OSRIN Annual Report: 2011/12

Oil Sands Research and Information Network

University of Alberta

School of Energy and the Environment

May 2012

Oil Sands Research and Information Network

OSRIN is a university-based, independent organization that compiles, interprets and analyses available information about returning landscapes and water impacted by oil sands mining to a natural state and provides knowledge to those who can use it to drive breakthrough improvements in reclamation regulations and practices. OSRIN is a project of the University of Alberta's School of Energy and the Environment (SEE). OSRIN was launched with a start-up grant of $4.5 million from Alberta Environment and a $250,000 grant from the Canada School of Energy and Environment Ltd.

OSRIN provides:

- **Governments** with the independent, objective, and credible information and analysis required to put appropriate regulatory and policy frameworks in place
- **Media, opinion leaders and the general public** with the facts about oil sands development, its environmental and social impacts, and landscape/water reclamation activities – so that public dialogue and policy is informed by solid evidence
- **Industry** with ready access to an integrated view of research that will help them make and execute reclamation plans – a view that crosses disciplines and organizational boundaries

OSRIN recognizes that much research has been done in these areas by a variety of players over 40 years of oil sands development. OSRIN synthesizes this collective knowledge and presents it in a form that allows others to use it to solve pressing problems. Where we identify knowledge gaps, we seek research partners to help fill them.

Citation

This report may be cited as:

OSRIN, 2012. *OSRIN Annual Report: 2011/12*. Oil Sands Research and Information Network, School of Energy and the Environment, University of Alberta, Edmonton, Alberta. OSRIN Report No. SR-8. 25 pp.

Copies of this report may be obtained from OSRIN at osrin@ualberta.ca or through the OSRIN website at http://www.osrin.ualberta.ca or directly from the University of Alberta's Education & Research Archive at http://hdl.handle.net/10402/era.17507.

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ACKNOWLEDGEMENTS

The Oil Sands Research and Information Network (OSRIN) acknowledges the continuing and valued guidance of the Board of Directors.

OSRIN is also very grateful for the advice and guidance provided by Joseph Doucet, past Director of the School of Energy and the Environment and Chair of the OSRIN Board of Directors, and the leadership provided by Dr. Steven Moran during his tenure as Executive Director of OSRIN.

OSRIN is grateful to Leah Vanderjagt and Carrie Jackson of the University of Alberta Libraries for their support of the Education & Research Archive storage facility for OSRIN's reports.

Finally, OSRIN thanks the core funding agencies – Alberta Environment and Water and the Canada School of Energy and Environment Ltd. – for their commitment to the program.

1 INTRODUCTION

This report describes Oil Sands Research and Information Network (OSRIN) activities and accomplishments for the fiscal year (FY) April 1, 2011 – March 31, 2012.

Key accomplishments for OSRIN this past year include:

- Publication of eight technical reports arising from contracted research;
- Publication of two staff reports and updates to three others;
- Release of the online, searchable Oil Sands Environmental Management Bibliography on the Cumulative Environmental Management Association's website
- Continued digitizing and making publically available historical research and policy reports as pdf documents (200 made available to date);
- Extensive outreach efforts by the OSRIN Executive Director through presentations at nine seminars and conferences.

Publication of OSRIN reports provides the public and researchers with additional information on environmental management of oil sands impacts. They are available from the University's Education & Research Archive (http://hdl.handle.net/10402/era.17209).

Over 3,900 copies of OSRIN's reports were downloaded from September 2011[1] until the end of March 2012.

1.1 Board of Directors

The Board of Directors met in April and November 2011 and in February, 2012. The Board was chaired by Dr. Stefan Scherer, Director, School of Energy and the Environment, University of Alberta. Chris Powter, Executive Director of OSRIN participated as a resource to the Board and Barbara LeFort provided secretariat functions.

The Board was expanded (new), and members changed (change) during the course of the year. At the end of the fiscal year the Board members were:

David Layzell	Institute for Sustainable Energy Environment and Economy (ISEEE)
Haneef Mian	NAIT Ledcor Group Applied Research Chair – Oilsands Environmental Sustainability (new)
John Zhou	Alberta Innovates – Energy and Environment Solutions
Julia Foght	University of Alberta
Murray Anderson	Alberta Sustainable Resource Development (change)
Robert Skinner	Canada School of Energy and Environment (CSEE)
Roger Ramcharita	Alberta Environment and Water

[1] The University's ERA site changed the way it measures report downloads in September 2011. Prior to making the change there were 3,739 report downloads.

Sandra Klashinsky	Alberta Infrastructure, Oil Sands Secretariat (change)
Ted Cyr	Alberta Energy
Terry Abel	Energy Resources Conservation Board

1.2 More about OSRIN

OSRIN operates with minimal staff – Chris Powter is the Executive Director and Barbara LeFort is the Administrative Assistant.

More information on OSRIN's research strategy is available in the following report:

> OSRIN, 2011. *OSRIN's Design and Implementation Strategy*. OSRIN Report No. SR-7. 10 pp.

More information on past work undertaken by OSRIN is available in the following report:

> OSRIN, 2011. *Summary of OSRIN Projects – March 2012 Update*. OSRIN Report No. SR-5. 42 pp.

1.3 Report Organization

Section 2 provides an overview of projects funded by OSRIN in each of the core research program areas during 2011/12.

Section 3 outlines OSRIN's revenue, expenditures and remaining funds. OSRIN received $1,620.00 and spent $809,276.64 during 2011/12, leaving $1,627,827.58 available for future work.

Section 4 provides an outlook for FY 2012/13.

2 2011/12 PROGRAM

OSRIN has identified six program areas in which we are funding work. Within each program area we fund projects to scope out the state of knowledge, identify knowledge gaps, and provide insights regarding research priorities. OSRIN also directs funds to commission or support new work that will expand the knowledge base and fill in knowledge gaps.

The six research program areas are:

- Tailings Reclamation
- Regional Landscape Reclamation
- Monitoring Ecosystem Impacts
- Increasing Awareness
- Social, Economic and Regulatory
- Strategic Design

OSRIN publications, arising from the work described below, and from previous work, are found on the website at http://www.osrin.ualberta.ca/en/OSRINPublications.aspx.

Projects are listed in alphabetical order in each program area. The research performer is noted, followed by a table that shows the key project milestone dates[2], the title with website link of the final report (if applicable) and a description of the project.

2.1 Tailings Reclamation

This program seeks to identify challenges that must be addressed in accelerating the reclamation of tailings ponds and tailings disposal areas and to catalyze necessary research, demonstration and development efforts to resolve them.

2.1.1 *Catalogue of Analytical Methods for Naphthenic Acids*

Performer: Dr. Haneef Mian, NAIT

Commitment	Funding Amount	Funding Start	Funding End	Report
May 10, 2011	$22,000	Jun 24, 2011	Mar 31, 2012	May 2012

This project will produce a catalogue of methods used to analyze naphthenic acids. The Catalogue will provide an overview of naphthenic acids, current sampling and analytical methods and issues, analytical labs and needs for further work. Naphthenic acids are the most frequently discussed chemical component of oil sands process-affected water, in part because of their suspected link to toxicity. Naphthenic acids are complex molecules that require special chemical analyses. Knowledge of the chemical composition of naphthenic acids is important to:

- Determine the cause of toxicity and the fate of the toxic components
- Determine the appropriate level of analysis required for regulatory, monitoring and research purposes

[2] The following definitions were used in constructing the tables: *Project commitment* – the date that the performer is notified in writing that OSRIN will be funding their work. *Funding Amount* – the amount actually paid in FY 2011/12 (unless otherwise noted) or the amount committed if the project is not finished. *Funding start* – the start date in the contract or grant. *Funding end* – the end date of the contract or grant. *Report* – either the published date or the date planned for future publication. **Note** – any dates after March 31, 2012 are planned and may change.

2.1.2 *Engineered Biological Processes to Accelerate Oil Sands Tailings Consolidation and Improve Reuse Water Quality*

Performer: Dr. Tong Yu, Department of Civil and Environmental Engineering, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Sep 9, 2009	$30,000	Sep 9, 2009	Aug 31, 2012	Aug 2012

Methanogenesis has been demonstrated to occur in oil sands mature fine tailings with improved fine tailings densification. While research is on-going as to the microbial processes occurring, there is no open public research to adapt engineered wastewater treatment technologies that exploit the microbially-mediated processes. This study will explore engineered microbially-activated water treatment to significantly accelerate oil sands tailings consolidation and improve quality of water produced from the treatment processes for reuse. The project will study a number of biological processes and engineering reactor types. The engineered biological processes will employ both suspended and attached microbial growth and both anaerobic and aerobic processes. In addition to determination of the parameters for the design and operation of these engineered reactors, additional measures for enhancement of the reactor performances will also be investigated. If successful, the proactive engineering approach could significantly shorten the time for water-solids separation, reduce the volume of tailings produced, and improve water quality for reuse. The long-term goal is to avoid production of mature fine tailings as we now know it. The knowledge and experience obtained from this study can also be used to better treat existing mature fine tailings.

The initial grant of $150,000 for this project was given in FY 2009/10. The additional funds in FY 2011/12 allow for analysis of naphthenic acids in the bioreactor test systems.

2.1.3 *Quantitative Characterization of Air Pollutant Emissions from Oil Sands Tailings Ponds: Phase 1 Review and Assessment of Air Pollutant Measurement Technologies*

Performer: Dr. Zaher Hashisho, Department of Civil Environmental Engineering, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
May 29, 2009	$40,000 (FY 2009/10)	May 29, 2009	Sep 30, 2011	Feb 28, 2012

Report: Hashisho, Z., C.C. Small and G. Morshed, 2012. *Review of Technologies for the Characterization and Monitoring of VOCs, Reduced Sulphur Compounds and CH_4*. OSRIN Report No. TR-19. 93 pp.

The overall goal of this project was to better understand the advantages and limitations of air emission pollutant characterization and monitoring techniques from area sources. This will allow for the selection of current technologies that are most suitable for measuring fugitive emissions of air pollutants from oil sands tailings ponds.

The project consisted of the following tasks:

> Task 1: Review concentration measurement technologies for volatile organic compounds (VOCs) reduced sulphur compounds (including H_2S), and CH_4.
>
> Task 2: Review flux measurement technologies that are used or can be used to measure air pollutant emissions from oil sand tailing ponds.

The report concludes with recommendations for technologies to use for monitoring air emissions from oil sands tailings ponds based on the following factors: spatial coverage, quantification of the pollutants, determination of emission factor, characterization of VOC speciation, and frequency of monitoring. For a variety of reasons there may not be one technology that is best suited for emission measurements across the oil sands region, and it is important to understand the different advantages and limitations of the technologies when selecting an option and interpreting the resulting data.

2.2 Regional Landscape Reclamation

This program focuses on providing the knowledge necessary to support development of regional reclamation targets as well as site- and mine-level objectives.

2.2.1 *Development of a Geomatics Monitoring Tool for Oil Sands Reclamation Monitoring*

Performer: Dr. Karl Staenz, University of Lethbridge

Commitment	Funding Amount	Funding Start	Funding End	Report
Sep 27, 2011	$50,000	Nov 21, 2011	Dec 31, 2013	Apr 2013

OSRIN, Alberta Environment and Water, and TECTERRA are providing funding for this project. The project will support both oil sands reclamation monitoring and monitoring related to other forms of industrial land in Alberta. The proposed mapping/monitoring software system will fill a significant gap in monitoring reclamation success by offering a novel technology that can be implemented within Alberta Environment's reclamation monitoring process. The software system will consist of newly developed algorithms in combination with existing ones,

which will be adapted within the context of Alberta Environment's requirements. It will link the processing steps, including a spectral and radiometric normalization module, geometric rectification module, information extraction module, change detection module and results assembly module. The workflow for each type of processing is encapsulated within a dedicated job script that uses different software components including open source, commercial and in-house tools. The software system will provide the capabilities to produce indicators about vegetation condition using LiDAR and passive optical remote sensing technologies.

A report will be prepared for OSRIN providing information on:

- background and utility of remote sensing to assess disturbance and ecosystem recovery including aspects of vegetation succession, site productivity and ecosystem health
- introduction and rationale for study design and technology choices to monitor reclamation success at different scales (well sites, pipelines, coal mines, in situ oil sands, oil sands mines)
- results and recommended approaches

2.2.2 *Equivalent Land Capability Workshop*

Performer: Mark Polet, Klohn Crippen Berger

Commitment	Funding Amount	Funding Start	Funding End	Report
Nov 15, 2010	$4,995.17 (FY 2010/11)	Nov 15, 2010	Jul 1, 2011	Jun 10, 2011

Report: Oil Sands Research and Information Network, 2011. *Equivalent Land Capability Workshop Summary Notes*. OSRIN Report TR-13. 83 pp.

The Equivalent Land Capability Workshop, held on November 26, 2010 at the University of Alberta, provided an opportunity for 60 reclamation specialists to share views about Equivalent Land Capability and how it is applied to oil sands mine reclamation, and to identify research and information needs.

The purpose of the workshop was to develop a shared understanding of the concept and application of Equivalent Land Capability (ELC) as it applies to oil sands mine reclamation.

The workshop format was a series of presentations, each followed by group discussions, which were guided by a series of questions provided by the organizers. A final open forum plenary discussion asked what people had learned and what they felt the next steps should be.

There was general agreement that government should develop a policy document on what ELC means today, and acknowledge that the vision may change in the future. The policy document should acknowledge that ELC is much broader than the regulatory definition. ELC is a province-wide issue not just oil sands – therefore the oil sands could be a chapter in a bigger policy document. The policy should clearly distinguish the concept from the practice (implementation, measurement, etc.).

External discussion papers could be also commissioned, with representation from all the publics. The compilation of these papers can act as a pre-policy paper – a synthesis of opinions meant to inform policy. Contributors may need to be paid a stipend. It is not necessary to agree and there can be a diversity of opinions.

2.2.3 *Oil Sands Terrestrial Habitat and Risk Modeling for Disturbance and Reclamation*

Performer: Dr. Clive Welham, University of British Columbia

Commitment	Funding Amount	Funding Start	Funding End	Report
Jan 27, 2012	$87,500	Jan 1, 2012	Dec 31, 2012	Jan 2013

The objective of this project is to develop a framework that integrates risk management and strategic decision-making in order to evaluate the impact of disturbance (natural and industrial) on ecosystem products and services, and on habitat availability for terrestrial species in Alberta's Lower Athabasca planning region. This will include an evaluation of the impact of disturbance (including natural disturbance due to insect outbreaks, fire and wind, and industrial and agricultural disturbance), conservation, and reclamation activities associated with oil sands development both at the lease and regional levels.

Four scenarios will be incorporated into the analysis. Scenarios include a base case, climate change, mine development plans, and regional development plans. The base case scenario is a series of outcomes derived with no consideration for future climate change. The importance of the base case is that it provides a context for comparing the relative impact of different climate change scenarios. Data for the base case scenarios are derived from historical climate records.

This is the third phase of a multiphase project. Phase I (FY 2009/10 – $104,000) and Phase II (FY 2010/11 – $70,000) have been completed and reports released:

- Welham, C., 2010. *Oil Sands Terrestrial Habitat and Risk Modeling for Disturbance and Reclamation – Phase I Report*. OSRIN Report No. TR-8. 109 pp.
- Welham, C. and B. Seely, 2011. *Oil Sands Terrestrial Habitat and Risk Modelling for Disturbance and Reclamation – Phase II Report*. OSRIN Report No. TR-15. 93 pp.

2.2.4 *Potential Impacts of Beavers on Oil Sands Reclamation Success*

Performer: Brian Eaton, Alberta Innovates - Technology Futures

Commitment	Funding Amount	Funding Start	Funding End	Report
Jun 7, 2011	$24,500	Jun 7, 2011	Mar 31, 2012	June 2012

Beavers are commonly identified as a potential "threat" to the success of oil sands reclamation efforts, both from a water flow perspective and from a vegetation ecology perspective. This review will:

- Describe the characteristics (habitats and habits) of beavers as they may impact reclamation
- Describe the characteristics of reclaimed waterbodies with a focus on their suitability and attractiveness to beavers
- Discuss the potential impacts of beavers on reclamation success
- Recommend potential design considerations to avoid or mitigate beaver impacts

2.2.5 *Preliminary Watershed Hydrology and Chemical Export Model for Reclaimed Oil Sands Sites*

Performer: Dr. Gordon Putz, University of Saskatchewan

Commitment	Funding Amount	Funding Start	Funding End	Report
Sep 13, 2011	$70,000	Dec 2, 2011	Feb 28, 2013	Jan 2013

The overarching goal of this research project is to take the first steps toward development of a watershed streamflow and water quality assessment tool (model) to support oil sands mine reclamation in Alberta. An extensive monitoring and research program following natural and harvest disturbance in forested watersheds on the Boreal Plain (FORWARD) has indicated that vegetation, streamflow, water quality and bio-indicators follow predictable impact and recovery trajectories. A watershed streamflow model (SWATBF) has been constructed and successfully applied in several reference watersheds on the Boreal Plain associated with Alberta's forestry sector. In addition, a hydrologic modelling framework utilizing SWATBF has been developed to model changes in water yield from harvested sites. The framework has been applied in two detailed forest management plans. To further advance the model and apply it in support of oil

sands reclamation, the past two decades of soil, vegetation and hydrologic research on oil sands reclaimed sites needs to be compiled and used to set-up and calibrate the model. These oil sands reclamation data exist in several forms including theses, journal papers, grey literature (internal and external reports) and company databases.

The primary objective of this project is to compile the oil sand reclamation research data, assess its suitability for establishment of watershed streamflow models based upon SWATBF and to provide a summary report on the pertinent data. A second objective is to establish a preliminary watershed model as a test case utilizing the existing research data and to recommend parameter calibration ranges for SWATBF. The second objective is contingent upon the existence and availability of the required data.

2.2.6 *What Constitutes Success for LFH Salvage and Replacement*

Performer: Dr. Anne Naeth, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Feb 24, 2011	$25,000	Feb 24, 2011	Sep 30, 2012	June 2012

OSRIN and the coal mining sector commissioned a literature review that will summarize the expected benefits of using LFH (luvic-fulvic-humic) surface soils for forested land mine reclamation over traditional reclamation soil mixtures (e.g., peat, peat:mineral, peat:tailings sand, and peat:mineral:overburden in the oil sands and topsoil/subsoil mixtures in mountain/foothills coal mines etc.).

Based on research results documenting the benefits of using LFH in oil sands reclamation, Alberta Environment and Alberta Sustainable Resource Development recently attended three oil sands mine Energy Resources Conservation Board hearings and requested that industry be required to use soil luvic, fulvic and humic (LFH) materials for reclamation. Justification for the request was that using natural surface soil materials, rather than constructed ones, would provide a better environmental outcome after reclamation. This approach would be consistent with soil salvage and replacement approaches used on most other Alberta industrial sites. It is reasonable to assume that, in the near future, coal mines will be asked to undertake a similar LFH based salvage and replacement approach.

There is currently no clear and accepted description of what constitutes a better environmental outcome with LFH based reclamation. There is currently no clear documentation of what successful LFH based reclamation would look like, and why it would be different from success achieved from mine reclamation practices using traditional soil salvage and replacement methods. Concern has been raised that the benefits of LFH based reclamation may be short lived, and thus in the long term not be an economical or environmentally sound basis for implementation.

2.2.7 *Woody Debris Field Guide*

Performer: Dr. John Spence, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Jan 13, 2011	$14,850 (FY 2010/11)	Feb 25, 2011	Aug 31, 2012	Aug 2012

Woody debris is a critical, but often overlooked, component of forest ecosystems. Its high variability provides critical habitat for a host of organisms, contributes to nutrient cycling, and has unique potential for assisting with reclamation and access management efforts in Alberta. This project will result in development of a *Woody Debris Management Guide* for Alberta oil and gas operators to facilitate extension of research results to on the ground users. The guide will focus on providing resource managers and contractors with tangible information to be used in construction and reclamation efforts. In particular, the extension project aims to set woody debris targets and provide examples of current best practices for managing woody debris. Consideration will also be given to current policies in Alberta that dictate how woody debris is to be managed. Following completion of this extension project, companies will have up to date information that can be used to plan and deliver exploration and other development programs in a cost effective manner.

2.3 Monitoring Ecosystem Impacts

This program focuses on components of a comprehensive, robust system in Alberta to monitor the effects of oil sands mining operations on ecosystem health – a system that is scientifically sound and has the confidence of the general public.

2.3.1 *Microcosm Evaluation of CLPP in Oil Sands Process Affected Water*

Performer: Dr. Jim Davies, Alberta Innovates - Technology Futures

Commitment	Funding Amount	Funding Start	Funding End	Report
Aug 5, 2011	$60,000	Aug 5, 2011	Sep 30, 2012	Oct 2012

Expanding upon previous OSRIN-funded work, this project will describe the response of Community Level Physiological Profiling (CLPP) to the presence of oil sands process water (OSPW), at ecologically relevant concentrations, within aquatic microcosms.

The project consists of two laboratory experiments: one to test the ability of CLPP to detect effects of OSPW on aquatic microbial communities and the ability of the communities to adapt to and recover from introduction of OSPW; and a second to test the ability of microbial communities to degrade OSPW. The photo to the right shows the acrylic rods that will be colonized by microbial communities.

If successful, the results of this project would be used to support future field trials of the same techniques. Ultimately, the goal of this research is development of a technology that could rapidly, easily, and inexpensively evaluate the ecological status of natural, reclaimed, or engineered wetlands.

2.3.2 *Organic Footprint of Atmospheric Deposits: Snow and Surface Water Fingerprinting Across the Athabasca Region*

Performer: Dr. Jean Birks, Alberta Innovates – Technology Futures

Commitment	Funding Amount	Funding Start	Funding End	Report
Mar 15, 2012	$60,600 (FY 2012/13)	Mar 1, 2012	Dec 31, 2012	Jan 2013

Following up on a previous OSRIN project, this study will characterize the dissolved organics present in rivers, lakes and process affected waters in the Athabasca oil sands region and from lakes and river samples collected during the spring and summer of 2011. The results of this study will provide oil sands researchers with a better understanding of the composition of the compounds present in dry and wet deposition across the region and possibly also a tool for partitioning contributions of organics from different sources. The transfer of atmospherically derived organics to aquatic ecosystems is a key knowledge gap in the region and this study will help address this by evaluating if the organics detected in the snow survey can be detected in spring runoff in the Athabasca or in nearby lakes. This study will provide a more complete picture of the types of organics present in snow and surface water across the Athabasca oil sands

region and a better understanding of the proportion of these organics captured by existing monitoring.

2.3.3 *Potential to Use Wildlife as Monitors of Ecosystem Health in the Oil Sands Region*

Performer: Dr. Judit Smits, University of Calgary

Commitment	Funding Amount	Funding Start	Funding End	Report
May 10, 2011	$20,000	May 10, 2011	Dec 31, 2011	Feb 8, 2012

Report: Cruz-Martinez, L. and J.E.G. Smits, 2012. *Potential to Use Animals as Monitors of Ecosystem Health in the Oil Sands Region*. OSRIN Report No. TR-18. 52 pp.

This review is focused on the effects of contaminants on wildlife and the potential for using wildlife as sentinels for human and environmental health. Some wildlife are permanent residents of the boreal forest encompassing the oil sands region, while many others are seasonal residents using this area as breeding grounds (i.e., migratory birds), both providing the potential for ongoing research into the biological effects of contaminants from oil sands activities. The graphic to the left shows how the environment and organisms are linked.

Wildlife species may act as sentinels, or early warning systems, providing insight into the effects of contaminants on environmental and even human health. In the oil sands, both field and laboratory studies have used wildlife as bioindicators and/or sentinels of ecosystem health. The great majority of this research has focused on aquatic ecosystems and organisms.

2.3.4 *Surface Water – Groundwater Interactions in the Lower Athabasca Region*

Performer: Melanie Dubois, Cumulative Environmental Management Association

Commitment	Funding Amount	Funding Start	Funding End	Report
Sep 16, 2011	$10,000	Sep 16, 2011	Mar 31, 2012	Mar 23, 2012

OSRIN and CEMA's Groundwater Working Group partnered with Alberta Innovates – Technology Futures to prepare a scope of future work to address the need to improve understanding of surface water – groundwater interactions within the Lower Athabasca Region. A secondary objective was the preparation of a summary report of existing surface water –

groundwater initiatives in the Lower Athabasca Oil Sands Region and other jurisdictions and which also discusses the key characterization methodologies currently employed. The academic literature was reviewed, pertinent groups and stakeholders will be consulted regarding existing initiatives, and a detailed scope of proposed future work was developed while carrying out this project.

The final report will be available through the CEMA website.

2.4 Increasing Awareness

This program aims to increase awareness of OSRIN and oil sands issues through an active website presence (www.osrin.ualberta.ca), sponsoring oil sands related conferences, digitizing historical information and publication of OSRIN research results.

2.4.1 *Background Information Journalists Need for Oil Sands Articles*

Performer: Janice Paskey, Mount Royal University

Commitment	Funding Amount	Funding Start	Funding End	Report
May 10, 2011	$18,700	May 10, 2011	May 31, 2012	Jan 25, 2012

Report: Paskey, J. and G. Steward, 2012. *The Alberta Oil Sands, Journalists, and Their Sources*. OSRIN Report No. TR-17. 33 pp.

Twenty journalists who regularly produce articles, televised reports and videos about the Alberta oil sands and issues pertaining to the oil sands participated in this study.

Although most of the stories about the Alberta oil sands that appear in the news media have a business or economic focus, this study reveals that a clear majority of the 20 journalists who participated believe that the tension between economic and environmental aspects of oil sands development is the driving issue.

A clear majority of respondents also said that there are many stories about the oil sands that go unreported and many of these unreported stories have to do with environmental issues.

While journalists didn't specify why certain stories are not covered by the news media, they did report that some of the sources they would need to produce credible articles or documentaries are not easily available and, in some cases, not available at all. Most reported that industry sources are easily available although they would prefer to speak with decision makers rather than communications staff. And while they often rely on government statistics about the oil sands and the environment, a significant number of respondents said it is usually difficult to reach federal and provincial government representatives to discuss these statistics.

Academics have become an important source of expertise, particularly for journalists who write about environmental issues, as have advocacy groups such as the Pembina Institute. However, most journalists suggested that there are so many vested interests with a stake in oil sands development that it is often difficult to know who to believe. For this reason they use a variety of sources, especially when covering environmental issues.

Most journalists suggested that up-to-date expertise is such a valuable commodity when reporting about the oil sands that they expect all their sources to have it, even citizen and Aboriginal sources.

It is also apparent that most of the journalists rely heavily on online sources of information such as other media stories, government reports and documents, industry updates, advocacy group reports and events, contact information for Aboriginal bands, statistical information of all sorts, and media releases.

Most of the respondents were experienced journalists who have been covering the Alberta oil sands for more than five years. They believe that oil sands development is one of the most important, if not the most important issue, facing the province and the rest of the country.

2.4.2 *Canadian Oil Sands Symposium*

OSRIN, in conjunction with the Embassy of Canada in Sweden, Ethix SRI Advisors and NEI Investments held a virtual workshop to connect speakers at the University of Alberta with an international audience of large investment firms in Stockholm, Sweden. There were no research costs associated with this symposium but OSRIN did contribute $157 to host the event.

In Alberta, a panel of speakers from the Pembina Institute, Canadian Oil Sands Trust, Royal Society of Canada, Natural Resources Canada, Alberta Environment and Water, and Alberta Intergovernmental, International and Aboriginal Relations provided a brief overview of the issues and actions each is taking with respect to oil sands development. The Panel then responded to questions posed by the Stockholm audience, which focused on the implications of the proposed European Union Fuel Directive, tailings ponds, health effects, greenhouse gases and pace of development. Click here for background information provided to the Symposium participants.

2.4.3 *CEMA Oil Sands Bibliography Enhancements*

Performer: Kyle Harrietha, Cumulative Environmental Management Association

Commitment	Funding Amount	Funding Start	Funding End	Report
Jun 9, 2011	$25,000	Jun 9, 2011	Mar 31, 2012	Mar 19, 2012

There is a large and growing literature on oil sands reclamation and related disciplines. OSRIN has identified a need to make publicly available an online, searchable bibliography of current and

historical references (wherever possible with links to electronic copies). OSRIN has confirmed this need with a number of reclamation specialists and potential users. The lack of a readily accessible, current listing of research can lead to unintentional repetition of previous work which wastes valuable resources. In addition, access to historical information will allow researchers to focus on key issues, or components of previous studies that were not explored.

OSRIN has partnered with the Cumulative Environmental Management Association (CEMA) to enhance and update CEMA's Reclamation Research Database (renamed as the Oil Sands Environmental Management Bibliography). Enhancements include improved searching and reporting tools and addition of references will be added to the database to make it more comprehensive.

The Bibliography was made available to the public through the CEMA website in March, 2012. New references will continue to be added.

2.4.4 *Conference Sponsorship*

OSRIN provides support to conferences and other venues to ensure that there are opportunities for practitioners to access oil sands information. In FY 2011/12 OSRIN sponsored six conferences for a total of $16,043.44. Lists of current sponsorships and past sponsorships are available on the website.

2.4.5 *Digitize Historical Research Project Reports*

OSRIN staff have digitized historical oil sands related government-sponsored research reports from the Alberta Oil Sands Environmental Research Program (access all 134 reports or access list of digitized reports) and the Reclamation Research Technical Advisory Committee (access all 40 reports and two conference papers or access list of digitized reports) and placed them on the University of Alberta's Education & Research Archive website to make information more readily accessible to stakeholders. These reports provide context and, in the case of the AOSERP reports considerable baseline information, to help stakeholders appreciate the depth and breadth of research undertaken since the mid-1970s to understand oil sands impacts and develop appropriate mitigation. Other Government of Alberta reports are also being digitized to provide additional context (access all 26 reports or access list of digitized reports).

OSRIN appreciates the significant assistance from the University of Alberta Libraries, provision of RRTAC reports from Alberta Environment and Water, and the submissions of digitized versions of reports from Environment Canada, Pedocan Land Evaluation and Millennium EMS Solutions.

In FY 2011/12 OSRIN spent $1,717.44 on digitization work.

2.4.6 *iGEM Award Sponsorship*

Performer: ConocoPhillips Canada (on behalf of the Oil Sands Leadership Initiative – OSLI)

Commitment	Funding Amount	Funding Start	Funding End	Report
May 15, 2011	$25,000	May 15, 2011	Mar 31, 2012	Not applicable

The International Genetically Engineered Machine competition (iGEM) is the premiere undergraduate Synthetic Biology competition. Student teams are given a kit of biological parts at the beginning of the summer from the Registry of Standard Biological Parts. Working at their own schools over the summer, they use these parts and new parts of their own design to build biological systems and operate them in living cells. This project design and competition format is an exceptionally motivating and effective teaching method.

For the past two years OSLI and OSRIN have sponsored a special Oil Sands Challenge competition within the overall iGEM competition. In 2011/12 OSRIN contributed $25,000 to sponsor awards for participating teams in the oil sands competition within the overall iGEM competition. OSLI provided $125,000 to the award pool.

2.5 Social, Economic and Regulatory

This program seeks to identify social, economic and regulatory issues that may affect environmental management of oil sands and to evaluate the effectiveness of environmental management in addressing social, economic and regulatory issues.

2.5.1 *Audit Protocol to Support Implementation of the Mine Financial Security Program*

Performer: Richard Dixon, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Mar 22, 2012	$30,000	Jun 25, 2011	Dec 31, 2011	May 2012

Alberta's recently announced Mine Financial Security Program (MFSP) includes provisions for Alberta Environment to audit the Mine Financial Security Program Annual Report and the supporting information used to prepare the report. The Guide to the Mine Financial Security Program describes a four-stage audit system and provides some general areas that may be covered in an audit (section 7.4). The Mine Financial Security Program Standard describes the procedural steps of an audit.

The Audit Protocol will assist Alberta Environment staff, and potentially external consultants, in conducting audits in one or more of the four audit stages. The Protocol will identify the types of

questions that audit personnel could use to determine if the Mine Financial Security Program requirements were met. The Protocol will also provide an indication of the supporting documentation that auditors should expect to find and some potential issues to watch for.

2.5.2 *How Qualifying Environmental Trusts Work as Reclamation Security*

Performer: Richard Dixon, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Mar 23, 2012	$25,000	Jun 25, 2011	Dec 31, 2011	June 2012

Alberta's recently announced Mine Financial Security Program (MFSP) includes a provision to consider use of Qualifying Environmental Trusts as one form of security that Alberta Environment may consider. This project will clarify what these Trusts are, how they are structured, how they are administered, how they operate, where else they have been used, what level of protection they offer government and what other implications they have before considering whether or not they would be suitable for use in Alberta.

2.5.3 *Impacts of Changing Environmental Standards on Oil Sands Royalties*

Performer: Elis Valera, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Jul 22, 2011	$5,757.99	Aug 15, 2011	Dec 23, 2011	May 2012

Provincial royalty payments are reduced by allowable costs, which include some expenditures related to environmental management. Changes to environmental standards or requirements can therefore have an impact on the royalties paid to the province. In effect this means that the province (on behalf of the people of Alberta) bears a portion of the costs of compliance with environmental standards. This report will describe the concept of allowable costs as it relates to environmental expenditures and will summarize the impact of changing standards on royalty payments.

2.5.4 *Implications of Corporate Certification on Reclamation Security Estimates*

Performer: Benjamin Thibault, Pembina Institute for Appropriate Development

Commitment	Funding Amount	Funding Start	Funding End	Report
Dec 21, 2011	$15,000 (FY 2012/13)	Jan 1, 2012	Mar 31, 2012	June 2012

Alberta's recently announced Mine Financial Security Program (MFSP) requires that a Chief Executive Officer, Chief Financial Officer, or a Designated Financial Representative sign the Corporate Certification section of the MFSP Annual Report that is submitted to Alberta Environment and Water. The Annual Report provides summary information on assets, liabilities and the resultant reclamation security that the company must provide. The signature of the Corporate Officer is intended to provide increased confidence for the regulators and the public in the accuracy of the estimates, in part because of the implications of statutory and accounting rules, and in part because companies have developed internal policies and procedures to ensure the Corporate Officer is not placed at risk when signing such a document.

This project will assess the expectation of increased confidence by describing the implications of signoff and the steps companies will normally take when obtaining the Corporate Officer's signature.

2.5.5 *Information Required for Estimating Oil Sands Plant Decommissioning Costs*

Performer: Mark Morton Sr., WorleyParsons

Commitment	Funding Amount	Funding Start	Funding End	Report
Jul 20, 2011	$48,786.92	Jul 22, 2011	Oct 30, 2011	Dec 7, 2011

Report: Morton Sr., M., A. Mullick, J. Nelson and W. Thornton, 2011. *Factors to Consider in Estimating Oil Sands Plant Decommissioning Costs*. OSRIN Report No. TR-16. 62 pp.

This report provides a number of cost estimating factors, common terminology and common practices derived from industrial decommissioning projects, international cost estimating practices and the outcome of a joint university, industry and regulator workshop. The cost estimation factors identified in this report represent common practice in the decommissioning industry and are intended to cover the key cost components for a detailed oil sands plant decommissioning cost estimate. This report also identifies factors that may affect the reliability

of the estimates (i.e., the level of uncertainty and therefore an indication of the contingency factors that may need to be applied to the estimate).

The intent of this document is to supplement the existing guidance on the content of the MFSP Liability value that is in the Guide to the Mine Financial Security Program. The report does not prescribe what needs to be included at any point in the Approval Holder's MFSP estimate. Included in the report are the things one should consider at some point in the life cycle of the oil sands plant (especially close to the time the Operating Life Deposit is made) and some information on the methodology and accuracy of estimates. Similarly, the intent is not to prescribe when the Approval Holder chooses to include increased detail or accuracy to the estimates – this is the Approval Holder's decision. The report does offer suggestions (e.g., estimate methods, content, and when and why the accuracy of the estimate might be updated, etc.) to assist in developing an estimate.

2.5.6 *Plain Language Summary Explanation of Human Health Risk Assessments*

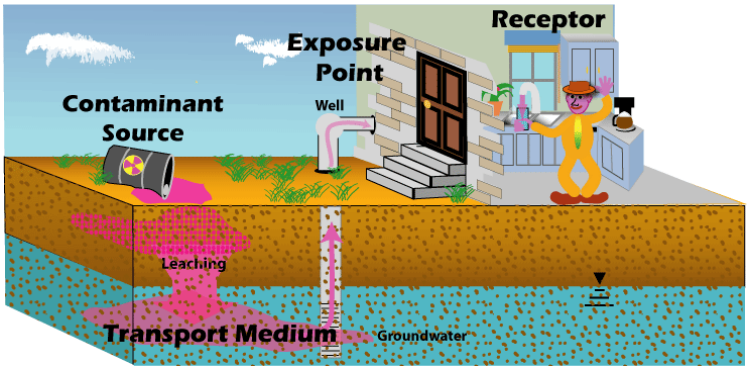
Performer: Dr. Mohamed Gamal El-Din, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Nov 1, 2010	$12,000 (FY 2010/11)	Nov 1, 2010	Apr 30, 2011	Jun 29, 2011

Report: Kindzierski, W., J. Jin and M. Gamal El-Din, 2011. *Plain Language Explanation of Human Health Risk Assessment*. OSRIN Report TR-14. 37 pp.

Many factors can affect a person's health, such as quality of life, how long they live, and whether or not they suffer diseases. These factors are referred to as *determinants of health*. The quality of environmental media related to oil sands developments in northeastern Alberta represents a concern to people at the local, national, and international level. The key determinants of people's exposure to chemical pollutants are: time-activity (where we spend time and what we do), interaction with indoor environments, diet, and occupation. In most instances these determinants explain most or all of what influences exposure to chemicals in the environment. One way to investigate the relationship between the quality of environmental media and human health risk is to perform a human health risk assessment (HHRA).

A human health risk assessment is an important component of most environmental impact assessments of new oil sands development projects. Human health risk assessment is also likely to be a key requirement for understanding potential human health impacts of the release of oil sands process-affected waters to the environment.



A human health risk assessment is the process of determining if a particular chemical or other hazard in the environment (e.g., particulate matter) poses a health risk to people for a specific set of conditions. People are called *receptors* in human health risk assessment. It is not possible to tell where in time and space people will actually be in relation to where chemical pollution exists, and therefore the extent to which they are actually exposed. Thus assumptions need to be made about their exposures to allow us to assess human health risk.

Human health risk assessments are prepared by professional consultants (scientists and engineers) for government, industry and other organizations. This is done to help decision makers, especially policy makers and regulators, understand potential health impacts from the release of chemical pollutants into the environment by industrial operations. This type of information – along with social, economic, and other information – can help to inform policy and regulatory decisions that help protect people from chemical exposures as a result of pollution.

Human health risk assessment procedures described here are normally accepted by regulatory agencies because they are, purposely, conservative. This conservatism makes it less likely to under estimate potential exposures and human risk and more likely that resulting regulatory decisions made will protect people from chemical pollution by industrial operations in real situations.

2.5.7 *Review of Health Effects of Naphthenic Acids*

Performer: Dr. Warren Kindzierski, University of Alberta

Commitment	Funding Amount	Funding Start	Funding End	Report
Sep 10, 2010	$18,000 (FY 2010/11)	Sep 1, 2010	May 31, 2011	April 11, 2012

Report: Kindzierski, W., J. Jin and M. Gamal El-Din, 2012. *Review of Health Effects of Naphthenic Acids: Data Gaps and Implications for Understanding Human Health Risk*. OSRIN Report No. TR-20. 43 pp.

Human Health Risk Assessments (HHRA) form an important part of oil sands mine Environmental Impact Assessment reports and are likely to be a key requirement in any future

requests to release process-affected waters to the environment. Oil sands mining involves removal of water from the Athabasca River. Water produced during the extraction of bitumen from oil sands is referred to as process-affected water. Naphthenic acids are solubilized and concentrated in process-affected water and are likely to be an important part of any HHRA related to discharging process-affected waters. OSRIN has commissioned a literature review describing the known health effects of naphthenic acids and how this information is incorporated into HHRAs (e.g., pathways, effects, required doses, whether they treated as carcinogenic or non-carcinogenic, etc.).

2.6 Strategic Design

This program focuses on the development and refinement of OSRIN's strategic intent and program delivery. No work was undertaken in this program area.

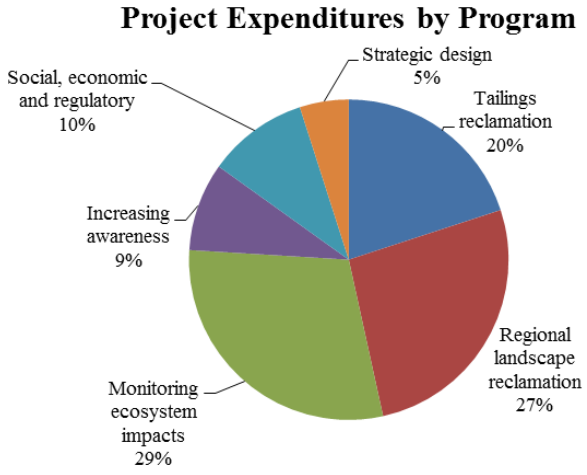
3 FINANCIAL STATUS

3.1 Revenue

During 2011/12 OSRIN gained $1,620.00 through contracts for work undertaken by the Executive Director and direct contributions to support OSRIN and/or specific projects.

3.2 Expenditure

In 2011/12, OSRIN spent $809,276.64 (broken down by program area and administration in the table below). The figure belowt shows the split of project funding by program from 2008 until March 31, 2012.



Cost Centre	$ Spent[1]	% of Total $ Spent
Tailings Reclamation	$52,000.00	6.43
Regional Landscape Reclamation	$257,000.00	31.76
Monitoring Ecosystem Impacts	$90,000.00	11.12
Increasing Awareness	$86,460.88	10.68
Social, Economic and Regulatory	$109,544.91	13.54
Strategic Design	$0.00	0.00
Program Expenses[2]	$4,908.52	0.61
OSRIN Expenses[3]	$209,362.33	25.9
TOTAL	**$809,276.64**	**100.00**

[1] Includes grants, purchase orders, invoices and expenses related to projects.

[2] Includes expenses directly attributable to a project or program area such as costs to host a workshop or travel to a conference sponsored by OSRIN

[3] Includes salaries, and travel and expenses for OSRIN staff

Section 2 summarizes expenditures by project.

3.3 Remaining Budget

At the end of March 31, 2012, total cumulative OSRIN expenditure since 2008 was $2,980,674.50. An additional $185,600.00 in outstanding commitments leaves an uncommitted balance of $1,627,827.58 which is available for future research work and to cover overhead.

4 FUTURE RESEARCH

OSRIN will continue to fund projects in the first five program areas during 2012/13, based on the results of current projects, advice from the Board of Directors, and discussions with other funding and research management agencies. OSRIN does not foresee work in the Strategic Design program area in 2012/13.

OSRIN notes the continuing emphasis on tailings and monitoring in the media and public policy arenas and will focus work in those areas to support regulators and industry and to improve public awareness.

Every effort will be made to co-fund projects with partners, likely by co-funding work of others. In some cases OSRIN may decide the issue is important enough that it should fund the work on its own; however, each case will be carefully examined to ensure the Board of Directors agrees the project will add value.

OSRIN will initiate a Request for Proposal program targeting academic institutions in 2012/13. Requests for Proposals will be issued for specific projects.

5 ACRONYMS USED IN THIS REPORT

AOP	Advanced Oxidation Processes
CEMA	Cumulative Environmental Management Association
CLPP	Community Level Physiological Profiling
ELC	Equivalent Land Capability
FY	Fiscal Year
HHRA	Human Health Risk Assessment
iGEM	International Genetically Engineered Machine
LFH	Luvic-Fulvic-Humic (or Litter-Fibric-Humic)
MFSP	Mine Financial Security Program
MFT	Mature Fine Tailings
OSLI	Oil Sands Leadership Initiative
OSPW	Oil Sands Process Water
OSRIN	Oil Sands Research and Information Network
SEE	School of Energy and the Environment
VOC	Volatile Organic Carbon

6 LIST OF OSRIN REPORTS

OSRIN reports are available on the University of Alberta's Education & Research Archive at https://era.library.ualberta.ca/public/view/community/uuid:81b7dcc7-78f7-4adf-a703-6688b82090f5. The Technical Report (TR) series documents results of OSRIN funded projects. The Staff Reports series represent work done by OSRIN staff.

The following list includes all OSRIN reports prepared to date (the reports prepared in this fiscal year have been noted in the individual project summaries).

6.1 Technical Reports

BGC Engineering Inc., 2010. *Oil Sands Tailings Technology Review*. OSRIN Report No. TR-1. 136 pp.

BGC Engineering Inc., 2010. *Review of Reclamation Options for Oil Sands Tailings Substrates*. OSRIN Report No. TR-2. 59 pp.

Chapman, K.J. and S.B. Das, 2010. *Survey of Albertans' Value Drivers Regarding Oil Sands Development and Reclamation*. OSRIN Report TR-3. 13 pp.

Jones, R.K. and D. Forrest, 2010. *Oil Sands Mining Reclamation Challenge Dialogue – Report and Appendices*. OSRIN Report No. TR-4. 258 pp.

Jones, R.K. and D. Forrest, 2010. *Oil Sands Mining Reclamation Challenge Dialogue – Report*. OSRIN Report No. TR-4A. 18 pp.

James, D.R. and T. Vold, 2010. *Establishing a World Class Public Information and Reporting System for Ecosystems in the Oil Sands Region – Report and Appendices*. OSRIN Report No. TR-5. 189 pp.

James, D.R. and T. Vold, 2010. *Establishing a World Class Public Information and Reporting System for Ecosystems in the Oil Sands Region – Report*. OSRIN Report No. TR-5A. 31 pp.

Lott, E.O. and R.K. Jones, 2010. *Review of Four Major Environmental Effects Monitoring Programs in the Oil Sands Region*. OSRIN Report No. TR-6. 114 pp.

Godwalt, C., P. Kotecha and C. Aumann, 2010. *Oil Sands Tailings Management Project*. OSRIN Report No. TR-7. 64 pp.

Welham, C., 2010. *Oil Sands Terrestrial Habitat and Risk Modeling for Disturbance and Reclamation – Phase I Report*. OSRIN Report No. TR-8. 109 pp.

Schneider, T., 2011. *Accounting for Environmental Liabilities under International Financial Reporting Standards*. OSRIN Report TR-9. 16 pp.

Davies, J. and B. Eaton, 2011. *Community Level Physiological Profiling for Monitoring Oil Sands Impacts*. OSRIN Report No. TR-10. 44 pp.

Hurndall, B.J., N.R. Morgenstern, A. Kupper and J. Sobkowicz, 2011. *Report and Recommendations of the Task Force on Tree and Shrub Planting on Active Oil Sands Tailings Dams*. OSRIN Report No. TR-11. 15 pp.

Gibson, J.J., S.J. Birks, M. Moncur, Y. Yi, K. Tattrie, S. Jasechko, K. Richardson, and P. Eby, 2011. *Isotopic and Geochemical Tracers for Fingerprinting Process-Affected Waters in the Oil Sands Industry: A Pilot Study*. OSRIN Report No. TR-12. 109 pp.

Oil Sands Research and Information Network, 2011. *Equivalent Land Capability Workshop Summary Notes*. OSRIN Report TR-13. 83 pp.

Kindzierski, W., J. Jin and M. Gamal El-Din, 2011. *Plain Language Explanation of Human Health Risk Assessment*. OSRIN Report TR-14. 37 pp.

Welham, C. and B. Seely, 2011. *Oil Sands Terrestrial Habitat and Risk Modelling for Disturbance and Reclamation – Phase II Report*. OSRIN Report No. TR-15. 93 pp.

Morton Sr., M., A. Mullick, J. Nelson and W. Thornton, 2011. *Factors to Consider in Estimating Oil Sands Plant Decommissioning Costs*. OSRIN Report No. TR-16. 62 pp.

Paskey, J. and G. Steward, 2012. *The Alberta Oil Sands, Journalists, and Their Sources*. OSRIN Report No. TR-17. 33 pp.

Cruz-Martinez, L. and J.E.G. Smits, 2012. *Potential to Use Animals as Monitors of Ecosystem Health in the Oil Sands Region*. OSRIN Report No. TR-18. 52 pp.

Hashisho, Z., C.C. Small and G. Morshed, 2012. *Review of Technologies for the Characterization and Monitoring of VOCs, Reduced Sulphur Compounds and CH_4*. OSRIN Report No. TR-19. 93 pp.

Kindzierski, W., J. Jin and M. Gamal El-Din, 2012. *Review of Health Effects of Naphthenic Acids: Data Gaps and Implications for Understanding Human Health Risk*. OSRIN Report No. TR-20. 43 pp.

6.2 Staff Reports

OSRIN, 2010. *Glossary of Terms and Acronyms used in Oil Sands Mining, Processing and Environmental Management - June 2011 Update*. OSRIN Report No. SR-1. 102 pp.

OSRIN, 2010. *OSRIN Writer's Style Guide*. OSRIN Report No. SR-2. 22 pp.

OSRIN, 2010. *OSRIN Annual Report: 2009/2010*. OSRIN Report No. SR-3. 27 pp.

OSRIN, 2010. *Guide to OSRIN Research Grants and Services Agreements - June 2011 Update*. OSRIN Report No. SR-4. 21 pp.

OSRIN, 2011. *Summary of OSRIN Projects – March 2012 Update*. OSRIN Report No. SR-5. 54 pp.

OSRIN, 2011. *OSRIN Annual Report: 2010/11*. OSRIN Report No. SR-6. 34 pp.

OSRIN, 2011. *OSRIN's Design and Implementation Strategy*. OSRIN Report No. SR-7. 10 pp.