## Work Plan Application

| Project Information | |
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| **Project Title:** | Groundwater Monitoring |
| **Lead Applicant, Organization, or Community:** | Seth Xeflide |
| **Work Plan Identifier Number:** If this is an on-going project please fill the identifier number for 24/25 fiscal by adjusting the last four digits: **Example:** D-1-2425 would become D-1-**2425** | GW-LTM-3-2425 |
| **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 2024/25 Project Budget**: From all sources for the 2024/25 fiscal year | $2,218,747.62 |
| **Requested OSM Program Funding:** For the 2024/25 fiscal year | $2,218,747.62 |
| **Project Type:** | Long Term Monitoring |
| **Project Theme:** | Groundwater |
| **Anticipated Total Duration of Projects (Core and Focused Study (3 years))** | Year 3 |
| **Current Year (choose one):** | Focused Study<br>Year 3 of 3 |
| | Core Monitoring<br>Year 3 of 3 |

## Contact Information

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| **Lead Applicant/ Principal Investigator:**<br><br>Every work plan application requires one lead applicant. This lead is accountable for the entire work plan and all deliverables. | Seth Xeflide |
| **Job Title:** | Hydrogeologist |
| **Organization:** | AEPA |
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## Project Summary

In the space below, please provide a summary 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 and **should not exceed 300 words**.

The objectives of this work plan is to continue to improve the groundwater Oil Sands Monitoring (OSM) program. In previous years, conceptual models (CM) for the relationship between the environment and the oil sands industrial activity (OSIA) were developed. These models decompose the relationships between OSIA into Pressure-Stressor-Pathway-Response-Effect pipelines by identifying activities (Pressures) that can potentially cause local changes in groundwater systems (Stressors), which can translate into broader changes in groundwater systems (Pathways), which in turn may affect ecosystems and human populations that depend on groundwater systems (Effects), and are a fundamental reference for the groundwater OSM work plan. Also in past years, existing data (compliance monitoring, EIA and GOWN wells ) in the oil sands region was inventoried, compiled and synthesized. The field operations team of the OSM program assessed and documented the status of groundwater monitoring infrastructure. These activities culminated in the development of a draft Monitoring, Evaluation and Reporting (MER) Plan that informed provisional well network rationalization and prioritization. It is expected that the GWTAC would provide feedback/review comments to the MER plan by end of 2023.

This work plan includes the continuation of ongoing operational work, evaluating and optimizing the current well network, and continuing ongoing sub-projects that aim to: a) revise/update the conceptual model and finalize the draft groundwater MER plan; b) update baseline regional groundwater quality database followed by an extended assessment of temporal trends in regional groundwater quality; c) determine baseline and hydraulic head change in Quaternary aquifers; d) document methods for identifying groundwater dependent ecosystems (GDEs); e) identify methods and metrics that are acceptable for monitoring GDEs; and f) participate in the state of the environment reporting.

This work plan also compliments community-based monitoring, and includes publishing groundwater monitoring data, and evaluating and reporting on regional groundwater quality and quantity conditions.

## 1.0 Merits of the Work Plan

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

- Describe the key drivers for the project identifying linkages to 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, sourcing of groundwater for production, subsurface disposal of wastewater, tailings seepage, thermal mobilization of naturally occurring contaminants due to steam injection, and reclamation etc. (Birks et al., submitted; McClain et al., 2021).

The overarching goal of the project is to determine if oil sands activities (mining and in situ) are causing changes in groundwater conditions (quality and quantity), and whether there is potential to affect terrestrial ecological receptors, namely terrestrial ecosystem health, aquatic groundwater dependent ecosystem health, or human health. The approach to reach this goal follows the adaptive monitoring framework and work has included input from the OSM Groundwater Technical Advisory Committee (GWTAC). One of the key question that has been adapted in the groundwater scope of work document is the answer to the question "has the quality and quantity of groundwater discharge to GDE, or other surface waters of interest, changed?' This demonstrates how crucial GDE is for change detection. Methods for identifying GDE (as well as mapping GDE in a selected watershed in the Athabasca oil sands region) and methods/metrics for choosing an acceptable GDE monitoring scheme would be pursued in 2024/2025. To address concerns related to GDEs, the GWTAC would organize a workshop with other TACs (such as wetlands, aquatic and surface water) in 2024. The overall goal of the GDE work is to identify appropriate methods for identifying GDEs, map their locations and assess methods and metrics for monitoring them.

During fiscal years 2020/2021 to 2023/2024, the groundwater monitoring program and Alberta Geological Survey (AGS) have successfully begun to characterize pre-development/baseline groundwater head (quantity) conditions and changes over time in the Cretaceous (completed) and mapping Quaternary (ongoing) aquifers on regional scale (Manchuk et al., 2021; Nakevska, 2020; Nakevska and Lemay, 2021; Singh and Lemay, 2021). The work also include characterizing baseline hydraulic heads in the Quaternary aquifers in the North Athabasca Oil Sands (NAOS) and South Athabasca Oil Sands (SAOS) regions.
In the 2024/2025 fiscal year, this work will continue with the goal of Quantifying baseline water-level conditions in Neogene-Quaternary aquifer systems across the Cold Lake Oil Sands and Athabasca Oil Sands areas to support the determination of natural ranges of variability and to assess whether oil sands stressors are changing groundwater quantity levels. The objectives of this baseline hydraulic head and hydraulic change work is to: a) produce datasets providing a compilation of water levels for Neogene-Quaternary aquifers in the CLBR area; b) generate maps of baseline water level conditions in Neogene-Quaternary aquifers within the CLBR area; c) quantify hydraulic head changes in the NAOS and SAOS areas; d) produce surficial and subsurface mapping of the Western Athabasca Oil sands (WAOS) area, initiate the development of a new Neogene-Quaternary geological framework and improve knowledge of the aquifer systems; and e) illustrate the connection of the project outcomes to the OSM groundwater conceptual

model (stressors, pathways and receptors).
Overall, this work will: a) help improve knowledge of the Cretaceous and Quaternary aquifers at the Athabasca and Cold Lake Oil Sands Designated Areas b) help understand baseline hydraulic heads and hydraulic head change (relative to baseline) in the Cretaceous and Quaternary aquifers; c) help understand hydraulic connectivity of aquifers and connection to surface; and d) help with the long-term groundwater program design.

In 2021/2022 and 2022/2023, the groundwater monitoring program included the characterization of baseline groundwater discharge to rivers and springs (baseflow) and wetlands. Focus study by the OSM program and its contractors (U of C and Innotech) have successfully identified five groundwater quality temporal anomaly zones within the oil sands region (Manchuk et al., 2021). In 2023/2024 this groundwater quality anomalous work is being expanded to quantify the extent to which natural versus anthropogenic drivers are responsible for observed groundwater quality anomalies. In 2024/2025 baseline regional groundwater quality database would be updated followed by an extended assessment of temporal trends in regional groundwater quality ( U of C). The objective of this project is to investigate groundwater quality trends and anomalies in the oil sands region and to determine which natural and/or anthropogenic sources and processes are responsible for the observed water quality trends.

New items for the 2024/2025 fiscal year are: a) characterizing baseline and hydraulic head change in the Quaternary aquifers; b) update baseline regional groundwater quality database followed by an extended assessment of temporal trends in regional groundwater quality;  c) documenting methods for identifying GDEs (including mapping locations of GDE in a selected watershed in the Athabasca oil sands region); and e) identify methods and metrics that are acceptable for monitoring GDEs.

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 2024/25 work plan below

For the fiscal year of 2024/2025 the objectives are:

1. Finalizing a long-Term groundwater monitoring plan. Revise/update the conceptual model to rank and capture key stressors, and focusing on prioritize watersheds/areas identified in the MER 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 ongoing grants. Synthesis and state of environment reporting from 2021/2022, 2022/2023 and 2023/2024 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; c)increase knowledge of groundwater systems at the watershed/aquifer scale; and d) better understanding of methods for identifying GDEs.

3. Groundwater Monitoring. Collect groundwater data to: a) monitor areas where changes have been identified and add additional monitoring/request industry data in those areas to validate observed hydraulic head change as appropriate (e.g., areas identified by; AGS hydraulic head change work,draft MER plan ); b) rationalize integrity of existing GOWN wells and prioritize monitoring locations.

4. Publish Groundwater Data. Release of data collected in 2022/2023 and other associated data (building on data inventory from 2021/2022, 2022/2023 and 2023/2024) to the public via AEPA KiWQM and OSM Data Catalogue.

## 3.0 Scope

**Evaluation of Scope Criteria (Information Box Only- No action required)**

Your workplan will be evaluated against the criteria below. A successful workplan would:

- Be in scope of the OSM Program (e.g., regional boundaries, specific to oil sands development, within boundaries of the Oil Sands Environmental Monitoring Program Regulation)
- 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 Theme

Please select the theme(s) your monitoring work plan relates to:

- [ ] Air
- [x] Groundwater
- [ ] Surface Water
- [ ] Wetlands
- [ ] Terrestrial Biology
- [ ] Data Management Analytics & Prediction
- [ ] Cross Cutting

## 3.2 Core Monitoring, Focused Study or Community Based Monitoring

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.

Long Term Monitoring

## Themes

Please select the theme from the options below. Select all that apply.

- [ ] Air
- [x] Groundwater
- [ ] Surface Water
- [ ] Wetland
- [ ] Terrestrial
- [ ] Cross-Cutting

## 3.3.2 Groundwater Theme:

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

**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.

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

Yes (partially), but not all critical elements of the monitoring plan are fully developed and being monitored yet. Baseline and changes from baseline have been identified for groundwater quantity in the Cretaceous Aquifer. Baseline (pre-development) groundwater levels and change from baseline condition are being determined in the Quaternary aquifers. No normal change in GDE has been established.
Limits of change have not been identified for groundwater quality parameters, however, regional limits and triggers has been derived in the 2013 Groundwater Management Framework. This limits and triggers will be revised.
In 2024/2025 the GWTAC would organize a multi-day workshop to discuss baseline for groundwater quality and quantity.

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. Nonetheless, the interpretation of those changes is still ongoing and attribution of cause and the role of oil sands industrial activity in groundwater change may not be conclusive due to heterogeneity of the geological environment. Ongoing work (2023/2024) seek to quantify the extent to which natural versus anthropogenic drivers are responsible for observed water quality anomalies. In 2024/2025 regional groundwater quality database would be updated followed by an extended assessment of temporal trends in regional groundwater quality.

Currently, it is not possible to assess ecological effects associated with changes in groundwater quality and quantity. Assessing responses of ecological receptors to any groundwater quantity and quality changes will only be possible after mapping and focusing monitoring work on GDEs. Ongoing OSM sub-projects include identifying locations of GDEs on a pilot basis and as well documenting methods for identifying these GDEs. Also, current ongoing (supplement 03 of the 2023/2024 work plan) and proposed 2024/2025 (supplement 02) work by U of C will provide current baseline groundwater quality against which potential future changes can be assessed. The 2023/ 2024 ongoing work (supplement 05 of the 2023/2024 work plan- AGS) and the proposed 2024/2025 AGS baseline hydraulic head and hydraulic head change analysis work (supplement 01) will provide baseline and hydraulic head change in important aquifers.

The information above will assist in refining groundwater monitoring program design to include sampling locations for integrated monitoring (including surface water and at least aquatic ecosystems health indicators) and will assist in interpreting data by evaluating and partially separating natural causes for groundwater quality and quantity changes.

At present, it is still premature to identify cumulative effects of OSIA in groundwater, nonetheless ongoing studies is characterizing baseline in groundwater quantity and quality as well as change relative to baseline.

Further expansion of Indigenous key questions will continue as the groundwater monitoring program is developed. In 2024/2025 GWTAC will host a workshop with indigenous community to discuss key indicators as well as areas of groundwater discharge and springs.
In general, oil sands groundwater quality data can be compared against water quality guidelines or other

benchmarks to inform indigenous concerns and health (e.g. is the water safe to drink?). This may be particularly relevant in the Cold Lake Beaver River region where groundwater may more frequently be used for domestic consumption purposes.

Indigenous concerns are supported by specific work plans that are being submitted through specific channel.

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

No.

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 one ongoing project with the Fort MacKay indigenous communities that focuses on indigenous concerns, part of this project is covered in supplement 06 in the 2023/2024 work plan.
In 2024/2025 the GWTAC will host a workshop with indigenous community to discuss key indicators.

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

Yes. All data that has been collected in the field has been uploaded into OSM data Systems (KiWQM), all historical data in older data bases have been quality assessed analyzed and transferred to the same data base as the data that has been collected during field work. Historical data that has been collected under groundwater OSM sub-projects have been aggregated recompiled into readable and editable data tables, and has been assessed for quality analysis and control. These data are to be published in the OSM data catalog.

The data that will be collected in the year of 2024/2025 by AEPA and all grant and contract proponents will also be compiled and made available through KiWQM or the data catalog.

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

Standard methods for groundwater monitoring are being used for fieldwork where available. A comprehensive groundwater monitoring field manual composed of SOPs is currently under development by AEPA. In the interim we aim to follow U.S. Geological Survey (2006), "Collection of Water Samples (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A4."
Any deviations from the standard methods will be discussed with the GWTAC prior to implementation.

For the year of 2024/2025 SOPs will be revised and, where necessary, adapted for supporting community based monitoring.

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

Phases of this work plan include specific tasks and subproject that will assist in determine locations for potential integrated work with other descriptors. Task 2.4 of the 2023/2024 geospatial work plan focuses on mapping groundwater dependent ecosystems. This work will assist in delineating multi theme integrated monitoring including groundwater and aquatic ecosystems.

The wetland and groundwater programs have collaborated on evaluating the use of remote sensing techniques for identifying wetland/groundwater interactions.
In 2024/2025 this work is been undertaken under the geospatial work plan. The goal of the 2024/2025 project is to generate seasonal and multi-year surface water area and water level changes in lakes and wetlands concerning Alberta's oil sands activities.

In 2024/2025 the GWTAC will hold workshop with all the relevant TACs (wetland, aquatic etc.) to discuss

issues related to GDEs.
The groundwater program includes a sub-project that focuses on Fort MacKay's indigenous communities concerns, and several SOPs/user manuals are currently in development and will be adapted in community based monitoring ensuring standardization of the sample collection procedures and protocols.

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

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?

Current 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 in the Oil Sands Region. When applicable, the data is compared to drinking water quality guidelines and uploaded into AEPA data systems. Temporal variability in the data is also being assessed towards detecting patterns that may be associated with the oil sands industry.

Groundwater discharge (quantity and quality) in the McKay watershed is also being measured to support CBM.

The results from previous groundwater OSM sub-projects associated with baseflow trends and groundwater discharge, will also provide information on the most likely areas of groundwater discharge which allow adapting the program sampling design to accommodate areas with surface water-groundwater interactions.

How will this work advance understanding transition towards adaptive monitoring?

Detecting patterns of variability in the data that are associated with industrial activities may be a source of focus studies to better understand how local changes are being translated into broader regional contexts, or on better understanding of the contributions of affected aquifers to local ecosystems and detecting indices of environmental degradation on biological indicators at groundwater discharge areas.

Mapping of Quaternary (shallow) and Cretaceous (deep) aquifers and the change detection work would advance the understanding and identification of areas of aquifer connectivity and relationship to surface. This knowledge would help focus and adapt monitoring to these identified areas.

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 additional knowledge provided by the data analysis and sub-projects may be of relevant use for State of the environment reporting. A chapter on groundwater quantity would be prepared and added to the current groundwater State of the Environment report in 2024/2025 as required.

## 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). The Quaternary mapping work by AGS (supplement 01) would help to define overburden aquifers for the Lower Athabasca Region and by extension help inform the the Lower Athabasca Region Groundwater Management Framework.

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

Other internal reports, or chapters on the state of groundwater, groundwater data, groundwater monitoring parameters, sampling design and work progress will be produced to inform internally on the groundwater monitoring program and its results. These results will be important to delineate next steps for the groundwater OSM program. The data analysis will report on any relevant deviations from drinking water quality guidelines observed in aquifers that are used for human consumption.

The information generated from the groundwater monitoring program can be used to:

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

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

3. 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 add background monitoring data from operators. In 2024/2025 a request (water quality and quantity data) would be made.

Groundwater monitoring, supports transboundary agreements with the Northwest Territories for the Mckenzie River Basin and may contribute to 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 were successfully completed in 2020/2021 under the groundwater work plan to investigate indigenous community key questions and concerns on water levels and quality in rivers, and the potential role of groundwater activities associated with oil sands mining. One of these has scaled up and is a stand alone work plan from Fort MacKay Metis Nation (FMMN) in 2021/2022, 2022/2023, 2023/2024 and is also being submitted in 2024/2025. Separate EOI's are being submitted by communities in 2024/2025 and are not integrated into the core groundwater monitoring work plan. The GWTAC have collaborated with the FMMN on this monitoring work and this collaboration would continue in 2024/2025.

The Cold Lake First Nation (CLFN) indicated interest in working with OSM groundwater to sample for water isotopes in surface water (lakes) as part of CLFN's monitoring program after the September 29 and October 2, 2023 workshop (the community would complete the sampling on behalf of OSM and OSM would pay for the laboratory analysis). Additionally, routine water quality parameter collection has been requested by the OSM program. Since lakes in the CLBR region are not currently being monitored by the OSM program, gathering this data would serve as a first step toward the creation of a more extensive monitoring program in the future. This monitoring program would enhance the understanding of surface water (lake) groundwater interaction in the Cold Lake Beaver River region.

Groundwater discharge monitoring fieldwork and evaluation and reporting in the MacKay River watershed provide western science data and interpretations of baseline conditions and change that can be used by Fort McKay Metis Nation in their investigation of cause to address community 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**

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

Are there any community specific protocols that will be followed?

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.

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.

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

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

How does this work plan directly benefit Indigenous communities? How does it support building capacity in Indigenous communities?

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

## 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. 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 fiscal years 2021/2022, 2022/2023 and 2023/2024 baseline groundwater levels have been established for Cretaceous (complete) and Quaternary aquifers (in NAOS and SAOS). Models on baseflow and groundwater discharges have been tested (2021/2022 and 2022/2023) and baseline/temporal series of water quality parameters have been assessed.

In 2024/2025 the work will continue to expand and conclude the establishment of baselines and detection of change in groundwater quality (supplemental 02) and quantity (supplemental 01). Also in 2024/2025 (Q1) the GWTAC would hold a workshop to discuss baseline (to define what constitute baseline) for groundwater quality and quantity.

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

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 more resolution at a regional level and better understand groundwater quantity and quality patterns of temporal variability and connectivity among groundwater systems/aquifers.

A prioritization scheme that included a variety of methods to compare groundwater and surface water usage with limits of sustainability, information about groundwater stressors (e.g., extent of mine footprint, modelled drawdown), areas where changes in groundwater quality or quantity have changed,and areas where groundwater discharge to surface water has changed, has been developed (draft MER plan). The scheme has been used to flag watershed/areas for focused monitoring.

Field-based monitoring (Objective 3) continues to add data from wells where temporal changes in water quality were identified, these data are valuable for continuing to detect and validate part of the identified temporal trends and will in the future resolve some uncertainty associated with data gaps.
In 2024/2025 monitoring would continue to be used to evaluate/validate areas where changes have been identified (both MER plan and AGS change detection work in the Cretaceous and Quaternary aquifers). Data collected would be validated against baseline and change conditions as appropriate. Where data gaps exist, industry data would be requested and used if possible.
Additionally, a groundwater numerical model is currently being developed by the AEPA policy branch within the SAOS. It is anticipated that results of this model would be used to identify areas of cumulative drawdown impacts. Monitoring data would also be used to validate modeled drawdown and initial condition (baseline) in both shallow and deep aquifers.

Evaluation and reporting on groundwater monitoring data and indicators continues (Objective 2) to work towards answering the core questions of the OSM program, including baseline conditions and change.

Monitoring stable isotopes as routine parameters in the OSM surface water quality program and the integrated groundwater wetland monitoring programs allows for potential surveillance-tier method to detect changes in groundwater discharge at the watershed-scale (e.g., water balance).

The long-term groundwater monitoring design began in 2020/2021, 2021/2022 and 2022/2023 with a workshop series and will continue in 2024/2025 including making specific recommendations for indicators to monitor, linked to the conceptual model components, and methods that will be used to evaluate change and uncertainty in groundwater quality and quantity/discharge over space and time.

## 7.0 Accounting for Scale

**Evaluation of Accounting for Scale Criteria (Information Box Only- No action required)**

Your workplan will be evaluated against the criteria below. A successful workplan would potentially be:

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

Explain how your monitoring tracks regional and sub-regional state of the environment, including cumulative effects. As relevant, 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 River (CLBR) Region, the Northern Athabasca Oil Sands Region (NAOS) Regions and the Peace River Oil Sands (PROS) Region.

The current work plan proposal includes two main sub-projects with regional components (2022/2023 and 2023/2024 and 2024/2025) on aquifer mapping, baseline groundwater level, hydraulic head change and baseline groundwater quality trends and anomalies. Sub project with sub-regional component (2023/2024 and 2024/2025) include GDE mapping on a pilot basis. Previous sub-project with sub-regional component include baseflow and groundwater chemistry baseline and change, and on locating groundwater discharge areas.

These projects and the core monitoring of the AEPA monitoring wells contribute to advance knowledge on answering to 3 key questions that were adapted in the groundwater scope of work document:

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?

In 2017/2018 and 2021/2022 an operator’s groundwater quality and quantity data request was made (and received) to assess background well data, to increase data representativeness at the Northern and Southern Athabasca and Cold Lake regions. A request was made in May 2023 and another request will follow in March 2024 to add data from areas outside AEPA GOWN network.

Data that has been collected from external sources under the 2020/2021, 2021/2022, and 2022/2023 will be added to the existing databases and analyzed. These data will fill spatiotemporal data gaps in the AEPA well network and assist in expanding the data analysis to a regional scale, they will also assist in increasing the sub-regional representation of the Peace River Oil Sands Designated Region which is currently underrepresented.

Identifying likely discharge areas in the oil sands region (OSR) adds information that can be used for the location of groundwater dependent ecosystems and potential wintering water bodies that are used by aquatic communities as refuge and by terrestrial macrofauna as feeding areas during winter. These locations can be added to studies on mapping groundwater dependent ecosystems (see task 2.4 in the 2023/2024 geospatial work plan) and then be targeted for integrated focused studies on groundwater surface water interactions and ecological responses in the future.

In the current monitoring well network, groundwater wells monitor quality and quantity conditions in both deeper regional aquifers as well as shallow local-scale groundwater systems, this network is currently being expanded following the adoption of 7 wells from Conoco Philips. Work on the well infrastructure condition has been conducted in 2020/2021 and 2021/2022 to evaluate the possibility of expanding the current active monitoring well network with the least cost possible. It is anticipated that these wells would come on line by 2025 pending AEPAs Airshed & Watershed Stewardship (AWS) branch approval.

In 2020/2022, 2021/2022 and 2022/2023 data from EIAs and EPEAs,WURS and other compliance monitoring data have been compiled and used to increase the spatiotemporal scope of the groundwater OSM data. The addition of this dataset is a valuable contribution to understanding groundwater system at watershed and regional scales.

The 2024/2025 work plan will continue to work towards completing a rationalized and adaptive long-term monitoring plan to align with the core OSM outcomes including identification of key questions, indicators, limits of change and assessment of cumulative effects of oil sands development on groundwater and connected ecosystems (e.g., groundwater dependent aquatic and terrestrial ecosystems) at multiple scales (i.e. local, watershed and regional scale). The adaptive monitoring plan will also make recommendations for how numerical modeling 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 generated by the groundwater program are targeted for dissemination as per the OSM program data management plan and the identified groundwater data assets (e.g., quality and quantity data). 2024/2025 groundwater quality data from the GOWN network will be automatically uploaded from the labs, validated and posted to the OSM Data Systems. Groundwater monitoring datasets coming from the data inventory and data compilation (e.g., from EIAs, EPEAs, WURS and other compliance monitoring will be recompiled into a format compliant with the OSM Data Catalogue).

Groundwater quantity data from 2022/2023 is currently being uploaded into the AEPA data systems. Groundwater quantity measurements taken in 2023/2024 and 2024/2025 will be uploaded into APEA data systems.

Part of the deliverables for the work plans of 2020/2021, 2021/2022, 2022/2023 are in preparation and will be published in scientific peer-review journals and will be fundamental for additional chapters of the State of the Environment Report (SoE). Submitting articles through peer review processes validates scientifically the results and interpretations coming from groundwater monitoring. The groundwater SoE synthesizes that information in plain language for the general public and will be assessable through a dedicated internet site.

In addition, public communication pieces on the 6 priority groundwater stressors are being prepared since 2021/2022 for publication. Multiple OSM technical documents summarizing contractor/grantee work have been drafted and several internal reports have been produced to support decision on relevant aspects of the monitoring work. Section 14.0 identifies a variety of deliverables for scientific and lay audiences, including a progress report.

All information coming from monitoring data and the sub-projects under the groundwater OSM program are evaluated presented to the groundwater TAC and used to delineate future work to better align the monitoring work with the core questions of the OSM program. Collecting-Assessing-Interpreting-Evaluating-Adapting are the basal steps in adaptive monitoring frameworks.

## 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 2020/2021, 2021/2022, 2022/2023 and 2023/2024 monitoring was integrated with multiple other OSM projects, all of which will continue in the 2024/2025 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.

Stand pipes were also installed at wetland sites (fens, swamps, bogs and open water sites) to measure surface water-groundwater interactions. This wetland monitoring will continue in 2024/2025 and water isotopes collected since 2017 would be analyzed as part of the 2024/2025 work plan. The expected outcome of this work would help focus on future studies on groundwater dependent ecosystems.

Task 2.4 under the integrated geospatial work plan of 2024/2023 include a grant to map locations of GDEs in a selected watershed in the Athabasca Oil Sands region on a pilot basis. The 2023/2024 work would identify locations of aquatic GDEs and document methods for identifying them. In 2024/2025 (supplemental 03), thematic coverage of GDE mapping will continue. Expected outcomes in 2023/2024 (geospatial sub-project) and subsequent 2024/2025 on the methods for identifying GDEs and mapping of GDEs will assist in defining areas for future focused studies on groundwater dependent ecosystems.

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).

This work plan also include collaboration with Cold Lake First Nation (CLFN) to sample lakes for water isotopes and routine water quality parameters within the CLBR region.

## 10.0 Work Plan Approach/Methods

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

Similar to previous years, the 2024/2025 work plan 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 2024/2025 are the research groups led by:

Dan Palombi (Alberta Geological Survey) - Groundwater Quantity – Determination of Baseline Hydraulic Head and Change Detection Analysis for Quaternary Aquifer Systems (202425_sup01_GroundwaterMonitoring_XeflideSeth.pdf').

Dr. Bernhard Mayer (University of Calgary)-Groundwater quality in the Oil Sands Regions: improving baseline estimates for change detection and attribution studies (202425_sup02_GroundwaterMonitoring_XeflideSeth.pdf).

Under the 2023/2024 geospatial work plan include a grant to map locations of GDEs in a selected watershed in the Athabasca Oil sands region on a pilot basis. This GDE mapping product will support the groundwater GDE initiative. The deliverable in 2023/2024 would form the basis for continued future GDE mapping work (e.g., 202425_sup03_GroundwaterMonitoring_XeflideSeth.pdf). In 2024/2025 this work would be contracted out to potential bidders/contractors.

Following the September 29 and October 2, 2023 SIKIC-GWTAC, it was agreed that the GWTAC convene a workshop 2024 with input from data and integration team. Items to be discussed at the workshop. include:

1. The role of springs and possible reference sites for monitoring climate
2. Connection of groundwater to lake monitoring work (aquatic ecosystems)
3. Engagement with community on Community Base Monitoring (CBM) work

With respect to item 1 above, previous work sponsored by OSM have identified locations of Alberta springs, based on sources published between 1980 and 2022. In 2024/2025 this data would be reviewed to asses if and how accessible these spring locations are relative to current monitoring location in the oil sand designated areas. GWTAC members and indigenous GWTAC representatives would be consulted for guidance.

Below, we list the tasks for the 2024/2025 groundwater work plan considering AEPA's work, the grant proposals from the University of Calgary and AGS, and potential contract recipoient.

1. Long Term Groundwater Monitoring Design (continued from 2023/2024)
1.1 Update conceptual model that captures relevant stressors, hydrogeological/hydrological features and synthesis of GOWN monitoring data taking from 2016 to 2022 and industry data if possible.
1.1.1 Update/simplify programmatic conceptual model
1.1.2 Create physical based (block diagrams) conceptual model (based on regions)
1.2 Finalize Monitoring Evaluation and Reporting (MER) Plan
1.3 Identification of areas that are more likely to be affected by the Oil Sands Industry and that are adequate targets for future monitoring
1.4 Opportunities for Community Based Monitoring
1.5 Planning for Implementation
2. Evaluation & Reporting (E&R)
2.1 Plain Language Reporting/State of the environment report
2.2 Groundwater Quantity data Evaluation & Reporting (continued from 2023/2024)
2.2.1 Baseline Hydraulic Head in Quaternary aquifers in the CLBR Region
2.2.2 Hydraulic Head Change in Neogene-Quaternary aquifers in the NAOS & SAOS Regions

2.2.3 Generate maps of baseline water level conditions in Neogene-Quaternary aquifers within the CLBR Region
2.2.4 Produce datasets providing a compilation of water levels for Quaternary aquifers
2.2.5 Produce surficial geology mapping in NTS 83P NE/SE
2.2.6 Produce surficial and subsurface mapping in the Western Athabasca Oilsands (WAOS) area to initiate the development of a new Neogene-Quaternary geological framework and improve knowledge of the aquifer systems
2.3 Groundwater Quality data Evaluation & Reporting (continued from 2023/2024)
2.3.1 Produce updated maps of baseline groundwater quality parameters including baseline ranges of various dissolved constituents
2.3.2 Produce updated water quality baseline dataset and groundwater quality database by combining the AEMERA, EPEA and WURS data sets with the AGG
2.3.3 Asses aquifer connectivity based on water quality and isotope data and refine conceptual models for aquifer connectivity in the northern portions of the study area (NAOS)
2.4 Review and Synthesis of Historic Integrated Groundwater Wetland Monitoring data (2017-2023)
2.5 Groundwater Dependent Ecosystem
2.5.1 Document methods for identifying groundwater dependent ecosystem
2.5.2 GDE mapping product
2.5.3 Identify methods and metrics that are acceptable for monitoring GDEs.
2.6 Ensure publication of the condition of the environment report, associated peer-review paper and other pending deliverables from previous years
3. Groundwater Monitoring
3.1 Regional Core Groundwater Observation Well (GOWN) Monitoring and Maintenance (continued from 2023/2024)
3.1.1 Groundwater Sampling (Fieldwork) at Selected Wells (~40) and Laboratory Analysis of Samples
3.2 Integrated Isotope Sampling to Inform Regional Water Balance (continued from 2023/2024)
3.2.1 Precipitation Water Isotopes at 3 Stations along a Latitudinal Gradient
3.2.2 Collaborating with Cold Lake First Nations to include Water Isotope Sampling in Lakes
3.2.3 Wetland Surface Water and Groundwater Isotope Sampling from Piezometers installed at Wetland
3.3 Groundwater Discharge along Reaches of the McKay River (extension of OSM funded ECCC work in 2012-2013; continued from 2024/2025)
3.4 Standard Operating Procedure Development (continued from 2023/2024)
4. Publish Groundwater Data (continued from 2023/2024)
4.1 Publish 2023/2024 Groundwater Monitoring Field Data (from tasks 3.1-3.2) via AEPA data systems
4.2 Publish Third party Groundwater Data via AEPA data systems
4.2.1 Operator Data Request - Water Level, Quality, and Metadata
4.2.2 Prepare and Publish data received from grantees AGS (supplement 01) and U of C (supplement 02) and contractors selected through submitted proposals
5. Project Management (continued from 2023/2024)
5.1 Strategic/Implementation Plan Preparation (continued from 2023/2024)
5.2 2025/2026 Work Plan Preparation
5.3 Quarterly OSM Program Office Reports on Fiscal Status & Deliverables
5.4 Annual OSM Program Office Report

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/pre-development hydraulic head for the Cretaceous aquifers. Hydraulic head change in the Cretaceous aquifer has also been assessed by comparing initial hydraulic heads (baseline) with 'recent' hydraulic heads. Temporal variation in groundwater

discharges and baseflow (2021/2022 and 2022/2023), and temporal variability of groundwater chemical parameters have also been assessed. In 2023/2024 it is anticipated that the work regarding quantifying the extent to which natural versus anthropogenic drivers are responsible for observed water quality anomalies can be used to assess oil sands activities on water quality change.

The approaches to detect changes in 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 (statistical/probabilistic model). Both approach is being used because they are complimentary.

The first approach centers on the interpretation on the differences between observed and predicted values find changes associated with Oil Sands Operations, 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 2024/2025 the amount of information on baselines, change detection and spatial distribution of groundwater quality and quantity data will allow for a better understanding of change at the watershed and at the regional levels.

The 2024/2025 work plan will continue developing baseline estimates for groundwater hydraulic head (quantity) in Quaternary aquifers (hydraulic head distribution) in the CLBR region and hydraulic head change in the NAOS and SAOS regions.
Data synthesis will continue in the 2024/2025 work plan to support the geochemical interpretation of groundwater chemistry (supplement 02), and the data from previous work (Dr.Tricia Stadnyk) on groundwater discharge baselines and change would be compiled/documented.

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 Lower Athabasaca Regional Plan (LARP) Groundwater Management Framework, however these are drafts and are currently under revision. Surface water quality Guidelines (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.)

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 (i.e., updated/ simplified programmatic conceptual model to capture relevant stressors, pathways, response and create a block diagram (pysical based) conceptual model based on oil sand region/activity), stressor prioritization, and water quantity and quality analyses and well infrastructure condition completed in 2020/2021, 2021/2022, 2022/2023, and 2024/2025 to identify future monitoring needs. The groundwater monitoring design will include an adaptive monitoring decision framework. Monitoring would be focused on prioritized areas/HUC 8 watersheds identified based on existing work (e.g., the draft MER plan and AGS change detection work). If possible prioritized areas with data gaps would be supplemented with industry data. Opportunities for focused studies, traditional land use studies, and community-based monitoring will be recommended. At least one to two-day long-term monitoring program design workshop will be convened to get input from the groundwater TAC, and to discuss timing, requirements, and strategy for phased

implementation. Task 1.2 involved finalizing the draft MER plan which would incorporate feedback comment from the GWTAC.

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 2024/2025 groundwater work plan submission.

Task 2.2 Groundwater quantity evaluation and reporting focuses on addressing key data gaps for monitoring data, characterization of baseline and change detection in Quaternary aquifers : (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.

Task 2.3 refers to focused study on updating baseline regional groundwater quality database followed by an extended assessment of temporal trends in regional groundwater quality in the oil sands regions. The study will also determine which natural and/or anthropogenic sources and processes are responsible for observed water quality trends.

Task 2.4 refers to reviewing and synthesizing integrated groundwater wetland monitoring data (2017-2023) to understand water-balance conditions (and groundwater contributions) over time and to assess any relationship to oil sands activities.

Task 2.5 refers to groundwater dependent ecosystem.
Under this task, methods for identifying GDEs would be documented in a technical report including documenting locations of GDEs in the Athabasca Oil Sands area(tasks 2.5.1-2.5.2). Methods and metrics that are acceptable for monitoring GDEs would be reviewed and documented under task 2.5.3.

Task 2.6 refers to increased focus on ensuring publication of pending peer review deliverables and dependent reports from previous years.

3. Groundwater Monitoring

Task 3.1 Regional core Groundwater Observation Well (GOWN) monitoring (water levels, temperature) and maintenance will continue at approximately 134 wells (including ~40 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 written in 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 continue to be collected under the 2024/2025 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 form 2020/2021and 2022/2023, model outputs and community concerns, to supplement community based monitoring in the watershed (2017-2021), and as a next step in the sequence of ECCC work funded by OSM in 2012-2013.

Task 3.4 refers to Standard Operating Procedures (SOPs) that will be written for groundwater quantity and quality monitoring and CBM support in standardizing western science-based sampling procedures.

4. Publish Groundwater Data

Task 4.1 Groundwater monitoring field data (from tasks 3.1-3.2) collected during the 2024/2025 fiscal year will be published via the OSM KiWQM.

Task 4.2 Data collected third party (e.g., grant/ contract recipients) will be restructured, recompiled and will be uploaded into APEA's data systems.
Groundwater data collected and compiled by grant and contract proponents, and geospatial data, collected and/or compiled as a part of previous year's approved OSM groundwater work plans, will be prepared and published via the OSM Data Catalogue.

5. Project Management
Effectively coordinate work plan execution and project reporting for the OSM program office among AEPA, ECCC, contractors, sub-contractors, and grantees by using 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.

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

Indicators of changes to groundwater quantity include water levels and groundwater discharge.
Groundwater quality parameters indicators are based on a) primary list of indicator parameters; b) secondary list of indicator parameters; and c) tertiary list of indicator parameters associated with oil sands mining and in-situ operations

For mining operations, the following are the indicators parameters:
Primary water quality Indicators: pH, redox, total dissolved solids, sodium, chloride, arsenic, ammonia, naphthenic acids
Secondary water quality indicators: All other major ions + remaining trace elements, fluoride, dissolved organic carbon, BTEX, phenols, LMW PAHs.
Tertiary water quality indicators: GC-MS, stable or radiogenic isotopes

Similarly, the following are lists of indicator parameters for in-situ operations:
Primary water quality Indicators: Temperature, redox, total dissolved solids, chloride, silicon, arsenic, boron, phenols.
Secondary water quality indicators: All other major ions + remaining trace elements, naphthenic acids BTEX, PHC F1 and F2, LMW PAHs.
Tertiary water quality indicators: GC-MS,stable or radiogenic isotopes

## 11.0 Knowledge Translation

**In the space below, please provide the following:**

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

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

## 12.0 External Partners

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

Task 3: includes laboratory analysis with the following laboratories and current contracts: ALS, InnoTech, BV, AXYS. Fieldwork is partially conducted using helicopter access by contract to various vendors, and groundwater monitoring well enhancement by various vendors.

Tasks 2.2.1 to 2.2.6 and 2.3 associated with AGS (supplement 01) and University of Calgary grants (supplement 02). Tasks 4.2.1 and 4.2.2 relate to preparing data delivered by grantees to AEPA and uploading them into the Data Catalogue.

Tasks to support objective 2- evaluation and reporting are mostly delivered by, or dependent on the following grants or contracts:

The Alberta Geological Survey for: "Determination of Baseline Hydraulic Head and Change Detection Analysis for Quaternary Aquifer Systems" as described in supplement 01: Task 2.2 Evaluation and Reporting Groundwater Quantity: Quantifying baseline water-level conditions in Neogene-Quaternary aquifer systems across the Cold Lake Oil Sands and Athabasca Oil Sands areas, determine natural ranges of variability and assess whether oil sands stressors are changing groundwater quantity levels (Tasks 2.2.1 to 2.2.6)

University of Calgary for: "Groundwater quality in the Oil Sands Regions: improving baseline estimates for change detection and attribution studies" as described in supplement 02: Task 2.3 Evaluation and Reporting Groundwater Quality: update and expand the regional baseline groundwater quality database followed by an extended assessment of trends in regional groundwater quality (Tasks 2.3.1 to 2.3.3).

The GDE work under task 2.5.1-2.5.2 would be completed by contractors selected through submitted proposals, or the GWTAC will identify potential contractors.

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 2024-25 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.*

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:

Jun 1, 2024

13.5 Estimated Data Collection End Date:

Nov 30, 2024

13.6 Estimated Timeline For Upload Start Date:

Jun 1, 2024

13.7 Estimated Timeline For Upload End Date:

Feb 28, 2025

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

Yes

**Table 13.9 Please describe below the Location of Data and Data Type:**

**Add a Data Source by clicking on the add row 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 | OSM 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/ future OSM geospatial data portal | shapefile/feature class/ raster | Open by Default |
| AGS Quaternary Aquifer Water Level Data | AGS website | csv | Open by Default |
| GDE mapping product | OSM Data Catalogue/ future OSM geospatial data portal | shapefile/feature class/ raster | -Select One- |

## 14.0 2024/25 Deliverables

**Add an additional deliverable by clicking on the add row on the bottom right side of table**

| Type of Deliverable | Delivery Date | Description |
|---|---|---|
| OSM Program Annual Progress Report (required) | Q4 | Global progress report on the 2024/2025 work plan |
| Other (Describe in Description Section) | Q4 | DATA - OSM core monitoring water quality and water quantity data to upload in in OSM Data Catalogue |
| Other (Describe in Description Section) | Q4 | DATA – 2022/2023 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 | Q4 | Peer-review paper associated with the condition of the environment report |
| Technical Report | Q4 | 2023/2024 OSM groundwater monitoring report. Technical interim report work and findings on groundwater and evaluation/ recomendation of next steps. |
| Other (Describe in Description Section) | Q3 | Groundwater field work for engagement with indigenous community members at Fort MacKay. |

| Type of Deliverable | Delivery Date | Description |
|---|---|---|
| Other (Describe in Description Section) | Q4 | DATA – Compilation and upload of wetland, precipitation and spring water isotopes data into OSM data systems (KiWQM). |
| Other (Describe in Description Section) | Q4 | DATA- Lake Isotope data xlsx file from CLBR for upload into the OSM data Catalogue |
| Other (Describe in Description Section) | Q4 | MAP-Regional-scale hydrogeological MAP products providing a baseline water level synthesis for Neogene-Quaternary aquifers in CLBR in pdf to be upload in OSM data catalogue. |
| Other (Describe in Description Section) | Q4 | MAP - Publication of two map sheets for NTS 83P NE/SE in pdf files to upload in OSM data catalogue. |
| Other (Describe in Description Section) | Q3 | DATA - Tabular dataset of Water-level for CLBR Neogene-Quaternary aquifers including all AGS data holdings for Quaternary aquifers and any data received from industry. 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 OSM data catalogue. |
| Other (Describe in Description Section) | Q4 | DATA-Tabular dataset of Neogene-Quaternary unit picks and modelled geobodies. Data contains elevation values and grids for the Neogene-Quaternary sediment units in the southern portion of the WAOS area. Data will be derived from a compilation of stratigraphic picks from published and Digital data release contains elevation values and grids for the Neogene-Quaternary sediment units in the southern portion of the WAOS area. Data will be derived from a compilation of stratigraphic picks from published and unpublished sources in AGS holdings, supplemented by new stratigraphic picks from oil and gas geophysical logs and any contributions from industry. Data will be supplied in csv, xlsx and ASCII format) to be prepared and uploaded in OSM data catalouge. |

| Type of Deliverable | Delivery Date | Description |
|---|---|---|
| Peer-reviewed Journal Publication | Q4 | CLBR Open File Reports and/or journal publication on results from surficial and Quaternary mapping |
| Technical Report | Q4 | Groundwater Quantity–Report of Change Detection Analysis for Neogene-Quaternary aquifers in NAOS and SAOS |
| Technical Report | Q4 | Groundwater Quality-Groundwater quality in the Oil Sands Regions: improving baseline estimates for change detection and attribution studies |
| Other (Describe in Description Section) | Q3 | DATA - Tabular data of updated (baseline) groundwater quality database including all data mined from WURS, AEMERA, U of C-AGG provincial database. Data will be supplied in xlsx and csv to be prepared and uploaded in OSM data catalogue Task (2.3). |
| Other (Describe in Description Section) | Q4 | DATA- Isotope data xlsx file for upload into the OSM data catalogue |
| Other (Describe in Description Section) | Q4 | Groundwater operators data Workshop and data request |
| Technical Report | Q2 | Finalized MER Plan (Task 1.2) including updating conceptual model (Task 1.1) |
| Other (Describe in Description Section) | Q4 | Groundwater operators data workshop and data request |
| Other (Describe in Description Section) | Q4 | MAP & DATA- Geospatial data and products ( maps) of identified Groundwater Dependent Ecosystem Data to be uploaded to OSM data catalogue/ future OSM geospatial data portal (Tasks 2.5.1-2.5.2) |
| Technical Report | Q4 | Report documenting methods for Identifying Groundwater Dependent Ecosystem including GDE locations |
| -Select One- | -Select One- | |
| -Select One- | -Select One- | |
| Other (Describe in Description Section) | Q4 | Groundwater TAC meetings on major findings from sub-projects and internal data analysis |
| Other (Describe in Description Section) | Q4 | Groundwater OSM 2025/2026 work plan |
| Other (Describe in Description Section) | Q3 | Quarterly project tracking reports |

| Type of Deliverable | Delivery Date | Description |
|---|---|---|
| Other (Describe in Description Section) | Q4 | Annual Project management report |
| Key Engagement/Participation Meeting | Q1 | TAC Workshop: meeting on 2023/2024 progress update and data collected by OSM |
| Key Engagement/Participation Meeting | Q4 | TAC Meeting-Regular update meetings with TAC |
| Key Engagement/Participation Meeting | Q4 | Quarterly progress reports to support AEPA quarterly project management and finance reporting |
| Key Engagement/Participation Meeting | Q3 | Report on Review and Synthesis of Historic Integrated Groundwater Wetland Monitoring data (2017-2023) |
| Other (Describe in Description Section) | Q4 | Publication of SOPs related to groundwater |
| Key Engagement/Participation Meeting | Q2 | Inter-TAC Workshop-<br>1. to discuss GDE (including Identification of methods and metrics that are acceptable for monitoring GDEs-Task 2.5.3)<br>2. The role of springs and possible reference sites for monitoring climate<br>3. Connection of groundwater to lake monitoring work (aquatic ecosystems)<br>4. Engagement with community on CBM work |
| Key Engagement/Participation Meeting | Q1 | TAC-half-day Meeting with TAC to discuss industry data request |
| Key Engagement/Participation Meeting | Q1 | Multi-day workshop on baseline for quality and quantity |
| Key Engagement/Participation Meeting | Q2 | Workshop to discuss MER plan finalization (involve Wetland TAC) |
| Key Engagement/Participation Meeting | Q1 | Multi-day Workshop involving community to discuss indicators, groundwater discharge and springs areas |
| Technical Report | Q4 | Report on synthesis and analysis of historic integrated groundwater wetland monitoring data (Task 2.4) |

## 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, TAC co-lead and Principal Investigator and contributor to design, evaluation and reporting; Greg Bickerton, ECCC senior hydrogeologist, outgoing TAC co-lead, Alex Oiffer AEPA Hydrogeologist, incoming TAC co-lead, Robert Clarkson, Industry (Cenovus) representative Principal Hydrogeologist, incoming TAC co-lead, Tahina Choudhury, Indigenous representative hydrogeologist, incoming TAC co-lead, and program advisor contributing to design, evaluation and reporting. Roles/ responsibilities of other team members are described below.

Key Team Members:
-OSM Groundwater Monitoring Technologists, AEPA: Conduct fieldwork and support data systems
-AEPA groundwater science data analyst: data systems and evaluation & reporting
-Service Alberta: groundwater data services
-Bernhard Meyer, University of Calgary
-Dan Palombi and Jordan Brinsky, Alberta Geological Survey
-Mina Nasr, AEPA: Geospatial groundwater data compilation, geodatabases, (e.g., stressor gradient maps) and data/knowledge transfer from contractor to AEPA
-AEPA aquatic scientists: Data systems and evaluation & reporting on surface water/groundwater data
-Vanessa de Koninck, AEPA: OSM Interdisciplinary Social Scientist; Knowledge co-production advisor, advise on methodologies for design and implementation of CBM and bicultural indicator development

- Executive Director WBEA: coordinate sampling for water isotopes in precipitation at Fort McKay Bertha Ganter station and Fort Chipewyan station
- Executive Director LICA: coordinate sampling for water isotopes in precipitation at Cold Lake Maskwa station

## 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 AEPA 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 AEPA**

Add an additional AEPA Staff member by clicking on the add row below the 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 |
|---|---|---|
| Xeflide, Seth | Principal Investigator | 100 |
| Senior 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 add row below the table. The total FTE (Full Time Equivalent) is Auto Summed (in Table 16.2.2) and converted to a dollar amount.

| Name (Last, First) | Role | %Time Allocated to Project |
|---|---|---|
| Bickerton, Greg | Senior Hydrogeologist | 50 |

The tables below are the financial tables for Alberta Environment & Protected Areas (AEPA) 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. Please note that completion of this Project Finance Breakdown Template is mandatory and must be submitted along with each workplan.

**PROJECT FINANCE BREAKDOWN TEMPLATE**

**Table 16.2.1 Funding Requested BY ALBERTA ENVIRONMENT & PROTECTED AREAS**

| Organization - Alberta Environment & Protected Areas ONLY | Total % time allocated to project for AEPA staff | Total Funding Requested from OSM |
|---|---|---|
| Salaries and Benefits (Calculated from Table 16.1.1 above) | 500 | $600,000.00 |
| **Operations and Maintenance** | | |
| **Consumable materials and supplies** | | $92,000.00 |

| | |
|---|---|
| **Conferences and meetings travel** | $8,000.00 |
| **Project-related travel** | $148,282.00 |
| **Engagement** | |
| **Reporting** | |
| **Overhead** | $80,500.00 |
| Total All Grants<br>(Calculated from Table 16.4 below) | $325,500.00 |
| Total All Contracts<br>(Calculated from Table 16.5 below) | $745,981.62 |
| Sub-Total<br>(Calculated) | $2,000,263.62 |
| **Capital*** | $133,500.00 |
| AEPA TOTAL<br>(Calculated) | $2,133,763.62 |

* 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<br>(Please manually provide the number in the space below) | 50 | $60,000.00 |
| **Operations and Maintenance** | | |
| Consumable materials and supplies | | |
| Conferences and meetings travel | | $24,000.00 |
| Project-related travel | | |
| Engagement | | |
| Reporting | | |
| Overhead | | $984.00 |
| ECCC TOTAL<br>(Calculated) | | $84,984.00 |

* 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 add table below the table. The total of all Grants is Auto Summed in Table 16.2.1**

| GRANT RECIPIENT - ONLY: Name | Determination of Baseline Hydraulic Head and Change Detection Analysis for Quaternary Aquifer Systems |
|---|---|
| GRANT RECIPIENT - ONLY: Organization | Alberta Geological Survey (AGS) |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits FTE | $229,500.00 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| GRANT TOTAL (Calculated) | $229,500.00 |

| GRANT RECIPIENT - ONLY: Name | Groundwater quality in the Oil Sands Regions: improving baseline estimates for change detection and attribution studies |
|---|---|
| GRANT RECIPIENT - ONLY: Organization | University of Calgary |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits FTE | $96,000.00 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| GRANT TOTAL (Calculated) | $96,000.00 |

**Table 16.4**

**Complete ONE table per Contract recipient.**

**Add a Recipient by clicking on add row below the 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 | Laboratory analysis of water isotopes |
|---|---|
| CONTRACT RECIPIENT - ONLY: Organization | InnoTech Victoria |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits | $4,232.00 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL (Calculated) | $4,232.00 |

| CONTRACT RECIPIENT - ONLY: Name | Laboratory analysis of water - Routines, nutrients, organics, and Naphtenic Acids |
|---|---|
| CONTRACT RECIPIENT - ONLY: Organization | ALS Canada |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits | $20,027.48 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL (Calculated) | $20,027.48 |

| CONTRACT RECIPIENT - ONLY: Name | Laboratory analysis of water – Trace Elements,rare earth elements, NA speciation |
|---|---|
| CONTRACT RECIPIENT - ONLY: Organization | Innotech Alberta |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits | $50,132.64 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL (Calculated) | $50,132.64 |
| CONTRACT RECIPIENT - ONLY: Name | Laboratory analysis of water – Isotopes [87Sr/86Sr, 3H, 14C (DIC), Sulphate iso.etc.] |
| CONTRACT RECIPIENT - ONLY: Organization | Bureau Veritas |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits | $89,596.50 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL (Calculated) | $89,596.50 |
| CONTRACT RECIPIENT - ONLY: Name | Laboratory analysis of water – polycyclic aromatic hydrocarbons (PAHs) |
| CONTRACT RECIPIENT - ONLY: Organization | AXYS |

| Category | Total Funding Requested from OSM |
|---|---|
| Salaries and Benefits | $31,993.00 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL (Calculated) | $31,993.00 |
| CONTRACT RECIPIENT - ONLY: Name | Groundwater Dependent Ecosystems (GDEs): Mapping |
| CONTRACT RECIPIENT - ONLY: Organization | TBD |
| Category | Total Funding Requested from OSM |
| Salaries and Benefits | $300,000.00 |
| **Operations and Maintenance** | |
| Consumable materials and supplies | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL (Calculated) | $300,000.00 |
| 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 | |

| | |
|---|---|
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL<br>(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 | |
| Conferences and meetings travel | |
| Project-related travel | |
| Engagement | |
| Reporting | |
| Overhead | |
| CONTRACT TOTAL<br>(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<br>Sums totals for salaries and benefits from AEPA and ECCC ONLY | $660,000.00 |
| **Operations and Maintenance** | |
| Consumable materials and supplies<br>Sums totals for AEPA and ECCC ONLY | $92,000.00 |
| Conferences and meetings travel<br>Sums totals for AEPA and ECCC ONLY | $32,000.00 |
| Project-related travel<br>Sums totals for AEPA and ECCC ONLY | $148,282.00 |
| Engagement<br>Sums totals for AEPA and ECCC ONLY | $0.00 |
| Reporting<br>Sums totals for AEPA and ECCC ONLY | $0.00 |
| Overhead<br>Sums totals for AEPA and ECCC ONLY | $81,484.00 |
| Total All Grants (from table 16.2.1 above)<br>**Sums totals for AEPA Tables ONLY** | $325,500.00 |
| Total All Contracts (from table 16.2.1 above)<br>**Sums totals for AEPA Tables ONLY** | $745,981.62 |
| SUB-TOTAL<br>(Calculated) | $2,085,247.62 |
| Capital*<br>**Sums total for AEPA** | $133,500.00 |
| GRAND PROJECT TOTAL | $2,218,747.62 |

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

## 17.0 FINANCIAL MANAGEMENT

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

☑ Please check this box to acknowledge you have read and understand

**In the space below please describe the following:**

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

The budget of this 2024/2025 work plan, compared to 2021/22, reflects the fact that several sub-projects funded by grants over the last three years are at their last final stages. It also translates an increase in the core sampling network (40 wells), well maintenance and associated transportation costs and work on identifying groundwater dependent ecosystems (Task 2.5).

Quarterly budget reviews and forecasts will be conducted. A work plan amendment may be submitted should significant cost overruns be projected. Support with groundwater data and geospatial data services from Service Alberta is required to streamline data management, availability and access. AEPA manages the 3 grants/contracts. Multi-project grants that span across multiple work plans will be coordinated with wetlands, TBM, air, and the program office. Because a significant portion of the work for this project will be completed under contract/grant, there is a risk that if contracts and grants are not quickly approved and formalized in Q1 of 2024/2025 fiscal year, multiple objectives/tasks/deliverables may be delayed or not completed in entirety within the fiscal year.

## 18.0 Alternate Sources of Project Financing - In-Kind Contributions

**Table 18.1 In-Kind Contributions**

***Add an In Kind Contribution by clicking on the table and then clicking on the add row on the bottom right side of table.***

| Description | Source | Equivalent Amount ($CAD) |
|---|---|---|
| | | |
| | TOTAL | $0.00 |

## 19.0 Consent & Declaration of Completion

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.

**Lead Applicant Name**

Seth Xeflide

**Title/Organization**

Hydrogeologist

**Signature**

Seth.Xeflide Digitally signed by Seth.Xeflide Date: 2023.11.03 13:59:11 -06'00'

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

**Title/Organization**

**Signature**

**Please save your form and refer to the instructions page for submission link.**

## Program Office Use Only

**Governance Review & Decision Process**

this phase follows submission and triggers the Governance Review

**TAC Review (Date):**

**ICBMAC Review (Date):**

**SIKIC Review (Date):**

**OC Review (Date):**

**Final Recommendations:**
**Decision Pool:**

**Notes:**

**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):**

**SIKIC Review (Date):**

**OC Review (Date):**

**Comments:**
**Decision Pool:**

**Notes & Additional Actions for Successful Work Plan Implementation:**

Signature