Work Plan Application

Project Information	
Project Title:	Integrated Terrestrial Biological Monitoring
Lead Applicant, Organization, or Community:	Kristin Hynes, AEPA
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**	B-LTM-TB-1-2425
Project Region(s):	Oil Sands Region
Project Start Year: First year funding under the OSM program was received for this project (if applicable)	2019
Project End Year: Last year funding under the OSM program is requested **Example: 2024**	2025
Total 2024/25 Project Budget: From all sources for the 2024/25 fiscal year	$6,545,550.00
Requested OSM Program Funding: For the 2024/25 fiscal year	$6,545,550.00
Project Type:	Long Term Monitoring
Project Theme:	Terrestrial Biological Monitoring
Anticipated Total Duration of Projects (Core and Focused Study (3 years))	Year 5
Current Year (choose one):	Focused Study -Select One-
	Core Monitoring Year 3 of 3

Contact Information

Lead Applicant/ Principal Investigator: Every work plan application requires one lead applicant. This lead is accountable for the entire work plan and all deliverables.	Kristin Hynes
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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**.

Terrestrial biological resources support a wide breadth of values to those living in and around the oil sands region (OSR) of Alberta, including cultural and spiritual components, harvesting and subsistence resources, recreational opportunities, access to clean water, and other critical ecosystem services. In addition, there are strong regulatory drivers within the OSR, encompassing species-at-risk and cumulative effects assessment, that must be satisfied. From both western science and Indigenous knowledge perspectives, it is important to understand how oil sands development in the region is impacting terrestrial biological resources. This includes understanding impacts both immediately adjacent to development as well as impacts that extend more broadly, including traditional use areas.

This Integrated TBM Workplan focuses on priority indicators either known to be sensitive to oil sands-related stressors, known to be at-risk, or are of specific importance to Indigenous communities. The monitoring follows the Before-After Dose-Response (BADR) monitoring framework).

The 2024/25 Integrated TBM Workplan has the following major components:

1. Terrestrial Monitoring:
a. Baseline & Trigger Development
b. Mammal Distributions, Habitat Selection, and Communities
c. Landbird Distributions and Demographics

2. Contaminants Monitoring
a. Wildlife Health Surveillance
b. IOC: Mercury in Downstream Receiving Environments
c. Focus: Development of an Integrated Contaminants Monitoring Program

Much of the work in this TBM Workplan critically depends on a number of geospatial monitoring efforts scoped in a separate OSM Geospatial Workplan, described in detail in the Sub-Workplan Appendix. While this TBM Workplan makes reference to these components, the work to develop these necessary geospatial monitoring products is not scoped or budgeted in this TBM Workplan.

Additional TBM work is included in the following ICBM workplans:
1. Terrestrial Biological Integrated ICBM
2. Community Led Berry Contamination Study
3. Wildlife Health ICBMs

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.

DESCRIBE THE KEY DRIVERS FOR THE PROJECT IDENTIFYING LINKAGES TO THE ADAPTIVE MONITORING FRAMEWORK PARTICULARLY AS IT RELATES TO SURVEILLANCE, CONFIRMATION AND LIMITS OF CHANGE (AS PER OC APPROVED KEY QUESTIONS).

The foundation for the 2024/25 TBM Workplan is the BADR design, which provides a monitoring framework that measures changes in selected indicators, at multiple spatial scales, relative to reference areas, in response to oil sands developments and activities. It accomplishes this using two monitoring approaches:

1. Before-After: Monitoring at different phases of oil sands development (currently developed, not yet developed, and undeveloped reference); and
2. Dose-Response: Monitoring along a gradient of current oil sands-related disturbance (high to low).

The flexibility of the BADR design allows us to adapt the monitoring design and prioritize effort as change is observed in oil sands stressors, pathways, and biological responses, and in response to changing oil sands development.

The BADR design monitors across gradients of known drivers of change in the OSR (i.e., identified OSM conceptual model pathways), including:
1. Landscape disturbance (e.g., seismic lines, well pads, mines, etc.);
2. Physical infrastructure (e.g., in-situ facilities, including associated noise and light);
3. Chemical contaminants (i.e., known patterns of deposition); and
4. Ecological , topographical, latitudinal, climatic gradients that can induce variability in the monitored indicators.

The BADR design is, at its foundation, a surveillance monitoring program for oil sands stressors, collecting monitoring data on a wide breadth of terrestrial indicators using efficient multi-taxa methodologies via tools such as remote cameras, autonomous recording units (ARUs), and capture-mark-recapture (MAPS) banding. This approach is an efficiency of the BADR design, providing data on multiple species for the cost of monitoring for a single species. The methods being used offer the most cost-effective approach to gathering the largest volume and most reliable data out of time spent in the field, consistent with a surveillance monitoring approach. In this multi-taxa approach, priority indicators are treated differently only in their analytical focus, rather than in their field monitoring focus (i.e. the data analyses undertaken define priority indicators, not the gathering of data). A critical advantage is the ability to analytically revisit past years' data to assess other priority indicators should they be identified in the future. For example, if change is observed in an unanticipated indicator (e.g. via Indigenous knowledge), having historic surveillance data across known stressor gradients for multiple taxa that can be retroactively analyzed is a key advantage.

Monitoring described in this workplan addresses the most comprehensive of the OC Approved Key Questions, namely "How have terrestrial ecosystems changed from baseline?" Within this question, "terrestrial ecosystems" captures a wide breadth of indicator metrics, including species distributions (i.e. occupancy and abundance), communities, populations and demography (i.e. large scale distributions), and health (i.e. function and reproduction). Analyses based on data collected under BADR's hierarchical design can identify effects at multiple relevant scales, from local to landscape, and for migratory species, to a continental scale.

Terrestrial data acquired in this program are also amenable for analyses within the adaptive monitoring framework, such as investigations of cause, and may also be integrated with datasets acquired by others. To generalize more broadly across landscapes, change can also be assessed relative to modeled hindcasts of species distributions under more intact landscape disturbance conditions. More comprehensive baseline and trigger (i.e. limits of change) development work is also ongoing or planned (see Section 3.4.5 & the Sub-Workplan Appendix).

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.

While many pathways of change in terrestrial distribution (i.e., non-health) indicators in the OSR are well established (such as general responses to landscape disturbance, facilities, etc.), there exist knowledge gaps within the conceptual model both in terms of our resolution of understanding and mechanisms of effect (i.e., specifics of knowledge required to inform useful management action). In the context of the OC Approved Key Questions for TBM:

HOW HAVE TERRESTRIAL ECOSYSTEMS CHANGED FROM BASELINE (SPECIES DISTRIBUTIONS, COMMUNITIES, POPULATIONS, HEALTH)?

Multiple studies in the peer-reviewed literature have linked changes in terrestrial indicators in the OSR to oil sands development (summarized in Roberts et al. 2021; Saracco et al. 2022). Most of the responses observed are negative (i.e., declining populations), although species that prefer early successional landscapes have benefitted. This evidence spans multiple taxonomic, spatial, and temporal scales, and reflects the complexities and interdependencies of this multi-stressor landscape. Terrestrial biota in the oil sands region are simultaneously subject to habitat alteration, human activity and infrastructure, chemical contaminants from both natural and anthropogenic sources, natural disturbance regimes, and climate gradients. While TBM has provided substantial insight into the effects of oil sands development to date, the ongoing monitoring is required to more precisely quantify linkages among the diversity of terrestrial disturbances and the individual and cumulative responses of priority indicators.

WHAT ARE PATHWAYS OF EFFECT FOR TERRESTRIAL SYSTEMS?

The land disturbance pathway is defined as the loss, degradation, restoration and/or natural recovery of habitat resulting from a stressor and being imposed on a receptor. Similarly, dispersion and deposition of contaminants emitted from a source represents the pathway of exposure to terrestrial receptors. These are the primary pathways embodied in current TBM initiatives. Within-fenceline reclamation activities are not currently within scope.

HAS THE NATURE AND QUALITY OF TERRESTRIAL HABITAT CHANGED? WHAT IS THE EXTENT OF THE HUMAN FOOTPRINT?

The rate of change over time and the attribution of change specifically to the oil sands industry, particularly with respect to human footprint, are ongoing areas of geospatial development. This work is critical to TBM and is scoped in the 2024/25 Geospatial Workplan and described in the Sub-Workplan

Appendix.

WHAT IS THE EXTENT AND MAGNITUDE OF NOISE?

The use of autonomous recording units (ARUs) provides measurements of soundscapes across a range of oil sands industrial activities. These data are being collected coincidentally (spatially and temporally) with indicator response data, so subsequent analyses on the effect of noise on priority indicators (e.g., specific wildlife species) are possible. Noise mapping with this data is an area of collaboration with the Human Footprint monitoring work proposed in the 2024/25 Integrated Geospatial Work Plan.

WHAT IS THE EXTENT AND MAGNITUDE OF DEPOSITION?

While monitoring the extent and magnitude of deposition is primarily the purview of the Air TAC, The TBM Wildlife Health program measures contaminants deposition through the use of passive air samplers, and measures contaminant burdens in abiotic and biotic matrices in receiving environments, often where there are air passive samplers being deployed, both to supply information to the conceptual pathways diagrams and to provide “groundtruthing” to air and deposition models. Providing information to the pathways diagrams allows the work to inform efforts towards attribution of the source of the contaminants measured in receiving environments.

WHAT IS THE CONTAMINATION BURDEN OF KEY RESOURCES?

Partnering with land users and communities, and ICBM programs provide samples of key resources and indicator species to allow an assessment of the potential effects of the contaminants stressor on the quality and quantity of key natural resources.

WHAT ARE SOCIAL AND CULTURAL BARRIERS TO INCREASED HARVESTING/WHAT ARE BARRIERS TO ACCESSING RESOURCES/ WHAT IS A CRITICAL LEVEL OF DISTURBANCE BEFORE S. 35 RIGHTS CANNOT BE EXERCISED?

Wildlife Health surveillance will provide valuable information on the contaminant burden and health of key resources, to aid in addressing this question in collaboration with ICBM programs. The concept of “ecological grief” will be weaved into our program to generate more understanding on how a mistrust in traditional food quality can impair a community’s access to this resource; hampering food security. In addition, geospatial data on human footprint (spatial extent and type) provides information on physical barriers related to oil sands footprints for use by communities in assessing S. 35 rights (work proposed in integrated geospatial work plan).

DO OS CONTAMINANTS OF CONCERN REACHING RECEIVING ENVIRONMENTS IMPACT HARVESTING AND OCCUPANCY PATTERNS, HARVESTING VOLUMES (FOOD SECURITY), INTERGENERATIONAL TRANSFER OF KNOWLEDGE, SHARING OF RESOURCES LINKED TO THE REINFORCEMENT OF KINSHIP BONDS, PEOPLE’S RELATIONSHIP AND OBLIGATIONS TO THE LAND?

Wildlife Health surveillance will provide valuable information on the contaminant burden and health of key resources, to aid in addressing this question in collaboration with ICBM programs. The concept of “ecological grief” will be weaved into our program to generate more understanding on how a mistrust in traditional food quality can impair a community’s access to this resource; hampering food security, and their relationship and obligations to the land.

DESCRIBE HOW THE PROJECT MEETS THE MANDATE OF THE OSM PROGRAM OR AREAS OF LIMITED KNOWLEDGE IS THE WORK IS BEING DESIGNED TO ANSWER WITH CONSIDERATION FOR THE TAC-SPECIFIC SCOPE OF WORK DOCUMENT AND THE KEY QUESTIONS?

The TBM program directly addresses OSM priorities by (1) leveraging monitoring data acquired to date, and (2) implementing ongoing stressor-based terrestrial surveillance monitoring and analysis, utilizing existing knowledge in the OSR, via an adaptive monitoring framework. Terrestrial ecological systems within the OSR include a wide breadth of habitats and taxa, so monitoring to address OC Approved Key Questions such as “What are pathways of effect for terrestrial systems?” and “Has the nature and quality of terrestrial habitat changed?” and “How have terrestrial ecosystems changed from baseline?” necessitate the consideration of a wide breadth of indicators from single species through to community composition. The main stressor indicators of priority within TBM are landscape disturbance, industrial facilities, and contaminants, which provide the basis for the stressor-based BADR design. The OSM conceptual model outlines environmental stressors, pathways, and resulting responses in addition to identifying Valued Components which represent aspects of the environment that local communities and greater society value and to which oil sands activities have the potential to affect. Within TBM, the priority Valued Components are Biodiversity, Healthy Ecosystems, and Traditional Resources and Cultural Practices (Swanson 2019, Bayne et. al., 2021, Roberts et al. 2021). In addition to the OSM conceptual model, a conceptual model specific to TBM has been developed to provide greater resolution for model components that are relevant to terrestrial ecosystems (Bayne et. al., 2021).

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.

Information and results generated through the TBM program to date provide critical information to support the OSM State of Environment report, contributing content for Chapters 6: State of Wildlife and Plants; specifically supporting environmental stressors and pathways, and more comprehensive development of baselines and triggers. Within the report the TBM information also supports the identification of the effects of oil sands-related development (e.g., seismic lines, in situ facilities, mines, etc.) within the OSR, answering the OC Approved Key Question “How have terrestrial ecosystems changed from baseline?” and visually outlining and depicting such changing over time from the perspective of reference state, current state, drivers and the potential cumulative effects.

Supporting information regarding merits of specific components in the TBM Workplan can be found in the attached Sub-Workplan Appendix.

2.0 Objectives of the Work Plan

List in point form the objectives of the 2024/25 work plan below

1. Monitor impacts from oil sands activities on terrestrial biological indicators in different habitats and at different scales.

2. Address OC Approved Key Questions to support regulators, government, local communities, and the public in assessing change to terrestrial ecosystems from oil sands activities. This will involve integration of geospatial footprint and habitat monitoring into these assessments.

3. Assess change; evaluate connections to oil sands operations; and inform adaptive monitoring approaches;

4. (a) define baseline/reference conditions and (b) develop triggers for indicators selected according to a TAC-determined process that includes engagement of key stakeholders;

5. Support efforts on the development of Indigenous-led indicators and community-based or participatory monitoring; working collaboratively with the OSM Indigenous Community-Based Monitoring Advisory Committee (ICBMAC);

Additional information regarding the Objectives of specific components in the TBM Workplan can be found in the attached Sub-Workplan Appendix.

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

3.3.5 Terrestrial Biology Theme

3.3.5.1 Sub Themes

Cross-Cutting

3.3.5.2 Terrestrial Biology - Key Questions:

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

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

To date, baselines and triggers (aka, thresholds or limits of change) have not been well established within the field of terrestrial ecology in general, so ongoing development is focused on meeting the adaptive monitoring needs of the TBM program. The development of TBM baselines and triggers is supported both by historic and recent (i.e., BADR) surveillance monitoring data via purely statistical approaches, but may also consider Indigenous indicators and ways of life such as ability to exercise S. 35 rights, Species at Risk listing criteria; proposed Biodiversity Management Framework indicators and triggers under Alberta's Land Use Framework; EPEA approval conditions; toxicity thresholds such as embryonic mortality in birds; or Canadian Council of Ministers of the Environment (CCME) guidelines.

Over the past three years, work within the TBM TAC has produced knowledge and guidance on approaches to baseline and trigger development in the form of a) comprehensive reviews of other monitoring programs (completed in 2021/22), b) implementation feasibility assessments, and initial evaluation of potential approaches, and identification of potential indicators (completed in 2022/23) and c) application of baseline and trigger development and completion of western science-based indicator selection (ongoing in 2023/24)). As discussed in the TBM workshops, quantitative assessments (landbirds and mammals) using the best available statistical models are being used.

In 2024/25, we plan to undertake baseline and trigger development for additional priority terrestrial indicators. The specific selection of terrestrial indicators for which to expand baseline and trigger development will be created based on (1) ongoing engagement and previous direction from the TBM TAC; and (2) results from ongoing feasibility assessment work (i.e., data availability and methodological practicality). This project will rely heavily on datasets generated by PIs working within TBM.

The terms "baseline" and "reference" require clarification. The efforts described in this workplan to develop baselines are not efforts to describe a pre-colonial state of environment. Such characterizations require not only ecological but also sociocultural considerations, including extensive consultation with Indigenous communities. This work is important, but is not within the scope of this core monitoring workplan. Rather, the baseline characterization undertaken here is to establish a state of comparison (or reference state) to analogous contemporary habitats experiencing minimal development to enable assessments of change. This comparative baseline is critical to monitoring and management and is built into the BADR framework.

More details on baseline and trigger/limit of change development are provided in the Sub-Workplan Appendix.

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

Multiple studies in the peer-reviewed literature have linked changes in terrestrial indicators in the OSR to oil sands development (summarized by Roberts et al. 2021). This evidence spans multiple taxonomic, spatial, and temporal scales, and reflects the complexities and interdependencies of this multi-stressor landscape. Terrestrial biota in the oil sands region is simultaneously subject to habitat alteration, human activity and infrastructure, chemical contaminants from both natural and anthropogenic sources, natural disturbance regimes, and climate gradients.

Use of the BADR design allows for identification of indicator response(s) attributable to oil sands activity. While TBM has provided substantial insight into the effects of oil sands development to date, continued monitoring is necessary to provide data that more precisely defines linkages between the effects of specific development components and broader cumulative impacts on the priority indicators.

CONTAMINANTS

Baseline contaminants burdens in these animals have not been established and so change relative to baseline is not possible. Rather, contaminant burdens and health assessments are conducted across the landscape and in "reference areas" which provide a "treatment versus reference" comparison. To accomplish this, these key indicator species are monitored across the region, within northern Alberta, and into the Peace-Athabasca Delta following a gradient of exposure approach from higher to lower contaminant exposure. Further, since it is not possible to establish baseline because pre-development wildlife samples are not available for study of contaminant burdens, changes relative to baseline are approached through a "treatment versus reference" sampling design. Also, rather than baseline, the results of the contaminant monitoring program can be compared to established guidelines, where available. As an example, guidelines are available from the Canadian Council of Ministers of the Environment for certain chemicals of concern. Another approach includes quantile regression approaches, an approach that matches contaminants burdens in wildlife against provincial baseline information. A demonstration of this approach, based on information generated using land-user harvested animals can be found on the kotawan portal (kotawanportal.ca).

Very few species-specific triggers or limits of change exist. This is an ongoing effort of the TBM program. In the contaminants program of TBM it is possible to measure contaminant burdens in particular species against established limits of change in a very limited number of species. An example of this is the established limits of change for embryotoxicity due to mercury exposure of the embryos of common terns.

Using our chosen indicator species, the results follow patterns and pathways established by other species-specific contaminants monitoring programs in the vicinity of large industrial operations.

Studies have assessed changes in contaminant burdens and wildlife health across many taxa in the OSR, and a list of key priority indicators has been developed and continues to be refined. Over years of monitoring in northern Alberta contaminants in receiving environments and contaminant burdens and health metrics in wildlife across spatial and temporal gradients, more recently following the BADR design, along with investigations of pathways and efforts towards establishing source or cause, represents a large and ongoing contaminants assessment effort towards state of the environment reporting in the oil sands region. A large part of this effort has been directed at the establishment and validation of the appropriate indicator species. Briefly, the indicator species being monitored in the TBM contaminants program, and included in this contaminants scope of work, are those that have well known life histories, have a large literature database available on their response to contaminant exposure with known or predictable responses to chemicals of concern, allow measurement of contaminants that have accumulated in their tissues from local sources, have peer-reviewed literature concerning their response to OS chemicals of concern and are known to be responsive and sensitive to this stressor, and/or are of importance to land users and communities. These priority indicator species are listed below, with information on how they contribute to the assessment of the contaminants stressor.

Key indicator species for the contaminants stressor and monitoring results (priority species noted with *asterisk):

*Birds. Gulls and terns (colonial waterbirds). Research has shown higher mercury concentrations in the eggs of colonial waterbirds in downstream receiving environments of the Athabasca River (Dolgova et al. 2018; Hebert et al. 2011, 2013), and the critical role of riverine transport processes in regulating mercury availability to waterbirds in downstream receiving environments (Hebert, 2019). In the Athabasca Oil Sands Region (AOSR), research has shown that tree swallow nestlings reared near OS development sites will divert resources and energy to contend with contaminant exposure (Luis Cruz-Martinez et al. 2015), compared to birds developing away from development, and field exposure to and accumulation of polycyclic aromatic compounds (PACs) near OS development can influence tree swallows' reproduction, development, and thyroid function (Fernie et al. 2018; Godwin, Barclay, & Smits 2019; Fernie et al. 2019).

*Mammals. River Otters, furbearers, traditionally harvested mammals, bats. Contaminant burdens in tissues and health responses have been measured in semi-aquatic mammals. PACs, trace elements (including heavy metals) and anticoagulant rodenticides are more elevated in wildlife collected on trap lines near OS industrial operations and in downstream environments (Peace Athabasca Delta; PAD). Changes in wildlife health biomarkers (such as river otter and mink baculum bone material properties) as well as incidence of wildlife diseases and parasites correlate with some of the identified contaminants in the region (see for example Thomas et al. 2020). Other priority mammals provide information from surveillance or regional monitoring – developing a further list of priority indicators will involve closer coordination with Indigenous partners to identify species and define traditional wildlife markers of health that could be adapted to the larger regional monitoring program; this effort will be aided by the development of new conceptual framework and pathway diagrams, as above.

*Amphibians. Wood frogs. Amphibians are very sensitive to contaminant exposure, and respond to classes of chemicals in predictable ways. They are used as indicators in contaminants monitoring, and to study the impacts of chemicals in the environment. Elevated levels of contaminants have been detected in wood frog tadpoles and their breeding habitat (i.e. wetlands) in the OSR (Mundy et al., 2019) establishing that exposure to these chemicals is a concern in the region. Impacts on the health of the animals from these exposures is being investigated. Further, through contaminant monitoring with air and water passive samplers, and sampling in wetland ecosystems and amphibians, it is possible to enter data across an entire pathway of stressor-receiving environment-indicator/receptor-response in order to address the core OSM outcome for the OS chemicals of concern stressor. Indigenous concerns regarding amphibians have been voiced in the region, which is spurring work to try to answer a key question from communities: why do we not hear frogs anymore?

*Plants. Berries. Berries collected near upgraders and open pit mines were shown to have a greater abundance of dust-supplied trace elements, including lead, aluminium, and uranium, on their outer surfaces, relative to berries collected outside of the OSR (Stachiw et al., 2019). Efforts to monitor the potential effects of deposition on medicinal plants are being initiated. Other plant and lichen monitoring for contaminant effects is important for input to the pathway diagrams and conceptual models.

One unanticipated result that might be mentioned is the finding that furbearers trapped near OS development projects/in high disturbance areas had unhealthy (above threshold for effects) burdens of second-generation anticoagulant rodenticides in their tissues. An original observation through traditional knowledge led to a study to determine the cause, which was revealed to be the use of these products for pest control on site and around camps. (A simple solution was employed through the reduction of the use of these compounds.) Other results from the program that might include unanticipated results are being published.

LANDSCAPE DISTURBANCE

Many taxa respond to landscape disturbance and habitat alteration, and differences in observed change may depend on the type and character of disturbances (e.g., linear vs. polygonal, small vs. large, vegetated vs. non-vegetated), the habitat preferences of the individual species, and/or the spatial scale of measurement (Venier et al. 2014; Fisher and Burton 2018; Toews et al. 2018). Briefly:

Landbirds. Statistical analyses and modelling of a number of bird species have identified cumulative effects and many analyses attribute these to specific oil sands (OS) activities, including clear evidence of response to land disturbance (Foster et al. 2017, Wilson et al. 2018, Pyle et al. 2020, Saracco et al. 2022), including from wells (Bayne et al. 2016), seismic lines (Bayne et al. 2005, Machtans 2006, Lankau et al. 2013) and other linear features (Ball et al. 2009, Bayne et al. 2016). In general, habitat specialists are more likely to be negatively impacted by anthropogenic disturbances, while habitat generalists are more likely to benefit (Mahon et al. 2019). Footprint mapping coupled with scenario modelling approaches have been used to assess bird population responses to habitat change caused by oil sands and other anthropogenic development (e.g., Mahon et al. 2014). Scale of analysis and the metric of abundance influence the magnitude but not the direction of effects.

Mammals. Extensive field monitoring and multi-taxa analyses have linked oil sands industrial activities to changes in the health, behaviour, distribution, populations, and communities of many mammal species (Fuller et al. 2022, Darlington et al. 2022, Fisher et al. 2021, Wittische et al. 2021, Fisher and Burton 2021, Fisher et al. 2020). Many specific species responses to specific stressors can vary in direction and magnitude among landscapes and in response to different underlying ecological conditions (Fisher and Ladle 2022, Fisher et al. 2021, Fisher & Burton 2018, Toews et al. 2018) and at different temporal and spatial scales.

CUMULATIVE EFFECTS

The assessment of oil sands activity contributions in the context of cumulative effects have been partially addressed with existing datasets; more thoroughly for some taxonomic indicator groups than others. Species habitat models which describe relative abundance in response to oil sands activities (e.g., seismic lines, mines, in-situ facilities, etc.) and other stressors have been established with varying degrees of detail for species within all indicator groups. Refinements to achieve greater clarity on linkages between observed changes in terrestrial indicators and cumulative oil sands-related stressors are included in the sub-workplans for birds and mammals (details in the Sub-Workplan Appendix).

The BADR design guides monitoring efforts across gradients of known drivers of change in the OSR (i.e., identified OSM conceptual model pathways), including landscape disturbance, physical infrastructure, chemical contaminants and climate gradients; it is stratified across key oil sands disturbance types/ features in specific habitat types. Robust statistical approaches allow for incorporation of a range of anthropogenic and natural (e.g., different stand ages result from forest harvest or wildfire) disturbances to investigate cumulative effects, and parse apart the relative contributions of OS stressors. Future decisions of whether, when, and where to add monitoring locations will be guided by the analytics proposed in these workplans.

Geospatial data and analyses that are suitable for accurately identifying source-pathway-receptor relationships are critical tools for cumulative effects assessment, including establishing and measuring against baselines, understanding pathways of effects, and accurately attributing changes in indicators to OS stressors. Stressor monitoring to date has captured the amount and distribution of oil sands footprint. However, to understand and manage cumulative effects, trends in land surface trajectories with a targeted evaluation of drivers of change are needed at multiple temporal and spatial scales. The human footprint data and habitat regeneration development proposed within the separate 2024/25 Geospatial Workplan is a critical requirement for the analyses of oil sands-specific and cumulative effects.

Additional information on observed changes and their attributions to oil sands activities for specific components of the TBM Workplan can be found in the attached Sub-Workplan Appendix.

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

Detecting unanticipated responses is what the BADR design and its multi-indicator approach to monitoring was meant to achieve. Inferences about causal mechanisms between OS stressors and indicators are one of the products of the BADR design, delivered annually through this workplan. In addition, targeted investigation into causal links will be conducted for the following topics:

● IOC: Mercury in Downstream Receiving Environments (2024/25 Final Year)

Additional details on unanticipated results in data how they inform the adaptive monitoring process can be found in the attached Sub-workplan Appendix.

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

The TBM program occurs across the OSR, and thus overlaps with the traditional territories of multiple Indigenous communities. The data and knowledge generated can provide information on the landscapes and species that Indigenous communities rely on to support their rights to hunt, trap, fish, and gather, and maintain a traditional way of life. Exercising these rights requires: (1) healthy populations of all valued species, including birds, mammals, amphibians, and vascular plants; (2) sufficient quality habitat to support these species into the future; and (3) sufficient land that is safely and freely accessible for Indigenous community members. Footprint and biodiversity monitoring contained in this workplan provides robust data that can inform these three aspects of exercising Treaty rights and can be enhanced or customized to address local priorities in partnership with communities.

Population monitoring efficiently and simultaneously collects multi-species data that can be evaluated by Indigenous communities for priority species, such as furbearers and hunted ungulates like moose (Fisher et al. 2021), birds (Saracco et al. 2022), and their habitats. This information can be summarized and presented using customized approaches and at scales in line with community interests. The monitoring of human footprint proposed separately in the 2024/25 Geospatial Workplan enables the assessment of cumulative effects in contexts meaningful to Indigenous communities. Specifically, it can serve as a foundation for assessing the cumulative loss of the priority Valued Components, Biodiversity, Healthy Ecosystems, and Traditional Resources and Cultural Practices (Swanson 2019, Bayne et. al., 2021, Roberts et al. 2021) such as land and access issues that community members face.

Multiple Indigenous communities are also actively involved in tissue collection to monitor contaminant burdens in the terrestrial environment, including from harvested mammals. This work directly addresses community concerns over the safety of traditional foods for human consumption.

Engagement, capacity building, and field monitoring partnerships with multiple local Indigenous communities to build joint wildlife camera programs occur under a separate 2024/25 OSM ICBM workplan and are integrated with the TBM core monitoring.

The TBM Wildlife Health component integrates work conducted directly with Indigenous communities under the TBM core monitoring as well as linked ICBM workplans. These workplans are scoped and delivered, in consultation with the ICBMAC, by TBM PIs who are involved in core terrestrial monitoring activities. Areas of focus with interested communities include capacity building via training on the collection of animals and tissue samples for wildlife health and contaminants analyses, and assessing traditional wildlife health indicators.

Consistency of project participants in both the terrestrial core monitoring and ICBM workplans ensures that integration of new ICBM projects are aligned to the greatest extent possible.

Additional details regarding how observed changes in terrestrial ecosystems inform Indigenous Key Questions and Concerns can be found in the attached Sub-Workplan Appendix.

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

YES. The TBM Theme is committed to alignment with OSM data requirements as these requirements are developed and distributed. Further, TBM PIs have been and will continue to be active with respect to identifying and utilizing cross-party data repositories, with some already well established (e.g., WildTrax, Borealis: The Canadian Dataverse Depository, Kotawân Portal). TBM PIs continue to collaborate with Service Alberta as requested in the development of the OSM Data Catalogue, providing data asset inventories and feedback on catalogue structure and organization. Additionally, existing standards developed by ECCC and/or Government of Alberta will be considered.

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

YES. Standard Operating Procedures and protocol documents are available for data collection, management, and analysis. Many of these have been developed and established by the various project PIs themselves; some have been carried over or adopted from well-established international monitoring programs. The field monitoring methodologies used represent the most up-to-date monitoring methods available for biological data collections. The proposed work combines state-of-the-art field methodologies (e.g., remote camera arrays, autonomous recording units) and other long-proven approaches (e.g., capture-mark-recapture methods). Many of these methodologies are used in complementary monitoring programs, including site-specific monitoring conducted by industry, allowing for pooling of data.

Additional details regarding methodologies can be found in the attached Sub-Workplan Appendix.

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

This workplan integrates all of TBM's activities into a single, cohesive program aligned with the BADR design. Integration is a foundational principle of TBM work, and is occurring in the following ways:

Within the TBM team:

- Data collection is aligned under an integrated monitoring design (BADR) grounded in the OSM conceptual model, and adaptive monitoring framework;
- Data collection protocols are integrated and co-delivered, where feasible and sensible, to maximize efficiency across the TBM team;
- Data collection is co-located at JEM sites when feasible;
- Analytical efforts are collaborative or divided based on strengths of team members within the sub-workplan groups; and
- Housing data in shared repositories and managing data in common data platforms (e.g., WildTrax), including the integration of data pipelines, analysis, and co-deliverables both within TBM and across the various OSM theme areas.

With other Themes:

- Collaborative deliverables with the Wetland Theme on surveillance wetland monitoring – protocols, data collection, and analysis;
- Continued effort on scoping joint areas of work with the Surface Water and Groundwater Themes, including an integrated project to monitor Groundwater Dependent Ecosystems (scoped and proposed in the Geospatial Workplan for 2024/25).
- Active collaboration on the scoping, implementation, and use of human footprint and habitat monitoring work within the Geospatial Workplan; and
- Collaboration across TACs with the Integrated Contaminants Effects Working Group to support the development of an integrated Contaminants Monitoring Program.

With communities and other partners:

- Involvement of local communities in contaminant monitoring of Traditional Resources and with the reporting and outreach activities with the data;
- Identifying and building opportunities for Indigenous involvement in data collection, e.g., via ICBM camera programs and wildlife health programs and through engagement led by ICBMAC ; and
- Scoping opportunities to integrate on-site industry data, where available, into regional datasets.

Additional details regarding integration amongst projects, themes and communities can be found in the attached Sub-Workplan Appendix.

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?

BADR is a stressor-pathway-indicator response monitoring design, intended to facilitate efficient and integrated (i.e., coincidental in space and time) data collection on multiple indicators along major OS-related stressor gradients. By controlling for habitat, by operating at different hierarchical spatial scales, and by incorporating temporal before-after monitoring, the design also informs pathways. In these respects, the proposed monitoring falls both on the frame of the terrestrial conceptual model (i.e., stressors and responses) as well as down the middle (i.e., pathways). It must be emphasized that the resolution and accuracy of data analyses proposed herein is contingent on the continued development of timely and informative geospatial products–work scoped in the 2024/25 Geospatial Workplan. Other theme areas (e.g., Air and Water) also inform the conceptual model pathways to contaminant stressors that we consider here, as well as contributing to measurement of change in the context of cumulative effects.

The conceptual model is fundamental to integration because it provides a consistent framework for all monitoring within and among OSM Themes. This TBM Workplan uses the conceptual model to:

- Prioritize key linkages with oil sands-related stressors which have the potential to affect indicators at local, sub-regional, and/or regional scales over various time scales;
- Ensure that monitoring addresses complete linkages across the model from stressors through pathways to responses which, in turn, affect the indicators;
- Assist in identifying linkages which may contribute to cumulative effects of multiple stressors or cumulative effects of individual stressors distributed across various spatial scales;
- Provide clarity regarding the required points of integration with other OSM Themes (e.g., connecting work on atmospheric deposition with TBM work on responses in vegetation and wildlife); and
- Explicitly illustrate the linkages to Indigenous Valued Components.

The TBM Theme has prioritized the stressor-pathway-response linkages as identified in the conceptual model (see the Sub-Workplan Appendix) through a qualitative examination of risk completed collaboratively by the TAC and principal investigators.

How will this work advance understanding transition towards adaptive monitoring?

The BADR design allows for adaptation in that sampling can evolve iteratively as new information is attained at either the landscape or the local scale to answer modified or new questions. This allows us to allocate effort to where it is most needed to capture information required to assess ongoing surveillance, develop focused studies, and/or implement investigation of cause. By aligning monitoring of various stressor-pathway-response linkages in time and space, questions related to identification of cause and cumulative effects can be better addressed in a more efficient and economical manner. TBM will continue to provide ongoing surveillance monitoring and contribute to investigation of cause where possible for indicators that are confirmed to be changing.

An example of this would be the observed and confirmed change in mercury levels of colonial waterbird eggs in Lake Athabasca and Mamawi Lake. As a result, work adapted to an Investigation of Cause to assess the source attribution for mercury in downstream receiving environments. This Study is set to be completed in 2024-25.

The BADR design is also responsive to the needs of the adaptive monitoring framework. As baseline and trigger development is completed, learnings can be used to optimize allocation of effort within the design. In 2024/25, continued effort will focus on the identification of baselines and monitoring triggers for priority indicators, which will include:

- Continuing to enable indicator selection by the TBM TAC based on sensitivity to different oil sands activities and other criteria, where sufficient data are available. Continued collection of data for multiple indicators under the BADR design supports the ability to assess and prioritize indicators to ensure adaptive monitoring needs are met.
- Implementing recommendations on approaches to baseline and trigger development completed in 2022/23 for select indicators with appropriate data and expanding the approach piloted in 2023/24 for land birds and mammals.
- Developing additional recommendations and identifying any challenges and data gaps observed during implementation.
- Engaging with the TBM TAC to ensure awareness, and input from key stakeholders, including additional engagement of stakeholders when directed by the TBM TAC.

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. Information and results generated through the TBM program have and will provide critical information to support the OSM State of Environment report.We previously contributed content for Chapters 6: State of Wildlife and Plants; specifically supporting environmental stressors and pathways, and more comprehensive development of baselines and triggers. New results from the first two years of BADR are now available for inclusion in State of Environment reporting efforts.

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.

While it is not within the purview of the TBM TAC or monitoring partners of OSM to determine whether oil sands companies are in regulatory compliance, there are recurring terrestrial approval conditions that appear in most of the mining EPEA deemed compliance documents, and that fall within the scope of OSM. These include:
1. Long-term monitoring of cumulative effects on biodiversity and wildlife;
2. Long-term monitoring of species at risk; and
3. Analysis & collection of regional data to validate Habitat Suitability Index (HSI) models.

1 - LONG-TERM MONITORING OF CUMULATIVE EFFECTS ON BIODIVERSITY AND WILDLIFE

Regional monitoring of biodiversity is a required activity for oil sands operators under EPEA approval conditions. The exact wording of this requirement varies across operators but generally refers to the requirement to monitor the long-term cumulative effects on biodiversity and wildlife. In some cases, these conditions make reference to specific programs or organizations such as ABMI and the former Ecological Monitoring Committee for the Lower Athabasca (EMCLA). In other cases, the approval-holder is to select appropriate monitoring methods and actions and demonstrate that these are adequate. TBM efforts contribute scientific information needed to assess the efficacy of existing regulations and compliance with approvals as they apply to indicator responses to oil sands stressors at local, sub-regional, and regional scales.

2 - LONG-TERM MONITORING OF SPECIES AT RISK

The landbird monitoring component of the TBM Workplan provides data for several federally and provincially listed species, including demographics driving population changes for species monitored within the MAPS program.

3 - REGIONAL DATA TO VALIDATE HABITAT SUITABILITY INDEX (HSI) MODELS

Data collected under the TBM Workplan to date have been used to generate multiple species-habitat models (i.e., HSI models) which are available at the regional scale. These models can be used to build maps for specific areas of concern, or for comparison with site-specific models to determine the appropriateness of a regional approach to model construction. Models for many terrestrial indicator species are built from existing data and can be used to adaptively change our sampling design to identify the habitat conditions for which we need additional information.

OTHER LINKS TO MANAGEMENT AND REGULATORY COMPLIANCE

In addition to these three areas related to regulatory compliance, TBM outcomes will provide an understanding of the effects of oil sands development, by type, on a range of terrestrial indicators. These results will have implications for company management programs and regulatory agency policy decisions such as industry environmental management procedures, regulatory limits on disturbance, disturbance-buffer selection, and restoration management requirements.

The protocols used by TBM are also used by other research and monitoring groups funded by forestry companies. This expands the ability to develop and validate HSI models at a regional scale, bringing in data from parallel programs to expand the scope of questions and analyses that can be conducted in support of indicator responses to regional stresses, at a cumulative effects scale. For example, landbird use of well pads can be compared to use of forests recovering in harvest blocks and burn areas to provide an alternative reference comparison related to time since disturbance, using data collected in collaboration with numerous forestry companies in Alberta.

The BADR design incorporates spatial stratification based on land use, allowing the monitoring to contribute directly relevant information to regional frameworks such as LARP regarding observed changes in response to oil sands stressors and cumulative effects.

Industry makes a significant investment each year in "within fence line" wildlife monitoring and mitigation planning, often using the same or similar data collection techniques to TBM, such as MAPS, wildlife cameras, and acoustic surveys. Operators often also hold information on detailed land use and management decisions that occur within site boundaries. These data have the potential to contribute to regional monitoring efforts and help better inform the pathways of biodiversity change. TBM continues to explore integration with this and other available industry-operated programs and datasets.

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

The work described in this workplan can inform whether changes in terrestrial ecosystems are affecting Indigenous concerns and Section 35 rights. Monitoring of contaminants in traditional foods informs the safety of foods for human consumption and relies on Indigenous involvement for delivery. Section 35 rights also require sustainable populations of plants and animals in critical local areas of harvest, as well as physical access for communities to traditional use areas. Data collected and analyses performed under this workplan can inform these issues by reporting on status and change of harvested species in spatially explicit formats.

Ongoing engagement with Indigenous communities is required on a long-term basis to ensure alignment between the BADR design and ICBM workplans. Through 2023/24, TBM PIs maintained and established partnerships with a number of Indigenous communities on wildlife health and population monitoring. We anticipate continuing these long-term partnerships and using feedback from these projects to inform protocols and approaches for future ICBM and TBM work.

Additional information on how 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 can be found in the attached Sub-Workplan Appendix.

Does this project include an Integrated Community Based Monitoring Component?

Yes

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?

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. Community-specific protocols around the monitoring of Wildlife Health will follow consultation with community partners.

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.

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. Methods to share information or knowledge are not involved in a formal setting. Semi-structured interview questions might be used as a guide to lead discussions in the field (for example: at the muskrat camp), but there are at the moment no plans to collect and record proprietary Indigenous knowledge. Should the need arise, we would abide by the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans (TCPS 2, 2014) and would consult with relevant social science experts in the field who are also project participants (including Dr Janelle Marie Baker and Ave Dersch).

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.

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. The activities do not include any other collecting/sharing, interpreting, or applying Indigenous knowledge, see #2 response for more detail.

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

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. As in previous years, Indigenous knowledge holders will be involved in designing the research and monitoring around questions and priorities in each respective community. The "what", "where", "when", and "why" questions will be answered for the most part by the braiding of Indigenous knowledge with the western science generated over the last decade. The integration of other ICBM data (for example: MCFN CBM water quality and quantity datasets) will provide more context and will guide sample analysis and generation of new knowledge on the cumulative effects of multiple stressors on wildlife "health" (also defined through traditional wildlife health indicators).

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

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. Indigenous communities are involved in identifying or confirming the appropriateness of approach, methods, and/or indicators through frequent and early consultations. For example, in October 2023, Phil Thomas met local elders and land users in Fort McKay to provide an update on some of the latest results in muskrats, and to discuss more holistic definitions of muskrat "health" grounded in Indigenous knowledge and confirmed changes by land users.

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

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. This work plan directly benefits communities and supports capacity building through the training and subsequent hiring of competent CBM technicians who can assist land users and elders in collecting relevant samples, intermediate storage, shipping and analysis. All of this training and capacity enhancing exercises are continuously provided by the Wildlife Health program (incl. Phil Thomas).

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?

Community Based Monitoring within this work plan submission is limited to the Wildlife Health Program. This information is reported back to communities through ongoing dialogue and community visits, through the drafting and circulation of plain language reports to project participants, and through the Kotawan Data Portal (www.kotawanportal.ca).

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 BADR design has been developed and implemented to collect multi-taxa data allowing for attribution of environmental change in response to oil sands industrial activity. It achieves this by:

1. Using ecologically relevant spatial units that align with other TACs;
2. Examining environmental response along stressor gradients at various spatial scales;
3. Including reference sampling units in both space and time;
4. Including ecologically relevant indicators at the individual, population, and community level, while preserving the ability to detect unexpected biological responses;
5. Incorporating areas of planned oil sands expansions; and
6. Producing results which can be used for model validation and forecasting purposes.

This approach requires monitoring of biological responses of indicators to terrestrial disturbance combined with up to date, detailed human footprint and habitat monitoring.

BADR BASICS

Details on the approach used under the BADR design are provided in Bayne et al. 2021. The two key elements of this design that contribute to measuring change against a baseline are:
1. Before-After: Monitoring at different phases of oil sands development (before and after development occurs); and
2. Dose-Response: Monitoring along a gradient of current oil sands disturbance (high to low).

Both of these elements require highly detailed stressor monitoring across time and space as the foundation for the program design.

MEASURING CHANGE ALONG STRESSOR GRADIENTS

Habitat degradation and loss is a known outcome of oil sands development. The BADR design allows for assessment of whether any observed change is greater in magnitude than expected from habitat loss alone. This effectively tests for functional habitat loss due to fragmentation, edge effects, avoidance of light/noise, contamination, etc. Within the adaptive monitoring framework, this determination of “is a change expected or observed?” drives whether such observations necessitate focused monitoring/investigation of cause (if the source of the change needs to be determined), or whether monitoring returns to a surveillance approach (if the change is expected). The dose-response used under the BADR design ensures balanced sampling of individual stressors and combinations of stressors (i.e., cumulative effects). This is achieved by targeting monitoring along a gradient of spatially-defined disturbance strata:

1. Reference: a site with low energy sector disturbance;
2. Soft linear: a site with high density of seismic lines, pipelines, etc.;
3. Road: a site with high density of energy sector roads;
4. Low activity: a site with energy sector disturbance without light or noise impacts (e.g., exploration well

pads);
5. High intensity: sites with high intensity disturbances (varying combinations of high human activity, light, noise and atmospheric deposition).

It is important to recognize that the BADR design permits stratification of monitoring across environmental and disturbance gradients, but that the analyses of data acquired through monitoring within the BADR design is dependent on accurate, up-to-date and explicit geospatial data that precisely define disturbances.

Adding contaminants, including from aerial deposition, on top of the spatially-defined disturbance strata allows cumulative effects and the relative influence of different stressors to be investigated.

ASSESSING CHANGE AGAINST BASELINE

Observed data quantifying pre-disturbance condition in the oil sands region does not exist for most priority indicators, necessitating either a space-for-time substitution or back-cast modeling approach. We note that Indigenous Knowledge can play an important role in defining baseline conditions (see Section 10.4).

Historically, western science biological monitoring in the oil sands region has defined terrestrial biological baseline as the ecological conditions present, or those that would be present, in the absence of human footprint. This was typically calculated by (1) monitoring sites free from human footprint; (2) empirically predicting landscape habitat conditions if footprint was not present; and (3) completion of multi-indicator surveys at random, systematic sites throughout the entire OSR. The field component of ABMI’s systematic grid is now effectively complete and, in combination with collated data from other research and monitoring, has resulted in baseline species-habitat models for multiple species groups that should be validated and/or improved by adaptive sampling in areas with higher model uncertainty.

The BADR design further develops baseline specific to oil sands footprint (and different types of oil sands footprint) by monitoring along a gradient of oil sands stressors in three contexts:
1. Landscape units where oil sands development (surface mining and in-situ) is already extensive, providing the high end of a dose-response gradient and contaminant loads;
2. Landscape units where oil sands exploration has occurred, but development has not yet occurred, providing (in short term) both the middle of the dose-response gradient and (in long term if developed) validation of dose-response models by confirming biodiversity changes over time as development proceeds; and
3. Landscape units where oil sands activities are minimal and unlikely to occur in the future, providing reference sites to observe any changes associated with non-oil sands pressures such as climate change, extra-regional effects, forest fire, forest harvest, etc.

Dose-response models developed from such data can also be used in backcasting and forecasting what species distributions looked like in the past or might be under future development scenarios based on the availability of habitat or emission modeling at different time periods; numerous examples of such models exist for areas within the OSR (see Leston et. al. 2020). Such models can be used to assess the range of natural variability in relation to natural disturbances like fire and hydrological cycles. By combining data collected under the BADR design with historical datasets, we will further improve habitat models for use in backcasting and forecasting scenarios to estimate the magnitude of change based on known species-habitat relationships. Data from future field collections can be compared to these forecast triggers to monitor for unexpected change, magnitude of change, or when development is reaching a point where an ecological threshold is being reached (i.e. the number of individuals of a species based on habitat models and/or trend estimates reach a minimum acceptable level).

STATISTICALLY DRIVEN CHANGE DETECTION

Effect size is a statistical concept that measures the strength of the relationship between stressors and responses. Effect size, explanatory power, statistical power, sample size, and critical significance are outcomes of various analyses proposed for the data collected under the BADR design. In other words, sampling must be designed so that there is sufficient confidence that we can detect change, derive correlations and cause-effect relationships among oil sands stressors and responses, report measured exceedances of critical significance levels, and produce validated model predictions of exceedances of critical significance levels. Sensitivity and power (precision) analyses are used to determine the level of monitoring effort required to confidently detect change. These analyses are also used to identify the most efficient approach to return interval and replicates for monitoring.

CONTROLLING FOR CONFOUNDING FACTORS

The BADR design minimizes the impacts of potential confounding factors though habitat and disturbance stratification. This minimizes variation which could impact our ability to detect change due to oil sands activity.

Monitoring focuses on the two dominant habitat types in the OSR: 1) upland deciduous/mixedwood at least 40 yrs old, and 2) treed lowlands at least 20 yrs old. These two habitat types represent groupings of finer habitat and age types that are common across the majority of the oil sands region. Both these habitat strata have been mapped across the entire OSR.

STATISTICAL MODELING

The use of spatially defined disturbance and habitat strata allows us to statistically model responses in un-sampled areas of these strata within each LU and across the broader OSR. We will use observations from monitoring sites as a stratified sample of the LU to make LU-level to population-level estimates of effects of oil sands disturbance. The total cover of treatment strata across the OSR will be used to infer the overall regional effect of oil sands disturbance and how this changes over time, allowing extension of results throughout the OSR.

In addition, dose-response regression models created from JEM site data can be mapped at larger regional extents to predict the abundance of species at un-sampled locations to estimate regional population sizes. The level of accuracy in these spatial predictions will increase over time as we collect additional data. It is anticipated that multiple years of data collection will be required to complete this task.

Additional details regarding how specific components of the TBM Workplan measure change can be found in the attached Sub-Workplan Appendix.

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.

RELEVANT MONITORING SCALES

We address two types of scale within the TBM Workplan:

1. Scale of ecological organization. Data are collected on individual behaviour and health as well as species' distributions and populations, and their communities. The details on the selected levels of biological organization are provided in Section 10.5 Indicators.
2. Spatial and temporal scale. Monitoring locations were intentionally selected to represent local and regional disturbance, such that data and analyses provide knowledge relevant to local, landscape, and regional questions, efficiently addressing indicators at several relevant organizational scales (organisms, communities, and populations). Moreover, as ecological processes and the landscapes themselves change through time, BADR was designed for resampling, with return interval varying based on method (eg. 1-3 years).
The BADR design allows for integration of data across scales and address regional and sub-regional questions by using two levels of disturbance gradient:
a. First, a regional disturbance gradient is generated by dividing the OSR into watershed or landscape units and assigning them a score based on cumulative oil sands footprint. Sub-sampling occurs across the region to ensure balanced dose-response sampling at the landscape level.
b. Second, within each landscape unit, sites are selected to fill in a local disturbance gradient within each targeted habitat type. This local gradient is a set of spatially mapped disturbance strata which are described in brief under Section 6.0.

Details on implementation for different taxa are provided in the attached Sub-Workplans. Further details on the BADR design are presented in Bayne et al. 2021.

MODEL VALIDATION

As noted above, species-habitat models that describe relative abundance and population demographic responses to oil sands disturbance and other stressors have been established with varying degrees of detail for species within all indicator groups. These analyses will validate and advance existing predictive models. Within an adaptive monitoring framework, discrepancies between predicted and observed impacts on indicators (i.e., forecast triggers) may trigger focused monitoring and/or investigation of cause.

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.

OVERALL

Based on guidance from the OSM Program Office, TBM PIs will prepare raw, QAQC'ed and derived data products generated from this workplan for dissemination through priority venues and platforms, such as the OSM data portal. As part of the process, TBM PIs will confirm the target audience of each product to ensure content is delivered in an appropriate format and with meaningful documentation, to support its active uptake by end users. Data will be made available on an annual basis, although timing may be adjusted based on user input and data processing timelines. TBM PIs will also provide access to these data and information products through their own organizational websites, and guide users to the location of OSM-program related content.

DATA

Currently, many TBM project collaborators (e.g., ABMI, ECCC, OMEI) host and distribute data in a variety of formats via their own publicly accessible repositories, interactive portals, and through regulatory databases which provide access to a significant accumulated data asset. The TBM team also continues to work with OSM Program staff, EPA geospatial staff and Service Alberta to make data accessible and discoverable in a timely manner through the OSM data portal. Service Alberta is leading discussions on data standards and metadata requirements with TBM PIs to ensure data can be effectively integrated and support OSM data objectives and processes.

PUBLICATIONS AND REPORTING

Results generated by this workplan will be compiled, analyzed, and shared in multiple formats to reach target OSM program audiences. In 2024/25, this will include manuscripts intended for scientific publication, technical reports to advance results of relevance to decision-makers, and annual reports generate by TBM program PIs.

PUBLIC DISSEMINATION

Some members of the TBM team have access to expertise in the production of lay language products within their organizations (notably ABMI, ECCC, and OMEI). These organizations will continue to generate content for public release to enhance awareness of the activities and outcomes of the OSM program overall, but also for specific purposes including outreach to communities.

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.

Within the TBM Theme, the BADR design integrates and unifies the core terrestrial monitoring efforts along a disturbance gradient. The design facilitates co-location of monitoring efforts at nested spatial scales, which further facilitates integrated data analysis to support effective investigation of cause and cumulative effects assessment. Our approach to data collection is integrated at the sub-workplan level to maximize efficiency, share resources, and capitalize on the strengths of the individual organizations involved.

The TBM team continues to engage with other OSM Theme areas to identify integration opportunities. These include:

- Groundwater Dependent Ecosystems monitoring in collaboration with the Groundwater TAC. This work is scoped within the 2024/25 Geospatial Workplan;
- Wetlands monitoring group collaborating on wetland vegetation and integration of wetland vegetation protocols;
- Active collaboration on human footprint and habitat monitoring with the 24/25 Geospatial Workplan;
- Water TAC collections in collaboration with the Wildlife Health Surveillance, Investigation of Cause: Mercury in Downstream Receiving Environments;
- Collaboration with the Air TAC on the Berry ICBM Program; and
- Air, Water, Wetlands, Groundwater and Data integration TAC coordination on the Integrated Contaminants Program (under development)

In addition to the collaborations with the Wetlands, Air, and Groundwater theme areas (e.g., exploration of alignment of study design and data collection protocols), the TBM team also has several ongoing, established partnerships outside of OSM, that contribute to the overall value of the OSM program. These include (1) Participation in broader research collaborations such as the Boreal Ecological Recovery Assessment (BERA), Alberta Biodiversity Chairs (ABC) and the Boreal Avian Modelling (BAM) project; (2) Organization-level partnerships with delivery agencies and collaborators that contribute value such as InnoTech Alberta, and the University of Alberta, and University of Victoria, among numerous other universities; and (3) Industrial ‘within fence line’ monitoring programs that align with TBM protocols, supporting industrial environmental management.

Indigenous communities and land users have been involved in wildlife contaminants and toxicology monitoring since the initiation of the JOSM monitoring program in 2012 and continue to be highly integrated into sample and data collection and reporting both individually and through CBM programs. Indigenous community involvement in wildlife camera programs has successfully been established and is continuing to grow. Additional engagement will be done with interested communities via ICBMAC to facilitate consistency in terrestrial monitoring approaches where appropriate.

Additional information on efficiencies and integration in specific components of the TBM Workplan can be found in the attached Sub-Workplan Appendix.

10.0 Work Plan Approach/Methods

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

PHASE 1 - Terrestrial monitoring in alignment with adaptive framework using the BADR design

Task 1 - Site selection/refinement & logistics planning

○ Site selection for upcoming monitoring year(s): Coarse JEM site selection for BADR has now undergone a full rotation of LUs. JEM sites from previous visits to the LU are assessed for optimal placement relative to human footprints, which may have changed in the local area around JEMs since the last visit. Camera deployments at the LU scale will replicate past sampling.

○ Site access permissions: PIs will communicate with industry and First Nations (the latter coordinated through the OSM OC and SIKIC) to gain access to identified sites. Note that some sites will occur on lease, and that specified industry safety and training requirements will be followed by all staff accessing sites on lease. Some sites occur on Indigenous TLUs and the OSM OC and SIKIC has agreed to maintain responsibility (informed by PIs) for coordinating consultation in these events.

○ Logistics planning: coordinate field efforts to conduct terrestrial monitoring on the landscape in an efficient manner. This includes lodgings, transportation, field scheduling to align terrestrial monitoring being completed, etc.

○ Protocol review and finalization: All SOPs will be reviewed before and after use and updated as necessary.

○ Indigenous engagement: consult with local Indigenous communities to determine sites, species, and indicators of health that include Indigenous knowledge for the wildlife health contaminants program.

Task 2 - Data collection

○ Timing and methodologies specific to each sub-workplan/indicator: Field methodologies (e.g., remote camera arrays, autonomous recording units, mark-recapture surveys,etc.) will be implemented to monitor the terrestrial environment in the OSR. Alignment in timing of fieldwork among the TBM sub-workplans as well as with other OSM Themes will be achieved where feasible and reasonable to do so.

○ Industry data acquisition: Requests will be made for relevant industry data to supplement data collected in the field. All requests will be made via the COSIA form for industry data requests.

Task 3 - Data management

○ Data processing and QAQC: Standard Operating Procedures and protocol documents are available for data collection and management. Collected data will be processed as per specified lab protocols and/or standard operating procedures (e.g., OSM Camera Trap Image Processing). Paper or tablet collected data will undergo QAQC procedures to ensure data is complete and accurate. MAPS data will continue to undergo rigorous QAQC through established processes used across the continent by MAPS operators. All data processing and QAQC documentation will be updated as necessary.

○ Compliance with OSM Program data management framework: All terrestrial monitoring data, technical reports, and peer-reviewed literature will be submitted to the OSM data catalogue or be made publicly available through other mechanisms (e.g., established CWS, AEP databases). Further, PIs will continue to be active with respect to identifying and utilizing cross-party data repositories (e.g., WildTrax, and Borealis: The Canadian Dataverse Portal). Additionally, existing standards developed by ECCC and/or Government of Alberta will be incorporated wherever possible.

PHASE 2 - Analysis and evaluation of change

Task 1 - Analysis of historical and new data as available

○ Ongoing analysis of existing datasets to address identified questions. Details of annual questions by indicator are provided in the Sub-Workplans Appendix. Questions largely focus on (1) Evaluating change in response to OS stressors; (2) Integrated analytical approaches; and (3) Assessing and refining approach.

Task 2- Stressor and habitat monitoring
○ Leverage updated geospatial resources to assess changes in stressors & habitats. The ability to analyze and interpret indicator responses to terrestrial disturbance is contingent on the continued development of timely and informative geospatial products–work scoped in the OSM Geospatial Workplan.
○ Assessing the spatial variability and temporal change in receptors.
○ Supporting clarification of the ecological pathways that link stressors to receptors.

PHASE 3 - Adaptive implementation of the integrated monitoring design

Task 1 - Baselines and triggers ongoing development
○ Continue developing statistical/empirical baselines and monitoring triggers for priority terrestrial indicators with adequate data, evaluate and expand approaches developed for bird and mammal indicators.

Task 2 - Consideration of updated/new habitat and stressor monitoring data
○ Scoping and development of coarse-filter habitat and landscape indicators.
○ Evaluation of options for incorporation of natural disturbance factors such as wildfire.
○ Collaborative review of disturbance and habitat categories and updated footprint layers.

Task 3 - Integrated planning for 2025/26
○ Identify successes and challenges from field monitoring efforts and update protocols and/or approaches as necessary. Protocols and methodologies can evolve iteratively, as new information is attained, at either the landscape or the local scale to answer new or modified questions.
○ Addressing results of ongoing precision analyses and incorporating new or modified questions as they relate to the identified OSM priorities for 2025/26 or program positions within the adaptive monitoring framework.
○ Incorporate priorities and input from ongoing TAC discussions and Indigenous partnerships into the direction of the program.
○ Evaluation of calculated baselines with new field data.

Additional details on the approaches/methods used in specific components of the TBM Workplan can be found in the attached Sub-Workplan Appendix.

Describe how changes in environmental Condition will be assessed

Changes in environmental conditions will be assessed along multi-stressor gradients which include reference conditions. Multiple analytical tools will be used to assess the results such as regression and multivariate analysis. Such models will be used to assess how species are likely to change in the future to assess risk (see Section 6.0). Similarly, the data will be used in conjunction with ongoing efforts to understand the natural range of variation caused by natural disturbances, such as fire, through academic partnerships (e.g., the Boreal Avian Modelling project; BAM) and through the Alberta Land-Use Framework planning process.

Additional details on how changes in environmental condition will be assessed by specific components of the TBM Workplan can be found in the attached Sub-Workplan Appendix.

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

The proposed terrestrial monitoring design includes monitoring in low-disturbance areas to establish a comparative reference condition against which to assess monitoring data from higher stress regions and locations. Implementation of the design will include consideration of effect size (i.e., what constitutes a significant change from reference) and the sample sizes needed to detect the effect size within a specified degree of confidence. Work to develop baselines and triggers for priority terrestrial indicators is ongoing. Engagement of the TAC through facilitated discussions will help to ensure awareness and solicit input and feedback from all OSM caucuses. Engagement beyond the TAC will be implemented where appropriate and at the direction of the TAC.

Additional details on Benchmarks used in specific components of the TBM Workplan can be found in the attached Sub-Workplan Appendix.

(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

Further details are provided in the TBM Workplan component descriptions in the Sub-Workplan Appendix.

PHASE 1 - Terrestrial monitoring in alignment with adaptive framework using the BADR design
- Field monitoring uses standardized data collection protocols for remote sensing, wildlife cameras, autonomous recording units (ARUs), capture-mark-recapture (mist-netting and bird banding), contaminant passive sampler and tissue sampling.
- Indigenous community involvement in the collection of animal and tissue samples for contaminant analysis.

PHASE 2 - Analysis and evaluation of change
- A number of quantitative statistical approaches will be employed on Western science data, such as species-habitat modelling, regression modelling, structural equation modelling, and multivariate analysis.

PHASE 3 - Adaptive implementation of the integrated monitoring framework
- Adjustments in the allocation of effort to monitoring based on sensitivity analyses, community analysis, trigger development, and literature review.
- Western science methods for knowledge and data inventory (systematic or comprehensive review of peer-reviewed and other grey literature).
- Western science (statistical/quantitative/modelling) approaches to guide baseline and trigger development.

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

See the Sub-Workplan Appendix for additional details, including indicator species lists.

Stressor Indicators:
- Landscape disturbance: human footprint inventories, land use, and land cover data
- Physical infrastructure: off lease above-ground pipelines, noise, light
- Contaminants: Emissions of SO_2, NO_2, base cations; Trace elements; PACs; Nitrogen; Phosphorus; Mercury; and VOCs; Snowpack measures: Inorganic/organic contaminants; Nutrients, trace elements, mercury, PACs, naphthenic acids; sediment trace elements, PACs
- Natural disturbance: Indices of fire, disease, drought

Pathway Indicators:
- Habitat loss
- Habitat degradation
- Habitat recovery/regeneration
- Wildlife and Habitat Health (contaminant exposure, burdens, effects)
- Increased frequency and severity of wildfire with deposition of contaminants
- Changes in habitat due to climate change

Response Indicators:

- Landbird demographics (Adult survival, adult population, population growth rate, post-fledging productivity), and distributions (Occupancy/density, habitat selection, functional group or guild abundance, species richness/diversity)
- Mammal distributions (Occupancy, abundance, density, habitat selection, community interactions)

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.

There are a number of end-users of TBM monitoring data and information products, including members of the oil sands industry, the Governments of Alberta and Canada, Indigenous communities, and the general public. Organizations participating in OSM also utilize program data and information to adjust scopes of annual workplans under an adaptive monitoring framework. To ensure that data and information effectively reach the intended end-users and are used to meet their own needs, appropriate knowledge translation tactics will be employed. These include:

FOR THE WESTERN SCIENTIFIC COMMUNITY

PIs constantly prepare and release conference and workshop presentations, technical reports, raw data, statistical code, and peer-reviewed publications. Data will become available, as per the OSM Program data management framework, via Service Alberta's Data Catalogue, as well as via individual agency/ institution websites (e.g., ABMI, WBEA).

FOR THE GENERAL PUBLIC

The TBM team will provide materials and products in support of the OSM program-level communications plan and/or in response to direct requests from the OSM Program Office. Support for State-of-Environment reporting is an ongoing activity. TBM PIs will develop lay summaries of monitoring findings and results as part of required program annual reporting, and for use as website content, if requested. When feasible and with OSM program oversight, monitoring activities and outcomes will be communicated in public-friendly formats such as blogs, social media, and multimedia reports. These formats support deeper engagement and appreciation of the OSM program goals and objectives, and findings. Individual agency/ institution websites will also host this content to further share TBM program results.

FOR INDIGENOUS COMMUNITIES

Many TBM PIs are already involved in the development and implementation of Indigenous community-based monitoring programs, as scoped both within this work plan and in separate ICBM workplans. TBM partners have also been actively engaged with the ICBMAC. In addition to engagement in ICBMACs, Wildlife Health knowledge is shared at community gatherings and on-the-land camps, and local wildlife and environmental monitoring data is accessible through the Kotawân Portal (kotawanportal.ca).

FOR INDUSTRY, THE REGULATOR AND GOVERNMENT

TBMI PIs are keen to deliver data and information to industry members that can inform their own operational activities in the OSR. Currently, TBM activities generate data and information that can support land management decision making, such as: species distributions, locations of rare habitats, and the current status of species and habitats, indicating those that are predicted to have decreased or increased abundance relative to reference conditions. Furthermore, TBM activities and data may satisfy various regional-scale regulatory approval conditions. Data derived from outside fence line monitoring activities can be compared and contrasted against data collected from within fence line monitoring activities to identify biodiversity risks and management opportunities. TBM PIs will work with the appropriate parties (industry representatives or associations, such as COSIA) to develop additional products and tools that meet industry needs. Data can also be used to generate predictive models to assess foreseeable risks and opportunities for biodiversity (See Section 6.0).

Terrestrial monitoring data has multiple potential applications to government, including providing information on species at risk, status of species and habitats that can inform regional land use plans, and baselines/ranges of natural variation to support policy development around limits of change and/or triggers. Data from all OSM (non-CBM) partners is open by default, and TBM partners also provide data to government branches as requested, as well as through established mechanisms including online data portals, peer-reviewed publications, and technical papers.

FOR THE TECHNICAL ADVISORY COMMITTEE (TAC)

The TAC and PI team will meet regularly over the course of the year to review the status of different components of TBM work and discuss next steps. The TAC Terms of Reference identifies that the TBM TAC has a leadership role to play in the development of technical design and reporting. These meetings will help ensure their guidance is captured and reflected in associated deliverables.

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

TERRESTRIAL MONITORING OPERATIONS
- Alberta Biodiversity Monitoring Institute (ABMI) - Existing grant (#23GRRSD37-01)
- InnoTech Alberta - Existing grant (#23GRRSD46)

Wildlife Health
- Environment and Climate Change Canada (ECCC Pauli) - No grant or contract required

LANDBIRDS
- Bayne Lab at the University of Alberta (UofA Bayne)- Existing grant (#23GRRSD25-01)
- Owl Moon Environmental Inc. (OMEI) – Contract (#24RSD831)
- Alberta Biodiversity Monitoring Institute (ABMI) - Existing grant (#23GRRSD37-01)

MAMMALS
- University of Victoria (UVic Fisher) - Existing grant (#23GRRSD27-01)
- Alberta Biodiversity Monitoring Institute (ABMI) - Existing grant (#23GRRSD37-01)

*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? *

No

13.2 Type of Quantitative Data Variables**:**

Both

13.3 Frequency of Collection:

Other

13.4 Estimated Data Collection Start Date:

Apr 1, 2024

13.5 Estimated Data Collection End Date:

Mar 31, 2025

13.6 Estimated Timeline For Upload Start Date:

Sep 1, 2024

13.7 Estimated Timeline For Upload End Date:

Dec 31, 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
See SUPPLEMENTARY FILE 4 for data descriptions			-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
-Select One-	-Select One-	See SUPPLEMENTARY FILE 5 for deliverables and descriptions

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.

See SUPPLEMENTARY FILE #6 for complete list of personnel by sub-project and partner organization.

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
Hynes, Kristin (Interim support for this role until TBM Scientist position filled).	Support for TBM activities in the OSR including coordination with working partners, contract and grant management, and working with the TBM TAC members and co-leads, as the TBM TAC Manager.	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
Pauli, Bruce	Wildlife Health: Principal investigator	50
Freemark, Maureen	Wildlife Health: Project oversight, technical support, liaison with OSM	75
Mundy, Lukas	Wildlife Health: Technical lead	60
Thomas, Philippe	Wildlife Health: Technical lead	75
Chételat, John	Wildlife Health- IOC Hg Downstream Receiving Environments: Principal Investigator	50
Dolgova, Svetlana	Wildlife Health: Field support, sample preparation and analysis	100
Technician TBD	Wildlife Health: Support engagement with ICBMs	100
Technician TBD	Wildlife Health: Support engagement with ICBMs	50
Technician TBD	Wildlife Health: Support sample preparation and analysis	100
Technician TBD	Wildlife Health- IOC Hg Downstream Receiving Environments: sample processing, analyses	100
Project Scientist TBD	Wildlife Health- IOC Hg Downstream Receiving Environments: support data analyses and reporting	100
Project Scientist TBD	Wildlife Health- Integrated Contaminants: oversight, technical support	100

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.

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)	100	$120,000.00
Operations and Maintenance		
Consumable materials and supplies		$1,500.00
Conferences and meetings travel		$1,500.00
Project-related travel		$1,500.00
Engagement		$1,500.00
Reporting		
Overhead		
Total All Grants (Calculated from Table 16.4 below)		$2,803,050.00
Total All Contracts (Calculated from Table 16.5 below)		$1,260,000.00
Sub-Total (Calculated)		$4,189,050.00
Capital*		
AEPA TOTAL (Calculated)		$4,189,050.00

* The Government of Alberta Financial Policies (*Policy # A600*) requires that all **capital asset** purchases comply with governmental and departmental legislation, policies, procedures, directives and guidelines. **Capital assets** (*Financial Policy # A100*, Government of Alberta, January 2014) are tangible assets that: have economic life greater than one year; are acquired, constructed, or developed for use on a continuing basis; are not held for sale in ordinary course of operations; are recorded and tracked centrally; have a cost greater than $5,000.
Some **examples of capital asset equipment include:** laboratory equipment, appliances, boats, motors, field equipment, ATV's/snowmobiles, stationary equipment (pier/sign/weather), fire/safety equipment, pumps/tanks, heavy equipment, irrigation systems, furniture, trailers, vehicles, etc. (*Financial Policy # A100*, Government of Alberta, January 2014).

Table 16.2.2 Funding Requested BY ENVIRONMENT & CLIMATE CHANGE CANADA

Organization - Environment & Climate Change Canada ONLY	Total % time allocated to project for ECCC staff	Total Funding Requested from OSM
Salaries and Benefits FTE (Please manually provide the number in the space below)	960	$1,318,678.00
Operations and Maintenance		
Consumable materials and supplies		$307,800.00
Conferences and meetings travel		
Project-related travel		$18,000.00
Engagement		$556,000.00
Reporting		$2,000.00
Overhead		$154,022.00
ECCC TOTAL (Calculated)		$2,356,500.00

* 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	Monica Kohler
GRANT RECIPIENT - ONLY: Organization	Alberta Biodiversity Monitoring Institute (ABMI)
Category	Total Funding Requested from OSM
Salaries and Benefits FTE	$1,177,000.00
Operations and Maintenance	
Consumable materials and supplies	$209,000.00
Conferences and meetings travel	
Project-related travel	$330,000.00
Engagement	
Reporting	$41,250.00
Overhead	$172,975.00
GRANT TOTAL (Calculated)	$1,930,225.00
GRANT RECIPIENT - ONLY: Name	Dr. Emily Herdman
GRANT RECIPIENT - ONLY: Organization	InnoTech Alberta
Category	Total Funding Requested from OSM
Salaries and Benefits FTE	$100,000.00
Operations and Maintenance	
Consumable materials and supplies	
Conferences and meetings travel	
Project-related travel	$2,000.00
Engagement	$3,000.00
Reporting	$15,000.00
Overhead	
GRANT TOTAL (Calculated)	$120,000.00
GRANT RECIPIENT - ONLY: Name	Dr. Erin Bayne
GRANT RECIPIENT - ONLY: Organization	University of Alberta

Category	Total Funding Requested from OSM
Salaries and Benefits FTE	$45,000.00
Operations and Maintenance	
Consumable materials and supplies	
Conferences and meetings travel	
Project-related travel	$80,000.00
Engagement	
Reporting	
Overhead	$25,000.00
GRANT TOTAL (Calculated)	$150,000.00
GRANT RECIPIENT - ONLY: Name	Dr. Jason T Fisher
GRANT RECIPIENT - ONLY: Organization	University of Victoria

Category	Total Funding Requested from OSM
Salaries and Benefits FTE	$301,560.00
Operations and Maintenance	
Consumable materials and supplies	$45,010.00
Conferences and meetings travel	$4,500.00
Project-related travel	$120,190.00
Engagement	
Reporting	$11,000.00
Overhead	$120,565.00
GRANT TOTAL (Calculated)	$602,825.00

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	Dr. Kenneth Foster
CONTRACT RECIPIENT - ONLY: Organization	Owl Moon Environmental Inc.
Category	Total Funding Requested from OSM
Salaries and Benefits	$905,500.00
Operations and Maintenance	
Consumable materials and supplies	$24,600.00
Conferences and meetings travel	$19,600.00
Project-related travel	$244,000.00
Engagement	
Reporting	$6,200.00
Overhead	$60,100.00
CONTRACT TOTAL (Calculated)	$1,260,000.00

Table 16.5 GRAND TOTAL Project Funding Requested from OSM Program

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

Category	Total Funding Requested from OSM
Salaries and Benefits Sums totals for salaries and benefits from AEPA and ECCC ONLY	$1,438,678.00
Operations and Maintenance	
Consumable materials and supplies Sums totals for AEPA and ECCC ONLY	$309,300.00
Conferences and meetings travel Sums totals for AEPA and ECCC ONLY	$1,500.00
Project-related travel Sums totals for AEPA and ECCC ONLY	$19,500.00
Engagement Sums totals for AEPA and ECCC ONLY	$557,500.00
Reporting Sums totals for AEPA and ECCC ONLY	$2,000.00
Overhead Sums totals for AEPA and ECCC ONLY	$154,022.00
Total All Grants (from table 16.2.1 above) **Sums totals for AEPA Tables ONLY**	$2,803,050.00
Total All Contracts (from table 16.2.1 above) **Sums totals for AEPA Tables ONLY**	$1,260,000.00
SUB-TOTAL (Calculated)	$6,545,550.00
Capital* **Sums total for AEPA**	
GRAND PROJECT TOTAL	$6,545,550.00

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

17.0 FINANCIAL MANAGEMENT

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

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

In the space below please describe the following:

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

All partners will follow good financial management practices as required by their agencies, institutions, or corporations, and will submit quarterly (or more frequent) financial reports to the OSM Program Office as per OSM requirements and schedule.

Determining precise financial over/underspending of the 2023/24 Terrestrial Biological Workplan is difficult as not all contracts are in place and thus invoicing is not yet complete and up to date. That said, we anticipate no major cost over/underruns from 2023/24 and all invoicing and reporting to date has been on schedule and on budget.

The major risks to this project include but are not limited to unforeseen barriers to fieldwork completion, including actions of non-stakeholders or natural incidents such as wildfires or floods or public health measures.

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)
Field monitoring equipment and sensor use (trucks, trailers, ATVs, cameras, ARUs, etc.)	Alberta Biodiversity Monitoring	$75,000.00
Computing and data infrastructure	Alberta Biodiversity Monitoring	$100,000.00
Leveraged research	Alberta Biodiversity Monitoring	$20,000.00
Salary time for Dr. Erin Bayne	University of Alberta	$20,000.00
Field monitoring equipment and sensor use (e.g., ARUs)	University of Alberta, Bayne Lal	$50,000.00
Lab analysis (supporting Wildlife Health Surveillance)	Environment and Climate Chang	$30,000.00
Field logistics and support (supporting Wildlife Health Surveillance)	Parks Canada	$10,000.00
	TOTAL	$305,000.00

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

Kristin Hynes

Title/Organization

Invertebrate Monitoring Biologist, Alberta Environment and Protected Areas

Signature

Kristin.Hynes Digitally signed by Kristin.Hynes Date: 2024.04.11 11:42:23 -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