in hydraulic head in Quaternary aquifers, including supporting on Quaternary hydrostratigraphy; (2) evaluating data availability, quality and temporal series; (3) continuing to define ranges of groundwater discharge to surface water under baseline in a broader spatial context and including possible future climate/development scenarios using isotope-enabled modelling of baseflow separation in the lower Athabasca River basin; For 2023-24 additional studies proposed include: 1)stratifying simulated data by aquifers that have been and will be mapped by AGS and improve knowledge and understanding of groundwater quality and quantity at the aquifer level. Task 2.2 also includes the study of groundwater quality evaluation and reporting focusing 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. Additionally data from operators compliance monitoring will be requested, to fill in spatiotemporal data gaps, improve the regional scope of groundwater

data and eventually expand the APEA's groundwater OSM monitoring network, and investigate geochemical changes (temporal anomalies from Manchuk et al., 2021);
2) assessing spatial distribution of OSM surface water quality sampling sites, evaluating time-series data of surface water chemical parameters, spatial variation of surface water quality and analyze eventual associations between groundwater surface water quality in known/larger groundwater influenced tributaries (e.g., Steepbank, Muskeg, Firebag, Christina Rivers);
3) Compiling and synthesizing spring and groundwater discharge locations data to identify locations suitable for continued monitoring with respect to Indigenous Knowledge, or GDEs
4) prioritize publication of pending technical reports and peer review deliverables transferred to 2023-24.

3. Groundwater Monitoring

Task 3.1: Regional core Groundwater Observation Well (GOWN) monitoring (water levels, temperature) and maintenance will continue at approximately 118 wells (including ~35 water quality wells) in the Cold Lake Beaver River, Peace and Athabasca Regions, with fieldwork being conducted by AEPA from April-December. Monitoring follows standard methods as described in section 3.3.2.2- 4. Additional SOPs are also being drafted (see Task 3.4). Laboratory methods are provided by contracted labs and reviewed by AEPA 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 collected under the 2023-24 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: Monitoring groundwater discharge (quantity and quality) along select reaches of the McKay River will be continued based on past work from 2020-21and 2022-23, 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 2012-13.

Task 3.4: Refers to Standard Operating Procedures (SOPs) to be drafted for groundwater quantity and quality monitoring, and CBM support in standardizing western science-based sampling procedures.

4. Publish Groundwater Data

Task 4.1: Field monitoring data collected as well as data collected provided under the workplan by contractors and grant recipients will be restructured, recompiled and uploaded into APEA's data systems.

Task 4.2: Groundwater monitoring field data (from tasks 3.1-3.3) collected during the 2023-24

fiscal year will be published.

Task 4.3: Groundwater data collected and compiled by grant recipients and contractors, as well as geospatial data will be prepared and published via the OSM Data Catalogue.

5. Project Management
Effectively coordinate work plan execution and project progress reporting to the OSM Program Office through project management tools, recurrent progress meetings 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 (e.g. Radon), 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, and technical reports will be used to transfer knowledge on the condition of the groundwater environment in the oil sands area to diverse target audiences (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

Task 3: Laboratory analysis provided under contract by: ALS (22RSD849), InnoTech (22RSD852; 18AEM818-02), BV (22RSD851), AXYS (22RSD853) and helicopter services to support fieldwork.

Task 1, 2.1, 2.2.1.4, 2.2.1.5, 2.2.2.4(CONFIRM), 2.2.2.6(CONFIRM), 2.2.3.5, 2.3(REMOVE), 2.4, 3.2 and 3.3 include significant collaboration from Innotech Alberta.

Tasks, 2.2.1, 2.2.2, 2.2.3 and 2.3 associated with AGS and University of Calgary grants depend partially on data that will be compiled and prepared by Innotech Alberta and their subcontracts.

Tasks 4.2.2 and 4.2.3 are related to preparing data delivered to AEPA under contract by Innotech and uploading the data into the OSM Data Catalogue.

Tasks to support Objective 2 (Evaluation and Reporting) are mostly delivered by, or dependent on the following grants:

1) University of Calgary: "Groundwater quality and the impact on surface water groundwater interactions on environmental health of the Oil Sands Region" (Tasks 2.2.3.1 to 2.2.3.4) – Dr. Bernhard Mayer (as described in supplement 4).

2) Alberta Geological Survey: "Groundwater quantity indicators for oil sands monitoring" (currently under designation 22GRRSD24) as described in Supplement 05 (Task 2.2.1 Evaluation and Reporting Groundwater Quantity: Determination of Baseline Hydraulic Head and Degree of Variability (Tasks 2.2.1.1 to 2.2.1.3))

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:

2023-06-01

13.5 Estimated Data Collection End Date:

2023-11-30

13.6 Estimated Timeline For Upload Start Date:

2023-06-01

13.7 Estimated Timeline For Upload End Date:

2024-02-29

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
Groundwater OSM water level data (Continuous, Discrete and Mean))	AEPA WISKI data system	csv	Open by Default
Groundwater OSM quality data	AEPA KiWQM data system	csv	Open by Default
Operator's groundwater quality and quantity data	OSM Data Catalogue	xlsx	Open by Default

Groundwater geo database	OSM Data Catalogue	shp	Open by Default
Compiled EIA, EPEA and compliance groundwater quality and quantity monitoring data	OSM Data Catalogue	xlsx	Open by Default
AGS Quaternary Aquifer Water Level Data	AGS website	csv	Open by Default
Spring Data compilation	TBD - OSM Data Catalogue	TBD xlsx and, or csv	Open by Default
Groundwater quantity and quality data from MacKay River discharge studies	TBD – OSM Data Catalogue	TBD xlsx and, or, csv	Open by Default

14.0 2023/24 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
OSM Program Annual Progress Report (required)	Q4	Annual Progress Report on the implementation of the approved 23-24 work plan
Other (Describe in Description Section)	Q4	DATA - OSM core monitoring water quality and water quantity data to upload in AEPA data systems
Other (Describe in Description Section)	Q4	DATA – 2022-23 operator's data request compilation and publication in OSM Data Catalogue
Condition of Environment Report	Q4	Groundwater condition of the environment report
Peer-reviewed Journal Publication	Q3	Peer-review paper associated with the condition of the environment report.
Technical Report	Q4	2023-24 OSM groundwater monitoring report. Technical interim report work and findings on groundwater and evaluation/ recommendation of next steps.
Other (Describe in Description Section)	Q4	Groundwater field operations SOPs on sample collection, and sample storage.
Other (Describe in Description Section)	Q4	Groundwater field procedures SOPs adapted for CBM
Other (Describe in Description Section)	Q3	Groundwater field work for engagement with indigenous community members at Fort MacKay.
Other (Describe in Description Section)	Q4	DATA – Compilation and upload of wetland, precipitation and spring water isotopes data into AEPA data systems (KiWQM).
Other (Describe in Description Section)	Q3	DATA - Digital dataset of CLOS Quaternary unit picks and modelled geobodies to prepare and upload in AEPA data systems.
Other (Describe in Description Section)	Q2	MAP - Regional-scale hydrogeological MAP products in pdf providing a pre-development water level synthesis for Quaternary aquifers in NAOS – to upload in AEPA data systems.
Other (Describe in Description Section)	Q3	MAP - Publication of four 100k map sheets for NTS 73L in pdf and shp files to upload in AEPA data systems.

Other (Describe in Description Section)	Q3	DATA - Tabular data including all data mined from Advisian/Matrix and AGS data holdings for Quaternary aquifers. Metadata may include: operator, geographic location and source, surface elevation and source, well interval details, geological unit, or completed aquifer. Data will be supplied in xlsx and csv to be prepared and uploaded in AEPA data systems.
Other (Describe in Description Section)	Q4	MAP - Regional-scale hydrogeological MAP products providing a pre-development water level synthesis for Quaternary aquifers in SAOS. Products wil be provided in pdf to upload in AEPA data systems.
Technical Report	Q4	Groundwater Quantity – Determination of Baseline Hydraulic Head and Degree of Variability. Annual Report.
Technical Report	Q1	Annual Report on GW-SW modelling.
Peer-reviewed Journal Publication	Q4	Evolving landcover in AB Oil Sands region.
Technical Report	Q4	Annual report on integration of isotope modelling into SW-GW separations.
Other (Describe in Description Section)	Q4	DATA- Isotope data xlsx file for upload into the APEA data Catalogue
Technical Report	Q4	Groundwater quality and the impact on surface water groundwater interactions on environmental health of the Oil Sands Region – Final Report
Other (Describe in Description Section)	Q4	DATA - Groundwater quality and the impact on surface water groundwater interactions on environmental health of the Oil Sands Region. Compiled data xlsx and csv data sheets.
Key Engagement/Participation Meeting	Q3	Final communication for relevant stakeholders by December 31, 2023
Other (Describe in Description Section)	Q4	DATA - Groundwater quality and the impact on surface water groundwater interactions on environmental health of the Oil Sands Region. Compiled data xlsx and csv data sheets
Other (Describe in Description Section)	Q4	Groundwater operators data Workshop and data request
Other (Describe in Description Section)	Q4	Groundwater TAC meetings on major findings from subprojects and internal data analysis
Other (Describe in Description Section)	Q3	Groundwater OSM 2024/2025 work plan

Other (Describe in Description Section)	Q4	Quarterly project tracking reports.
Other (Describe in Description Section)	Q4	Annual project management report
Key Engagement/Participation Meeting	Q1	TAC meeting: A half day meeting on progress
Technical Report	Q4	Groundwater Flow Modelling to improve network design- Matrix and Advisian reports will describe modeling and data used to approximate the full-build scenarios, InnoTech will synthesize these results to use for network design.
Other (Describe in Description Section)	Q4	DATA – Digital versions of predicted drawdowns and other relevant model output from Advisian and Matrix.
Technical Report	Q3	InnoTech will synthesize results from U of C change detection, U of C baseflow, AGS baseline and change detection work to summarize whether there are any implications to monitoring network design.
Other (Describe in Description Section)	Q3	DATA - Updates to databases on groundwater quality and quantity.
Key Engagement/Participation Meeting	Q1	Contributions to AEPA Field Program and Industry Data Request TAC meeting - Planning meeting to review updated MW network prior to field program.
Technical Report	Q4	Contributions to AEPA Field Program and Industry Data Request - Chapters on flow modelling Advisian, Matrix, Tricia Stadnyk, AGS, change detection and watershed prioritization will be incorporated into a technical report with recommendations for monitoring.
Technical Report	Q4	MacKay River Field Program to Investigate Community Concerns - Summary of 2023 field activities and results including water quality results from groundwater discharge and tributaries.
Other (Describe in Description Section)	Q3	DATA - Data from this program will be provided to AEPA in digital format.
Technical Report	Q4	EPEA Data Case Studies - chapters on flow modelling, change detection and watershed prioritization will be incorporated into a technical report with recommendations for monitoring.

Other (Describe in Description Section)	Q3	DATA - EPEA Data Case Studies. Data compiled from this activity will be provided in digital format.

Peer-reviewed Journal Publication	Q3	EPEA Data Case Studies – Demonstrating that the mechanisms associated with thermal mobilization of constituents of concern from in situ operations are well understood and that the multi-year monitoring datasets available from on-site EPEA monitoring indicate that thermal plumes are limited in spatial extent would be useful to justify whether regional groundwater quality in the vicinity of in situ operations are required.

Key Engagement/Participation Meeting	Q4	TAC meetings – Regular technical progress reports to TAC.

Choose an item.	Q4	Quarterly progress reports to support AEPA quarterly project management and finance reporting.

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 AEPA hydrogeologist (TBD), TAC co-lead and Principal Investigator and contributor to design, evaluation and reporting; 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.

Key Delivery Partners:
1)Alberta Environment and Protected Areas:
OSM Groundwater Monitoring Technologists (conduct fieldwork and support data systems);
OSM Groundwater Science Data Analyst (data systems and evaluation & reporting);
Service Alberta(groundwater data services)
Geospatial Scientist (geospatial groundwater data compilation, geodatabases, (e.g., stressor gradient maps) and data/knowledge transfer from contractor to AEPA)
Aquatic scientists (data systems and evaluation & reporting on surface water/groundwater data)
OSM Interdisciplinary Social Scientist (knowledge co-production; advice on methodologies for design and implementation of CBM and bicultural indicator development)

2) Innotech Alberta and its sub-contractors (e.g., EarthFx, Aquanty, Advisian and Matrix)

3) University of Calgary: Bernhard Mayer

4) Alberta Geological Survey: -Dan Palombi and Jordan Brinsky,

5) Wood Buffalo Environmental Association: coordinate sampling for water isotopes in precipitation at Fort McKay Bertha Ganter station and Fort Chipewyan station

Lakeland Industrial Community Association: coordinate sampling for water isotopes in precipitation at Cold Lake Maskwa station

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	100%
Groundwater Technologist	Monitoring and Data Systems	100%
Groundwater Technologist	Monitoring and Data Systems	100%
Groundwater Technologist	Monitoring and Data Systems	100%
Groundwater Science Data Analyst	Data Systems, Data Evaluation, Analysis and Reporting	100%

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)*	**500.00%**	**$600,000.00**
Operations and Maintenance		
Consumable materials and supplies		$98,650.00
Conferences and meetings travel		$2,000.00
Project-related travel		$132,207.00
Engagement		$0.00
Reporting		$0.00
Overhead		$80,500.00
Total All Grants *(Calculated from Table 16.4 below)*		**$189,400.00**
Total All Contracts *(Calculated from Table 16.5 below)*		**$736,079.00**
Sub- TOTAL *(Calculated)*		**$1,838,836.00**
Capital*		$90,000.00
AEP TOTAL *(Calculated)*		**$1,928,836.00**

* 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		$24,000.00
Project-related travel		$0.00
Engagement		$0.00
Reporting		$0.00
Overhead		$984.00
ECCC TOTAL *(Calculated)*		**$24,984.00**

* 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: Name	20GRAEM01 OSM Program: Science Program Reporting and Integration Support
GRANT RECIPIENT - ONLY: Organization	University of Calgary – Bernhard Mayer
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$119,400.00
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)*	**$119,400.00**
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	$70,000.00
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)*	**$70,000.00**
GRANT RECIPIENT - ONLY: Name	Mapping GDEs. Funding in: Integrated Geospatial Program (Task 2.4)
GRANT RECIPIENT - ONLY: Organization	ABMI – funding included in the geospatial workplan
Category	**Total Funding Requested from OSM**
Salaries and Benefits	0
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)*	**$0.00**

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	20AEM841 Oil sands long term groundwater monitoring
CONTRACT RECIPIENT - ONLY: Organization	InnoTech Alberta
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$333,535.61
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)*	**$333,535.61**
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	$6,105.00
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)*	**$6,105.00**
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	$12,022.60
Operations and Maintenance	
Consumable materials and supplies	0

Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	$0.00
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$12,022.60**
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	$69,960.00
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	$0.00
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$69,960.00**
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	$39,309.60
Operations and Maintenance	
Consumable materials and supplies	0
Conferences and meetings travel	0
Project-related travel	0
Engagement	0
Reporting	$0.00
Overhead	0
CONTRACT TOTAL *(Calculated)*	**$39,309.60**
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	$25,145.00
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)*	**$25,145.00**
CONTRACT RECIPIENT - ONLY: Name	Various – Helicopter transport
CONTRACT RECIPIENT - ONLY: Organization	Various
Category	**Total Funding Requested from OSM**
Salaries and Benefits	$150,000.00
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)*	**$150,000.00**
CONTRACT RECIPIENT - ONLY: Name	Various - Well maintenance and related projects
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
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***	$600,000.00
Operations and Maintenance	
Consumable materials and supplies *Sums totals for AEP and ECCC ONLY*	$98,650.00
Conferences and meetings travel *Sums totals for AEP and ECCC ONLY*	$26,000.00
Project-related travel *Sums totals for AEP and ECCC ONLY*	$132,207.00
Engagement *Sums totals for AEP and ECCC ONLY*	$0.00
Reporting *Sums totals for AEP and ECCC ONLY*	$0.00
Overhead *Sums totals for AEP and ECCC ONLY*	$81,484.00
Total All Grants (from table 16.2.1 above) *Sums totals for AEP Tables ONLY*	$189,400.00
Total All Contracts (from table 16.2.1 above) *Sums totals for AEP Tables ONLY*	$736,079.00
Sub- TOTAL	$1,863,820.00
Capital* *Sums total for AEP*	$90,000.00
GRAND PROJECT TOTAL	$1,953,820.00

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.*

This workplan was re-scoped to address funding conditions from the Oversight Committee of the OSM program. Overall, the change in 2023-24 workplan budget, reflects costs associated with the current core monitoring well network, required well maintenance, and associated fieldwork costs. The workplan budget also reflects the fact that several sub-projects funded by grants over the last three years are in their last final stages, and the transference of the work on identifying groundwater dependent ecosystems and the associated budget to the Geospatial Work Plan (Task 2.4).

A significant portion of the approved work will be delivered under contract/grant with various organizations, as such, delays with establishing contracts and grants may result in partial completion of some tasks/deliverables within the fiscal year. Quarterly implementation progress and budget reviews will be conducted through the fiscal year to identify and mitigate potential issues with project delivery. Support with groundwater data and geospatial data services from Service Alberta is required to streamline data management, availability and access.

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, technical expertise)	ECCC	$84,000.00
Salaries (evaluation and reporting)	University of Calgary	$54,500.00
TOTAL		**$138,500.00**

19.0 Consent & Declaration of Completion

Lead Applicant Name

Yemi Ilesanmi

Title/Organization

Science Program Manager

Signature

Yemi Ilesanmi

Date

2022-10-31

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.