



Northwest Territories Environmental Studies Research Fund

Annual Report and Budget
2021-2022



Ice-rich permafrost core in the drill barrel. Sampling was conducted at one of the long-term permafrost monitoring sites near Norman Wells, NT.
Photo credit: Emily Ogden.

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Northwest Territories

Environmental Studies Research Fund (ESRF)

Message from the Chair



I am very pleased to present the seventh annual report for the Northwest Territories Environmental Studies Research Fund (ESRF). As everywhere, the COVID-19 pandemic again presented many challenges to ESRF funded programs with another reduced field season in 2021, NWT border closures and continuing uncertainty. However, as in 2020, programs adjusted and were still able to make significant progress and by the end of March 2022 restrictions were set to loosen providing hope for a return to normal in the upcoming field season.

While the winter track survey multi-year funded project came to an end, two other multi-year projects related to caribou continued as well

as the groundwater monitoring project led by the University of Waterloo. The NWT ESRF also provided support to two new projects, one led by the Northern Alberta Institute of Technology, and one led by Concordia University.

I would like to take the opportunity to thank Heather MacPherson, Imperial Oil for her time on the Management Board and wish her all the best in retirement. Menzie McEachern who has been on the Management Board since inception of the NWT ESRF has also moved on and I'd like to thank him for his valuable contributions to the Board. Replacing Menzie as the second GNWT representative is Viktor Terlaky from the NWT Geological Survey. Welcome Viktor!

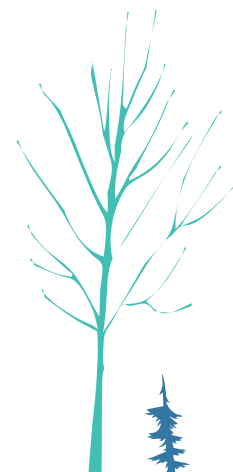
Andrew Applejohn, Chair
NWT Environmental Studies Research Fund

Introduction

The Northwest Territories Environmental Studies Research Fund (ESRF) is a research program established to finance environmental and social studies relating to oil and gas activity in the NWT that will help inform decision making. The fund is supported through the collection of levies from all interest holders of petroleum lands in the onshore areas of the NWT – Exploration Licences, Production Licences, and Significant Discovery Licences alike. Levy rates are determined by the ESRF Management Board on an annual basis, and interest holders are invoiced based upon their total land holdings (total number of hectares under licence) within the onshore NWT. With approved changes to the *Petroleum Resources Act*, a second public member has been added so now the Management Board is composed of representatives from government (2), industry (2) and public (2) of the NWT.

Management Board Membership

Chair: Andrew Applejohn – Environment and Natural Resources, GNWT member
Vice-Chair: Ken Hansen – industry member
Viktor Terlaky – Industry, Tourism and Investment, GNWT member
Vacant – industry member
Ray Case – public member
Richard Binder – public member



Summary of Activities in 2021-2022

Communications

1. In person meetings were still not possible due to Covid restrictions. However, a virtual introductory meeting was held to introduce Cenovus representatives to the NWT ESRF Management Board along with presentations from Dave Rudolph, University of Waterloo and Jennifer Baltzer, Wilfrid Laurier University who have long term research projects inside or adjacent to the Cenovus (formerly Husky) lease area.

Project reports available at

<https://www.nwt-esrf.org/publications>:

- University of Waterloo, Regional hydrologic and ecologic characterization, and baseline assessment 2021-2022 report.
- Wilfrid Laurier University, University of Colorado Boulder, Assessing terrain sensitivity to permafrost thaw and fire to understand and predict boreal caribou 2021-2022 report.
- Wilfrid Laurier University, Accelerating recovery of boreal caribou habitat via lichen seeding for oil and gas related remediation – Year 2 Project Progress Report.
- Northern Alberta Institute of Technology, Towards a Northern Landscapes Sensitivity Atlas: Cartographic Approaches to Net Environmental Benefit Analysis (NEBA): Proof of Concept Report.
- Northern Alberta Institute of Technology, Towards a Northern Landscapes Sensitivity Atlas: Cartographic Approaches to Net Environmental Benefit Analysis (NEBA) Plain Language Report.
- Concordia University, Remediation of Petroleum Impacted Soil Using the Natural Washing Agent 2022 Technical Report.
- Concordia University, Remediation of Petroleum Impacted Soil Using the Natural Washing Agent 2022 Plain Language Summary.
- R. Yue, C. An, Z. Ye, S. Gao, X. Chen, B. Zhang, K. Lee, and H. Bi, A pH responsive Phosphoprotein Surface Washing Fluid for Cleaning Oiled Shoreline: Performance Evaluation, Biototoxicity Analysis, and Molecular Dynamic Simulation, Chemical Engineering Journal (Elsevier), 437, 135336 (2022). <https://doi.org/10.1016/j.cej.2022.135336>.
- Multi-species monitoring using winter track surveys in the Sahtú Settlement Region, Final Report – James Hodson, Jessie Whittington, Jonathan Yakeleya.

Management Board Meetings

One virtual meeting of the NWT ESRF Management Board took place on October 7, 2021, as well as a specific project review in December 2021.

Key program direction for the 2021/2022 fiscal year included:

1. Levy rate for industry would remain the same.
2. Maintain existing research priorities of caribou, groundwater, and remediation.
3. 2022/2023 budget of 315K (85K administration, 230K research) is approved.
4. Two new proposals approved for single year funding: Concordia University – Natural washing agent for the enhanced oil removal from contaminated soil and Northern Alberta Institute of Technology – Towards a Northern Landscapes Sensitivity Atlas: Cartographic Approaches to Net Environmental Benefit Analysis (NEBA): Proof of Concept.

2020-2021 Funded Projects

Remediation of Petroleum Impacted Soil using the Natural Washing Agent

Project Lead: Chunjiang An

Organization: Concordia University

Project Description:

It is estimated that the NWT may hold 37% of Canada's marketable light crude oil resources. The NWT has over 870 km of oil transportation pipelines. Due to the fragility of ecosystems in cold regions, oil contamination can cause serious damage to soil ecosystems with low resilience stability.

Oil pollution is one of the major environmental concerns and the remediation of oil-contaminated site is of great importance. Traditional washing agents may have potential adverse effects on the environment after application. It is required to develop efficient, biodegradable, and low or even non-toxic washing agents.

The project aims to enhance the cleaning of petroleum impacted site through the development of a new biodegradable soil washing agent containing sodium caseinate (NaCas).

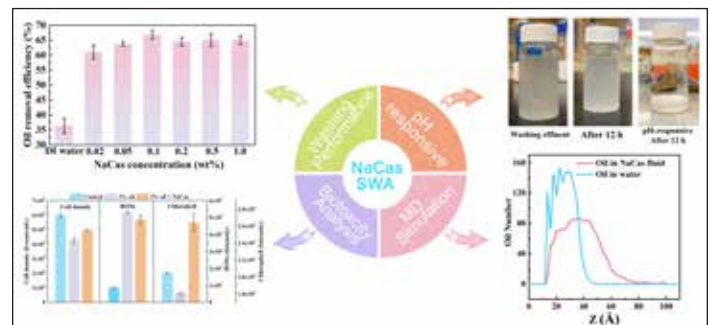
Oil washing experiments were conducted to assess the oil removal performance. Factorial analysis was used to analyze the influencing factors and biotoxicity tests were conducted to evaluate the toxicity reduction of NaCas washing agent. Molecular dynamic simulation was conducted to understand the removal mechanism.

Main Findings:

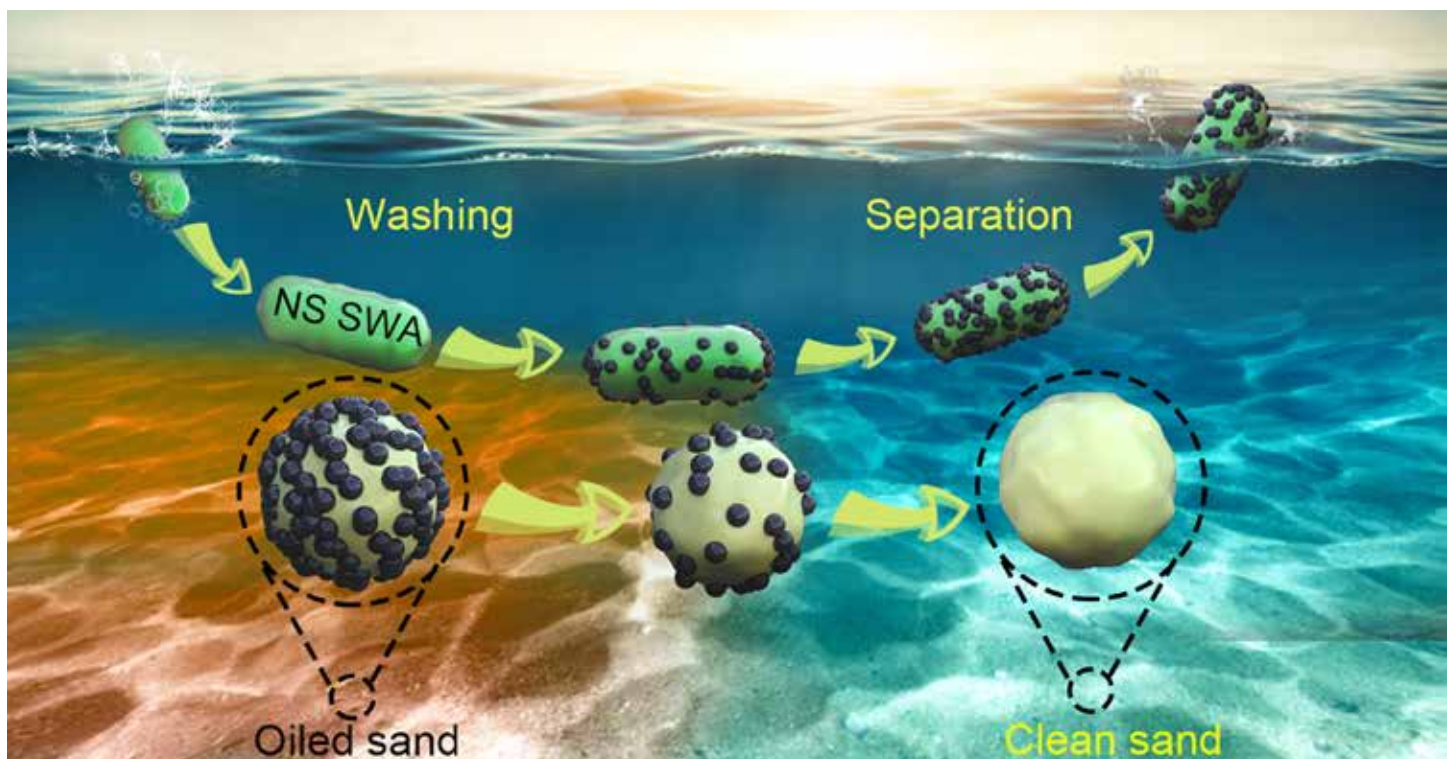
- Sodium caseinate (NaCas) washing agent showed good oil cleanup performance.
- Washing effluent could be readily treated through pH-responsive separation.
- The presence of NaCas could reduce the biotoxicity of oil droplets to algae.

NWT ESRF Funding: \$60,000

Project report available at <https://www.nwt-esrf.org/publications>



Sodium caseinate washing agent showed good performance in oil removal, responsive separation, and toxicity mitigation.



Cleanup of oiled sand using a dual responsive nanoclay/sodium alginate washing agent.

Towards a Northern Landscapes Sensitivity Atlas: Cartographic Approaches to Net Environmental Benefit Analysis (NEBA): Proof of Concept Project

Project Lead: Kevin Kemball

Organization: Northern Alberta Institute of Technology

Project Description:

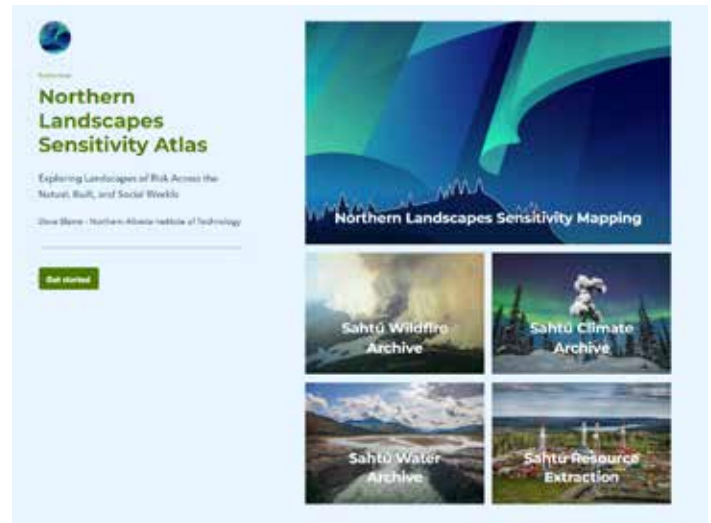
The goal of the proof-of-concept project is to see if a web-based hazard and risk mapping computer platform built by Northern Alberta Institute of Technology (NAIT) can be used as the foundation for a new tool to do NEBA for stakeholders in the Northwest Territories. The platform and tool are a computer-based Geographic Information System (GIS) that combines maps and related map data or information into one place. Another goal of the project is to see what maps and related information are currently available to use, and what the obstacles are in combining them.

The project focusses on the Sahtú Settlement Area and uses publicly available local, regional, national, and international data to see overlaps in the mapped information. It is hoped that observations made with this tool can help people make better and more inclusive decisions.

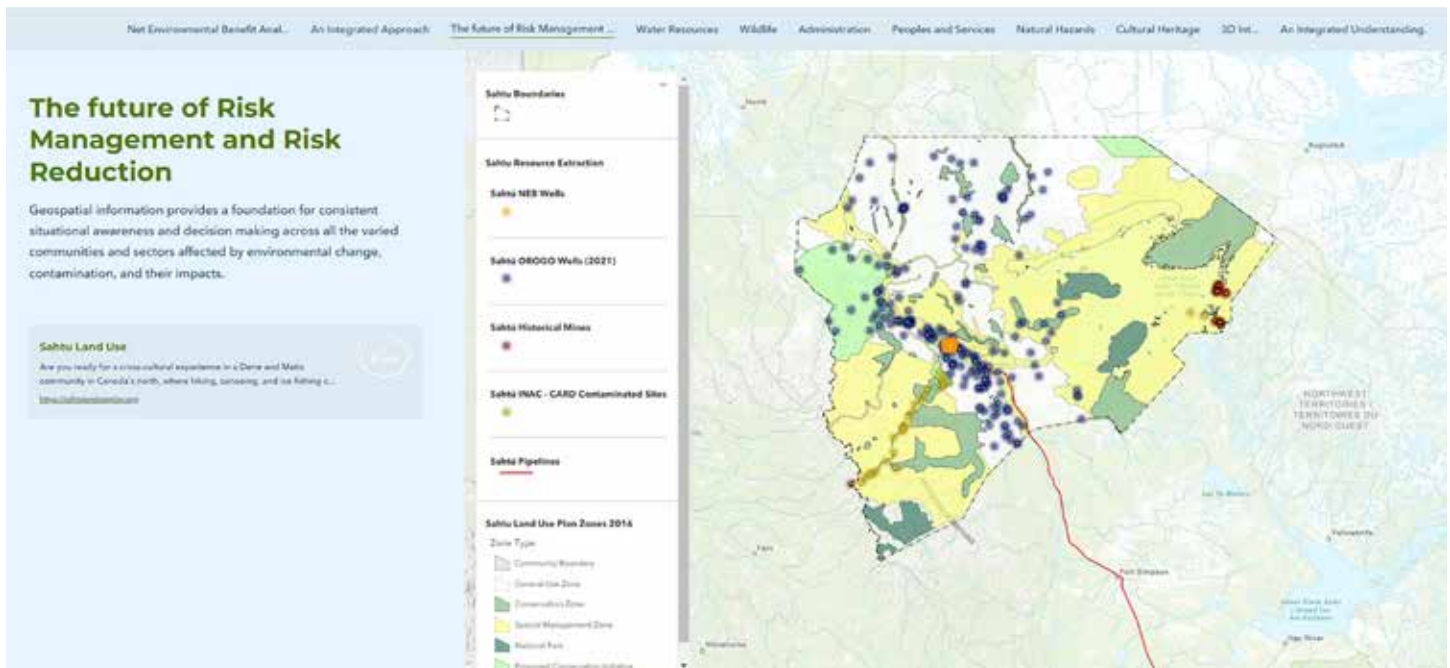
One of the important challenges is combining maps and related information from many sources. Taking information out of institutional silos and presenting them in a unified platform should provide an efficient single-point-of-truth for planners to make decisions that are inclusive, transparent, and evidence-based.

NWT ESRF Funding: \$28,000

Plain language and technical reports available at <https://www.nwt-esrf.org/publications>



Example of the Northern Landscapes Sensitivity Atlas landing page. From this page users can access map data and tools, explore curated data, or start a NEBA project.



Example showing the integration of various data points in a map of the region, allowing users to explore and filter data as needed for their project.

Multi-year Funded Projects – Updates

Accelerating recovery of Boreal Caribou Habitat via Lichen Seeding for Oil and Gas Related Remediation

Project Lead: Dr. Jennifer Baltzer

Organization: Wilfrid Laurier University

Project Description:

Background: Boreal caribou is a culturally significant species and an important subsistence food source for many communities in the Northwest Territories (NWT). However, across Canada, boreal caribou is threatened and in the NWT there is concern over the cumulative effects of increasing climate warming-related acceleration of disturbances (wildfire and permafrost thaw) coupled with development activities on boreal caribou populations. Successful remediation of sites that have been naturally disturbed by wildfire or associated permafrost decay could, in part, mitigate modern habitat loss, reducing stress on targeted boreal caribou populations. Lichen seeding techniques represent a novel remediation strategy, however we have limited understanding of the environmental conditions best suited for this remedial practice, particularly in discontinuous permafrost systems common to the Northwest Territories.

Objective: We will address this knowledge gap by determining under what landscape conditions caribou habitat recovery can be accelerated by lichen seeding.



Lichen seeding plot.
Photo credit: Catherine Dieleman

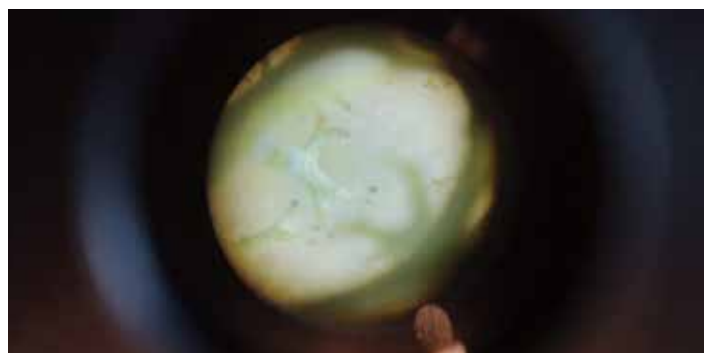
Expected Results: Our proposed research will determine the remedial potential of boreal caribou habitat historically impacted by wildfire and associated permafrost decay across southern NWT. Specifically, our program will identify the environmental conditions associated with degraded boreal caribou habitats that are primed for accelerated lichen establishment. By leveraging an established network of 503 permanent study plots we will be able to construct lichen seeding manipulations spanning a gradient of disturbance and landscape conditions found throughout the boreal caribou range. In doing so we will be able to create predictive spatial maps of caribou habitat rehabilitation potential.

This research program will be fully integrated with a broader Cumulative Impacts Monitoring Program (CIMP) funded project synthesizing the interactive effects of fire, permafrost decay, and anthropogenic development on caribou habitat quality in southern and central NWT. The results from our NWT ESRF program will combine with the ongoing characterizing of current caribou habitat quality as well as a historical aerial imagery analysis identifying long-term disturbance effects on caribou habitat to develop a collaborative decision support system. The system will improve boreal caribou habitat management as it is fed by spatially explicit permafrost and vegetation data, available data on caribou habitat use, and maps of hotspots for caribou habitat rehabilitation potential.

Overall, the results from our proposed research will empower decision makers, allowing them to determine if target areas, like seismic lines and access routes are amenable to mitigation efforts. The spatial maps of hotspots for caribou habitat recovery, will allow land use managers to target and prioritize remediation resources. This knowledge will ultimately facilitate planning by managers and communities for the long-term sustainability of boreal caribou, as stakeholders are able to understand where and how caribou habitat can be rehabilitated.

NWT ESRF Funding: \$50,000 over two years

Project Year 2 update report available at <https://www.nwt-esrf.org/publications>



A caribou lichen fragment under a field microscope at 20x magnification.
Photo credit: Elise Brown-Dussault

Assessing Terrain Sensitivity to Permafrost Thaw and Fire to Understand and Predict Boreal Caribou Habitat and Forage Quality in the Sahtú

Project Leaders: Dr. Jennifer Baltzer; Merritt Turetsky
Organization: Wilfrid Laurier University and University of Colorado Boulder

Project Description:

The proposed research will address how fire and permafrost conditions interact to determine caribou habitat responses to climate change and human activity in the Sahtú, a resource-rich region poised for substantial oil and gas development. Using a combination of field measurements and remotely sensed land cover change, we will improve predictions about the sensitivity of permafrost to fire and human activity in the Sahtú and how this relates to caribou forage availability and quality and caribou habitat use. This will be accomplished by quantifying key metrics of land cover change, terrain stability, and vegetation across a range of permafrost conditions and disturbance gradients.



Permafrost core from organic-rich soils collected at a long-term permafrost monitoring site near Norman Wells, NT.
Photo credit: Emily Ogden.

There are four distinct though interconnected components of this project:

1. Thermokarst vulnerability assessments – completed
2. Linking long-term changes in permafrost conditions to landcover change and water quality – new
3. Vulnerability of lichen peatlands to fire and thaw – ongoing
4. Post-fire forage recovery – ongoing

2021-2022 is the fifth year for this project (additional year of funding made available after original 4 year project timeline was complete).

NWT ESRF Funding: \$50,000/year for four years.
An additional \$73,700 awarded for 2021-2022.

Full project update available at
<https://www.nwt-esrf.org/publications>



PhD candidate Kristen Bill collects a water sample from a pond adjacent to long-term permafrost monitoring site near Norman Wells, NT.

Photo credit: Emily Ogden

Regional Hydrologic and Ecologic Characterization and Baseline Assessment of Remote Northern Canadian terrain in Advance of Shale Oil and Gas Development

Project Leader: Dr. David Rudolph

Organization: University of Waterloo

During the fifth year of the project, the limitations on field access related to the Covid-19 pandemic continued, which required a slight redirection of the work plans and research activities. Fortunately, with the assistance of our Government of the Northwest Territories (GNWT) collaborators and the leadership of the Sahtu Renewable Resource Board, Tulita Renewable Resources Council and the Norman Wells Renewable Resources Council, progress on the design and facilitation of a novel airborne geophysical survey was possible. The details of this survey and progress to date are included in the full annual report on the NWT-ESRF website.

In addition to the focus on the airborne geophysical survey, work was completed on the interpretation of the water chemistry and isotopic composition of surface and groundwater, which has identified different sources of water within the groundwater flow system. Extensive work was also completed on the development of new numerical modeling tools that are specifically designed to support the quantitative evaluation of key processes controlling permafrost thaw dynamics. This includes associated impacts related to land subsidence and solute mobility within the discontinuous permafrost environment of the Central Mackenzie Valley (CMV). The new modeling tools have now been published in peer reviewed journals and are being applied to the specific, data-supported conditions within the Bogg Creek watershed, which is the primary focus of the overall project.

Over the course of this previous year, there have been a number of conference presentations made by the research group related to research results derived from this project. The complete list of the publications and relevant conference presentations is included in this report.

As noted in last year's annual report, Husky Energy was sold to Cenovus during the 2020-2021 fiscal year. In October, 2021, the research team met virtually with the Cenovus program management team to present an overview of the research work that has been conducted within the Slater River hydrocarbon lease area near Norman Wells.

This meeting was facilitated by Mr. Chris Salewich, who has been our main field contact with Husky Energy over the entire course of the project. Mr. Salewich continues to work with Cenovus and remains our main point of contact moving forward. The Cenovus officials confirmed that we would be able to maintain access to the field site, once Covid restrictions have been lifted, and they expressed interest in the current and future research activity within the Bogg Creek water shed region.

The project continues to benefit from technical, financial and in kind support from research colleagues at Wilfrid Laurier University (WLU) and Cenovus. The financial and in kind support continues to be provided through our on-going participation in the Global Water Futures (GWF) program and specifically the Northern Water Futures project headed by Dr. Jenn Baltzer at WLU.

NWT ESRF Funding: \$100,000/year for five years

Full project update available at <https://www.nwt-esrf.org/publications>



The Resolve6 Airborne Electromagnetic system (AEM) in operation.
Photo credit: Xcalibur Multiphysics



The Resolve6 AEM system and helicopter preparing for a survey in the Northwest Territories.
Photo credit: Xcalibur Multiphysics



Configuring the Resolve6 AEM and magnetic equipment for a survey in winter conditions. (Northwest Territories).
Photo credit: Xcalibur Multiphysics

Budget for NWT ESRF Supported through 2020-2021 Levies

1. Administration of the Fund

This budget provides funding for a half-time equivalent position to perform Secretariat functions. Other costs associated with the budget are related to Board travel, direct meeting expenses and communications.

Administration Budget	
Compensation and Benefits	\$ 60,000
Travel	\$ 15,000
Communications and Promotions	\$ 3,000
Publications	\$ 2,000
Other	\$ 5,000

Financial Statement of the NWT ESRF for the Fiscal Year 2021-2022

Revenue *	
Industry Levies	\$ 214,174
Expenses	
Administration	
Compensation and Benefits	\$ (60,000)
Travel	\$ -
Communications and Promotions	\$ -
Publications	\$ (2,025)
Other	\$ (5,821)
Total Administration Expenses	\$ (67,846)
Science Program	
Caribou Studies	\$ (73,700)
Sahtú Hydrogeological Baseline	\$ (100,000)
Various Studies	\$ (113,000)
Total Science Program Expenses	\$ (286,700)
Total Expenses	\$ (354,546)
Total 2021-2022 Surplus (Deficit)	\$ (140,372)

* Industry levies are shown in the Main Estimates in the year they are invoiced and these amounts are to fund the projects for the following fiscal year. Revenue total of \$214,174 was invoiced in 2021-2021 to fund projects in 2022-2023.

NOTE: The ESRF Board has decided to continue the issuing of invoices to Strategic Oil & Gas Ltd for ESRF levies and to note as outstanding levies on the annual report until ownership is legally sorted.

Summary	
Opening Balance (April 1, 2021)	\$ 243,616
Revenue **	\$ 214,174
Expenses	\$ (354,546)
Closing Balance (March 31, 2022)	\$ 103,244

** The ESRF budget and actuals are provided each year in the main estimates as information. As 2022-2023 progresses and information on the current budget is updated, the revised main estimates for 2022-2023 will be reflected in the 2023-2024 main estimates.

2. Science Budget

The following science program budget was recommended for approval by the ESRF Management Board.

NWT ESRF Project Funding	
Science Program	\$ 230,000

Proposed Budget of the NWT ESRF for the Fiscal Year 2022-2023

Revenue *	
Industry Levies	\$ 215,000
Expenses	
Administration	
Compensation and Benefits	\$ (60,000)
Travel	\$ (15,000)
Communications and Promotions	\$ (3,000)
Publications	\$ (2,000)
Other	\$ (5,000)
Total Administration Expenses	\$ (85,000)
Science Program	
Funding available for caribou, groundwater, remediation (specific projects to be approved by Management Board)	\$ (230,000)
Total Science Program Expenses	\$ (230,000)
Total Expenses	\$ (315,000)
Total 2022-2023 Surplus (Deficit)	\$ (100,000)

Summary	
Opening Balance (April 1, 2022)	\$ 103,244
Revenue **	\$ 215,000
Expenses	\$ (315,000)
Closing Balance (March 31, 2023)	\$ 3,244

Levy Breakdown 2021-2022

Description	Hectares	Amount
Significant Discovery Licences	626,491	\$ 202,356.59
Production Licences	36,265	\$ 11,713.60
Pioneer Production Licences	321	\$ 103.68
Total	663,077	\$ 214,173.87

Location	Hectares	Amount
Mackenzie Delta / Arctic Islands	130,173	\$ 42,045.88
Central Mackenzie Valley	434,012	\$ 140,185.88
Southern NWT	98,892	\$ 31,942.12
Total	663,077	\$ 214,173.87

The levy rate for 2021/2022 was \$0.323 per hectare.

www.nwt-esrf.org