WILDLIFE HABITAT RECLAMATION WORKSHOP SUMMARY REPORT

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Executive Summary

On March 3, 2016 Alberta Innovates – Technology Futures (AITF) held a *Workshop on Reclamation Planning for Wildlife Habitat on Oil Sands Mines*. The goal of the Workshop was to review the current context for wildlife habitat reclamation planning, identify and discuss alternative approaches, and explore the objectives, location(s) and funding options for potential demonstration trials of alternative approaches. Nineteen government, industry, consultants and researchers attended the Workshop.

Workshop participants agreed there would be merit in asking people who were not able to attend the Workshop if they had additional observations to share. AITF sent out a survey on March 11 to over 60 individuals inviting them to provide answers to three over-arching questions related to wildlife habitat reclamation and encouraging them to share the survey with their colleagues – 21 responses were received.

It is clear that wildlife are an important feature of a reclaimed landscape, particularly in an area such as the oil sands where traditional land uses include hunting and trapping. Wildlife species are an integral component of many activities that help define an Aboriginal community's cultural values. Wildlife species are important as a food source but also as part of the traditional economy (e.g., furbearer pelts). At the same time, expectation has been created through approvals and company EIA's, that at the end of reclamation there will be wildlife habitat *and wildlife* … that the landscape will not just be capable of supporting wildlife but that the desired animals will actually be present. Therefore we need to ensure wildlife habitat is created through reclamation that will be colonized by, and support, desired species.

Existing regulatory processes (environmental impact assessments (EIAs), approvals, pre-disturbance assessments (PDAs)) require considerable information on wildlife habitat and wildlife species metrics. Models are used to extrapolate the extent and viability of pre-disturbance wildlife communities, the impacts of resource development, and the effects of reclamation as a mitigation strategy. However, in reviews of EIAs these models and their underlying data and assumptions are often the subject of considerable comment and skepticism from regulators and the public.

A key observation emerging from the Workshop is that we still have no clear understanding of the regulatory end objective for wildlife habitat reclamation, even after almost 50 years of development and reclamation. In particular, we need to know if the goal is capability (wildlife habitat) or productivity (wildlife). Once the goal is understood the tools required to achieve the goal and assess success can be developed – in particular, development of Best Management Practices, expected trajectories for reclaimed land development (and its attendant ability to support wildlife), monitoring tools to evaluate success, adaptive management practices to realign sites with the desired trajectory, and certification requirements.

Workshop participants noted that considerable work has gone into baseline data collection and that there are many hectares of reclaimed land where wildlife have been observed (though their level of use of those reclaimed habitats has rarely been quantified). There was a sense that increased awareness of

this information would significantly enhance wildlife habitat reclamation success – recommendations included: establishing a mechanism to share successes and failures, and developing a public data portal to facilitate a better understanding of regional wildlife habitat reclamation plans and status. There was strong interest in developing a community of practice on advancing wildlife habitat reclamation.

Workshop participants identified 11 immediate actions that could be initiated as a start to enhancing wildlife habitat reclamation success and four longer term actions.

Actions that are high priority and tractable in the short term:

- We should begin to develop fact sheets suitable for operator use (construction).
- We should explore ways to empower people on the ground doing the reclamation work: promote the idea that operators have a creative licence to do things that are not exactly to the construction drawings, and that this is permissible even if it costs a bit more money or takes more time – expecting that these costs will drop with experience.
- We should, wherever possible, modify construction specs and compensation for equipment operators and tree planters to encourage emulation of more natural types of habitat (e.g., greater diversity in attributes from soil placement and landform to how trees and other species are planted).
- We should share successes (and failures) of these modified contract specifications in enhancing the success of reclamation at local to regional scales.
- We need to develop good succession trajectories for different reclamation techniques and track as many sites as possible against these trajectories to build a solid database. We need to associate wildlife species presence and use with the stages of each trajectory.
- We need good wildlife habitat-based vegetation planting guidelines.
- We need to ensure that suitable quantities and types of vegetation propagules are available for planting, particularly for wetland species. We should explore enhancing capacity for seed collection.
- The Alberta Energy Regulator (AER) needs to ban grass as a reclamation cover, and instead encourage use of pioneer species (e.g., nitrogen fixers) to promote soil development rather than immediately planting secondary successional species.
- We need to enhance data availability. As a start, data collected under *Environmental Protection and Enhancement Act* (EPEA) approvals are public and should be added to the Oil Sands Information Portal (OSIP)[1]. In the longer term, efforts should be made to make other industry/consultant data available and to require submission of the data underlying EIA reports.
- Government should take on the role of setting standards for data collection and format to ensure consistency and remove competitive obstacles.

[1] See http://osip.alberta.ca/map/

- We need to make all closure plans available on-line in a GIS-type format, both for individual sites and for the region as a whole.

Actions that require better definition or are not achievable in the short term:

- Need documentation of historical reclamation prescriptions for soil mixes, depth, fertilizer applications, etc. The data will be important when assessing reclamation efficacy.
- Need to collect data for tailings Dedicated Disposal Areas – e.g., how deep the pit was before the tailings went in, what types of tailings went in and when, etc. May help understand things like salinity in an area.
- While we want people to publish in peer reviewed journals to enhance the credibility of work, we don't want to withhold data access for one or two years while the journal process is underway. We need to find some mechanism to share the data without impacting the ability to publish (Terrestrial Ecosystem Research Network, 2013). Perhaps aggregating data under the umbrella of an organization like Alberta Environmental Monitoring, Assessment, Evaluation and Reporting Agency (AEMERA) or Canada's Oil Sands Innovation Alliance (COSIA) would allow for both goals to be achieved.
- We need to find better ways to access and share Traditional Ecological Knowledge.

In the follow-up survey, seventeen people indicated an interest in participating in a community of practice to help improve wildlife habitat reclamation.

Acknowledgments

Thanks to the staff of the Calgary office of Alberta Innovates – Technology Futures, particularly Leona McComish, for their assistance in planning and delivering the workshop on which this report is based. Thanks also to all those who participated in the workshop, submitted responses to the post-workshop survey, or both.

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1. Introduction

On March 3, 2016 Alberta Innovates – Technology Futures held a workshop on *Reclamation Planning for Wildlife Habitat on Oil Sands Mines* (the "Workshop"). The goal of the Workshop was to review the current context for wildlife habitat reclamation planning, identify and discuss alternative approaches, and explore the objectives, location(s) and funding options for potential demonstration trials of alternative approaches. Nineteen government, industry, consultants and researchers participated in the Workshop (Appendix A), supported by a facilitator and two technical resource people.

1.1 An Ecological Framework for Wildlife Habitat Design for Oil Sands Mine Reclamation

Eaton et al. (2014) proposed an alternative approach to wildlife habitat reclamation planning and design for oil sands mines. A summary of their report was provided to participants to provide background and context for the Workshop (Appendix B).

1.2 Workshop Format

The Workshop was structured to gather information on what is working in wildlife habitat reclamation, what isn't working, what could be tweaked to improve reclamation success, and what non-traditional reclamation approaches might be considered. Workshop participants were encouraged to think of the full life cycle of wildlife habitat reclamation (Figure 1[2]) when providing input to the topics noted above.

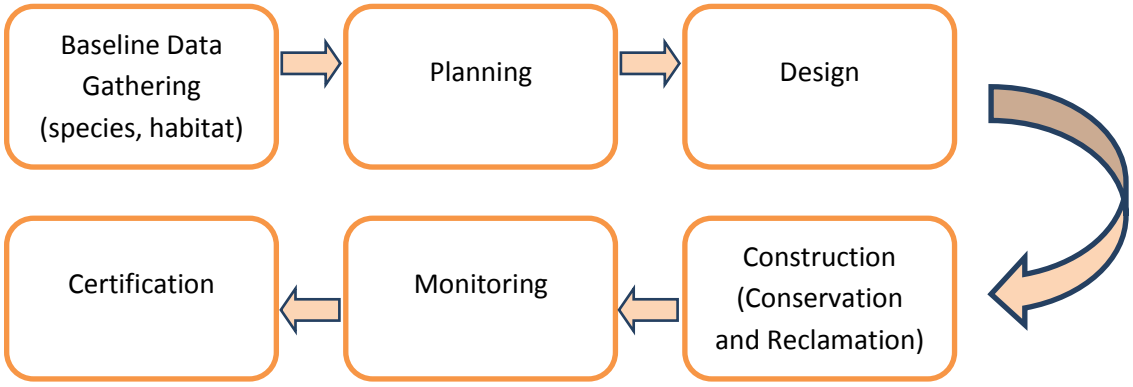

Figure 1. Life Cycle of Wildlife Habitat Reclamation.

2. Context for Wildlife Habitat Reclamation

Wildlife habitat reclamation following mining is required by policy and regulatory approvals, and desired by a variety of stakeholders. Considerable effort currently goes into planning, design, construction and monitoring of wildlife habitat to meet these expectations.

[2] Boxes 1 (Baseline Data Gathering) and 4 (Construction) in the Figure were modified based on clarification discussed by participants at the Workshop.

Alberta's regulatory system provides opportunities for government agencies and stakeholders to review and question submissions of proponents seeking environmental approvals. Common wildlife habitat-related questions asked in the regulatory process (see sections 2.1 and 2.2 and Appendices J, K and L for further information) provide insights into the issues that are of interest/concern (and therefore should be accommodated in planning and execution of wildlife habitat reclamation):

- Provide benchmarks and targets for wildlife populations over the lifetime of the project, in association with recolonization of reclaimed landscapes and other future development scenarios in the region. Discuss the time required to recolonize and sources for recolonization.
- Discuss how the proposed reclamation methods have performed in similar situations … including … re-population of these areas by plant and wildlife species of importance. Include in the discussion the plants and animals included in the Aboriginal communities' traditional species lists.
- Describe and assess the potential impacts of the project to wildlife and wildlife habitats, considering … the resilience and recovery capabilities of wildlife populations and habitats to disturbance.
- Discuss mitigation measures to minimize the potential impact of the project on wildlife and wildlife habitat … and to return productive wildlife habitat to the area. Consider … consistency of the plan with applicable regional, provincial and federal wildlife habitat objectives and policies.
- How can reclamation ensure habitat connectivity?
- Re-establishment of wildlife habitat is an uncertain outcome that is also in the far future; what can be done in the interim to mitigate loss?
- What measures will be taken to ensure the habitat enhancement measures remain intact until effective habitat capability is returned to the areas impacted by the Project?
- How can you address First Nations communities concerns about the loss of wildlife and wildlife habitat and the ability of companies to reclaim areas even over the long term?
- Provide a discussion of a quantitative assessment of impacts to traditionally important wildlife species (including, but not limited to, Fort McKay's cultural keystone species). Include mitigation strategies to address those impacts.
- Describe the potential changes to wildlife … including anticipated effects on the quality of traditionally consumed species including ungulates, rabbits and game birds.

Additional commonly-asked questions reflect the importance of good pre-disturbance wildlife population data and appropriate, validated models to predict impacts of development and mitigation. Questions about biodiversity are also often directly linked to wildlife and habitat.

2.1 Regulatory Context for Wildlife Habitat Reclamation

The Lower Athabasca Regional Plan (LARP; Government of Alberta 2012) indicates that a Biodiversity Management Framework will be developed that sets targets for selected biodiversity indicators (including wildlife) as well as addressing caribou habitat needs. LARP also sets a goal of "progressive and timely reclamation of land not required for further oil sands development".

The *Fort McMurray - Athabasca Oil Sands Subregional Integrated Resource Plan* (Alberta Sustainable Resource Development 2002) aims "to maintain, and, if possible, to enhance the diversity, abundance and distribution of wildlife resources for Native subsistence, recreational and commercial benefits." Specifically, within the mineable oil sands region the Plan aims "to maintain and enhance moose habitat to support at least 225 wintering moose, up from the current population of approximately 100".

Alberta's regulatory system for oil sands mines provides several insights into government and stakeholder expectations for wildlife habitat reclamation (Figure 2), including:

- Draft proposed terms of reference for Environmental Impact Assessment (EIA) reports (see Appendix J)
- Public comments on (EIA) proposed terms of reference (see Appendix K),
- Government questions on EIA reports (called Supplemental Information Requests – SIR; see Appendix L)
- Clauses in *Environmental Protection and Enhancement Act* (EPEA) approvals (see Appendix J)

Figure 2. Word Cloud of Common Words in Public EIA Comments and Government SIRs. Generated using WordClouds.com

The Cumulative Environmental Management Association (CEMA) prepared a report for the Government of Alberta proposing objectives, criteria and indicators for reclamation certification of oil sands mines (Poscente 2009). Objective 3 is *End Land Use Capability is Equivalent to that Prior to Disturbance*, and criteria 3.2 is *Wildlife Capability*. Poscente identified three indicators for Wildlife Capability, and described the key gaps for each:

3.2.1 Quantity of habitat for candidate species (Gap – Pre-disturbance capability is estimated in the EIA's. There are no standards or measures for evaluating what the pre-disturbance capability was compared to the post disturbance reclamation result.)

3.2.2 Quality of habitat for candidate species (Gap – is defining an acceptable monitoring program to follow (modeling or monitoring)).

3.2.3 Wildlife usage capability (Gap – The gap is determination of what point in time in the reclamation process that wildlife usage capability exists (acknowledging the succession stages of habitat). Some wildlife capability may not exist for a number of years beyond when reclamation certification would be expected to occur.

CEMA continued to develop and refine the criteria and indicators framework (Poscente and Charette 2012) and then submitted the final recommendations to Alberta Environment and Sustainable Resource Development (AESRD; now Alberta Environment and Parks (AEP)) who published the report in 2013 (Alberta Environment and Sustainable Resource Development 2013). In the revised version of the framework there were five wildlife-related indicators, each with detailed Recommendation Sheets (note that the numbers related to each indicator listed below are those used in the original AESRD (2013) report):

16 – Wildlife species with an important ecological role

17 – Wildlife habitat targets

18 – Wildlife habitat targets that support consumptive and non-consumptive uses

19 – Wildlife habitat targets that support cultural, spiritual, medicinal and ceremonial purposes as defined through stakeholder consultation

20 – Viable and healthy populations of wildlife

2.2 Aboriginal Context for Wildlife Habitat Reclamation

Following interviews with community members and a literature review, Garibaldi and Straker (2010) provided a list of seven Cultural Keystone Species (CKS) for the Fort McKay First Nation, which included moose (*Alces alces*) and beaver (*Castor canadensis)*, plus five plant species. The goal of the CKS project was to focus discussions and ultimately produce recommendations for relevant land reclamation within the Fort McKay traditional territory. In a 2015 workshop on *Aboriginal Participation in Land*

Reclamation Daniel Stuckless, from the Fort McKay Sustainability Department (in Powter et al. 2015), reaffirmed that reclamation success in the eyes of Fort McKay First Nation means "re-establishment of Traditional Land Use species, including culturally relevant species" (see Appendix K for more Aboriginal context).

In 2010 Shell Canada Limited submitted a Fort McKay Specific Assessment as part of their Jackpine Mine Expansion and Pierre River Mine EIA (Shell Canada Limited 2010). Section 6.1 of the Fort McKay Community Assessment Data Report (Appendix 1-1 of Shell's Fort McKay Specific Assessment report) lists Fort McKay's concerns related to wildlife habitat:

> Wildlife is an integral part of the Fort McKay's culture. Since the start of industrial development (late 1960s), the Community of Fort McKay has observed the transformation of some of their Traditional Lands from boreal forest and wetlands into oil sands open pit mines, in-situ operations, and associated infrastructure. The environmental impact assessments (EIAs) prepared by oil sands operators and proponents repeatedly claim that these developments will have little impact on wildlife populations and their habitats because reclamation will return the land to a productive state. However, there is a substantial time lag (in many cases decades) between the initial disturbance and the completion of wildlife habitat reclamation, and for that period of time the wildlife populations and habitats that sustain them are unavailable to Fort McKay. Additionally, Fort McKay community members remain skeptical of future reclamation success and whether reclamation will result in the restoration of key boreal forest habitats that support their traditional uses. Furthermore, the community believes that development already has negatively affected certain wildlife populations.
>
> Fort McKay community members are also concerned about the effect of industrial pollution on wildlife health and the quality of wild meat. This concern has deterred some community members from hunting near development areas. Other members of the community have indicated that they no longer eat moose because of concerns that the moose have been affected by pollution. Fort McKay community members have also noted that with the increasing number of oil sands workers in the area the moose have become habituated to people and are no longer wary of traffic or hunters.
>
> Wildlife species are an integral component of many activities that help define the Fort McKay community's cultural values. Wildlife species are important as a food source but also as part of the Fort McKay's traditional economy (e.g., furbearer pelts). Moose hides continue to be used for the making of ropes, gloves, and moccasins.
>
> The moose and beaver are considered Cultural Keystone species for the Community of Fort McKay. Canada lynx, fisher, and marten are furbearers are vital to the Fort McKay's traditional economy.

2.3 Industry Research

Golder Associates Ltd. (2015) has summarized wildlife research and monitoring projects of Canada's Oil Sands Innovation Alliance (COSIA) members, including:

- Horizon Oil Sands Early Successional Wildlife Monitoring Program
- Using Bighorn Sheep from Mined Land to Re-Establish Herds in Historic Ranges
- Wildlife Habitat Effectiveness and Connectivity Program
- Wildlife Observation Database

COSIA has also funded two Biodiversity Conservation Chairs at the University of Alberta[3] and is undertaking work on caribou habitat restoration in the in-situ oil sands region[4]. The latter work is summarized by Pyper et al. (2014) who produced a list of current practices (the Restoration Toolbox) and an analysis of what is working, what isn't working and what is needed in the areas of planning, applying treatments and monitoring.

3. Workshop Summary

As mentioned previously, Eaton et al. (2014) developed an alternative approach to wildlife habitat reclamation planning and design. To get feedback on the needs of industry, government, and stakeholders related to wildlife habitat reclamation, and to get direction for further work in developing a framework for ecological wildlife habitat reclamation, a range of participants were invited to a workshop on March 3, 2016 at AITF Calgary. The following sections capture the key input from the Workshop participants. Further details for each of the Workshop sessions are provided in Appendices C to I.

3.1 Wildlife Habitat Reclamation Stereotypes

To set the stage for discussion, participants were asked to identify which of four stereotypes best described their views of current wildlife habitat reclamation practice. The four stereotypes were:

> *Patty Perfect*. Patty believes the status quo will meet our needs. We simply follow the approval requirements and use current reclamation practices and we will get suitable wildlife habitat and the critters will come with minimal intervention.
>
> *Tina Tuner*. Tina thinks we will be somewhat successful with current practices but we can do better with some fine tuning such as adding snags, rockpiles, or nest boxes, or specialized plantings. She thinks we may need to bring some wildlife in to the site to ensure quicker re-population.

[3] See http://www.cosia.ca/initiatives/land/alberta-biodiversity-conservation-chairs
[4] See http://www.cosia.ca/initiatives/land/caribou-habitat-restoration and http://www.cosia.ca/initiatives/land/regional-industry-caribou-collaboration

Fanny Focus. Fanny believes we need to rethink the way we undertake wildlife habitat reclamation to be successful. She thinks we have to shift from the approach that wildlife can adapt to landscapes reclaimed for general purposes, or to reclaimed landscapes built for other purposes (e.g., commercial forestry), and move towards reclamation that is planned and built specifically to create wildlife habitat.

Helen Handbasket. Helen isn't sure wildlife habitat reclamation is going to work, or if it does there won't be enough animals within a suitable timeframe, or worse the wrong kinds of animals will be present. Helen thinks we should focus on off-site enhancement to replace lost habitat.

Of the 19 participants, 12 self-identified with Fanny Focus (3 government and 9 consultants); 5 with Tina Tuner (all industry); and one each with Patty Perfect (industry) and Helen Handbasket (consultant). Some of the participants noted that they felt more comfortable somewhere between Tina and Fanny – i.e., a mix of fine tuning existing practices and a need to develop new approaches to ensure success.

In a follow-up discussions to the exercise, the participants noted:

- If you know what you are trying to accomplish, you can figure out all the things you need to get there … we have a lot more information now that we used to even 10 years ago, so more chance to improve reclamation.
- Currently wrestling with end land use definitions (e.g., commercial forestry). Any one area is not just commercial forestry or just wildlife habitat, etc. Is there potential to layer several end land uses on the same polygon?
- Are there areas where wildlife habitat should be the primary end land use? Difficult to get credit for the ability of a polygon to provide multiple land uses.
- We should have a more holistic approach – not just oil sands mines … look at the scale of the entire province, and look at reclamation in other industries as well.

The original plan for the Workshop was to proceed with discussions related to each of the stereotype characteristics: Patty – what are we doing right; Helen – what are we doing wrong; Tina – what tweaks would make for better outcomes; and Fanny – what would you do if we were starting fresh. However, after beginning the discussions of Patty's world it became apparent that a different approach was required to capture the range of input being provided by the participants. The group agreed to switch focus to discussing the six wildlife habitat reclamation life-cycle stages in Figure 1. Comments that didn't fit into one of the life cycle stages, or that fit into multiple stages have been captured in Appendix I.

3.2 Baseline Data Gathering

Key participant observations around baseline data gathering are listed below (more comments are provided in Appendix C):

- There is a vast amount of data collected in EIAs and Pre-Disturbance Assessments (PDAs) but they are not compiled, analysed or made easily accessible. Data should be a common good. The Alberta Energy Regulator (AER) should be the integrator and repository for all EIA/PDA/monitoring data.
- We are collecting attributes when doing EIAs and PDAs, but using habitat function to assess reclaimed landscapes – these are different sets of metrics. As a result, pre-disturbance data are not particularly useful for reclamation planning and design.
- EIA/PDA data should be collected using the same methods as for monitoring post-reclamation to allow for better comparisons.

3.3 Planning and Design

The participants noted that these two components of the life cycle are inextricably linked so they have been combined into one list below (more planning comments are provided in Appendix D and Design comments in Appendix E):

- The Closure Plan should integrate all of the other plans required under the *Environmental Protection and Enhancement Act* (EPEA) approval (e.g., wildlife habitat, biodiversity, etc.).
- A multi-disciplinary team is involved in the planning and design phases; the ability of a landscape to support wildlife depends on understanding multiple levels of ecological organization and support.
- Planning of site reclamation needs to consider neighbouring mines, adjacent undisturbed land values, local and regional corridors, and regional plan goals.
- Planning for too many species is unrealistic and likely unachievable. However, planning for a single species such as caribou may mean that other species are excluded because they have conflicting habitat needs. In addition, some habitat types (e.g., yellow rail habitat) are very difficult to reproduce during reclamation.
- Soils and vegetation planning is based on small ecosite polygons but wildlife planning requires a much larger scale view (needs to integrate across multiple soil/vegetation polygons).
- Wildlife should be included at the beginning of the planning process. Reclamation wildlife biologists often get called in at the end to do their best with what has already been designed or built.
- We need to incorporate climate change into reclamation plans and wildlife habitat design.

- A high level of detail is inappropriate for mine-scale design, but may be important for construction.

3.4 Construction (Conservation and Reclamation)

For the purposes of this Workshop *construction* means conservation and reclamation. Key participant observations are listed below (more comments are provided in Appendix F):

- Need to work guidance into the specifications provided to operators in a way that they are comfortable with the guidance and that it achieves the outcome that you want as well … some operators need very specific instructions, while others may be open to less stringent guidance. Guides should be short, concise and in plain language that an equipment operator or construction supervisor can read and use on the ground. Include lots of photos showing what "good" and "bad" look like on the ground would be beneficial.
- We want heterogeneity but it can be a challenge for some operators to overcome habits instilled by previous training (level, smooth ground, straight line tree rows, etc.); need to make it clear that diversity on a reclaimed landscape is desirable.
- Don't plant agronomic species (this still occurs on in-situ and some pipelines).
- Need guidance on how to make temporal planting work better (may also require changes to regulatory requirements for concurrent planting). Succession should be emulated (e.g., initially plant colonizers like alder, not secondary succession species like white spruce). In the bigger picture of reclamation, it will not be a large cost to go in and do planting at different times.
- Safety considerations are impeding progressive and effective reclamation. For example, we are currently not supposed to plant berries because you don't want bears on an active mine site. , the current practice is to refrain from planting trees or shrubs on tailings dams so that visual monitoring of dam stability can occur (Hurndall et al. 2011).
- Site management practices may also be hindering success. For example, overfertilization and excessive herbicide application is shifting plant communities to undesired states. The latter also poses some danger to wildlife species.
- Trained reclamation supervisors with authority to direct work on the ground can have a significant positive impact on reclamation success.

3.5 Monitoring

The discussion related to monitoring proved to be the liveliest of the Workshop. Key participant observations around monitoring are listed below (more comments are provided in Appendix G):

- Early establishment of a clear purpose and objective for monitoring is critical. The purpose determines the appropriate methods, frequency of data collection and interpretation products.
- Monitoring methods should be consistent with reclamation certification methods to allow for better tracking and assessment of results.

- A common monitoring methodology is required (COSIA is working on this).
- Research and monitoring are not the same, though people often confuse them[5].
- Scale for wildlife monitoring may be very different from that used for soils and vegetation monitoring (i.e., traditional reclamation success monitoring).
- Technologies for monitoring over large areas, such as remote sensing, UAVs, acoustic recording units, and radio collars need to be developed to increase efficiency of monitoring programs. However these methods should replace some portion of existing labour-intensive field collection, not just add to existing monitoring efforts.
- Some declines (fluctuations) in species richness or the abundance of individual species are natural because of habitat succession, interactions with other species, etc. It is critical that people understand that wildlife populations are dynamic and are expected to fluctuate over time, so they don't see a decline in the short term and blame it on poor reclamation.
- We need to explore the value of showing people wildlife that are on reclaimed lands (are we missing an opportunity – note the publicity gained by mountain coal mine sheep photos).
- We need to find ways to engage Aboriginal communities in wildlife monitoring as they have a vested interest in the outcome and should be given an opportunity to participate in multiple stages of the reclamation process, including monitoring.

3.6 Certification

Key participant observations around certification are listed below (more comments are provided in Appendix H):

- The question of how we judge success is the central issue. We need a clear, measureable and achievable reclamation objective.
- Expectation has been created through approvals and company EIA's, that at the end of reclamation there will be wildlife habitat *and wildlife*[6] … that the landscape will be functional for wildlife. Aboriginals want to see the wildlife. Although the current objective of reclamation is equivalent capability (i.e., habitat), the requirement to measure tree/forest productivity sets precedent for requiring "proof of performance" (i.e., wildlife presence) for certification.
- Need a certification system that incents the desired outcome rather than specifies the reclamation methods, but also lends itself to assessment – hard to accomplish both.
- We are lacking tools to fix things that are going off trajectory if not acceptable (e.g., prescribed burns, trapping/culling, reseeding, planting shrubs). There is uncertainty about whether the

[5] Authors Note: they may be related – research can produce better monitoring methods, or can validate monitoring techniques or approaches, while monitoring can provide data used in research examining the success of reclamation techniques, etc.

[6] Authors Note: while it may be appropriate to expect demonstrable wildlife use on a fully reclaimed mine, it is less realistic to expect use of smaller blocks of reclaimed land adjacent to, or surrounded by active mine areas.

larger community (e.g., public, Aboriginal peoples) would accept the tool (e.g., public reaction to burning the reclaimed areas – witness reaction to prescribed burns in National Parks) and concern about whether the tool will work. At the same time, we need to understand and accept that not all deviations from the desired trajectory are bad[7].

- Soil and vegetation assessments are done in small ecosite polygons but wildlife needs to be assessed at larger scales (perhaps even larger than the area being applied for) – therefore how does wildlife habitat assessment get done?
- Need a record of progressive reclamation to provide certainty that work done to date will not have to be redone. However, it is important to note that establishing topography, soils and vegetation automatically sets (constrains) the potential types and performance of wildlife species that can occur on that site, to some extent.
- There is value in looking at the information available on primary successional pathways around the world – chronosequence approach[8]. How do plant communities develop given no human intervention? We are trying to use secondary successional plantings to bring sites back, but primary successional pathways might be a better model.

4. Main Takeaway's from the Discussions

Some points were repeated often and strongly and by a variety of participants from various sectors during the discussions. These are captured below:

- Wildlife are an important feature of a reclaimed landscape, particularly in areas where traditional land uses include hunting and trapping. Therefore we need to ensure wildlife habitat created through reclamation will support desired species.
- However, we still have no clear understanding of the regulatory end objective for wildlife habitat reclamation. In particular, we need to know if the goal is capability (wildlife habitat, i.e., the potential for wildlife to occur) or productivity (wildlife use of a reclaimed area). Without this we are potentially wasting valuable time and resources in each of the wildlife habitat reclamation life cycle stages.
- There is a lot of untapped value in the vast amount of data collected to date – we need a mechanism to make the data more accessible.
- A number of times in the discussions it was clear people were surprised to hear that so-and-so was working on something or had some information. We need greater collaboration and transparency to maximize value of our limited resources across companies, government agencies and interest groups.

[7] Authors Note: it is probably important to recognize that multiple different outcomes may be acceptable, especially if site reclamation is considered in the larger picture of the regional scale.
[8] Authors Note: the trick is to identify one or more chronosequences that we can agree are relevant to boreal forest oil sands mine reclamation.

- Plans are just that – it is the implementation of these plans by on-the-ground reclamation contractors that determines ultimate success. Therefore we need to develop and deploy appropriate support for the contractors so they can help us succeed.
- Rigid application of numbers-driven regulatory requirements will not be successful. Flexibility in setting outcomes and the methods to achieve them is required. A cultural shift is required to acknowledge and accept that reclamation plans and trajectories are conceptual rather than a precise and detailed set of instructions that form the basis for assessment and enforcement actions.

5. Next Steps

Participants identified a number of actions that should be undertaken to enhance wildlife habitat reclamation success. We have broken the list into two groups: those that seem to offer the biggest bang for the buck and are reasonably easy to explore, if not implement; and those that are less well defined or may be too difficult to achieve in the short term.

Actions that are high priority and tractable in the short term:

- We should begin to develop fact sheets suitable for operator use (construction).
- We should explore ways to empower people on the ground doing the reclamation work: promote the idea that operators have a creative licence to do things that are not exactly to the construction drawings, and that this is permissible even if it costs a bit more money or takes more time – expecting that these costs will drop with experience.
- We should, wherever possible, modify construction specs and compensation for equipment operators and tree planters to encourage emulation of more natural types of habitat (e.g., greater diversity in attributes from soil placement and landform to how trees and other species are planted).
- We should share successes (and failures) of these modified contract specifications in enhancing the success of reclamation at local to regional scales.
- We need to develop good succession trajectories for different reclamation techniques and track as many sites as possible against these trajectories to build a solid database. We need to associate wildlife species presence and use with the stages of each trajectory.
- We need good wildlife habitat-based vegetation planting guidelines.
- We need to ensure that suitable quantities and types of vegetation propagules are available for planting, particularly for wetland species. We should explore enhancing capacity for seed collection.
- AER needs to ban grass as a reclamation cover, and instead encourage use of pioneer species (e.g., nitrogen fixers) to promote soil development rather than immediately planting secondary successional species.

- We need to enhance data availability. As a start, data collected under EPEA approvals are public and should be added to the Oil Sands Information Portal (OSIP)[9]. In the longer term, efforts should be made to make other industry/consultant data available and to require submission of the data underlying EIA reports.
- Government should take on the role of setting standards for data collection and format to ensure consistency and remove competitive obstacles.
- We need to make all closure plans available on-line in a GIS-type format, both for individual sites and for the region as a whole.

Actions that require better definition or are not achievable in the short term:

- Need documentation of historical reclamation prescriptions for soil mixes, depth, fertilizer applications, etc. The data will be important when assessing reclamation efficacy.
- Need to collect data for tailings Dedicated Disposal Areas – e.g., how deep the pit was before the tailings went in, what types of tailings went in and when, etc. May help understand things like salinity in an area.
- While we want people to publish in peer reviewed journals to enhance the credibility of work, we don't want to withhold data access for one or two years while the journal process is underway. We need to find some mechanism to share the data without impacting the ability to publish (Terrestrial Ecosystem Research Network, 2013). Perhaps aggregating data under the umbrella of an organization like AEMERA or COSIA would allow for both goals to be achieved.
- We need to find better ways to access and share Traditional Ecological Knowledge.

Some participants indicated interest in establishing a community of practice to continue the development of wildlife habitat reclamation guidance. Alberta Innovates – Technology Futures will explore this further.

5.1 Post-Workshop Survey

Participants also agreed there would be merit in asking people who were not able to attend the Workshop if they had additional observations to share, and provide an opportunity for attendees to submit additional comments following the workshop. Alberta Innovates – Technology Futures sent out a survey on March 11, 2016 (with a reminder on March 17th) to over 60 individuals inviting them to provide answers to three questions and encouraging them to share the survey with their colleagues:

> Identify the top three *things that should be done* in the next 5 years to enhance success of wildlife habitat reclamation (consider all life cycle stages of reclamation: Baseline Data Gathering; Planning; Design; Conservation and Reclamation; Monitoring; Certification).

[9] See http://osip.alberta.ca/map/

Identify the top three wildlife habitat reclamation-related *products* you wish you had today (e.g., data / information / map / model / equipment).

Would you be willing to participate in a community of practice on advancing wildlife habitat reclamation?

The survey closed March 23, 2016 (a summary of the 21 responses is provided in Appendix M – Figure 3 shows the distribution of respondent affiliations).

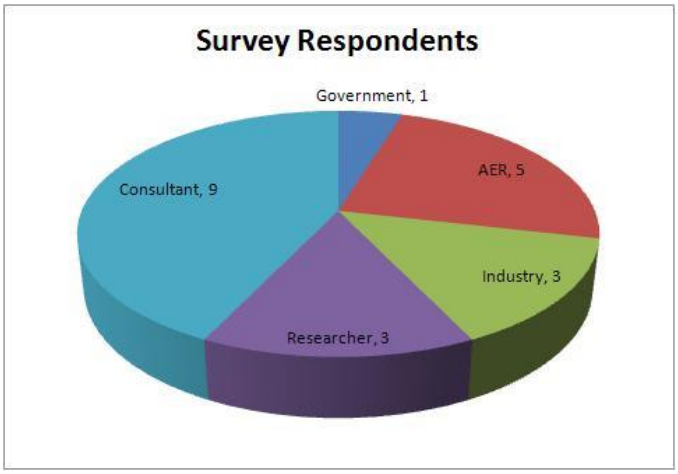

Figure 3. Survey Respondent Affiliations.

In general, the responses reflected the Workshop discussions, with three themes dominating the responses:

- Define criteria to meet success
- Develop an information portal of C&R plans and anticipated future developments at suitable scale for planning and coordination
- Get a working committee together to help Alberta mining companies learn from each other's successes and failures

Respondents also identified a number of policy issues related to expectations and regulatory processes.

Consistent with the final bullet above, 17 people indicated an interest in participating in a community of practice on advancing wildlife habitat reclamation.

6. Conclusions

It is clear that wildlife are an important feature of a reclaimed landscape, particularly in an area such as the oil sands where traditional land uses include hunting and trapping. Wildlife species are an integral component of many activities that help define an Aboriginal community's cultural values. Wildlife species are important as a food source but also as part of the traditional economy (e.g., furbearer pelts). At the same time, expectation has been created through approvals and company EIA's, that at the end of reclamation there will be wildlife habitat *and wildlife* … that the landscape will not just be capable of supporting wildlife but that the desired animals are actually present. Therefore we need to ensure wildlife habitat is created through reclamation that will support desired species.

Existing regulatory processes (EIAs, approvals, PDAs) require considerable information on wildlife habitat and wildlife species metrics. Models are used to extrapolate the extent and viability of pre-disturbance wildlife communities, the impacts of resource development, and the effects of reclamation

as a mitigation strategy however these models and the underlying data and assumptions are often the subject of considerable comment and skepticism from regulators and the public in reviews of EIAs.

A key observation of the Workshop is that, even after almost 50 years of development and reclamation experience, we still have no clear understanding of the regulatory end objective for wildlife habitat reclamation. In particular, we need to know if the goal is capability (wildlife habitat) or productivity (wildlife). Once the goal is understood the tools required to achieve the goal and assess success can be developed – in particular, development of Best Management Practices, expected trajectories for reclaimed land development (and its attendant ability to support wildlife), monitoring tools to evaluate success, adaptive management practices to realign sites with the desired trajectory, and certification requirements.

Workshop participants noted that considerable work has gone into baseline data collection and that there are many hectares of reclaimed land where wildlife have been observed (though their level of use of those reclaimed habitats has rarely been quantified). There was a sense that increased awareness of this information would significantly enhance wildlife habitat reclamation success – recommendations included: establishing a mechanism to share successes and failures, and developing a public data portal to get a better handle on regional wildlife habitat reclamation plans and status. There was strong interest in developing a community of practice on advancing wildlife habitat reclamation.

7. Glossary

The following terms and acronyms are used in the body of the report and in the appendices.

7.1 Terms

Cultural Keystone Species	Salient plant or animal species with a defining influence on a particular culture.
Temporal Planting	Planting species at different times to mimic succession and meet life cycle requirements (e.g., plant understory species after trees have grown enough to provide shade and cover).

7.2 Acronyms

ABMI	Alberta Biodiversity Monitoring Institute – http://www.abmi.ca/home.html
AEMERA	Alberta Environmental Monitoring, Reporting and Evaluation Agency – http://aemera.org/
ARU	(Acoustic / Autonomous / Automated) Recording Units
C&R	Conservation and Reclamation

CEMA	Cumulative Environmental Management Association
CKS	Cultural Keystone Species
COSIA	Canada's Oil Sands Innovation Alliance – http://www.cosia.ca/about-cosia
DEM	Digital Elevation Model
EIA	Environmental Impact Assessment
EPEA	*Environmental Protection and Enhancement Act*
FWMIS	Fisheries & Wildlife Management Information System – http://esrd.alberta.ca/fish-wildlife/fwmis/default.aspx
GIS	Geographical Information System
GLIMPS	Geographic Land Information Management and Planning System – http://aep.alberta.ca/forms-maps-services/industry-online-services/glimps/default.aspx
GoA / GOA	Government of Alberta
JEMA	(Shell) Jackpine Expansion Mine Application
KIR	Key Indicator Resource
LARP	Lower Athabasca Regional Plan
LSA	Local Study Area
MAPS	Monitoring Avian Productivity and Survivorship – http://www.birdpop.org/pages/maps.php
OSE	Oil Sands Exploration
OSIP	Oil Sands Information Portal – http://osip.alberta.ca/map/
OSRIN	Oil Sands Research and Information Network
PDA	Pre-Disturbance Assessment
PRMA	(Shell) Pierre River Mine Application
RSA	Regional Study Area

SIR	Supplemental Information Request
TEK	Traditional Ecological (Environmental) Knowledge
TOR	Terms of Reference
VEC	Valued Ecosystem Component

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APPENDIX A – Workshop Participants

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Resources – Brian Eaton, Alberta Innovates – Technology Futures; Gord McKenna – BGC Engineering

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APPENDIX B – An Ecological Framework for Wildlife Habitat Design for Oil Sands Mine Reclamation: Report Summary

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Introduction

In 2014 the Oil Sands Research and Information Network published a report developed by Alberta Innovates – Technology Futures describing a new way of thinking about wildlife habitat reclamation in the mineable oil sands region of Alberta (Eaton, B.R., J.T. Fisher, G.T. McKenna and J. Pollard, 2014. An Ecological Framework for Wildlife Habitat Design for Oil Sands Mine Reclamation. Oil Sands Research and Information Network, University of Alberta, School of Energy and the Environment, Edmonton, Alberta. OSRIN Report No. TR-67. 83 pp. https://era.library.ualberta.ca/downloads/cj82k851n). Here we provide a short summary of the report, with the intention of outlining the framework to promote discussion about the needs for wildlife habitat reclamation guidance, how best to harness and enhance current knowledge and practices in this field, and how to best develop a path forward for facilitating this process.

Closure planning and landform design are rapidly maturing in areas of geotechnical, surface water, groundwater, soils and vegetation, but there is little focus on specifically designing for wildlife habitat and only limited guidance in the general international mine reclamation literature in this respect. Improvements to planning, design, and operational practices for oil sands mines would benefit reclamation aimed at developing wildlife habitat as an end land use. Present reclamation efforts are largely limited to the creation of a mosaic of target ecosites using native species, then assessing the wildlife habitat potential of those designs using simplified Habitat Suitability Index (HSI) models at the lease/landscape level. The present report suggests a new approach – based on landscape and community ecology – to allow oil sands operators to plan, design and construct landscapes specifically for wildlife communities. The approach has been crafted to complement existing design and planning practices and to complement methods used in typical reclamation operations.

Context for Change

Mine closure plans indicate that, while closure landscapes target multiple end land uses, most reclaimed areas identify wildlife habitat as one of the main goals / land uses. Given wildlife habitat reclamation requirements in *Environmental Protection and Enhancement Act* (EPEA) approvals, reclamation, biodiversity and Aboriginal expectations in the Lower Athabasca Regional Plan (LARP), and the desire by

Aboriginal communities to use reclaimed land for traditional activities, there is an interest in ensuring reclaimed land supports viable and locally-appropriate wildlife communities.

For the oil sands region specifically, we contend that:

- There is a relatively poor understanding of the relationships between habitats and many species, with the exception of some boreal songbirds and a few other well studied species such as woodland caribou. Without empirical-based knowledge of these relationships, templates for reclamation guidelines have largely relied on unvalidated habitat suitability indices.
- Reclamation has largely ignored the context of the landform and landscape surrounding the disturbed site (nested spatial scales) with respect to wildlife ecology.
- Reclamation is typically treated as a one-time process, generally overlooking opportunities to conduct different reclamation activities (especially revegetation) at different times through succession to achieve the best wildlife objectives.
- There is little guidance to practitioners on designing a reclaimed landscape to provide wildlife habitat based on ecological knowledge and concepts of spatial and temporal scales.
- Measures, methods and thresholds for wildlife species/habitat indicators for reclamation certification remain undeveloped.
- It is expected that the landscape distribution of habitat types created by reclamation in the mineable oil sands region will differ from the original (i.e., shift from peatland-dominated systems to a landscape with increased amounts of upland and non-peat forming wetlands). Reclaimed sites themselves will have different hydrology, soil properties, and wildlife communities from those that existed previously.

Balancing these challenges creates an enormous opportunity to develop new and effective wildlife habitat reclamation approaches through the use of landscape ecology principles and the planning / design / operational practices outlined in this report. This opportunity is enhanced by the following positive features:

- The existing 7,800 hectares of reclaimed land provides an opportunity to understand wildlife use of reclaimed sites in the mineable oil sands region, albeit in discontinuous patches at the landform scale in proximity to major ongoing mine operations.
- There are tens of thousands of hectares of land already disturbed and scheduled for progressive reclamation, allowing a learn-by-doing approach if reclamation techniques are well documented and reclaimed sites monitored appropriately.
- Within the mineable oil sands industry there is existing infrastructure, access, a highly skilled workforce, a functioning regulatory system, supportive educational and research institutions, and nurseries that provide native vegetation for reclamation.

- Several mines will have large contiguous areas of mine reclamation – covering thousands of hectares – available to wildlife over the next decade, allowing testing of new and old mine reclamation design and operational methods to develop best practices.
- Mine reclamation investments by the industry, totaling billions of dollars, provide an opportunity for research and monitoring that will allow both a step change in wildlife habitat design processes and continuous improvements on current and future methods to enhance wildlife reclamation success while increasing cost-effectiveness.

The Landscape Ecology Approach

The landscape ecology approach to wildlife habitat reclamation proposed here is designed to fit within a framework of landform design and closure planning. This approach involves design at several spatial scales (regional, lease/landscape, landform, patch, and microsite – see Table 1 below) and across a range of temporal scales. It also stresses an adaptive management approach which includes specifying goals, monitoring, and both managing existing sites and improving design practices for future sites based on the outcomes of previous work. The landscape ecology approach includes a focus on design of patches for size, shape, vegetation planting patterns, connectivity with adjacent patches – both natural and reclaimed, and corridors. One of the major features is a focus on the use of natural analogs, and especially fire ecology in the boreal forest, to provide for guidance for designers.

We advocate an approach for reclaiming wildlife habitat based on a simple premise. If the microsite, patch, and landform structure of a reclaimed site emulate an undisturbed site (i.e., fit within the natural range of variation as much as possible), then the wildlife communities recolonizing that site should also be similar, provided the reclaimed sites are connected to appropriate patches (e.g., those supporting elements of the target wildlife community) within the surrounding landscape. In addition, we also assume that appropriate arrangement of habitat patches across the landscape will provide the necessary requirements for establishment and persistence of the species that make up the wildlife community; this includes connectivity between habitat patches within an area, between landscapes, and between regions (for migratory species). The major objectives and associated strategies for designing wildlife habitat during reclamation are summarized below (Table 2).

Table 1. Spatial scales that should be considered during wildlife habitat reclamation, and how they related to mine planning.

Scale	Size	Description	Example	Mine planning activity
Microsite	0.1 to 0.25 m^2	A small physical feature of importance to wildlife.	A snag, or a pile of coarse woody debris.	Construction plans and annual reclamation construction.
Patch	0.01 to 0.1 km^2	A connected system of microsites. A patch has consistent internal characteristics that make it unique from its surroundings, such as dominant tree canopy species.	A mixedwood forest stand, or an ephemeral pond.	Building block of all mine reclamation planning. Annual reclamation plans.
Landform	1 to 25 km^2	A connected system of patches that is topographically defined and is the major unit of specific design for mines.	A creek watershed; Syncrude 30 Dump	Landform design, reclamation plans
Landscape (Lease)	100 to 1000 km^2	A connected system of landforms that combine to create a functioning area, about the size of a company's lease.	Christina River watershed; Syncrude Lease	Closure planning
Region	50,000 to 100,000 km^2	A connected system of landscapes that includes leases but also rivers, lakes, towns, and conservation areas, which together support diverse values.	South Athabasca Oil Sands Region	Integrated regional closure planning

Table 2. Objectives and strategies for wildlife habitat reclamation following oil sands mining.

Objective	Strategy
Plan hierarchically	• From the region, to the lease/landscape (closure plans), to the landform (landform design) to patches (reclamation plans) and down to microsites (operational plans). • Design the landscape and landforms with topographic diversity to mimic the natural ranges, distribution, and mosaic of patches. • Set design goals for the region, lease/landscape, and landform scales. Focus designs on meeting these goals.
Emulate natural, undisturbed sites to the extent practicable	• Develop connectivity among patches within and between leases, emphasizing the critical role of connectivity for wildlife reclamation. • Recognize the natural variability, unpredictability and dynamism inherent in any designed landscape, as there is in natural landscapes.
Plan for wildlife communities rather than for individual species	• Depart from focal species. • Emulate wildlife enhancements occurring in natural habitats to support a natural wildlife community, including species at risk and other focal species of interest.
Create a diverse community	• Nest microsites within patches, and patches within landforms.
Maximize structural and biological diversity	• Enhance planting techniques. • Create a diverse topography. • Prescribe density and spacing of elements in the landscape. • Develop standard designs for elements/microsites based on how those elements are currently distributed in undisturbed sites. • Consider the possibility of transplanting wildlife, inoculating soil and wetlands, etc.

Our wildlife habitat reclamation philosophy is pragmatic: we advocate *using the best information currently available* to inform reclamation efforts now, rather than waiting until we know all the answers. We believe that much knowledge can be gained by adopting an "intelligent tinkering" approach (active adaptive management). Under this paradigm, each reclamation project is viewed as an experiment in which reclamation methods and materials are recorded, monitoring is carried out, and results are analyzed and adjustments are made, either to the original site or to reclamation at similar sites, and the information widely shared amongst practitioners and stakeholders.

We also advocate the use of *reference sites* to provide quantifiable benchmarks to assess reclamation success. Information on the range of natural variation for key attributes (e.g., snag and tree density,

patch size) derived from sites with minimal anthropogenic disturbance enhances our ability to mimic natural ecological form and function during reclamation. We recognize that practicality (e.g., the minimum or maximum patch size that can be cost-effectively constructed) will limit how much of the range of natural variation can actually be mimicked during reclamation. However, by mimicking the range of natural variation to the greatest extent possible, we can promote habitat and wildlife diversity within individual reclaimed sites and across the entire mineable oil sands landscape.

Design Approach

Patches are the fundamental building block of landscapes and wildlife habitat reclamation, both from an ecological standpoint and a mine planning / operational basis. In the oil sands mining context, patches are contiguous areas of reclaimed land with single soil and revegetation prescriptions, typically all planted in a single year; patches of 5 to 50 ha are common. Patch design is first done at the closure planning stage at the lease / landscape scale, with soils and revegetation targets typically assigned to polygons on the closure design surface that have similar substrates and topography (e.g., slope and aspect). The next level of detail comes at the landform design level, and in the three- and five-year reclamation plans. Note that, currently, these reclaimed patches are generally not optimized for wildlife habitat. Not all patches have a target end land use as wildlife habitat, but in many cases it may be possible to enhance potential wildlife habitat within sites developed for other land uses, such as forestry.

Importantly, patches are not just about reclamation planting; to be enduring they need to be supported by the design and construction of the landform (e.g., substrate and topography). Developing methods of adjusting such landform designs to facilitate creation of enduring reclamation landscapes supporting a variety of patch sizes, shapes, transitions and corridors is a significant next step toward future success in wildlife reclamation in the oil sands. Currently, most reclaimed patches are approximately rectangular, and often dissected by benches (very long narrow patches) and roads. Wildlife species typically are not adapted to this patch shape, so reclamation design must also diligently avoid straight edges wherever possible, instead creating convoluted shapes and feathered edges for every patch.

Designs for the microsite scale for wildlife habitat elements (e.g., snags) must be part of the reclamation plans, executed by field staff during soil placement and revegetation. Field operators will make on-site decisions to suit the site, but must do so armed with strong guidance and well-defined bounds on those decisions.

The natural progression of lease development and mining – including landform construction and reclamation – imparts certain temporal patterns on the landscape which may impact wildlife. Considerable landscape diversity naturally results from mining and reclamation practices as they currently occur, and as mining areas evolve over decades. Within logistic and cost constraints, there are many opportunities to enhance the pattern and timing of reclamation to benefit wildlife, particularly at the regional scale. Monitoring and adaptive management are important tools for increasing our understanding of how wildlife communities change as a result of natural processes and/or management

activities at a reclamation site over time, and for guiding periodic adjustments to the trajectory of reclamation sites in order to achieve end land-use targets.

Call to Action

The increasing regulatory and stakeholder interest in wildlife habitat reclamation provides a strong incentive to adopt this new ecological framework. Next steps include:

- Apply the framework to existing closure planning, landform design and reclamation planning. There are opportunities for optimizing mine reclamation strategies and processes systems; in some cases this will require relatively minor adjustments, while others present opportunities to make substantial changes. The framework allows for incremental adoption geared toward the final goal of integrated data-based planning, as opportunities arise.
- Inventory current reclamation sites to determine if they can be enhanced using the techniques provided in the framework.
- The framework incorporates design (planning) and element (operations) sheets to provide guidance on specific topics related to wildlife habitat reclamation (examples of a design sheet for patch size and shape, and an element sheet for snags are provided in the OSRIN report). Each sheet outlines the ecological basis for the guidance, how this translates into reclamation practice, and provides information on applying this information on the ground. This approach provides flexibility to develop these guidance sheets in a prioritized order, invoke different sheets as appropriate for different reclamation goals, and to allow easy incorporation of sheets developed by a range of proponents.
- The guidance sheets provide an excellent opportunity for patch- and landscape- scale research and development of new techniques at the design / operations level. The initial sheets can be based on existing data, and updated with additional experience in design, construction, reclamation, and performance. There is an opportunity to incorporate Traditional Environmental Knowledge in the development of these sheets. Future sheets and updates to these sheets will benefit from monitoring, observation, research and experimentation.
- The value of the new framework is predicated on an active adaptive management program to test wildlife response to reclamation practice, evaluate the efficacy of efforts, perform cost-benefit analysis, and make changes to future guides.

APPENDIX C – Baseline Data Gathering

The following points were made in the Baseline Data Gathering session:

Data Purpose

Don't need more pre-disturbance data collection – need to gather and share more on sites that have been reclaimed.

Collecting attributes when doing PDAs, but assessing function on reclaimed landscapes – different sets of metrics.

Should include functional attributes in PDAs/EIAs. There is a disconnect between the type of data currently collected, and what the data are actually used for.

Lots of EIA/PDA data on soils and vegetation before disturbance, but soils on reclaimed sites are very different so what is the value of detailed knowledge of original conditions?

Fatal flaw – we don't think about landscape function at the PDA/EIA stage.

What are the ecological, physical, and biological requirements of the soil that would allow certain habitats to develop or be supported?

Soil ecosystem data – starting to be collected – may change how we view reclamation and how different techniques impact the eventual outcome of the reclaimed ecosystem.

As a planner/designer what is needed, data or information? We really need information, which means data that have been analyzed and interpreted within the context of reclamation.

Data Usage

Information collected in PDAs is virtually useless in terms of mine design. Can different data be collected specifically to support design and planning?

Perhaps not so much about the data that are collected, but how those data are used.

Data Availability

Concern that there are a lot of data but little information (e.g. interpreted data).

Huge amounts of data on soil/vegetation are collected by consultants (e.g., Golder 80,000 data points) but these are not accessible to different players in the oil sands region to permit datamining or larger-scale analyses[10].

[10] See Australia's Terrestrial Ecosystem Research Network (TERN) ecological information portal at http://portal.tern.org.au/; think OSIP for ecology

We have a lot of data, but it has not been compiled or analyzed – EIAs don't require raw data to be submitted.

There is often a lot of data available, but the time and impetus to analyze these data to the point where they inform planning/design/management is lacking.

Some data are not linked to location.

Sometimes people (e.g., companies) can't even get access to their own data if it has been collected by another party (e.g., consultant).

We know enough about many bird and mammal species and habitats.

Data should be a common good. AER should be the integrator and repository for all PDA/EIA/monitoring data.

There other data sources … can they be accessed?

The trouble with historical data is that the landscape may have changed between when it was collected and now. It is therefore important to make sure the context for those data is understood during analysis and interpretation.

Geographic Land Information Management and Planning System (GLIMPS) data is on its own system – need integrated databases to aid in planning.

Methodology

PDA data should be collected using the same methods as for monitoring post-reclamation. Currently, data collection, analysis and interpretation must meet EIA requirements. Should be collecting data at the beginning to inform reclamation; we already know that the site is going to look different at the end of the mining cycle.

Need discussions on data collection methods.

What is the role of TEK? This might be included in the first steps (e.g., PDA, EIA stage) of the mine reclamation life cycle.

Other data collections such as forestry, trappers, and the Regional Municipality of Wood Buffalo should be tapped.

Data Missing

Missing from EIA data – wetland function; where is water and sediment on the landscape pre-disturbance?

We do not have a good understanding of soil biodiversity, especially after that soil has been stockpiled for 10 years … does this material have the ability to support the target habitats, or develop into a state where these habitats can be supported?

Arthropods, soil organisms – data gaps – not directly collecting data on many of these groups at the moment.

Big data gap on wildlife movement at the moment.

APPENDIX D – Planning

The following points were made in the Planning session:

Planning and design is a continuous process – it is hard to separate these.

Seed co-op – working well in mineable oil sands area but do not yet know how to propagate some of these species; this may be particularly true for rare species.

We are not where we need to be in terms of wetland planning, design and construction; lots of work still needed on a range of wetland types (we have a reasonably good handle on marshes at this time).

Basis for Planning

Do we include species at risk (SAR)? Different stakeholders want different targets or end points. Do you base the outcomes (e.g., SAR) on the EIAs?

We are going to have to include species at risk in reclamation planning. However, if we find 20 species at risk, is the expectation that all species would be included individually in the planning process? There is no way we can effectively plan for 20 species. The challenge with Species at Risk is they typically occur at low density, are hard to monitor, and their presence at a site is often based on detecting one individual[11]. The current species at risk approach meets a lot of federal assessment requirements.

Should the focus be on one or a few SAR (e.g., caribou)? Important to understand habitat structure that supports SAR. However, by creating the habitat for one species, it may mean that other species are excluded because they have conflicting habitat needs.

Planning of site reclamation needs to consider neighbouring mines, adjacent undisturbed land values, local and regional corridors, and regional plan goals. Wildlife don't respect mine boundaries.

We should gather data on cost and ecological value of different habitat types to allow for better planning.

Understanding the ecology of the target wildlife species or community is really important … what are their habitat needs spatially and temporally?

You can work from the ground up (e.g., topography, etc.), or you can set a species (e.g., Canada warbler) as the target and reverse-engineer from there and use this species to judge success.

Are we looking at all wildlife or is there too much focus on four legged ground creatures? Tend to focus on things we can see, but not looking at soil biodiversity, for example.

Soils and vegetation planning are based on small ecosite polygons but wildlife planning requires much larger scale view (needs to integrate across multiple soil/vegetation polygons).

[11] Authors Note: this may be a function of how EIAs are done, as they typically only include short-term snapshot types of monitoring (e.g., visual surveys of a site over one or a few visits).

Need a good understanding of trajectory of reclaimed areas (succession). At what year do you have groundcover, shrub cover, tree cover – hard to predict wildlife response unless we have an understanding of these relationships.

Wildlife should be included in planning at the beginning of the planning process. Reclamation wildlife biologists often get called in at the end to do their best with what has been implemented to fulfill other explicit needs (e.g., soil stability, commercial forestry, etc.).

Make decisions early on with respect to wildlife and wildlife habitat – what do you want to ultimately want to have on the landscape in terms of wildlife?

Some things can be changed early in the mining and reclamation process (e.g., direction of mining); we need to understand what things can be changed to achieve reclamation targets, and what has to be given up to achieve those targets. It is much harder and more expensive to change some things later on during construction.

Decisions on habitat reclamation are influenced by conscious decisions based on many factors, including economic considerations.

Need for planning to be based on multiple factors (landscape, landform, soils, hydrology, vegetation, etc.). We have the technical capacity to collect and manage data, but may lack the capacity to translate the data into a two-dimensional plan that stakeholders and equipment operators can understand.

Some habitat types (e.g., yellow rail) are very difficult to reproduce during reclamation. There has to be an evaluation of what is feasible for the final landscape, in terms of habitat that you can actually create or influence, as opposed to those habitat types which you can theoretically create the potential for, but which cannot actually be created.

There has to be a mechanism that the initial objectives flow through (e.g., wildlife reclamation) to inform decision on what you are targeting for each polygon, as this influences how you would monitor for success relative to that objective.

Need to have some flexibility in terms of priorities for reclamation; how do you weigh different priorities from different proponents to reach consensus?

Soil properties change spatially and temporally – especially in early reclamation; need to understand these dynamics in the planning cycle.

We expect long term changes after closure and succession, therefore we actually exert less control on the long-term outcome of reclamation than we may think.

When considering integration across the landscape in terms of reclamation, how can two projects that are side-by-side mesh their reclamation plans if they are at different stages of their lifecycle? For example, the older mine may be in the habitat reclamation stage while the new mine is just opening.

Wetlands are not wastelands … they should be valued as highly as other habitats, but there is a problem related to how different ecosites are designated (e.g., LCCS assigns a rating of 5 for wetlands because the system focuses on upland forest).

Commercial forest with no understory will have some wildlife but not at the levels of diversity or abundance that you could have achieved by explicitly including understory vegetation.

Need to be aware of, and plan for, off-spec water quality in mine pits for a long period of time, which could be an issue for wildlife exposure if "attractive" habitat exists nearby.

We are struggling to see a landscape-scale system for oil sands habitat reclamation; however, just because it's hard, doesn't mean it is not important.

Stakeholder Needs / Vision / Engagement

Stakeholders care about what is actually there on the landscape. You can demonstrate on paper you have developed effective habitat, but it is an assumption unless proven through monitoring on the ground.

Stakeholders probably think of wildlife (actual) and not wildlife habitat (concept).

The forestry sector is using a strategic foresight approach employing scenarios to convey to stakeholders that there is uncertainty and therefore multiple potential outcomes related to harvest operations. They can identify key points in site development and can then return to stakeholders at these key points and report success, or if off-trajectory they can discuss options.

"Novel ecosystems" not as palatable as returning an area to pre-disturbance conditions (different targets).

Good idea to compare outcomes at the planning stage with the long list of stakeholder desires to see what can reasonably be accomplished. Important to note we can't meet all needs at all sites.

We are developing better tools to show stakeholders what the expected outcomes will look like.

Closure Plan

Wildlife habitat is now explicitly included in a lot of Closure Plans.

Is there an overall goal that balances the goals of the various plans required by the EPEA approval process related to oil sands mines – all integrated in closure plans? It would be nice if there was only one plan that needed to be considered.

We need a regional closure plan – not sure how to do this; who pays for this, how often is it updated, etc.; hard to figure out what approach would be used for integration across operators. For wildlife, is

this required or will it be an emergent property of the landscape[12] if all the individual operators do their reclamation correctly?

Closure plans are updated every 5 years to account for changes that are occurring in mine plans and regulatory requirements.

Diversity / Patchiness

Need to put back a diversity of landforms and water attributes. At the end of the day, we can only control topography, vegetation to be planted, some habitat enhancements, etc.; we cannot control everything.

How do patches interact spatially and temporally with each other, how do different species react to patches, etc. There is no way to satisfy the needs of all species at the same time.

We can really only control what the patch itself looks like.

Include remnant forest islands. Show these in your design documents and protect them from development and minimize impact on these patches.

Climate Change

Climate change can impact all aspects of reclamation.

There are regulatory challenges to incorporating climate change in reclamation planning, design, and implementation.

Need to incorporate climate change into reclamation plans and wildlife habitat design.

How does climate change affect wildlife – need to consider impacts on hydrology, habitat and wildlife at the same time.

For the landscapes that we are planning post-mining it is hard to predict what will actually be there because of climate change, etc.; the landscapes will be different in the future than what it was in the past[13].

[12] Authors Note: it will be an emergent property only if the plans for individual operators include a landscape component (e.g., consider the landscape context in which the reclamation is being done, regardless of whether the spatial extent that must be considered is completely within the lease of one company, or includes area outside of this lease as well). In addition, the "landscape scale" will vary by species, so this will have to be acknowledged when developing landscape-scale plans.

[13] Authors Note: This will be true of the mined landscape, but alterations of the natural systems in the region are expected to occur with climate change as well.

APPENDIX E – Design

The following points were made in the Design session:

Multi-disciplinary teams are involved in planning and design phases of the mine reclamation life cycle. The ability of a landscape to support wildlife depends on understanding multiple levels of ecological organization and support.

What scale are you designing at? What scale do you need to plan at to achieve habitat mosaics, and how is planning influenced by the target species/communities?

When do you make decisions on microsite characteristics, distribution, etc.? Is this during the design stage? Or do you need to design at 1:1000 scale for habitat mosaics that you hope to achieve and then create microsite enhancements during construction or the monitoring stage?

Wildlife integrate landscape, landform, soils, vegetation and hydrology – we have to get all of these right and in the right combination to support target wildlife communities.

What is the link between design and construction? Information at a detailed scale may be important at the construction phase to provide guidance for operators on the ground.

It is important to recognize that the chain of Plan -> Design -> Outcome won't always work as expected – multiple outcomes are possible for any reclamation project.

A high level of detail is inappropriate for mine-scale design, but may be important at the operational scale.

There may be impacts of landforms on each other … e.g., mounding in one area may generate forces on nearby landforms and what would those look like and how would they impact function?

How do you deal with post-reclamation hydrology and salts in the landscape?

APPENDIX F – Construction (Conservation and Reclamation)

The following points were made in the Construction session (Construction includes conservation and reclamation phases):

Construction Specifications / Plans / Incentives

Nothing motivates an operator more than finding they are doing reclamation.

Need to work guidance into specifications for operators in a way that they are comfortable and that achieves the outcome that you want as well … some operators need very specific instructions, while others may be open to less stringent guidance and may be more comfortable with being creative.

Does the way operators are paid have an impact on the final landform/landscape? If paid by the hour, would they may be happy to be more creative? If paid by the job, do they tend to do the job fast and straight? Is there a scale issue – e.g., is it more efficient to be fast and straight on a larger site?

Bids for smaller areas with different specifications will be different than bids for much bigger areas (efficiencies) with one main specification.

How do you incentivize tree planters for reclamation – paying per piece does not work for getting a natural-looking area, as the most efficient way to plant is in straight rows at consistent spacing.

Would it be possible to institute a certification program for reclamation equipment operators? This might take the form of an industry-wide course. It would also be possible to include reclamation expectations as part of safety orientations and project kickoff meetings.

There are economic drivers at play for reclamation operators – if bidding by the job, they are more likely to make things uniform, rather than diverse. It may be necessary to pay for diversity … it will be more expensive to get operators to "play" on the landscape. It may be necessary to use a mixed model, with operations such as bulk soil placement as a job cost (e.g., bidding), while developing topographic diversity is added at an hourly rate.

There is a history in the mineable oil sands of accepting a little bit more project expense if there is value.

Guidance

Do we have enough guidance sheets for how to do things on the ground? This is a real need. Something short, concise and in plain language that an equipment operator or construction supervisor can read and use on the ground – currently reports just sit on shelf and are not utilized by operational staff.

There is a need for a guide for operators on how to reclaim landscapes. It would be great to have a standard presentation/course for operators as part of their contractor safety/training. This should include lots of pictures, drawings, examples, etc.

Development of short fact sheets would be beneficial. They should include lots of pictures showing what you want to achieve during reclamation.

We need a way to communicate to the operator what is desired as a final target during landforming, planting, etc.; photos have a lot of power in this regard. It is not necessary to include things like microtopography on a plan. Photos of good and bad and the outcomes from each[14] would be sufficient. It is important to clearly explain why things should be done in a certain way.

Materials Handling

May be best to just describe to operators what the final outcome is supposed to be, so they can use their skills to achieve this during construction.

Go and have fun – allow operators to play with the landscape and create diversity in microhabitats … do not overdesign the reclamation site.

Can be a challenge for some operators to create heterogeneity (overcome training).

Equipment

There are constraints related to equipment fleets (a fleet of large equipment makes finer work more difficult) – requires more planning and operational control to ensure success.

Some equipment has on-board computers where you could actually load spatial data about soil placement, etc.

Soils and Coarse Woody Material

What is net benefit of overstripping peat – it depends on the substrate.

We don't need 50 cm of peat/mineral mix for reclamation.

Need to continue maximizing direct placement and use of LFH; this approach provides economic benefits to the company and leads to earlier growth of understory.

The oil sands industry is getting better at using coarse woody materials for reclamation (we no longer burn it).

Animals contribute to soil development (e.g., fertilization, microbiology).

[14] See, for example, Pyper, M. and T. Vinge, 2013. A Visual Guide to Handling Woody Materials for Forested Land Reclamation. Oil Sands Research and Information Network, School of Energy and the Environment, University of Alberta, Edmonton, Alberta. OSRIN Report No. TR-31. 10 pp.
https://era.library.ualberta.ca/downloads/j098zc29n

Vegetation

We should ensure that we don't plant agronomic species during reclamation (though this still occurs on in-situ and some pipelines).

We must make sure that planting prescriptions make sense. For example, the best approach would be to plant understory layers after the overstory has grown large enough to protect the understory (e.g., provide shade).

We need guidance to make temporal planting of vegetation species work better. During this process, succession should be emulated explicitly (e.g., plant colonizers like alder, not secondary successional species like white spruce). In the bigger picture of reclamation, it will not be a large cost to go in and do plantings of different vegetation layers at different times.

There are currently no empirical data that link planting densities to reclamation outcome – we need research in this area.

Need new stem planting diagrams – we do not need each stem exactly one metre apart; what would be the best configuration of different plantings (e.g. different species, or mixes of species)?

We need to learn to plant in clumps, not in straight rows, etc.

What is a noxious weed in the context of mineable oil sands reclamation?

It should be acceptable to leave some weed species, if they are not really aggressive; species such as perennial sow thistle will eventually disappear on their own anyway, and it is important to understand the characteristics of different species before expending a lot of effort on control.

Practices / Rules

We should review and update "rules of thumb" for reclamation that are currently accepted without question – don't keep doing something because it was an accepted practice.

There are still elements of reclamation that originated in agricultural areas and that are now applied to forested/mine systems where they are inappropriate.

We are not supposed to plant berries during reclamation to avoid attracting bears to active mine sites (safety). Similarly, we are not supposed to plant trees or shrubs on tailings dams so that visual monitoring of stability can occur.

Are we constrained by uniform application of reclamation practices (e.g., uniform, smooth slopes), or can they be tailored to each situation?

We should not be so prescriptive about numbers … we need flexibility, e.g., 80% soil is not exactly 80% it is 80% plus or minus. After all, we want diversity not uniformity. However, it is important to acknowledge that this makes it more difficult for regulators to audit reclamation.

Reclamation targets and outcomes are driven by culture – how do you get landowners and government staff to agree on what numbers mean (absolute vs. average vs. range)? We want to encourage diversity/variability across the landscape, but how is this best achieved?

We need to recognize that some companies will do the minimum necessary for reclamation certification and that some will be leaders. We need to develop regulatory oversight that encourages the latter but can effectively deal with the former without overly restricting the leaders.

Overfertilization can shift plant communities the wrong way (e.g., away from target communities).

Control of noxious weeds sometimes results in the loss of all plants in an area because weed sprayers kill everything except grass. Biocides may also have direct impacts on wildlife and fish … including bioaccumulation and biomagnification.

Some short term animal control may be required if particular species interfere with long term success (e.g., beaver, hares, deer).

When do trial-scale demonstrations of wildlife habitat reclamation get built into large-scale treatments? It is sometimes possible to get really good reclamation in a small area but it's impact is lost in the larger reclaimed mine area.

Consistent on-site reclamation supervisory staff helps to ensure outcomes are being met – they can be trained in techniques and show operators why things are good or bad at actual reclamation sites. It is important to recognize that best laid plans will be impacted by weather etc., so local oversight is needed.

Does timing come into play during reclamation (e.g., takes 18 months to turn a seed into a seedling)? We need to make sure all the different players in oil sands mine reclamation understand how the timing of some things can impact design, implementation, etc. For example, availability of wetland seeds is limited but lots of wetland reclamation is being planned, suggesting that there may be a lack of sufficient seed for all the planned projects.

APPENDIX G – Monitoring

The following points were made in the Monitoring session:

In situ approvals require wildlife monitoring – these efforts are project-specific, and data are not consolidated.

There can be a legacy issue when there are changes in management in companies, etc. We need to make sure there is corporate memory related to how monitoring is, and has been, done in the past so that we are not re-inventing the wheel.

Timing

Initial monitoring event should happen before any revegetation; last chance to get an idea of initial conditions.

Long term monitoring to determine reclamation success is required – 2 or 3 years to be able to check off a box will not be enough.

We need to continue to monitor outcomes after certification to show that the predicted outcomes actually occur over the long term.

Purpose

What are the objectives for monitoring?

Monitoring to an objective is necessary to be able to interpret an outcome.

Monitoring objectives should be set early in the process. While things can change, there should be a mechanism to provide continuity, even if the monitoring objective changes.

Iterative, internal processes related to monitoring objectives are needed.

Study design and data collection are not the same. We need monitoring that is appropriate and tied to objectives.

Are we monitoring to identify all of the species present on a reclaimed site (and reference sites) or a good representative set? This will have a significant impact on time (and $) spent – e.g., Owl Moon – 25 hours to get peak number of species; Erin Bayne – 36 hours.

Monitoring means different things to different people or for different uses.

We tend to focus on monitoring in an academic sense when we talk about monitoring. The difference may be that the academic approach includes a null hypothesis (e.g., it is to answer a research question).

Research monitoring – must balance needs with availability of funding, applicability to management, etc.

Need to move beyond research and start operationalizing monitoring. Need a combination of on-the-ground and remotely-sensed monitoring approaches.

Methodology

A lot of work has been done on data collection methods but not enough on sampling design.

There are good monitoring programs for soil and vegetation growth; wildlife monitoring is lagging behind, with much variability across operators, etc.

It would be good if there were a common monitoring program that everyone could employ so comparisons could be made across reclaimed sites of different age, or reclaimed using different methods. Everyone is doing their own thing, without a standardized approach.

COSIA is working on a regional wildlife monitoring program/protocol. This approach includes intensive sampling over a 3 – 5 year period on a series of sites with varying characteristics, then development of a rapid assessment tool based on the data collected from these sites for use in judging reclamation success. This will help improve power for statistical analysis since smaller, site-specific samples are merged into a larger database.

We need to come out with guidance based on the monitoring we have done already.

It is ineffective to monitor on a project-by-project basis – we need cross-mine, regional monitoring to cover the ranges of many wildlife species.

Is it possible to measure the function of a landscape?

It is not only important to determine what species are on a reclaimed site, but also what they are doing there, etc. (Paradigm – If you build it will they come, but if they come will they stay, and if they stay will they thrive?).

The scale at which you are monitoring and judging success, in terms of wildlife, is important. The influence of scale on effectiveness monitoring is important.

How do you scale monitoring effort appropriately across the landscape, across site types, etc.?

What is practical for monitoring? One of the best approaches is probably a combination of intensive monitoring for some sites, or types of sites, with more extensive monitoring of other sites which are similar.

Are the monitoring tools appropriate for tracking wildlife response to reclamation over time? For example, can we monitor early-colonizing species progressing to old growth forests; this is predictable to a degree.

We need to be very careful of using some species as indicators of success, unless we have a good understanding of all the factors that may influence their distribution and abundance; for example, the density of moose may be inversely proportional to hunting pressures.

What are the variables that you are monitoring? Is this information actually useful and relevant? Some indicators should be dropped if they are not useful.

Use a systems approach, rather than an emphasis on a particular species, during monitoring. The distribution and abundance of species will vary across at landscape scales, so it may not be appropriate to monitor particular species in all places/habitats, etc.

What is scientifically credible? What is good science is good science, wherever or whoever it comes from.

How many current wildlife monitoring programs incorporate good reference sites (offsite analogues)? CEMA does, some companies may.

Think about the scale of monitoring, and how other technologies might be used more efficiently; for example, ARUs (acoustic recording units[15]). Still need to know what question you are going to answer with all those data, which are challenging and costly to analyze. What are you trying to get out of a site: are you trying to get all the species, or use the recordings to determine what species are using habitat effectively? It may be necessary to use a combination of field work and recordings to determine actual use (field work) at fewer sites, with presence/not detected (recordings) at a larger number of sites.

Recorders (ARUs) are good for estimating species richness and confirming presence.

Remote sensing and unmanned aerial vehicles (UAVs) are also good tools for monitoring large areas; they can be used as triage tools for selecting sites for detailed follow-up monitoring. However, remote sensing generates tons of data so you need to have a clear question(s) in advance to know which data to collect and use.

Radio collars can be used to get a better understanding of animal use of reclaimed land[16] (e.g., radio collared toads around Suncor Base mine).

Tools such as those listed above should be used to replace some traditional monitoring efforts, not add to monitoring work load, otherwise they are not improving the efficiency of the monitoring program.

Monitoring Avian Productivity and Survivorship (MAPS) program[17] – use birds to judge the quality of the breeding habitat. Directly measures 7-10 ha patches, influenced by 20 ha – mist-netting; use ARUs to search for type species that would be expected in certain ecosite types at certain times.

It is not just important to monitor animals, but also covariates (e.g., vegetation, water levels, etc.), in order to understand the context for the data on faunal distribution, abundance and habitat use.

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[15] See, for example, http://ftp.public.abmi.ca//home/publications/documents/74_Bayne_etal_2014_AmphibiansReport2012_ABMI.pdf

[16] See, for example, http://phys.org/news/2016-01-reclamation-benefits-alberta-grizzly.html

[17] See http://www.birdpop.org/pages/maps.php

Data Availability

Industry has collected data that show how species are recolonizing reclaimed areas BUT accessibility to these data is restricted.

There is concern that C&R data are not making it onto OSIP.

Managing Perception

Public perception management issue – some declines in species are natural because of habitat succession, interactions with other species, etc. Must make sure people understand that wildlife populations are dynamic and are expected to fluctuate over time so they don't see a decline and blame it on poor reclamation.

Is there value in starting to show people wildlife that are on reclaimed lands (are we missing an opportunity – note the publicity gained by mountain coal mine sheep photos)? What is the role of wildlife cameras, etc. (e.g., one company reported 30,000 to 40,000 camera shots per year) in publicizing wildlife use of reclaimed lands?

Aboriginal Involvement

What about citizen science? There is certainly a desire amongst Aboriginal communities to be involved[18]

Companies interact with Aboriginal communities even in the design and reclamation stages of oil sands mine development.

Aboriginal communities believe that the land has spirit – only Aboriginal communities can monitor for return of the spirit.

[18] See, for example, http://www.aboriginalmining.ca/en/education/closure_site_rehabilitation.asp and http://aemera.org/news/media-release-aemera-partners-with-miistakis-institute-to-involve-albertans-in-environmental-monitoring/

APPENDIX H – Certification

The following points were made in the Certification session:

What is Success?

Here we are 50 years in and still asking some basic questions

The question of how we judge success is central to the certification process. We need a reclamation objective.

There is a perception (reality?) that land capability is not the goal anymore – ecosite replacement is.

What does success look like? The absence of wildlife does not necessarily mean that effective wildlife habitat has not been created. What does effective mean? Need demonstrated use of the reclaimed site by wildlife.

Expectation has been created through approvals and company EIA's that at the end of reclamation there will be wildlife habitat and wildlife … that the landscape will be functional for wildlife. Aboriginals want wildlife you can see. The hardest concept is demonstrating that *apparently* capable habitat is *actually* capable and effective.

Reclamation is not successful unless the wildlife come back. It cannot be considered successful just on the basis of planting and diversity and habitat.

Data suggests that wildlife are following a successional pathway from day 1 following reclamation

For stakeholders, it will be important that we demonstrate that *capable* habitat is actually *effective* habitat as well.

Does the need to demonstrate *wildlife use* (effectiveness) mean that certification is set back by many years (ie., that certification cannot occur until wildlife has returned to, and is using, a reclaimed area, which may take decades for some species)?

Are people interested in wildlife itself, or wildlife habitat? By creating habitat that has potential to support wildlife, have we done enough to satisfy regulations?

How are equivalent and effective related? It is an interesting observation that a site may not be equivalent to what was present pre-mining, but may still provide effective habitat.

Whose values do you use to judge whether you have had a net positive environmental impact? This can be very complex (e.g., input from multiple stakeholders)

Reclamation Trajectory and Adaptive Management

How far along the reclamation trajectory do you need to be before getting certification?

We are currently lacking tools to fix things that are going off trajectory if not acceptable (e.g., prescribed burns, reseeding, planting shrubs). There is presently unwillingness and uncertainty related to whether the community (public) would accept the tool (e.g., public reaction to burning the reclaimed areas – witness reaction to prescribed burns in National Parks).

Fire is a natural part of the boreal, and also has important precedents in terms of cultural and historic use. Some Australian sites won't certify reclaimed land unless it's been through a burn cycle. This is natural, part of the plan, how it should be but is not being discussed in the context of the Alberta situation.

There are currently no data on how reclaimed systems react to fire (though some Oil Sands Exploration (OSE) sites and seismic line caribou restoration plots were burned in the Richardson Fire). There are questions around whether a reclaimed site that is burned will come back the way you want it. This makes people nervous. For example, will it set the system (and certification date) back, wasting all the money used on planting vegetation in the first place? Sooner or later it will burn anyway. There are always fires going throughout the oil sands region.

Can you identify and rectify deficiencies in reclaimed habitat (shift from expected/desired trajectory) to improve function, so that certification can be achieved?

What interventions actually have an effect, and which are only useful at the start of the reclamation process?

There is a danger in committing to make changes related to a deflection of recovery trajectory. Change isn't necessarily bad – it depends on where the trajectory is now heading. Trajectory change doesn't mean you necessarily have to make alterations – it presents an opportunity to weigh the potential outcome and make a conscious decision to accept the new outcome or take steps to correct the problem.

Adaptive management is about fine tuning results NOT redoing the original work.

Success Measures / Criteria

We need a certification system that incents the desired outcome rather than specifies the reclamation methods, but that also lends itself to assessment – hard to accomplish both.

Soil and vegetation assessments are done in small ecosite polygons but wildlife needs to be assessed at larger scales (perhaps even larger than the area being applied for) – therefore how/when does wildlife habitat assessment get done and how does this relate back to the reclaimed site scale?

The best approach is to build a reclaimed habitat that emulates natural systems relevant to the area being reclaimed.

For success you will need understory and overstory species but the current regulatory system seems to require concurrent planting, even though understory plants require the shade from taller overstory plants (therefore guaranteeing failure under the present paradigm). We need to allow for planting of

understory vegetation after the overstory species have achieved enough size to provide a suitable environment for understory species.

The metric of success changes with the scale of the animal's home range size and overall habitat needs.

Do we look at a polygon when assessing reclamation success, or determine success across the entire landscape? How do we judge that?

We should not use the occurrence or density of specific species as targets. Over time, the quality of the habitat will change for different species. For example, young forests provide better moose habitat than older forests.

What should we be doing differently? What information can we extract from arthropod data? For example, spider guilds can be used to track ecosystem shifts … may be important in tracking recovery trajectories. This may allow us to course-correct early in the reclamation process.

Not specifying a rule can be both a goal and a fear … this is particularly true when you are trying to judge reclamation success. We should not use specific numbers (% of certain ecosite types) when judging reclamation success.

Current reclamation criteria are not tied to whether wildlife species have actually returned to a reclaimed site. There may be concerns if reclamation certification is tied to presence of wildlife species.

We need to use the regional biodiversity framework to drive criteria for success. Right now, we are looking at habitat, not species presence, abundance, distribution, productivity, etc. New technologies will be important in filling in data gaps when people cannot be in the field.

Return of beaver = return of the spirit to the land.

Certification Process

It is not clear that we can certify some sites – are we developing an over-constrained system? A different system would say: is the land stable, did we put down the soil we said we would, did we plant what we said we would, 3 years in are the trees still alive?

Need a record of progressive reclamation to provide certainty that work done to date will not have to be redone. Important to note that establishing topography, soils and vegetation automatically sets some bounds on the potential types and performance of wildlife species.

How long after reclamation do you have to accomplish wildlife habitat? Before the reclamation certificate is issued, or – if after – for how long after?

Can you judge sites reclaimed based on previous techniques using today's standards? A site might fail even though it was fine using previous standards … is this fair?

Success Factors

Floral and faunal colonization of reclaimed patches is going to be important in achieving "success".

There is value in looking at the information available on primary successional vegetation pathways around the world – chronosequence approach. How do plant communities develop given no human intervention? We are currently trying to use secondary successional pathway to bring sites back, but primary successional pathways might be a better model.

Need to change the culture of expectation … understanding that sometimes there are stages that an area must go through to get to success.

What we don't know (e.g., soil microbiology) can have as big an impact on success as the things we are actually focusing on.

Example of a Wildlife Reclamation Measure

Based on current observations of species diversity you should be able to get a reclamation certificate after 15 years. This involves documenting changing species groups, based on natural systems, with the potential to course-correct based on monitoring for certain groups. There is a plateau in terms of species diversity at 15 years (Figure 4), based on reclaimed and reference sites. This is based on habitat structure, certain species, etc., and on a variety of sites that were reclaimed at different periods in the past. Some of these sites have been monitored since they were reclaimed. This is based on measuring productivity and survivorship of bird populations, not just diversity. This also includes data on amphibians and mammals (including bats). We can predict when some of these groups will show up at a reclaimed site.

Species accumulation curves suggest that variability in natural systems is high. How do you deal with this when developing criteria for success, as there will also be variability in reclaimed sites? The important difference is that bird work is also looking at breeding success, not just presence/absence.

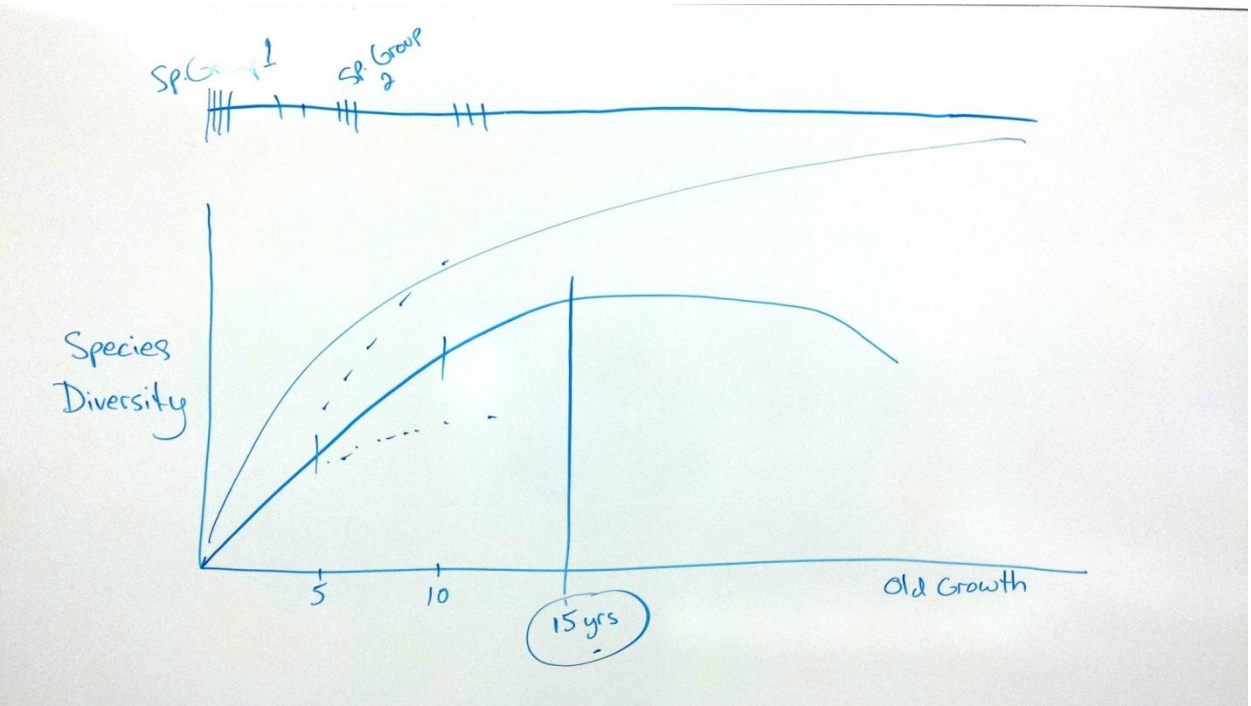

Figure 4. Species Diversity Curve for Reclaimed Sites and Natural Analogs.

The lower solid line represents actual data mirroring the expected / desired trajectory. The dashed lines represent potential deviations from the expected curve – if monitoring data fall here then it may trigger assessment of options to correct back to the desired trajectory.

Time zero is planting date. Data are for upland sites – early years (0 – 15) are from reclaimed sites; later data from undisturbed "controls". The upper horizontal line represents the predictable shifts in various species and groups that are found over time (not just birds) – presence of the species/group is indicator of success. There would be different curves for different ecosite types.

APPENDIX I – General Observations

The following general observations were made during the Workshop:

Research and monitoring play a role throughout the life cycle of a mine and there are feedback loops amongst the different stages.

Feedback loops at many of the steps in Figure 1.

There is risk and accountability in all decisions but if we want change we have to be willing to address both.

We should be more consistent with Best Management Practices across different industries (e.g., mine site vs. in situ) – some of those used on mines are not being allowed on in-situ sites.

Workshop Participant Interests

As part of the introductions at the Workshop participants were asked to identify their interests in the subject. The following comments were provided.

- challenge of doing appropriate habitat reclamation for wildlife – this is an endpoint, not an input
- what determines success in terms of wildlife habitat
- demonstrating that habitat that has been created is actually being used by appropriate wildlife guilds
- colonization by wildlife – especially by birds
- monitoring is a prime interest
- monitoring and reclamation planning
- soil chemistry and biodiversity – how does this change from stockpiling to use in reclamation
- harmonize obligations with species at risk (SAR) with what the forestry sector is obligated to do in terms of habitat needs
- how to tie in land development planning with developing habitat to encourage and deter wildlife at different parts of the mine life cycle
- reclamation design and monitoring during (coal) mine development

Regulatory Policies and Practices

Lag between research and demonstration, and implementation. May be a challenge related to regulation. Uptake from research to demonstration to commercialization is often poor.

Where is the line between too prescriptive and allowing the creativity that leads to diverse wildlife habitat design? How do you build a system that allows creative habitat design to occur?

BC Forest Practices Code[19] has gone through a number of cycles related to being flexible in reclamation (management) in commercial forestry - prescriptive, results-based, prescriptive, results-based.

It appears that approvals are moving away from soil prescriptions that used to preclude the development of some types of ecosystems, especially those that are drier.

Approval renewals often change conditions over life of a mine – decisions must flow through from start to finish to inform monitoring so there is concordance between initial objectives and how certification is determined – a key part of this is the economic implications of the approval changes.

Interpreting approval conditions and stakeholder expectations and building them into an action plan is difficult.

Hydrology and Hydrogeology

Water quality and the movement of salts are important for influencing the occurrence of aquatic species.

Restoring hydrology of an area can be complicated…how do you get the water to manage itself on a reclaimed landscape? Hydrogeology may be an even bigger challenge.

Wildlife

It is harder to keep animals out of an active mine area than it is to encourage them come in[20].

Keep wildlife out of some sites (e.g., use snags to control mice).

Some areas are still dangerous for wildlife, so they must be kept out, but nearby sites are supposed to be reclaimed for wildlife; this can be a challenge to manage.

When do you want animals on a reclaimed site? Is it important to keep them out of certain areas for the safety of the employees and/or wildlife itself?

Education programs for workers about not feeding wildlife are important; some companies have even fired people for feeding coyotes.

Operations that would benefit wildlife – garbage management must be exemplary to reduce human-wildlife conflict.

[19] See http://www.fao.org/docrep/w3646e/w3646e0a.htm

[20] Authors Note: this may be true of animals in general, but getting the target species to colonize and stay in a reclaimed area may be challenging.

Impact of wildlife on reclamation plans – e.g. impact of mice, etc., on plant survival (especially with young plants).

Control of deer and snowshoe hare to avoid loss of new plantings.

Beavers are a pest…

Goals and Outcomes

Government needs to get better at articulating what it is looking for – many players in government, need clear articulation of roles and responsibilities. It is important to understand who is doing the work, and interacting with people on the landscape.

Range of Potential Outcomes

Habitats will not remain stable because there are changes in soil chemistry over time as tailings age, etc. Long term changes may be unpredictable and uncontrollable, leading to changes in outcomes of reclamation…need to acknowledge that there are multiple potential outcomes that are acceptable.

Develop a range of probable scenarios with signposts along the way…use as a basis for engagement with stakeholders over time. Build the landscapes with the stakeholders. Incorporate a range of stakeholders (aboriginal, etc.) throughout the entire planning and implementation and monitoring cycle.

Need flexibility to try different things, such that you can be reasonably sure the regulator will accept a number of potential outcomes.

If there are many potential successful outcomes, who determines which of those outcomes are accepted as successful?

Some goals / uses will conflict with others – who decides which are appropriate?

Data

Fisheries & Wildlife Management Information System[21] (FWMIS) – data not linked to oil sands data portal.

Lots of wildlife/fisheries data are collected but not added to FWMIS. FWMIS principally consists of observational data; there is no habitat information linked to these data points.

[21] See http://esrd.alberta.ca/fish-wildlife/fwmis/default.aspx

APPENDIX J – Regulatory Context for Wildlife Habitat Reclamation

Alberta's regulatory system for oil sands mines specifies wildlife habitat reclamation requirements.

Environmental Impact Assessment

Under the Environmental Protection and Enhancement Act oil sands mine proponents must submit an Environmental Impact Assessment report that requires, among other things (Alberta Environment and Sustainable Resource Development 2013):

2.10[A] Provide a conceptual conservation and reclamation plan for the Project considering:

> (b) current land use and capability, vegetation, commercial forest land base by commercialism class, forest productivity, recreation, wildlife, aquatic resources, aesthetics, traditional land uses and land use resources;
>
> (f) post-development land capability with respect to:
>
> > (ii) traditional use with consideration for traditional vegetation and wildlife species in the reclaimed landscape,
> >
> > (l) promotion of biodiversity.

Environmental Operating Approvals

Environmental operating approvals for oil sands mines issued by the Alberta Energy Regulator pursuant to the Environmental Protection and Enhancement Act include the following requirements (Alberta Environment 2011):

6.2.8 [A] Mine Reclamation Plan [that] shall address, at a minimum, the following:

> (m) fish and wildlife habitat as defined by validated habitat modeling (or other habitat assessment tools recommended by the Director) for key species consistent with pre-disturbance capabilities;

6.2.8 [A] Life of Mine Closure Plan [that] shall address, at a minimum, the following:

> (l) fish and wildlife habitat as defined by validated habitat modeling (or other habitat assessment tools recommended by the Director) for key species consistent with pre-disturbance capabilities;

6.3.26 [A] Revegetation Plan [that] shall comply with the Guidelines for Reclamation to Forest Vegetation in the Athabasca Oil Sands Region, 2009, as amended, and shall at a minimum:

> (b) incorporate vegetation and vegetation communities that establish habitat for wildlife, including birds;
>
> (c) establish capability for long term biodiversity consistent with the Plan for Reclamation Biodiversity;

6.3.35(h) a Wetland Revegetation Plan that shall include at a minimum, the following:

> (iii) incorporation of vegetation and vegetation communities that can provide habitat for wildlife, including birds;
>
> (vi) re-establishment of the capability for long term biodiversity consistent with the Plan for Reclamation Biodiversity;

6.4.24 The approval holder shall re-establish wildlife and fish habitat levels, at a minimum, similar to that which existed prior to disturbance, in proportions appropriate relative to the approved Life of Mine Closure Plan.

6.4.25 The approval holder shall demonstrate, through monitoring, progress in achieving the wildlife and fish habitat levels as outlined in subsection 6.4.24.

6.4.26 The approval holder shall re-establish a diversity of wildlife and fish habitats similar to those that existed prior to disturbance, in proportions appropriate relative to the approved Life of Mine Closure Plan.

6.4.27 The approval holder shall demonstrate, through monitoring, progress in achieving a diversity of wildlife and fish habitats as outlined in subsection 6.4.26.

6.4.28 The approval holder shall document wildlife and fish habitat utilization on the reclaimed land by monitoring wildlife and fish species typically associated with and naturally occurring in the wildlife and fish habitat types present.

6.4.34 [A] Plan for Reclamation Biodiversity [that] shall include, at a minimum, all of the following unless otherwise authorized in writing by the Director:

> (a) a determination of the technology required to establish best practices for development of biodiversity for a range of target ecosystems through reclamation;
>
> (b) a determination of reclamation coversoil and subsoil composition and key vegetation species and their roles in supporting the return of biodiversity and native ecosystems in the reclaimed landscape;

(c) a plan and schedule to monitor and document the return of biodiversity in the reclaimed landscape; and

(d) a plan and schedule to evaluate and compare changes in biodiversity on reclaimed sites and in the region.

References

Alberta Environment, 2011. Environmental Protection and Enhancement Act Approval for Construction, Operation and Reclamation of the Joslyn North Processing Plant and Associated Mines (Leases 24, 452 and 799). Alberta Environment, Edmonton, Alberta. 75 pp. https://avw.alberta.ca/pdf/00228044-00-00.pdf

Alberta Environment and Sustainable Resource Development, 2013. Standardized Terms of Reference – Oil Sands Mine Environmental Impact Assessment Report. Alberta Environment and Sustainable Resource Development, Edmonton, Alberta. 22 pp.
http://environment.gov.ab.ca/info/library/8758.doc

APPENDIX K – Stakeholder Context for Wildlife Habitat Reclamation

Environmental Impact Assessment Proposed Terms of Reference Comments – Oil Sands Mines

Alberta's Environmental Impact Assessment (EIA) process allows for public comment on proposed terms of reference for the Environmental Impact Assessment report. The following comments relative to wildlife habitat have been extracted from recent EIAs on Alberta Environment and Parks' website. The majority of comments received on projects in the Athabasca oil sands region come from Aboriginal communities.

Syncrude Canada Ltd. Mildred Lake Mine Extension (MLX) Project – comments submitted by Fort McKay First Nation, October 2013.

2.10 Conservation and Reclamation

Provide a conceptual conservation and reclamation plan for the project considering … current land use and capability … including wildlife … productivity.

Discuss how the proposed reclamation methods have performed in similar situations … including … re-population of these areas by plant and wildlife species of importance. Include in the discussion the plants and animals included in the Aboriginal communities' traditional species lists.

Discuss, from an ecological perspective, the expected timelines for establishment and recovery of vegetative communities and wildlife habitat, the expected success of establishment and recovery, and the expected differences in the resulting communities.

3.7.2 Wildlife

Describe and assess the potential impacts of the project to wildlife and wildlife habitats, considering … the resilience and recovery capabilities of wildlife populations and habitats to disturbance.

Discuss mitigation measures to minimize the potential impact of the project on wildlife and wildlife habitat … and to return productive wildlife habitat to the area. Consider

> consistency of the plan with applicable regional, provincial and federal wildlife habitat objectives and policies
>
> a schedule for the return of habitat capability to areas impacted by the Project

5 Traditional Ecological Knowledge and Land Use

Provide a discussion of a quantitative assessment of impacts to traditionally important wildlife species (including, but not limited to, Fort McKay's cultural keystone species, and as determined in discussion with Fort McKay, other species for Fort McKay's traditional wildlife list). Include mitigation strategies to address those impacts.

6.1 Public Health

Identify the human health impact on country foods and natural food sources potential contamination, taking into consideration all Project activities as well as the impacts they might have on opportunities and desire (resulting from perceptions of health safety) for traditional activities.

UTS Energy Corporation/Teck Cominco Frontier Oil Sands Mine Project – comments provided by Athabasca Chipewyan First Nation, October 2008.

4.8 Wildlife

Any impacts to wildlife considered important to the First Nations should be mitigated with the goal of no net loss on a regional basis.

Provide benchmarks and targets for wildlife populations over the lifetime of the project, in association with recolonization of reclaimed landscapes and other future development scenarios in the region. Discuss the time required to recolonize and sources for recolonization.

Describe the potential changes to wildlife … including anticipated effects on the quality of traditionally consumed species including ungulates, rabbits and game birds.

Provide a discussion and consideration of the effects of ecosystem shifts with respect to reclamation success, prediction confidence and wildlife recolonization of the Local Study Area (LSA) and Regional Study Area (RSA).

Describe the residual effects of the Project and … identify impacts on wildlife species … to the opportunities for local Aboriginal residents to hunt and trap successfully.

UTS Energy Corporation/Teck Cominco Frontier Oil Sands Mine Project – comments provided by Mikisew Cree First Nation, October 2008.

Include a condition that requires setting specific targets or benchmarks of performance over time with respect to wildlife habitat use and the successful recolonization of disturbed landscapes by wildlife.

Please explain to the Mikisew Cree the local and regional measures of “success” and “effectiveness” of reclaiming the landscape for wildlife populations.

Please explain to the Mikisew Cree the current status of local and regional end land use targets or benchmarks for wildlife populations.

Shell Jackpine Expansion and Pierre River Mining Areas Project – comments provided by Fort McKay First Nation, September 2007.

6.1 Biodiversity

Determine a suite of biotic biodiversity indicators … and …

> include TEK (including but not limited to traditional plant and animal species lists, and identified sites of cultural significance) as appropriate in the determination of indicators, and discuss how it contributed to the assessment.
>
> discuss biodiversity on proposed reclamation ecosites and the implications or the project's incremental effects on biodiversity in the event that the assumption or completely successful reclamation does not prove accurate.

5.6.4 Wildlife

Discuss habitat enhancement and wildlife species populations it will support.

Environmental Impact Assessment Proposed Terms of Reference Comments – Quarries

Parsons Creek Aggregates Limestone Quarry Project – Comments of Fort McMurray First Nation, March 2007.

The interconnectivity of wildlife habitat and unimpeded movement by wildlife needs to be addressed and discussed in the EIA report. Developers assume that wildlife species will actually remain in the local or regional area in sufficient numbers to re-populate their reclaimed landscape – not to mention those of other regional and immediately adjacent developments. Where will these wildlife species reside and continue their lifecycles for the duration of the Parson Creek Project?

Parsons Creek Aggregates Limestone Quarry Project – Comments of Fort McKay First Nation, March 2007.

5.6.3 Wildlife

Indicate what measures will be taken to ensure the habitat enhancement measures remain intact until effective habitat capability is returned to the areas impacted by the Project.

5.6.4 Biodiversity

Discuss the expected biodiversity on reclaimed areas, cross referencing the Conservation and Reclamation Plan as to how this will be achieved.

Discuss how biodiversity on reclaimed sites will be assessed, including monitoring programs that may be used to conduct the assessment.

Other Stakeholder Views on Wildlife Habitat Reclamation

In a 2010 survey of 1,032 Albertans Chapman and Das (2010) found that *wildlife habitat protection* was ranked as the #2 value driver (among 8 choices). In their previous 2007 survey wildlife habitat was ranked #1. Respondents overwhelmingly believed the goal of reclamation should be to support and sustain a wide diversity of plants and animals (87% completely agreed or agreed).

Participants in a 2015 workshop on (Powter et al. 2015) on Aboriginal participation in reclamation identified the following wildlife reclamation issues and opportunities:

> Caribou are big issues for us and we are part of anything about caribou.
>
> Caribou rely on old growth forest, 80 years minimum to re-establish on cut blocks.
>
> Contribute to caribou decline; wolves use cutlines to spot caribou, issue for caribou.
>
> New issue with grizzly populations being pushed into caribou/moose habitat? Could be due to different vegetation? Unintended repercussions on fauna populations. How do we design reclamation plans to keep predators controlled? Are we beyond mitigating that and just need to accept the linear disturbances (seismic lines, pipelines) with regard to predators? The government doesn't realize that it takes decades to revegetate lichen and other caribou fodder.
>
> Need species specific strategies; caribou critical habitat.
>
> Some sites now are getting wildlife use now; land is becoming useful, closer to the end-goal.
>
> Ideal results of reclamation; trajectory in 5 years, 10 year, and after. Functional for human use, wildlife use.
>
> Tours and education opportunities. Reclamation tours, seeing natural revegetation as a reclamation plan, First Nation people are not understanding or trusting that this is a valid or productive way to reclaim. Tours can help them see the success of the natural revegetation and think of alternatives. Show them the berries, the browsing, tracks, show them that the wildlife is visiting the site.

In a report on reclamation challenges (Jones and Forrest 2010) survey respondents noted:

> End land uses … they are not independent of each other. Wildlife, recreation, First Nations use, forestry, all can occur at the same location.
>
> Natural boreal wetlands are a critical habitat for many important wildlife species, including woodland caribou, moose, muskrat, beaver, waterfowl (particularly diving ducks) and amphibian. They link to the traditional way of life of local Aboriginal people.

In Fort McKay we have reclamation keystone cultural species that would indicate success; the presence of beaver for example or ratroot.

References

Jones, R.K. and D. Forrest, 2010. Oil Sands Mining Reclamation Challenge Dialogue – Report and Appendices. Oil Sands Research and Information Network, School of Energy and the Environment, University of Alberta, Edmonton, Alberta. OSRIN Report No. TR 4. 258 pp. https://era.library.ualberta.ca/downloads/3j3333312

Parsons Creek Aggregates, 2007. Limestone Quarry Project Proposed Terms of Reference Public Comments. Alberta Environment, Edmonton, Alberta. http://esrd.alberta.ca/lands-forests/land-industrial/programs-and-services/environmental-assessment/documents/Parsons_Creek_Combined_Comments.pdf

Powter, C.B., J.J. Doornbos and M.A. Naeth, 2015. Aboriginal Participation in Land Reclamation: Enhancing the Dialogue. Prepared for the Land Reclamation International Graduate School, University of Alberta, and the Canadian Forest Service, Natural Resources Canada. Edmonton, Alberta. 84 pp. https://www.ualberta.ca/~lrigs/PDF%20Documents/LRIGS%20CFS%20Aboriginal%20Workshop%20Report%202015.pdf

Shell Canada Limited, 2007. Jackpine Expansion and Pierre River Mining Areas Project Proposed Terms of Reference Public Comments. Alberta Environment, Edmonton, Alberta. http://esrd.alberta.ca/lands-forests/land-industrial/programs-and-services/environmental-assessment/documents/Shell_JE-PRM_Combined_Comments.pdf

Syncrude Canada Ltd., 2013. Mildred Lake Mine Extension (MLX) Project Proposed Terms of Reference Public Comments. Alberta Environment and Sustainable Resource Development, Edmonton, Alberta. http://esrd.alberta.ca/lands-forests/land-industrial/programs-and-services/environmental-assessment/documents/Syncrude-PTORComments-Dec2013.pdf

UTS Energy Corporation/Teck Cominco, 2008. Frontier Oil Sands Mine Project Proposed Terms of Reference Public Comments. Alberta Environment and Sustainable Resource Development, Edmonton, Alberta. http://esrd.alberta.ca/lands-forests/land-industrial/programs-and-services/environmental-assessment/documents/Frontier-PTORComments-Oct2008.pdf

APPENDIX L – Government Context for Wildlife Habitat Reclamation

Alberta's Environmental Impact Assessment process allows for government agencies to ask questions to clarify the information provided by the project proponent. These questions are called Supplemental Information Requests (SIRs). This section provides examples of SIRs related to wildlife habitat reclamation plans to highlight issues that are of concern to government agencies – many other SIRs relate to wildlife in general and provide additional insight into factors that should be considered in a wildlife habitat reclamation plan.

UTS Energy Corporation/Teck Cominco Frontier Oil Sands Mine Project

SIR Round 1

Question 207
Volume 6, Section 4.5.19, Table 4-9, Page 4-238
Volume 3, Table 1-4, Page 1-21

Teck defines reversibility, but does not provide a timeframe for what is considered reversible.

a. Provide a clear definition of 'reversible', including the time frame for which it applies.

b. Does this vary by VEC, or by circumstance and species? If so, describe how and provide a table for all Key Indicator Species used in the assessment clearly indicating for what timeframe reversibility was assessed and why.

c. How was resiliency of species to disturbance considered in the determination of 'reversibility' of effects?

Question 222
Volume 6, Section 4.5.20, Page 4-250
Volume 6, Section 4.5.24, Page 4-256

Teck states that Progressive reclamation of the Project along with other developments and initiatives for expansion of protected areas (see Government of Alberta 2011, Internet site) will mitigate cumulative effects on wildlife habitat availability in RSA.

Teck states that Progressive reclamation of the Project along with other developments, and initiatives for expansion of protected areas as well as timely removal of linear features (see Government of Alberta. 2011, Internet site) will mitigate cumulative effects.

Teck is relying on other operators and [Government of Alberta (GoA)] initiatives to mitigate cumulative effects on wildlife habitat availability in the RSA.

a. Provide details regarding Teck's proposed progressive reclamation for the mine and discuss how these measures will mitigate cumulative effects on wildlife habitat availability in the RSA.

b. Outline how Teck will ensure the timely removal of linear features to facilitate the mitigation of cumulative effects.

Question 226
Volume 6, Section 4.6.3, Page 4-262

Teck has identified that the Frontier Project will add to the removal of a large land base in addition to the proposed [Pierre River Mine (PRM)], the approved Total Joslyn Mine and the existing CNRL Horizon Mine on the west side of the Athabasca River between the Birch Mountains and the Athabasca River. Teck has also identified that the Fort Hills Oil Sands Mine on the east side of the River will further reduce wildlife habitat connectivity in the area. Teck's mitigation strategy is to re-establish wildlife habitat through reclamation and minimize sensory disturbance.

Re-establishment of wildlife habitat is an uncertain outcome. It is also in the far future.

b. What additional mitigation measures will Teck implement to reduce the projects effect on habitat connectivity during construction and operations?

Question 228
Volume 6, Section 4.6.5.2, Figure 4-139, Figure 4-140, Pages 4-268 and 4-269

The figure shows extremely limited connectivity for moose under the existing reference condition but a substantial increase in connectivity for moose under the base case. This would seem to indicate that open pit mines are good for moose habitat connectivity. It could also however, simply be an artifact of the assessment design.

a. Provide a discussion of how the assumption that moose habitat can be reclaimed has affected the assessment of the regional effects on habitat connectivity for moose. If this assumption was not made, how would that change the assessment conclusions?

b. How is the assumption that moose habitat can be reclaimed consistent with a conservative approach to assessing impacts?

c. How were changes to landform and topography incorporated into the assessment of habitat connectivity for moose?

SIR Round 2

SIR Round 2 – Question 107
Volume 1, Section 6.5, SIR 228b., Page 6-256

Teck was asked how the assumption that moose habitat can be reclaimed successfully is or is not consistent with a conservative approach to assessing impacts.

In response, Teck states that The assumption that progressive reclamation will be successful and meet reclamation objectives for target species such as moose is realistic and supported by reclamation monitoring programs in the Athabasca Oil Sands Region (Hawkes and Tuttle 2013). No other evidence/ support as to the validity of this claim was provided.

The Hawkes and Tuttle report only comments on wildlife occurrences on early successional plots obtained through a pilot study. The primary purpose of the study was to assess the suitability of the monitoring methods to monitor the return of wildlife to reclaimed areas. It does not provide evidence to support the assumption that progressive reclamation will be successful in meeting reclamation objectives for target species such as moose or other species. In fact the report states that Without the inclusion of natural plots into the monitoring program there is no way of knowing whether the reclaimed ecosystems are on a trajectory towards pre-disturbance wildlife habitat capabilities. This inclusion of natural plots into the monitoring program is only now being initiated.

a. Correct/clarify the reference to the Hawkes and Tuttle report (2011).

b. Provide further evidence from scientific, peer-reviewed and regional literature that supports Teck's claim that this assessment took a conservative approach to assessing impacts on wildlife despite the heavily reliance on an unfounded assumption of wildlife habitat reclamation success.

Shell Jackpine Mine Expansion

SIR Round 1

ftp://ftp.gov.ab.ca/env/fs/EIA/2007-12-ShellJackpineMineExpansionPierreRiverMineProjects/JPME%20Sup%20Info%20R1.pdf

427 – Volume 3, Appendix 3-1, Table 1, Page 26.

TOR 5.6.4 l) call for a mitigation plan to minimize impacts on habitat and wildlife populations that takes federal policies into consideration. Shell identifies reclamation as the primary means of mitigating effects of the project on habitat and wildlife.

427A Clarify the consistency of the proposed reclamation plans with the objectives of the federal Policy on Wetland Conservation.

436 – Volume 5, Section 7.1, Page 7.2

Shell states The environmental consequences of the project on terrestrial resources are determined after closure and reclamation. For the period of operations, there will be complete loss of soil and terrain, terrestrial vegetation, wetlands and forest resources, wildlife and biodiversity in the Project development areas.

436B Discuss the generational time, implications of local extirpation, potential impediments to re-colonization, and potential long term shifts in the ecology of the area as a consequence of invasive species such as deer.

437 – Volume 5, Section 7.1.2, Page 7-5; section 7.5.2.2, Page 7-67; Section 7.5.2, Page 7-95

… (3) Shell states The development areas themselves will have no disturbance at closure and states Reclamation of terrestrial vegetation is understood, thus prediction confidence is High.

437C (3) seems to imply a high level of confidence in Shell's ability to reclaim the mine to its current, pre-mining, ecological function. Discuss how this might be measured. Given the state of reclamation knowledge and experience in the region, discuss Shell's confidence in stating that their development areas will have no disturbance at closure in the context of returning the following to pre-mining function:

ii. End pit lakes to functional … waterfowl habitat

iii. Overburden dumps to wildlife habitat

444 – Volume 5, Section 7.3, Page 7-26

Shell indicates the First Nations communities are concerned about the loss of wildlife and wildlife habitat and question the ability of companies to reclaim areas even over the long term.

444A How has Shell responded to these concerns and have they been resolved?

462 – Volume 5, Appendix 5-1, Section 2.5.3, Page 83

Shell states that re-colonization of the reclaimed landscape will depend on proximity to other natural sites and dispersal pathways from source populations, among other factors.

462A If there are further oil sands developments directly adjacent to JEMA and PRMA, what effects would this have on the potential for wildlife re-colonization?

462B Discuss features of the JEMA and PRMA development plan that might ensure maintenance of dispersal pathways from source populations.

Joint Panel SIRs

ftp://ftp.gov.ab.ca/env/fs/EIA/2007-12-ShellJackpineMineExpansionPierreRiverMineProjects/JPME%20Sup%20Info%20R1.pdf

SIR 19

In Chapter 7, Volume 5, Table 6.7-8 Shell provided the reduction in habitat for each wildlife [Key Indicator Resource (KIR)] for the Planned Development Case. In Shell's updated cumulative effects assessment, the Panel requests that Shell:

a. Provide maps for each wildlife KIR in the RSA indicating the various habitat suitability classes that … would occur in the future (prior to reclamation and after reclamation and closure).

SIR 37

Shell stated (Appendix 3-4, p. 39): "it is not clear, however, whether climate change will reduce or increase the overall recharge rates, or alter the seasonal distribution of recharge …". The Panel requests that Shell … indicate how changes in climate, particularly rainfall and recharge might impact revegetation and recolonization and … further discuss any impacts to wetlands and wildlife habitat.

References

Shell Canada Limited, 2009. Jackpine Mine Expansion and Pierre River Mine Environmental Impact Assessment. Alberta Environment and Sustainable Resource Development, Edmonton, Alberta. ftp://ftp.gov.ab.ca/env/fs/EIA/2007-12-ShellJackpineMineExpansionPierreRiverMineProjects/

UTS Energy Corporation/Teck Cominco, 2008. Frontier Oil Sands Mine Project Environmental Impact Assessment Report. Alberta Environment and Sustainable Resource Development, Edmonton, Alberta. ftp://ftp.gov.ab.ca/env/fs/EIA/2011-11-TeckResourcesLtdSilverBirchEnergyCorpFrontierOilSandsMine/

APPENDIX M – Post-Workshop Survey Input

After the Workshop, Alberta Innovates – Technology Futures sent out a short survey to workshop participants, to those who weren't able to participate in the workshop itself, as well as to some additional wildlife habitat practitioners to gather additional information. People who received the survey were encouraged to circulate it amongst their colleagues.

M.1 Survey Responses

A total of 21 people from a variety of sectors responded to some or all of the survey questions. The following sections summarize the answers received to each of the three questions – many of the responses to the first two questions were similar so we have reorganized them to fit best with the original intent of the questions. Similar responses were aggregated into themes (shown as sub-bullets under the main theme bullet).

M.1.1 Identify the top three things that should be done in the next 5 years to enhance success of wildlife habitat reclamation (consider all life cycle stages of reclamation: Baseline Data Gathering; Planning; Design; Conservation and Reclamation; Monitoring; Certification).

Policies

- Timely reclamation policies
- Be clear and explicit on a reclamation objective-setting process
- Development of frameworks and adaptive management systems
    - Framework for reclamation of wildlife habitat
    - Carefully ensure alignment between objectives and treatments. Use a planning framework to guide this and have humility.
- Clarification of regulatory expectations and requirements
- Clear communication process to regulatory decision makers
- Develop regional vision and objectives on wildlife habitat reclamation
    - Information on the long-term vision for reclamation certification
    - Set habitat goals (e.g. no net loss, replacement, quality and condition, etc.)
- Acknowledgement from regulators that pioneer species should be encouraged on reclamation landscape (fireweed, alder thickets) to treat peat mineral mix pH issues
- Dedicated sustainable funding for long-term

Information Exchange

- Get a working committee together to help Alberta mining companies learn from each other's successes and failures
    - A wildlife habitat reclamation discussion group consisting of practitioners from various groups/fields (including collaboration)
    - Collaboration amongst operators regarding key technologies
    - Sharing of results from research, operational trials, etc., between oil sands companies
    - Annual forum for exchange of information on reclamation practices, successes, etc.
    - Monitoring and sharing of results/failures
- Incorporate robust, peer reviewed science. Carefully select multiple academics that see program goals and have a track record of delivering. Using only one academic has its risks.

Baseline Data Gathering

- Operational guidance based on best available data
- Understanding of site limitations (data gathering)
- Have sound wildlife baseline data available for the project.
- Conduct gap analysis on the needs for additional data
    - Collect necessary data based on the gap analysis

Planning

- Coordinated, landscape-scale reclamation planning, design, and implementation
- Developing short, medium and long term plans
- Planning reclamation strategies for wildlife habitat
- Developing clear Best Management Practices that benefit wildlife habitat reclamation to incorporate into project planning
- Further guidance on "planning" and "designing" (i.e., when to target individual species or biodiversity overall, how consider landscape connectivity/movement potential, etc.)

Design

- Design with end wildlife species in mind

- Guidance on design for patch size and attributes for reclaimed land
- Increased complexity of reclamation prescription to include habitat patches, micro-topographic features
- Detailed landform design with 'boreal' mosaic surface expressions
- Clear spatial design examples of landscape, vegetation and features

Conservation and Reclamation

- Consider reclamation during the construction phase
- Develop guidelines for various reclamation techniques to enhance wildlife habitat based on available data
- Implement reclamation pilots
- Adaptive management experiments to test the effectiveness of alternative reclamation practices
- Collaborative efforts focused on large areas (i.e., not doing small amounts of work in many places)
- Detailed evaluation of effectiveness of reclamation in restoring wildlife habitat and populations
- Conservation and reclamation - proper oversight in the field during landform construction (what we say we will do and what actually happens are two separate things!)
    - Greater operational regulatory oversight during conservation and reclamation activities
    - Prompt C&R and enforcement of prompt action

Monitoring

- Incorporate sound wildlife monitoring programs into approval lifecycles by sector
    - Monitoring results feeding into planning
- Rigorous protocols for assessment and monitoring
    - Identify local and landscape monitoring survey objectives and methods
- Monitor wildlife habitat recovery after certification
- Targets and associated monitoring and changes
- Establish long-term "control" (reference) sites for wildlife (similar to what is done for vegetation)
- Monitoring - understanding temporal/spatial change of salinity and pH and what that means for reclamation trajectories

Certification

- Define criteria to meet success
    - Define success
    - Identify how "success" is defined for wildlife habitat reclamation (including standardizing the objectives, particularly as it pertains to potential certification)
    - Determine consistent measures of success
    - Clear reclamation criteria
    - Simplify and clarify reclamation certification criteria -- embrace the progressive certification system.
    - Create standardized reclaimed habitat evaluation criteria with reference to available guidelines
    - Clear rules/criteria for habitat requirements (species & area)
    - Regulators agree on certification requirements
    - Information from government on goals and objectives
    - Measurable objectives informed by science
- Identify key indicators for wildlife habitat

M.1.2 Identify the top three wildlife habitat reclamation-related products you wish you had today (e.g., data / information / map / model / equipment).

- Information portal of Conservation and Reclamation (C&R) plans and anticipated future developments at suitable scale for planning and coordination
    - Open access database of industrial sites in Alberta
    - Database on pre-disturbance baseline conditions
    - Maps including future development and C&R plans
    - Spatial (GIS) mapping of reclamation status, wildlife/vegetation features that fit together on a regional/cumulative basis
    - Routinely updated maps, in GIS environment, to facilitate landscape-scale planning for wildlife habitat reclamation
    - Restoration prioritization maps
    - A regional map of disturbance, existing reclamation, and planned reclamation in gory detail

- DEM map of closure landscape with as-builts and detailed designs.

- Data base and tools
  - A database that provides easy access to all wildlife reclamation monitoring efforts in the oil sands region
  - Data to support decision making
  - Data sharing tool, i.e., Standardized data entry/ upload
  - Data visioning tool (multi-level: stand, mine lease, landscape), i.e., web-based mapping or reporting (would need consistent evaluation criteria to work)
- Inventory and analysis of existing wildlife habitat reclamation projects
  - Detailed, georeferenced inventory of projects completed, in progress and planned
- Develop a list of ecological and societal wildlife habitat reclamation needs
- LiDAR for reclaimed industrial sites
- Mapping of regional natural wetlands, especially depth and soil characteristics, that could be applied to wetland design for reclaimed areas.
- Validated recovery trajectories for reclaimed habitats of different types
  - Index of wildlife habitat recovery
- Research data on wildlife and reclamation habitat relationships
  - Data/information – wildlife usage, population info, diversity, etc.
  - Habitat modeling information and mapping
  - Pre- and Post-treatment caribou population data
- A reclamation manual for the oil sands area that incorporates detailed prescriptions for restoring wildlife habitat
  - Reclamation Best Management Practices for wildlife (vegetative species, design factors, etc.)
  - Knowledge of what works
  - Data on techniques (effort vs. results information)
- Experimental controls against which to assess treatment effectiveness
- Integrated model (baseline, monitoring, predictive)
- Hydrological model of regional closure landscape (that can be adapted as plans change)
- Clear targets for each patch of reclaimed area
- Information on soil development in different ecoregions
- Tree and shrub stock options (species, size and condition)

- Succession pathways of reclaimed vegetation communities

M.1.3 Would you be willing to participate in a community of practice on advancing wildlife habitat reclamation?

A total of 17 people from a variety of sectors agreed to participate in furthering the discussion on advancing wildlife habitat reclamation.

M.2 Additional Comments Received

In addition, Alberta Innovates – Technology Futures received a few comments before and after the Workshop that are included here.

I honestly feel that we are beyond the days of working in isolation on this issue. We need to start collaborating way more than we have been.

The recommendations [in the OSRIN report] regarding the value of adaptive management are well founded, but the requirements for intensive inter-organizational cooperation may be unrealistic. I'm having trouble thinking of good precedents for success in this regard.

The ugly fact remains that we cannot wave a magic wand and instantly create ecosystems with the same structure and complexity as those that we initially disturbed. Most of the species that will comprise the ecosystems matching our long term goals must still arrive and "assemble" on their own, including all of the wildlife.

There was absolutely nothing in [the OSRIN document] on measures of success. How do we know when what we've done is "good enough"?

Although not directly involved in the wildlife habitat reclamation, through our regulatory work, we are involved in the design of Compensation Lakes/Offsetting lakes in the oil sands area, and our effort is to accommodate wildlife features in our design (this was one of aboriginal stakeholder's recommendations).

Monitoring data should be collected in standard protocols that allow direct comparison with regional biodiversity benchmarks (such as ABMI) to assess reclamation success.