Overview of the Restoration Toolkit

April 28, 2015

Context: The Caribou Story

- Proximate Cause = Predation
  - ↑ Early Seral Habitats
  - ↑ Alternate Prey
  - ↑ Predators
- Ultimate Cause of Declines = Habitat
  - Reduced Spatial Separation
  - Habitat Avoidance
  - Cumulative Impacts
  - Habitat Alteration

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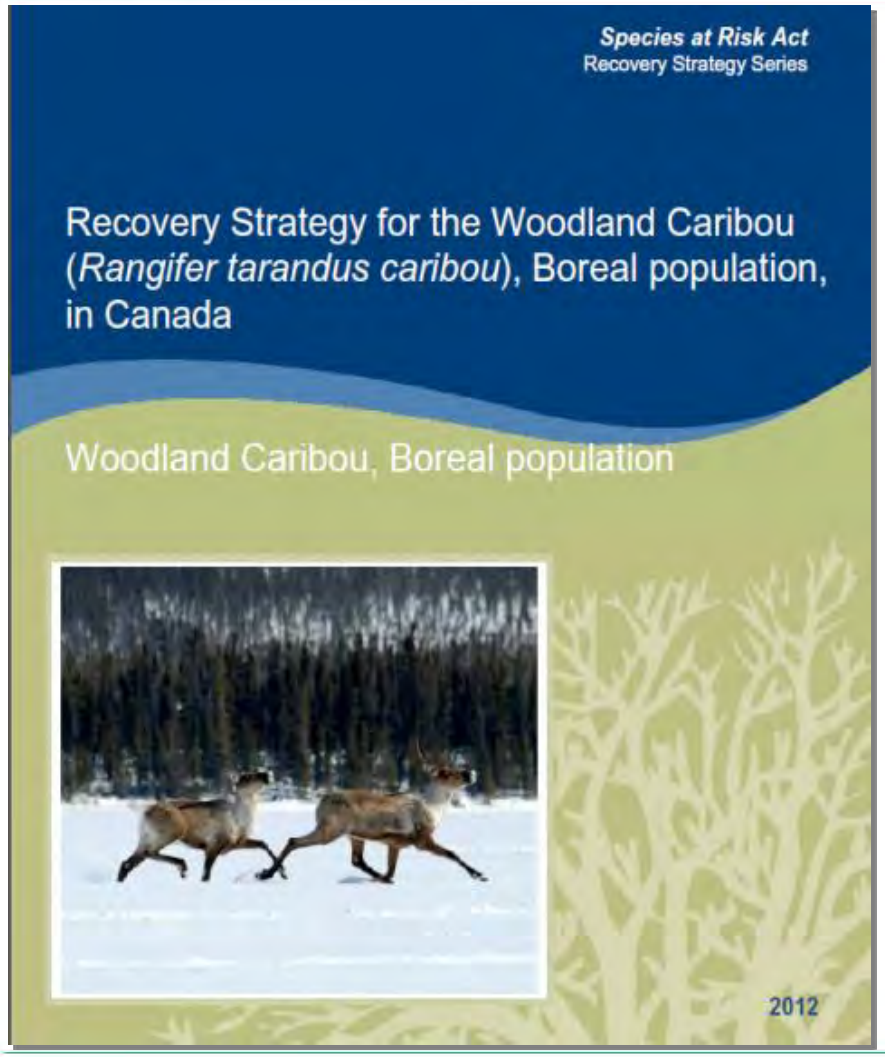

Target 65% undisturbed habitat

- 40+ years old
- Not fragmented

*"**Restoring industrial landscape features** such as roads, seismic lines, pipelines, cut-lines, and cleared areas in an effort to reduce landscape fragmentation and the changing predator-prey dynamics"*

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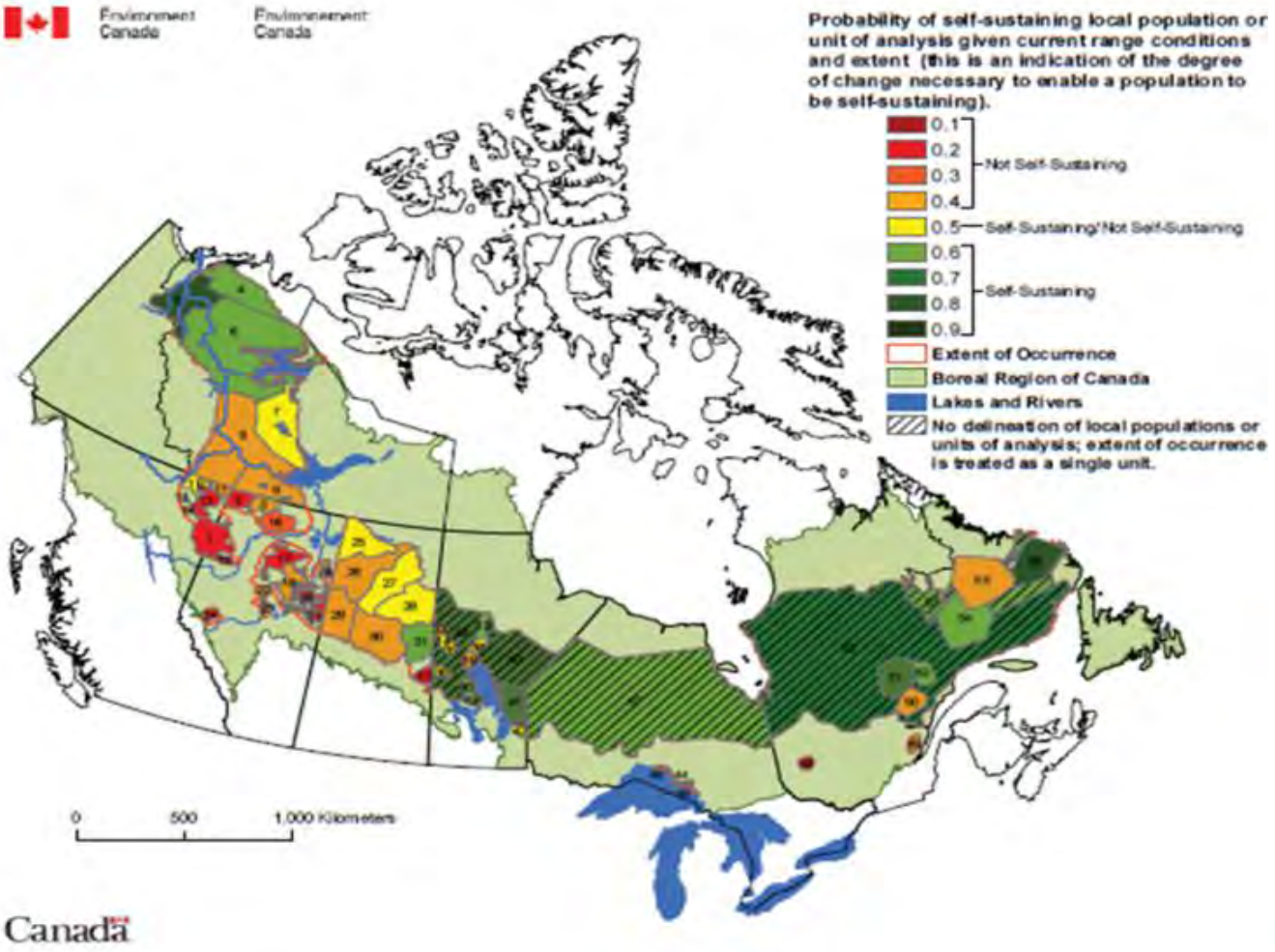

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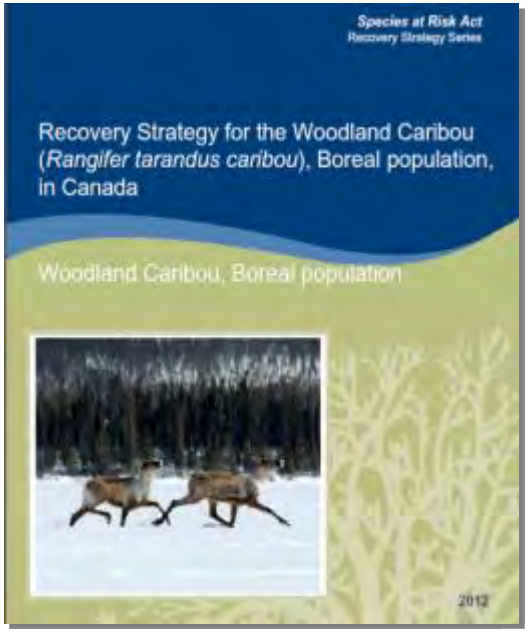
British Columbia – Provincial Perspective



Interim Operating Practices in Boreal Caribou Habitat

- Operating Practices in UWRs and WHAs

Reclamation and restoration requirements:

"Permanently decommission infrastructure to state of functional habitat restoration as soon as practical. Implement interim reclamation program."

Interim Reclamation includes: Revegetating non-operating portions of well pads, facility sites and camps to a conifer trajectory as soon as possible

- Environmental Protection and Management Guide
- Certificate of Reclamation (CoR)

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Habitat Restoration – What is It?

Restoration Workshop June 2013

Restored (decades) - disturbed caribou range is returned to functional habitat that can support self-sustaining caribou population without ongoing intervention (e.g., predator control).

Need to consider spatial and temporal scales, trajectories, as well as predator/prey dynamics

Short Term Objectives:

1. Vegetation Recovery Trajectory
   - Conifer abundance & Growth
   - Restore species distribution
   - ↓ alternate prey forage
2. Human / Predator Access Control
   - Protect vegetation recovery
3. Line-of-Sight Blocking / Cover

Habitat Restoration – What is It?

Canadian Association of Petroleum Producers (CAPP)

"Application of techniques on anthropogenic disturbances that deter predation, primary prey and human use in the near term, that supports long term habitat recovery".

Short Term Objectives:

1. Vegetation Recovery Trajectory
   - Conifer abundance & Growth
   - Restore species distribution
   - ↓ alternate prey forage
2. Human / Predator Access Control
   - Protect vegetation recovery
3. Line-of-Sight Blocking / Cover

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Habitat Restoration History - CRRP

- Not all linear disturbances equal; address O&G concerns
- Caribou Range Restoration Project (2001-2008)
- Historical linear disturbance
- Initiated by Alberta Environment and Sustainable Resource Development (ESRD) and the Boreal Caribou Committee
- Initial silviculture methods based on knowledge of forestry treatments, access control, and enhancing recovery rate of disturbance
- Guidance Document on site selection and treatments
- Monitoring protocol for revegetation (unpublished)

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Habitat Restoration History

- AEPEA In-Situ Approval Conditions (Project Specific)
  - Wildlife Habitat Enhancement Programs
  - Caribou Mitigation and Monitoring Programs
- Regulator Expectations for Project Approval
  - Provincial
- Industry – Voluntary (Movement to Regional Initiatives)
  - OSLI/COSIA Restoration Efforts (www.COSIA.ca)
  - Cold Lake Regional Collaboration
  - Foothills Research Institute (FRI)
- Industry – Federal Approval Conditions
  - National Energy Board

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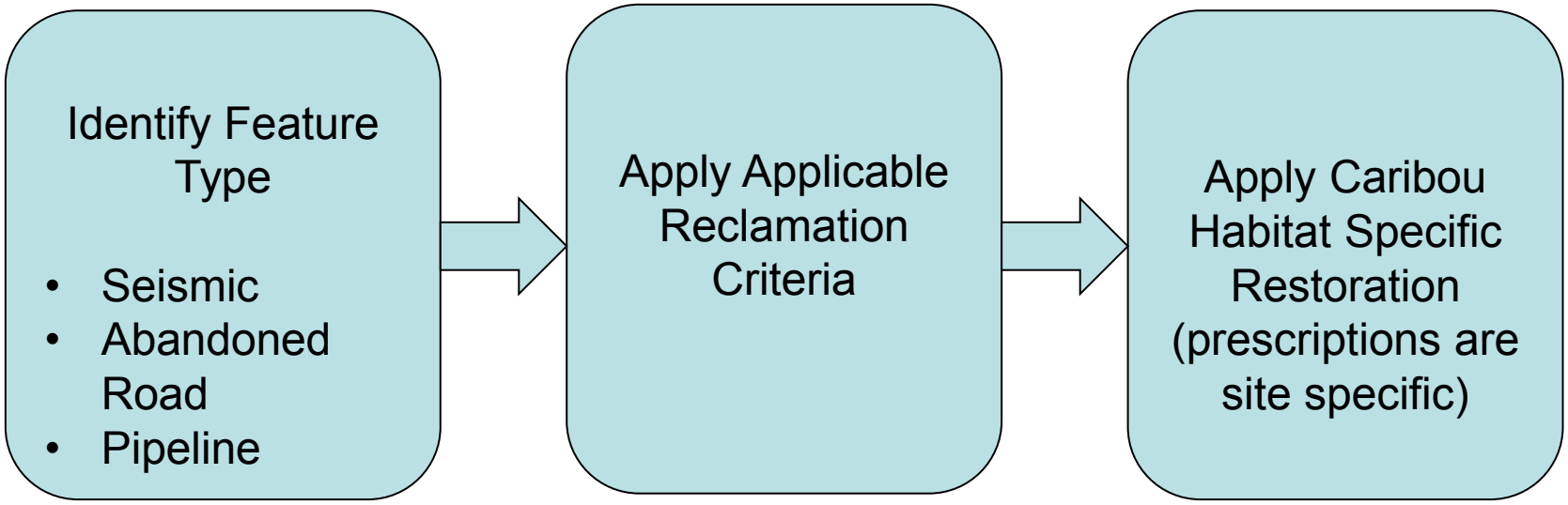
Prescriptions / Treatment Selection

Objectives

Reclamation to Restoration Flowchart



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Prescriptions / Treatment Selection

- Considerations (T. Vinge Draft Treatment Matrix):
  - Biogeoclimatic Ecosystem Classification/ Forest Type / DWT (very wet to very dry)

    lowland – transitional – upland
  - Type of disturbance

    Width, light levels and shade effect from the adjacent site
  - Disturbance Level

    Severe (road) → Minimal (LIS, cutline)
  - Moisture / nutrient regime
  - Availability of Woody Materials
  - Access into Area
  - Seed Availability
  - Current human and predator use
  - Winter Planting

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Prescriptions / Treatment Selection

Objectives

- Control Access
  - human and wildlife use

Prescriptions / Treatment Selection

Objectives

- Revegetate to speed trajectory to restore original habitat

‘Treatments’: Natural Vegetation Recovery

Treatments: Woody Material

Considerations:

1. Microsite Creation
2. Human/Predator Access Control
3. Fire Fuel Loading Considerations

(BC Wildfire Regulation and Fuel Hazard Assessment and Abatement; max 175 m3/ha)

Vinge and Pyper 2012
Pyper and Vinge 2012
"Visual Guide to handling woody materials for forested land reclamation" 60 – 100m3/ha

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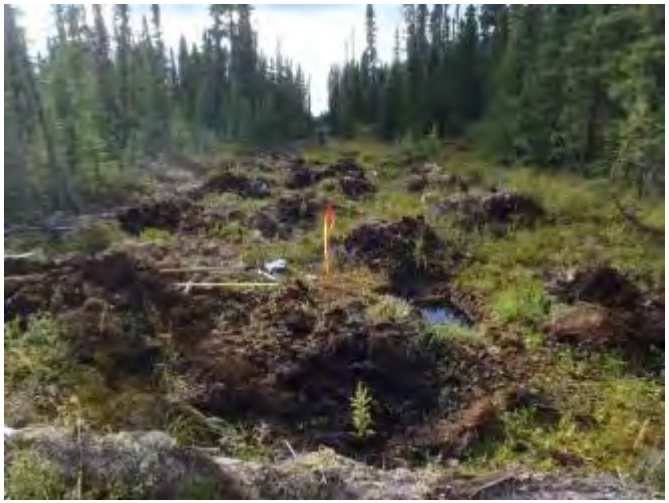
Treatments: Woody Material

Treatments: Mounding, Seedling Planting

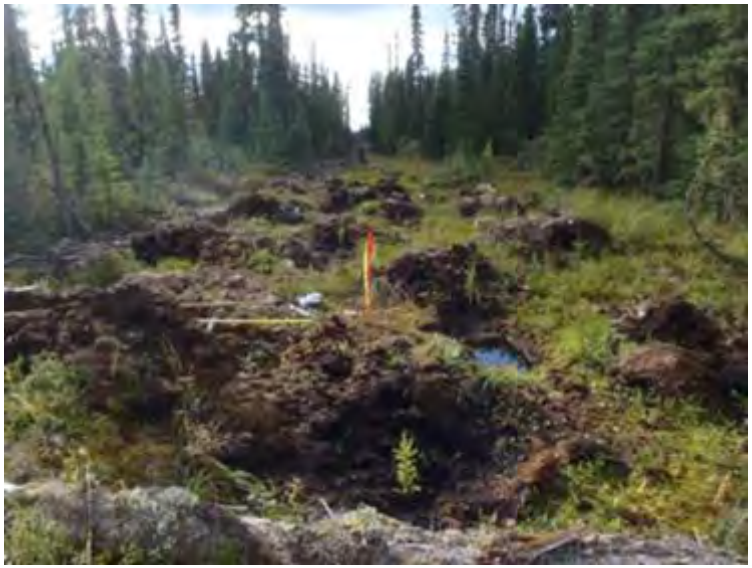


Treatments: Mounding

Photos Courtesy of Interpipe 2014

Treatments: Seedling Planting

Treatments: Seedling Planting



- Native Tree / Shrub Species (Alder)
- Consider ecological function and wildlife habitat values
- Winter Planting
  - Species
  - Temperature
  - Storage
  - Snow protection
- Availability of Seedlings (seed source)
- Microsite, moisture, nutrient considerations (Section 11 Revegetation in EPMG)

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Treatments: Stand Modification – Tree Felling and Bending

Treatments: Stand Modification – Tree Felling and Bending

Treatments: Stand Modification
Tree Felling, Tree-bending

Treatments: Transplanting

- Limited success in CRRP but lack of monitoring
- Need to consider stand type, location, costs, availability, objective

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Treatments: Fences

Wooden Fences

Geotextiles ?

The Challenges

- Restoration Objectives – clear?
- Tactical Planning – selecting the right lines
- Land use application process and approvals
  - Legacy Sites, Orphan Sites
  - Liability
- Prescriptions and Specifications Provided but … and implementation requires qualified reclamation or silviculture practitioner for planning around site specific considerations
- Fire, Access, and Forest Management Considerations

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Ministry of Forests, Lands and Natural Resource Operations

Boreal Caribou in Northeastern BC

Presented by Megan Watters, Ecosystem Biologist (FLNRO)

Photo Credit: D. Culling

Photo Credit: M. Watters

Photo Credit: D. Culling

Ministry of **Forests, Lands and Natural Resource Operations**

Boreal Caribou in BC

- Threatened in BC and across Canada
- Six Ranges and 15 Core Areas
- **Minimum Population Count** in March 2015 of 669
- Recruitment averaged 15 calves: 100 cows

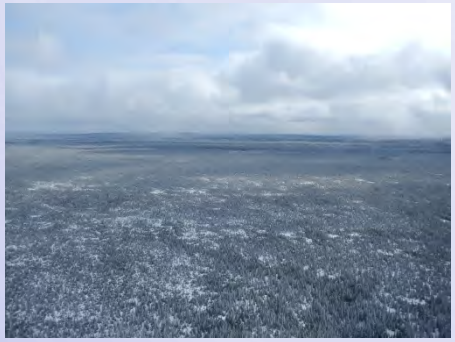
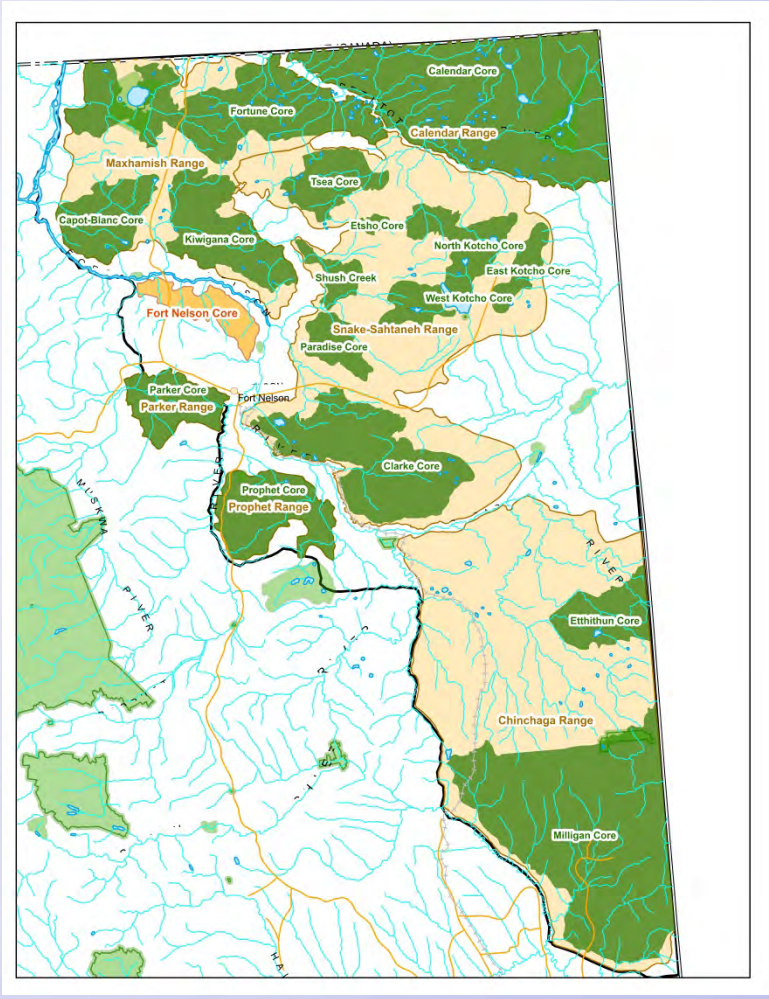


Photo Credit: M. Watters

Photo Credit: D. Culling

- Primary predators are wolves, as well as grizzly bear, black bear, wolverine and even lynx.
- Prefer large areas of contiguous lowland habitat such as peat bogs and fens.



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BC Boreal Caribou Implementation Plan

- **Relevant goals, objectives and targets:**
  - Decrease expected rate of decline
  - Restoration activities
  - Manage size of industrial footprint
  - Monitor effectiveness of management actions

- **Research and Effectiveness Monitoring Board (REMB):**
  - Purpose: ensure government implementation goals and objectives for boreal caribou are being achieved
  - Representatives from government and industry
  - Funded by portion of oil and gas levies and application for wells

Photo Credit: D. Culling

Photo Credit: C. DeMars

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Caribou Program

- VHF and GPS collars deployed on caribou in all six ranges and Fort Nelson “range” from 2012 to present
- Recruitment surveys conducted in late winter annually
- Collars monitored for mortality
- Mortalities investigated to determine cause of death.

Photo Credit: D. Culling

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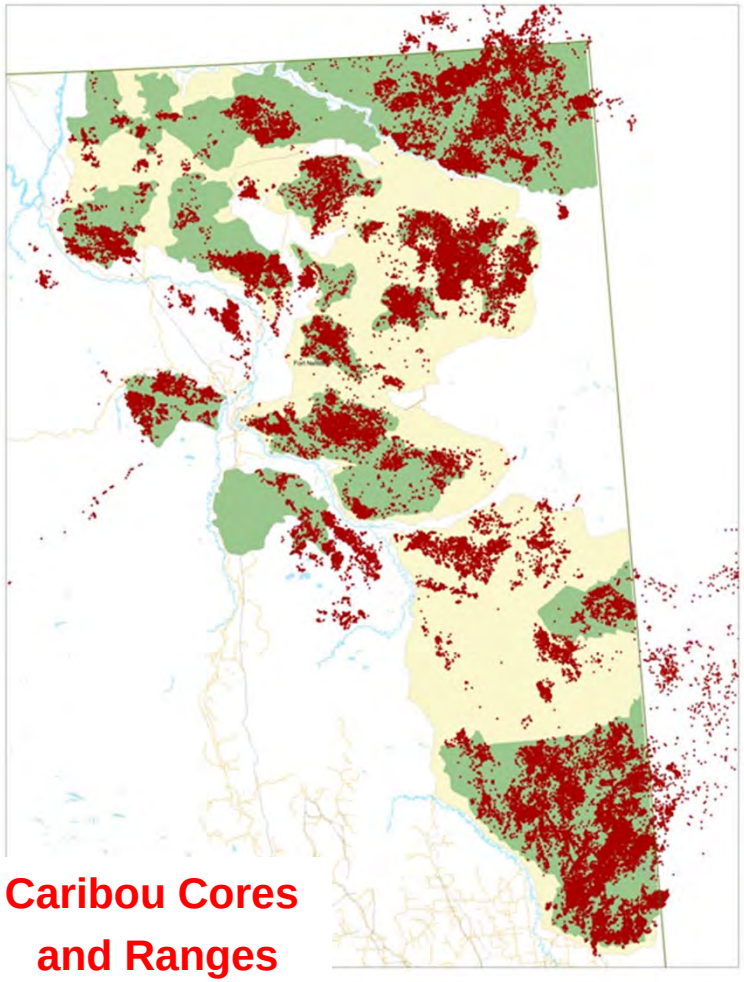
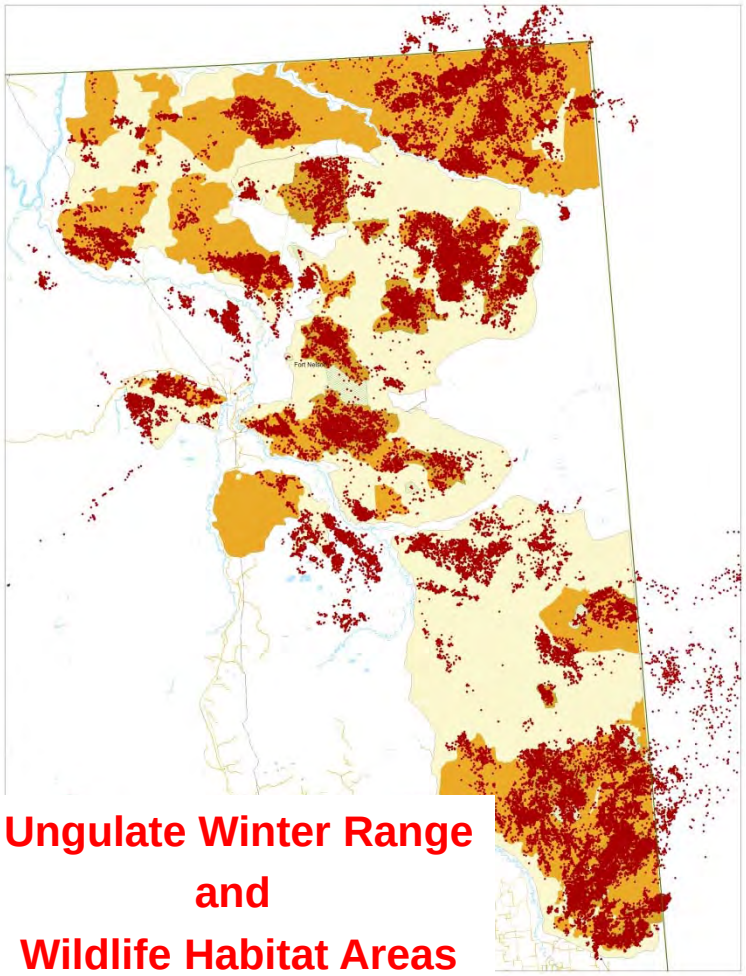
How is the REMB using the Data?



Caribou Cores and Ranges



Ungulate Winter Range and Wildlife Habitat Areas

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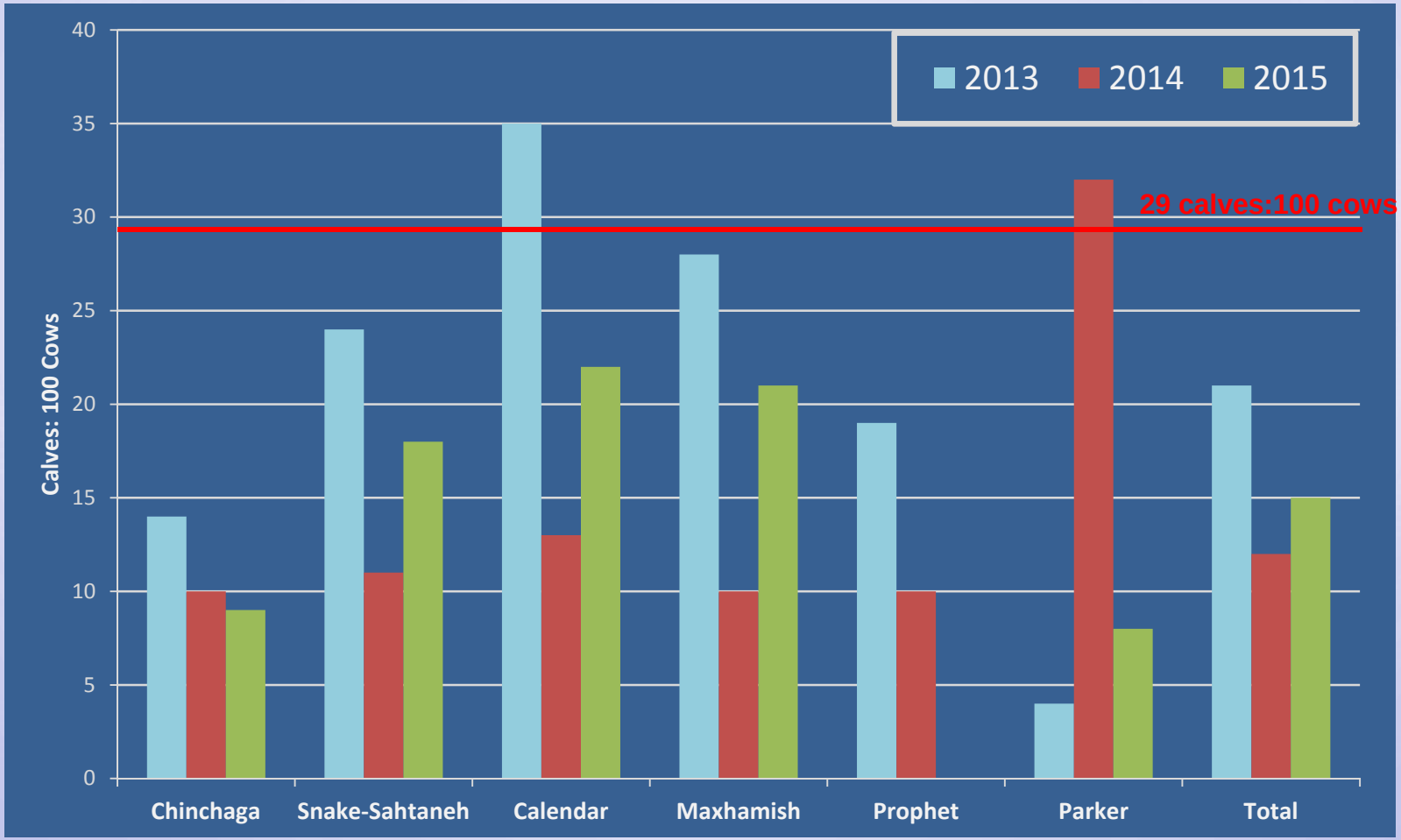
Population Metrics: Recruitment



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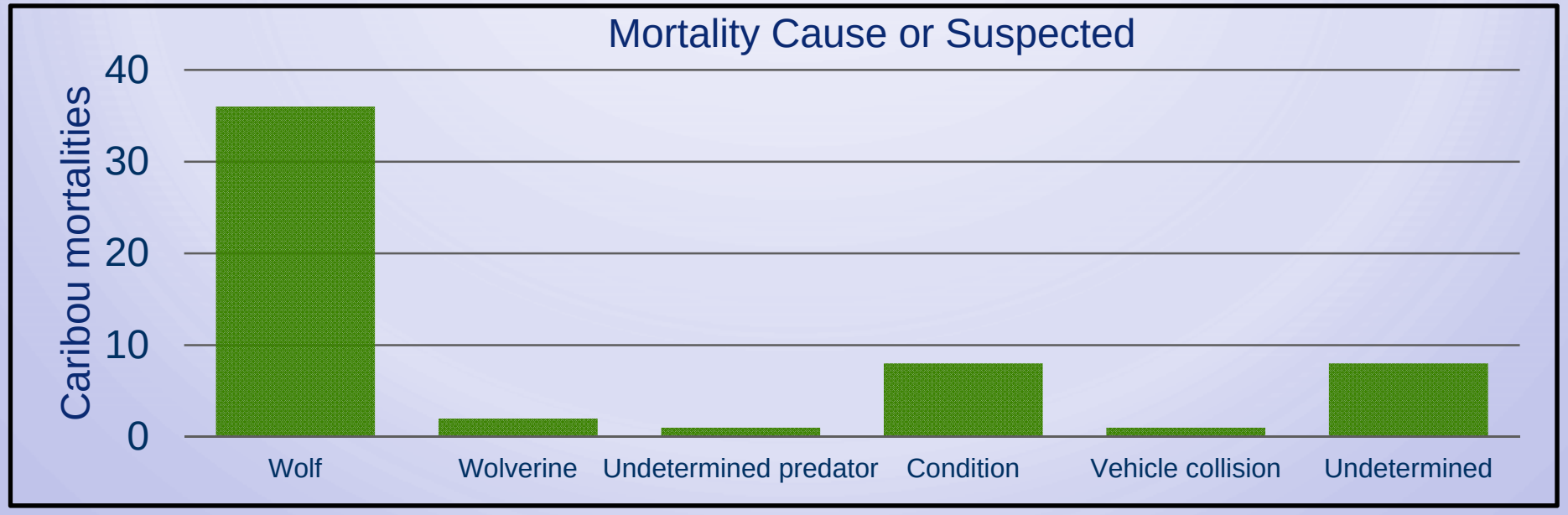
Mortality Risk

- VHF and GPS collars deployed on wolves in Northeast BC:
- High rate of attrition due to collar malfunction and mortality.
- Some wolves have emigrated to NWT

Photo Credit: D. Culling



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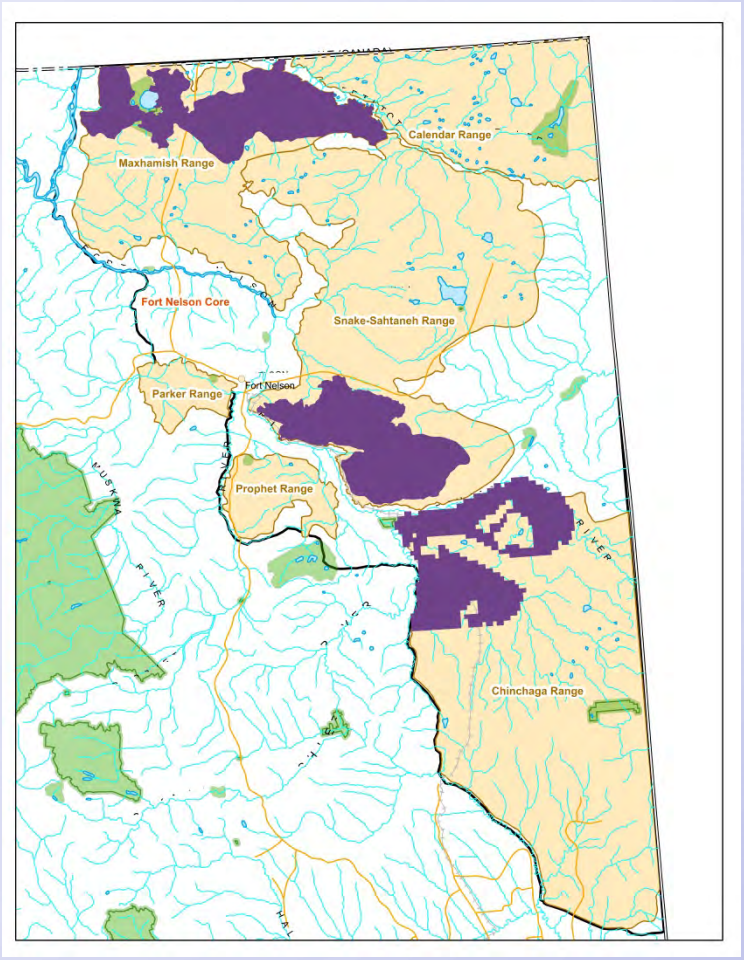
UNBC Moose-Caribou-Wolf Project

- Partnership between the REMB and UNBC
- Objectives:
  - Is moose distribution & abundance related to anthropogenic habitat change?
  - Is wolf use of caribou habitat related to moose distribution & abundance?
  - Do predator & prey abundance & behaviour interact to put caribou at risk?
- Three study areas: Fortune core, Clarke core and Chinchaga Resource Review Area.



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UNBC Moose-Caribou-Wolf Project

- GPS Collars:
  - Winter 2014/15: 38 collars
  - Winter 2015/16: Top up to 60 collars

Photo Credit: B. Culling

Photo Credit: B. Culling

- 2015-2016: Monitor moose locations and mortalities, conduct survival analyses.

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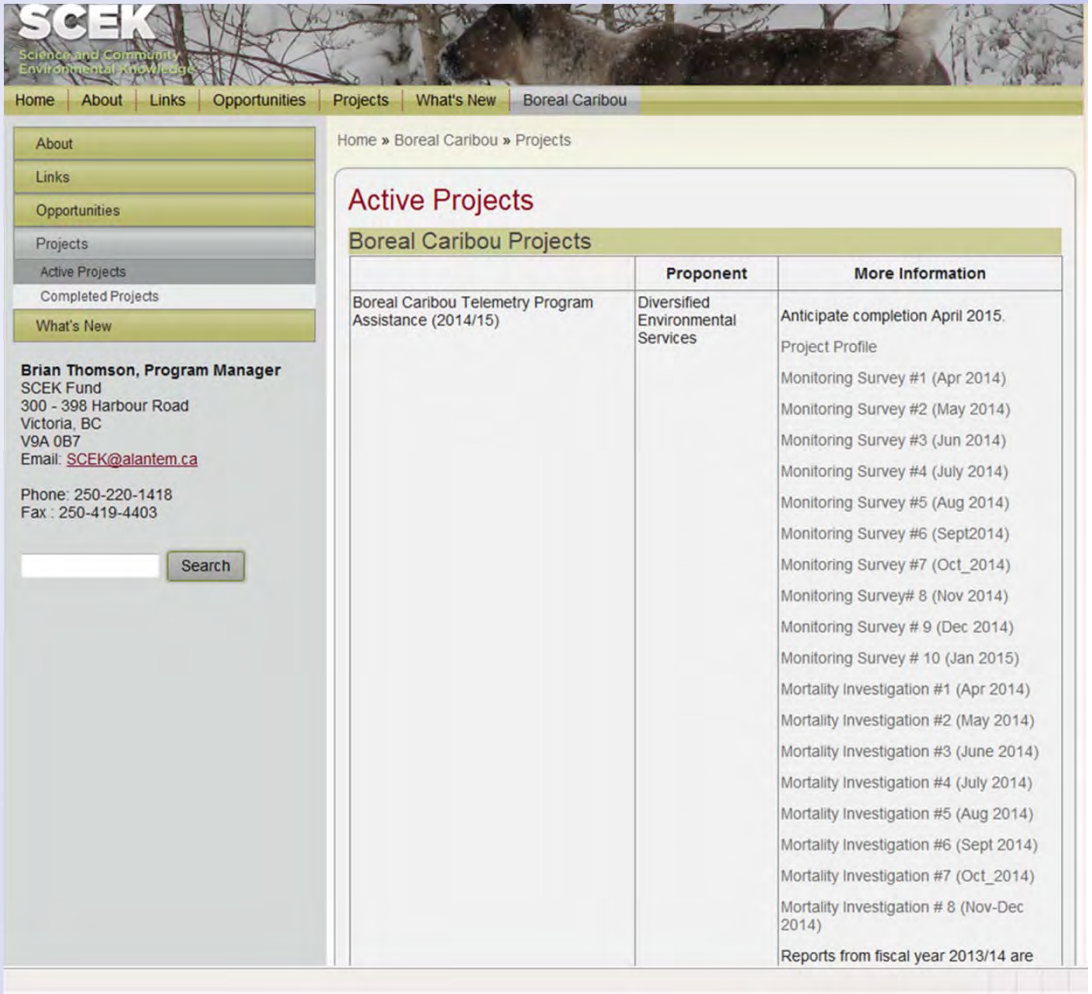
How can Industry use the Data?

- Tens of thousands of telemetry locations from about 235 collared caribou in total
- BC Telemetry data and reports are available to industry and the public on the Science and Community Environmental Knowledge Fund (SCEK) website.

http://www.scek.ca/boreal-caribou/projects/active



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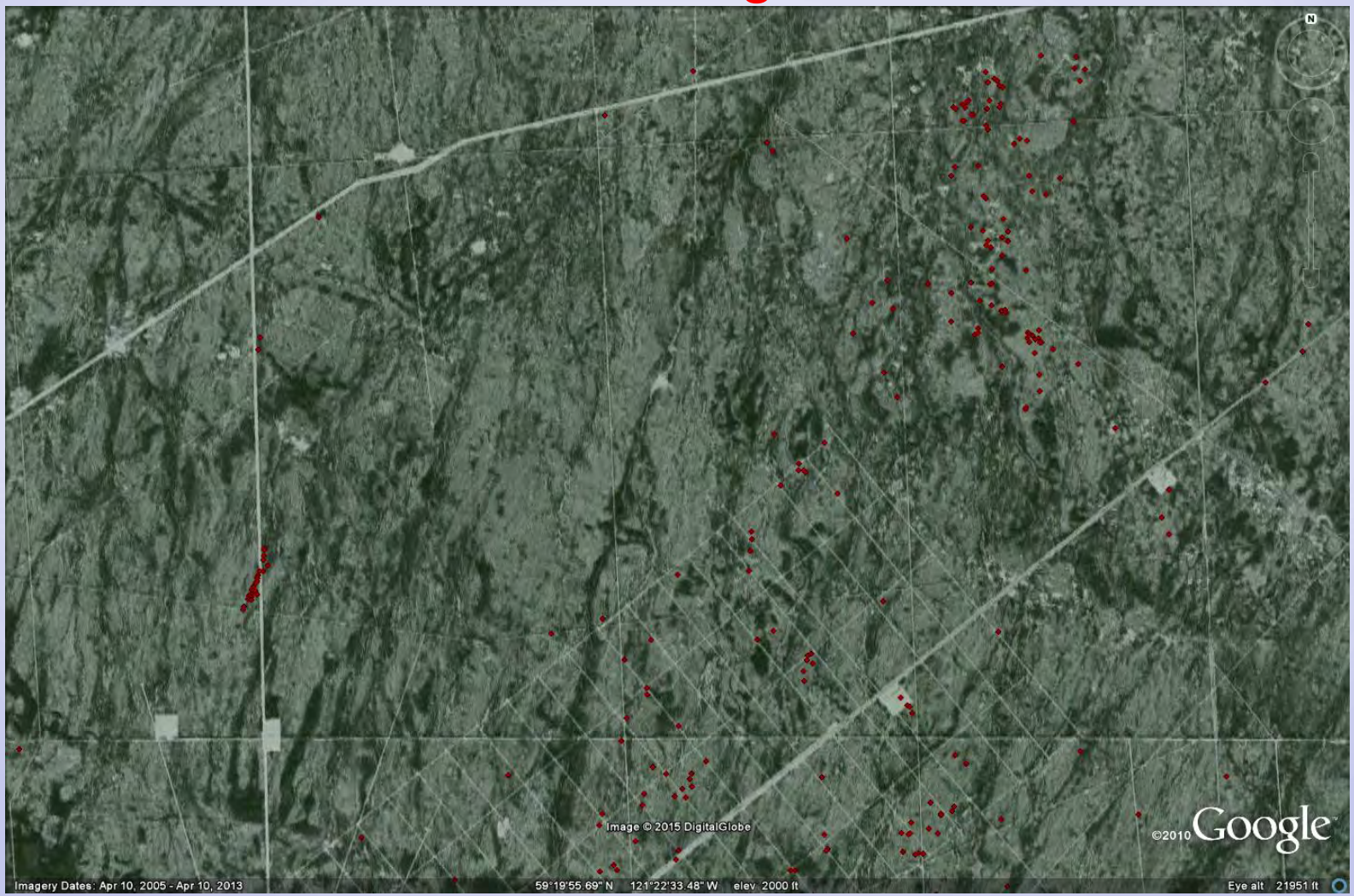
Planning



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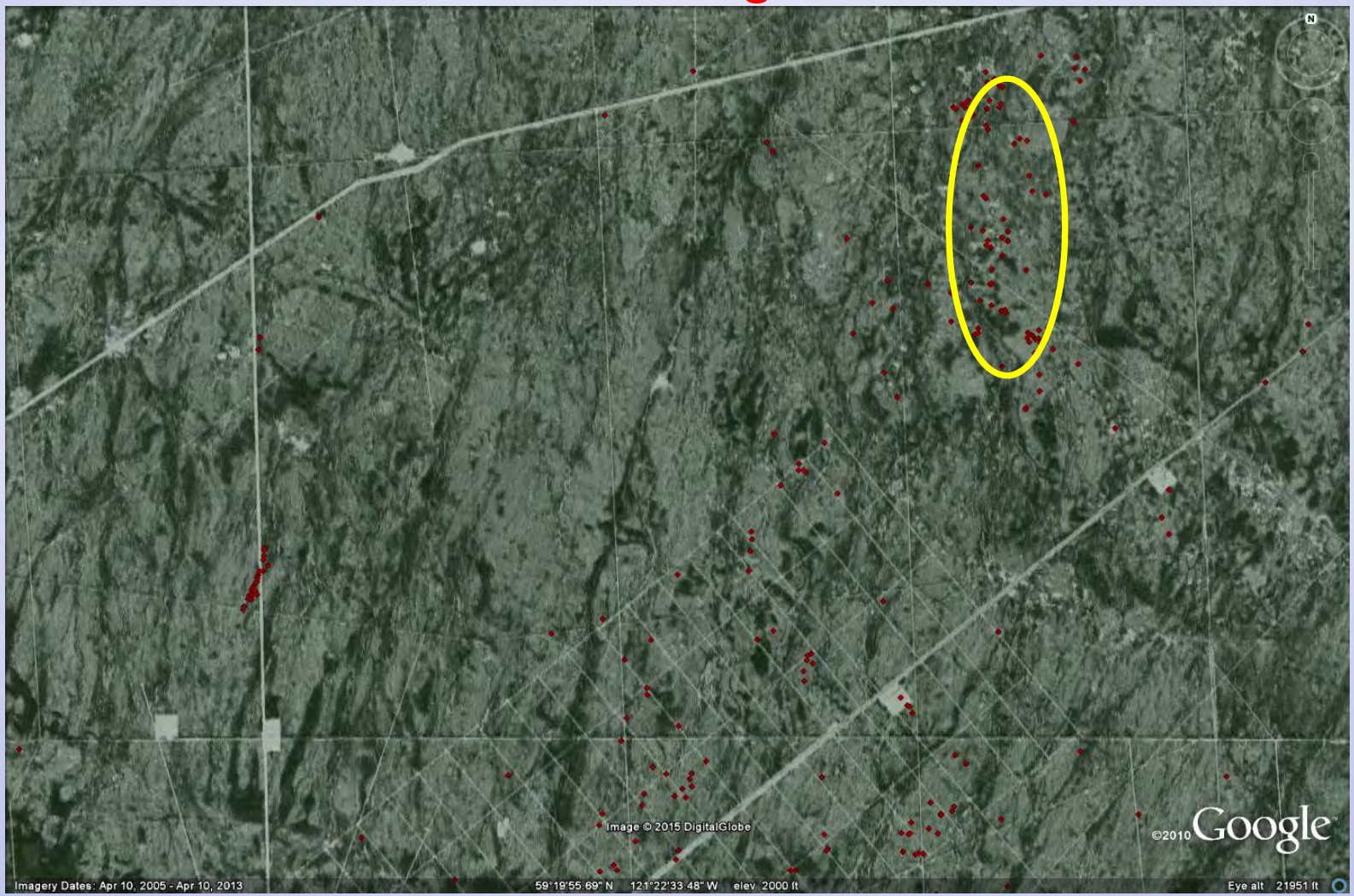
Planning



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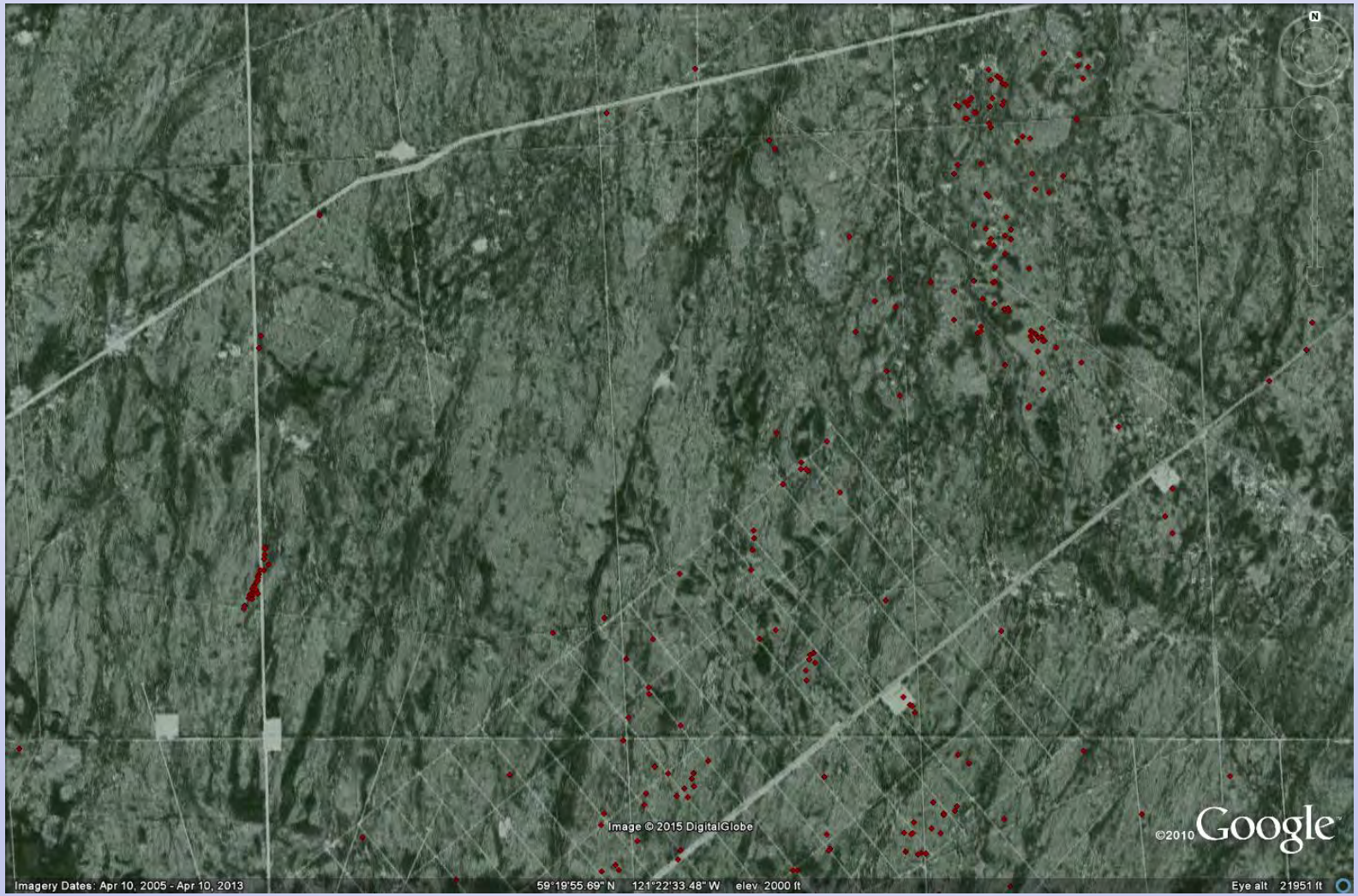
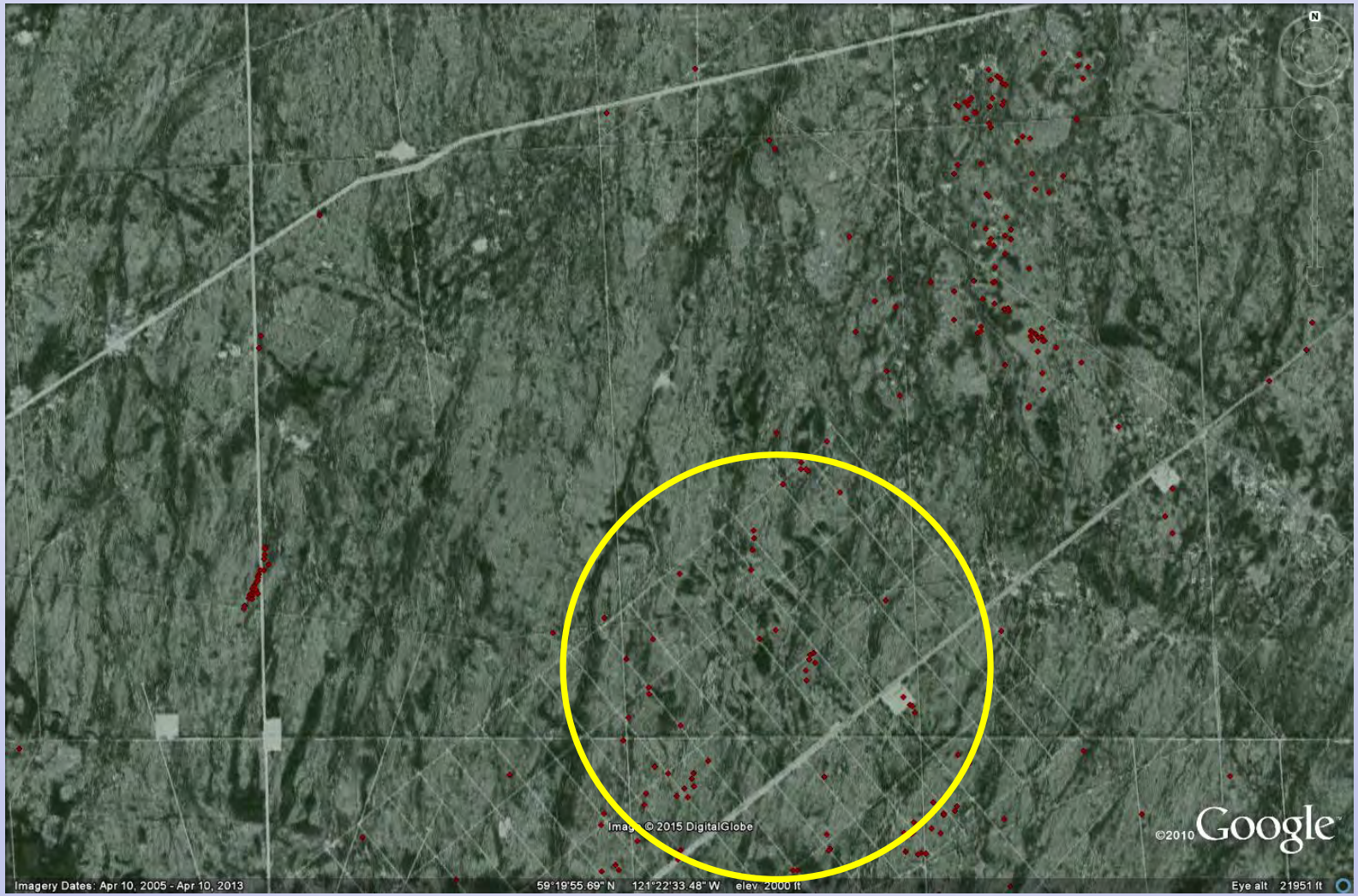
Restoration Effort



Ministry of **Forests, Lands and Natural Resource Operations**

Restoration Effort



Ministry of **Forests, Lands and Natural Resource Operations**

Boreal Caribou Habitat Restoration
Operational Toolkit for BC

BC Oil & Gas COMMISSION

Regulatory Considerations

Boreal Caribou Restoration
Operational Toolkit for BC

BC Oil & Gas COMMISSION

Regulatory Considerations

Topics

- Overview: Restoration under OGAA
- Certificate of Restoration (CoR)
- EPMR Section 19 (Areas to be Restored)
- Monitoring and Compliance
- Questions

BC Oil & Gas COMMISSION

3

Current Restoration Requirements under Oil and Gas Activities Act

- Interim Operating Practices in Identified Boreal Caribou Habitat (IOPs)
- EPMR Section 19 – Areas to be Restored
- Certificate of Restoration (CoR)
- Roads: in accordance with the OGRR (Part 6), EPMR (Section 19) and any other agreement on ALR or private land
- Pipelines – deactivation and surface decompaction

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4

The Interim Operating Practices (IOPs) in Boreal Caribou Habitat

- Operating Practices in UWRs and WHAs

  Reclamation and restoration requirements:

  Permanently decommission infrastructure to state of functional habitat restoration as soon as practicable.

  Implement interim reclamation program.

Interim Reclamation includes:

Revegetating non-operating portions of well pads, facility sites and camps to a conifer trajectory as soon as possible

EPMR Section 19 – Areas to be Restored

Operator must, as soon as practicable, restore the operating area by doing the following:

- soil decompaction
- redistribute surface soils
- restore natural drainage pattern
- revegetate exposed soils – promote restoration of wildlife habitat
- stabilize soil where erosion potential exists
- remove crossing structures
- re-contour bladed areas or excavation in pipeline corridors and seismic lines

Certificate of Restoration

A certificate stating an operator has adequately restored land disturbed by oil and gas activities to a state as near as practical to pre-activity land use.

2 Part Application Process

1. Site Assessment identifying potential contamination, remediation and management.
2. Assessment of surface reclamation activities in restoring site productivity (commonly submitted years after part 1).

Commission reviews, if accepted, issues CoR.

BC Oil & Gas COMMISSION

7

Certificate of Restoration

About this Summary

2012/13 Oil and Gas Site Restoration Summary

This Oil and Gas Site Restoration Summary provides an overview of British Columbia's Certificate of Restoration (CoR) program. The BC Oil and Gas Commission (Commission) is responsible for overseeing restoration and issuing CoRs when appropriate, ensuring restoration activities are completed in the public interest with regard to environmental, economic and social effects.

The CoR process ensures land used for oil and gas development is restored to a safe and productive condition. When an oil and gas site, which includes wellsites, facilities and pipelines, is no longer productive, the operator is required to reclaim the site and is not allowed to cease payment on surface land tenures until a CoR has been issued. In order to obtain a CoR, the impacted lands must be returned to a state, as near as is reasonable, to the surface condition which existed before the oil and gas activity was commenced.

Previous site restoration reports and background information on the CoR program can be viewed here:

- 2008 Annual Site Restoration Report
- 2009/10 Site Restoration Annual Report
- 2010/11 Site Restoration Annual Report
- 2011 Oil and Gas Restoration Summary
- Fact Sheets

Aerial view of a wellsite in Northern BC

Certificate of Restoration
12 month reporting

1.5 Reclamation

To ensure land developed for oil and gas activities is restored to its pre-activity state when an oil and gas site is no longer productive, the respective operator may choose to reclaim the site to attain a Certificate of Restoration (CoR). Table 9 presents the quantities of Part 1 applications required as part of the CoR process that were received for the reporting period and the past 12 months. CoRs granted are also provided for the same time periods in Table 9, and Figure 3 displays their monthly distribution for the previous 12 months.

Table 9: Certificates of Restoration

	March	Past 12 Months
Accepted Part 1s	5	174
CoRs Granted	5	91

Figure 3: 12-Month Distribution of CoRs Granted

Certificate of Restoration

All decisions made by the Commission in issuing CoRs are guided by CSR standards established by the Ministry of Environment.

Does not absolve operators of future liability with the impacts operations may have on a restored site.

Provides assurance to stakeholders that site has been restored in accordance with **current standards and requirements**

Known contamination has been mitigated.

Orphan sites: where no responsible party can be identified. Commissioner designates an orphan site, and draws funds from the Orphan Site Reclamation Fund (OSRF) to complete necessary restoration work.

Commission oversight and risk associations

Legacy Sites	All sites that received a Certificate of Restoration (CoR), or were exempt from the requirement, prior to October 2004.
Orphan Sites	Oil and gas sites that may require remedial work but no viable operator can be identified. The Orphan Site Reclamamtion Fund was created for such instances. These sites are designated by the Commissioner.
Certificate of Restoration (CoR)	This certificate ensures that a site used for oil and gas development was restored to a safe and productive state. The Commission is responsible for overseeing the restoration activity ensuring all applications approved are in the public interest with regard to environmental, economic and social effects.

Compliance and Enforcement

OGC Compliance and Enforcement Division monitors for compliance with Permitted activity.

EPMR regulatory requirements that could be included in compliance inspections:

- EPMR Section 9 – Water Quality
- EPMR Section 10 – Aquifers
- EPMR Section 11 – Crossings of streams, wetlands and lakes
- EPMR Section 12- No Deleterious materials into streams, wetlands or lakes
- EPMR Section 13- Operations within wetlands
- EPMR Section 14- Natural range barriers
- EPMR Section 15- Invasive Plants
- EPMR Section 16 – Forest Health
- EPMR Section 17 – Conserving Soil
- EPMR Section 18 – Seismic Lines
- EPMR Section 19 – Areas to be Restored
- EPMR Section 20 – Water Quality

Permitting & Authorizations

So now that we have a brilliant list of restoration techniques, how do we get a permit for Restoration Activities?

Comply with the EPMR and all other restoration/reclamation requirements embedded in other regs and legislation.

Adhere with Section 19 – Areas to be Restored

Restoration linked to a specific oil and gas activity – okay

Restoration not linked to particular site or activity – evolving.

Considerations for Regulatory Improvement

- Capturing restoration as an activity under OGAA.
- Offsetting: Enable the Commission to require and regulate offsets outside a permit area for impacts to valued habitat within a permit area.
- Amendment to Section 19 to create an authority for the OGC to require restoration beyond the base level currently in section 19.
- Reclamation Notification: Companies to notify OGC when restoration and reclamation completed.

Boreal Caribou Habitat Restoration
Operational Toolkit for BC

BC Oil & Gas COMMISSION

Regulatory Considerations

Questions?

OGC Stewardship

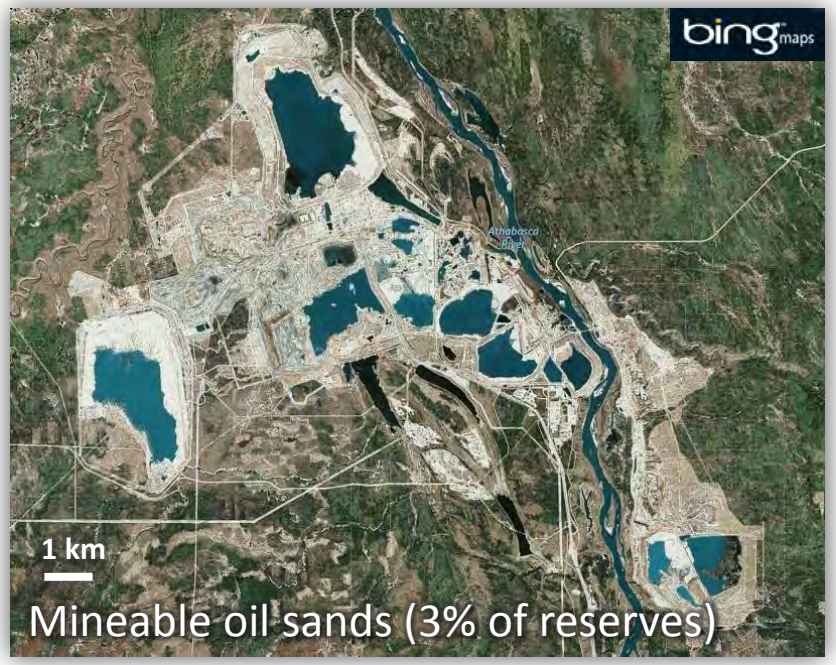
Restoration of linear disturbances at landscape scales

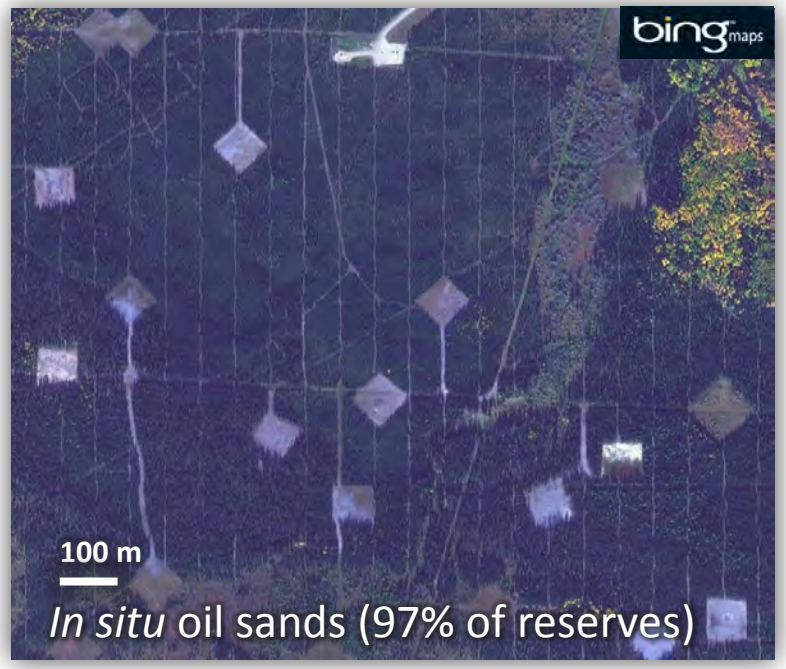
Scott Nielsen[1], Cassidy van Rensen[1,2] & Tim Vinge[2]

March 31, 2015

[1] University of Alberta, Department of Renewable Resources
[2] Alberta – Environment & Sustainable Resource Development

Biodiversity management in oil sands





142,000 km^2 bitumen deposit in Alberta

Line restoration for in situ oil sands

DART:

BUILD (LMP):

Objectives

Vegetation responses on legacy (2D) lines

Prioritize places to minimize footprint (ILM)

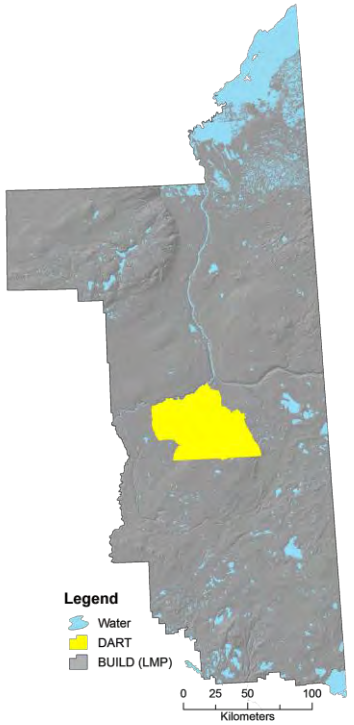
Prioritize restoration of 2D line segments

Regional prioritization of 2D line restoration

Local (Stony Mtn)

Scale

Regional (LARP)



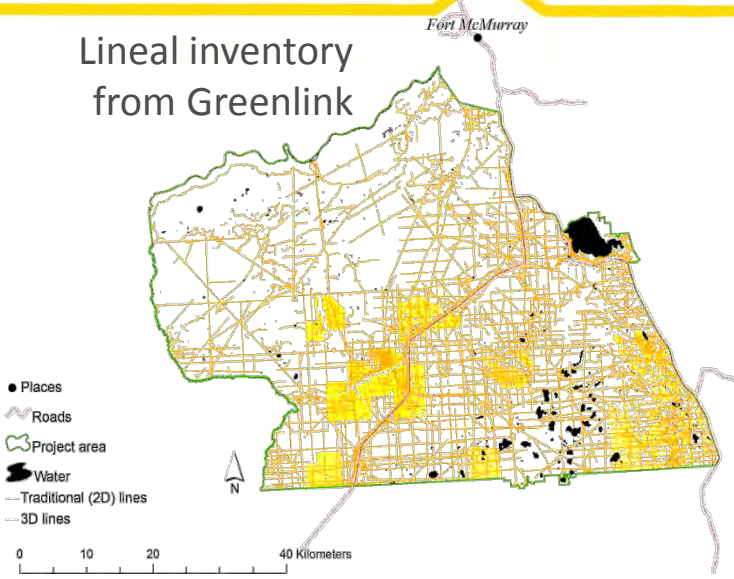
DART project

- **Study area**: Stony Mountain 800
- **Data**: 900 LiDAR plots (2m x 50m)
- **Objectives**:

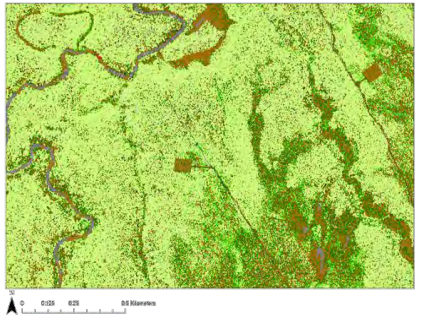
1. Understand factors affecting forest recovery on legacy 2D lines
2. Predict responses
3. Prioritize line segments for restoration

DART: **D**isturbance **A**nd **R**ecovery **T**rajectory

Lineal inventory from Greenlink



LiDAR WAM & point cloud



cosia CANADA'S OIL SANDS INNOVATION ALLIANCE

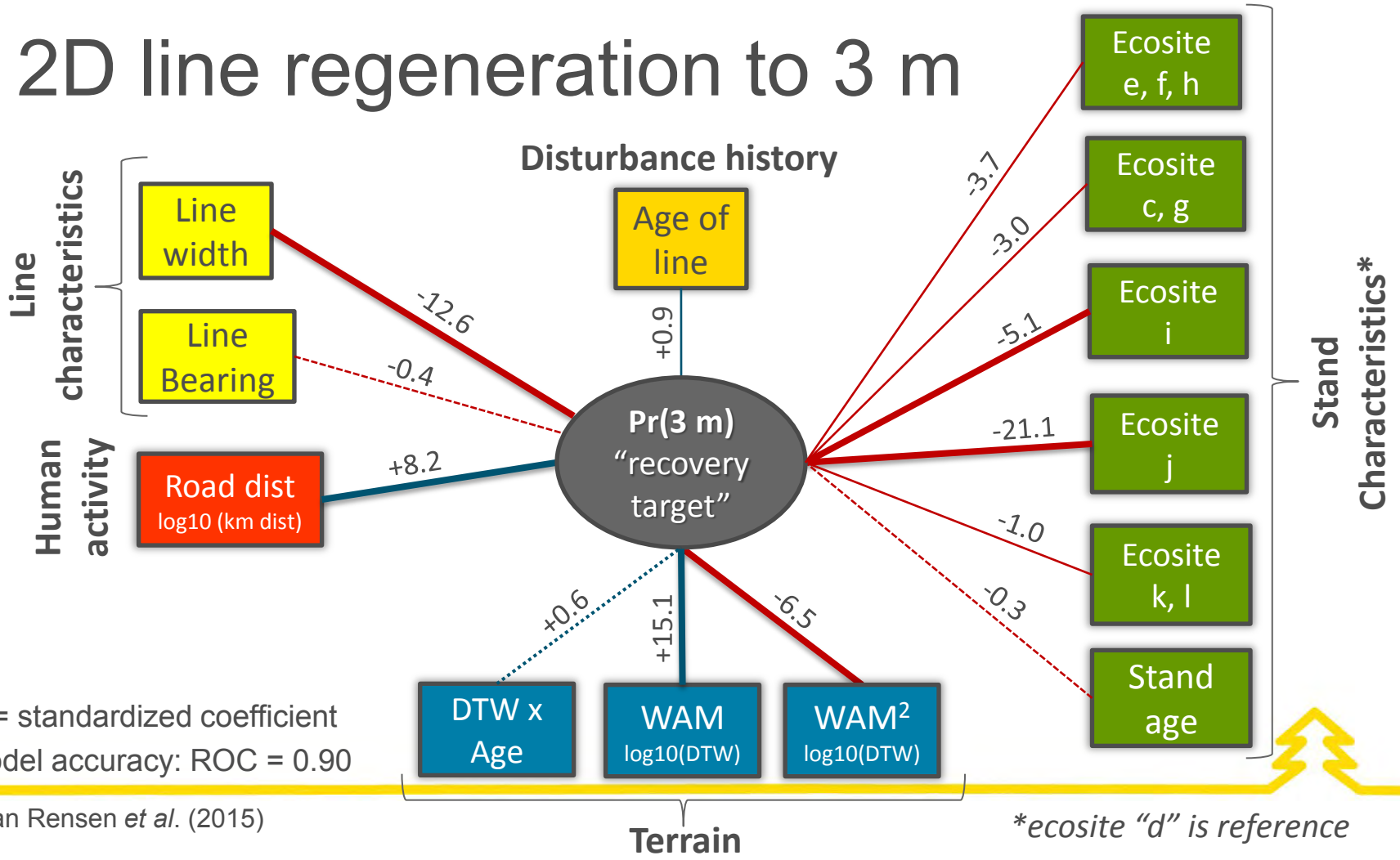
Alberta Innovates Energy and Environment Solutions

nexen

Alberta Environment and Sustainable Resource Development

NSERC CRSNG

2D line regeneration to 3 m



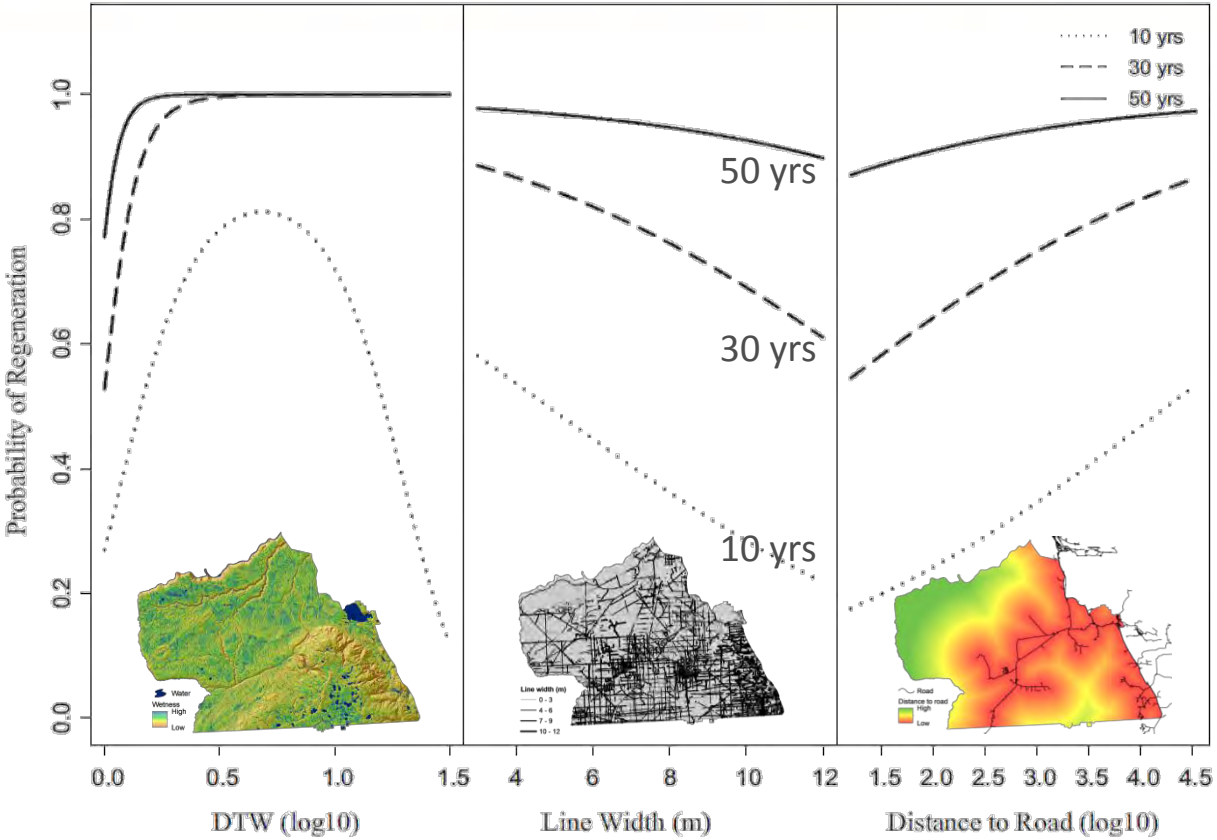
= standardized coefficient

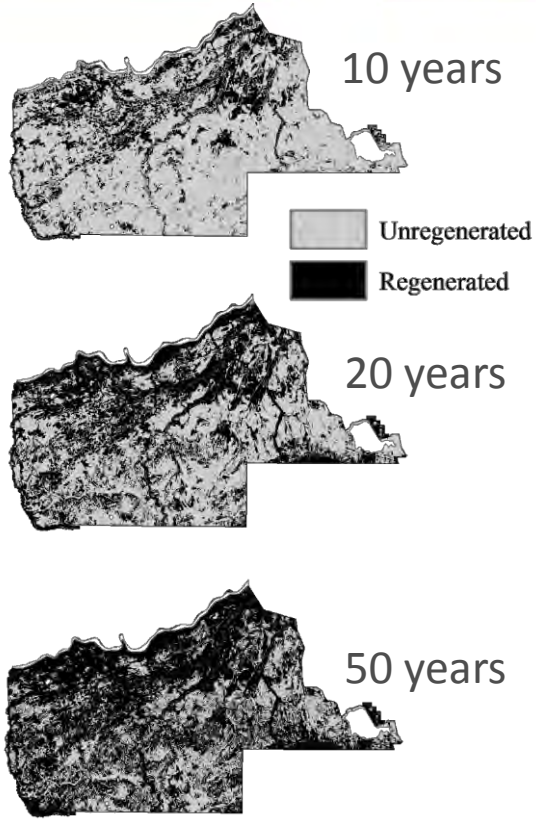
Model accuracy: ROC = 0.90

van Rensen *et al*. (2015)

**ecosite "d" is reference*

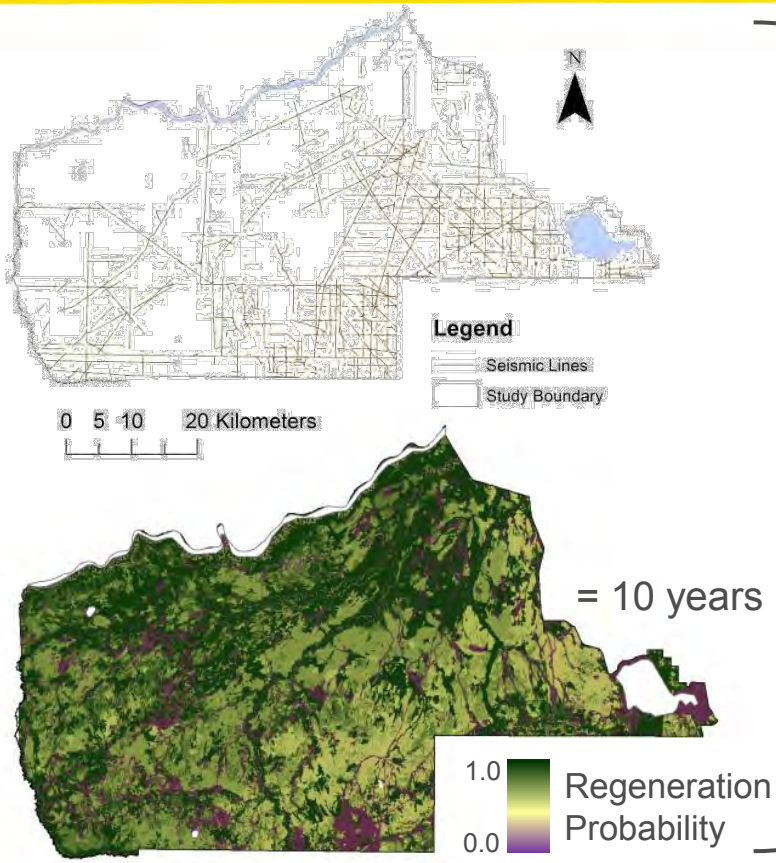
Predicting recovery trajectory





van Rensen *et al*. (2015)

Linear restoration: passive vs. active



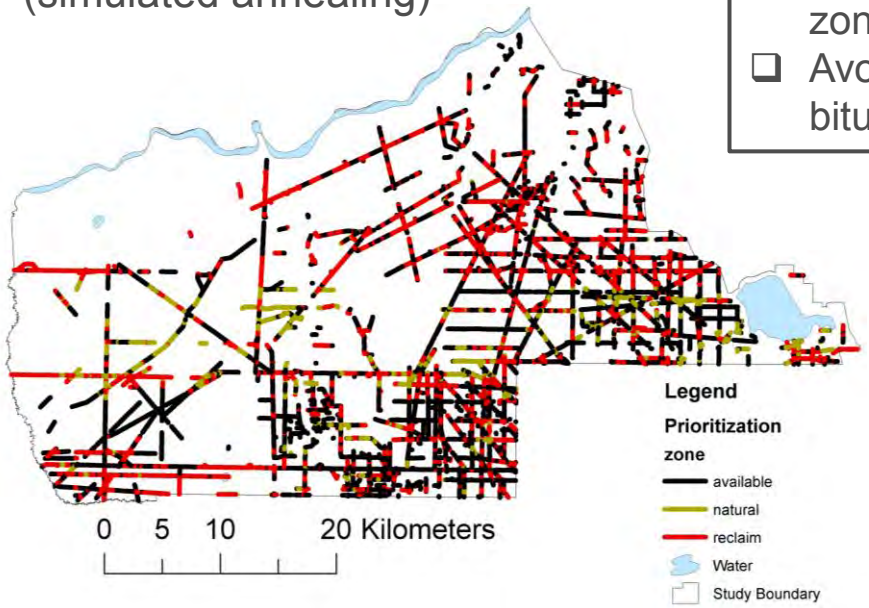
Prioritize restoration:

1. Use site characteristics to **predict** recovery (10, 30, 50 years)
2. Identify sites that will recover w/in a time frame (**passive** restoration)
3. Identify other sites that require **active** restoration (arrested succession)

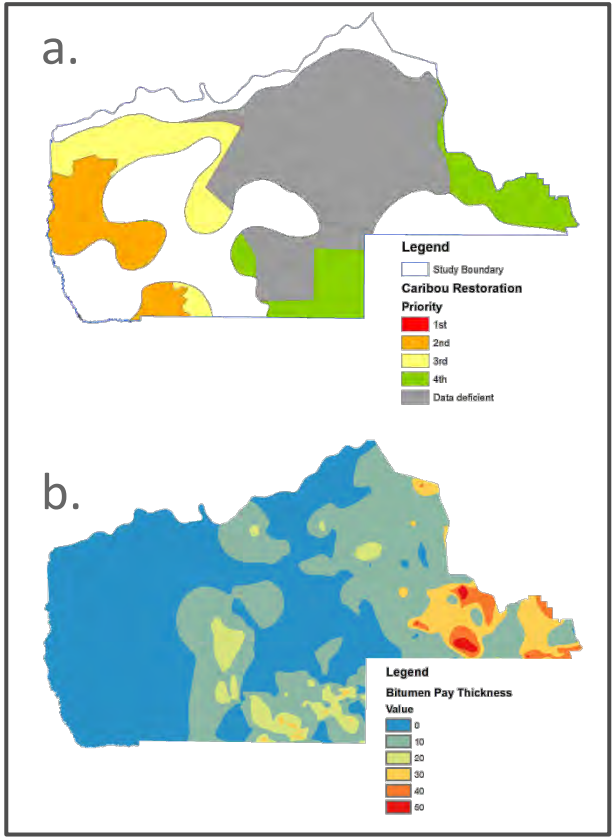
Prioritize 2D line restoration

Target 50% recovery of lines

optimized solution
(simulated annealing)



- ❑ Consider natural recovery ($0)
- ❑ Emphasize caribou zones (a.)
- ❑ Avoid areas of high bitumen (b.)



van Rensen *et al*. (in prep)

Solution = $1.80 M (vs. $2.44 M)

Line restoration for *in situ* oil sands

DART:

BUILD (LMP):

Objectives

Vegetation responses on legacy (2D) lines

Prioritize places to minimize footprint (ILM)

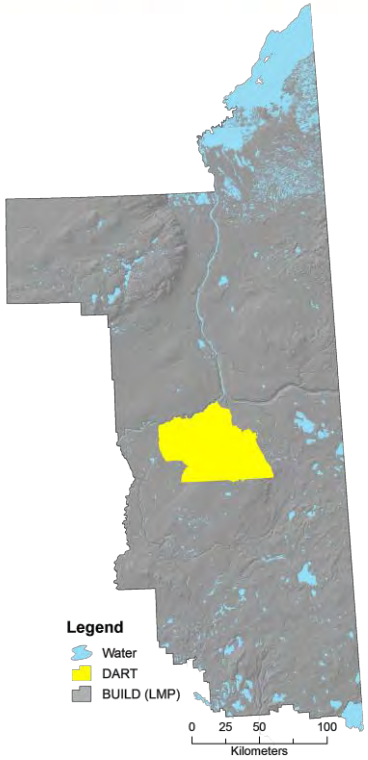
Prioritize restoration of line segments

Regional prioritization of 2D line restoration

Local (Stony Mtn)

Scale

Regional (LARP)

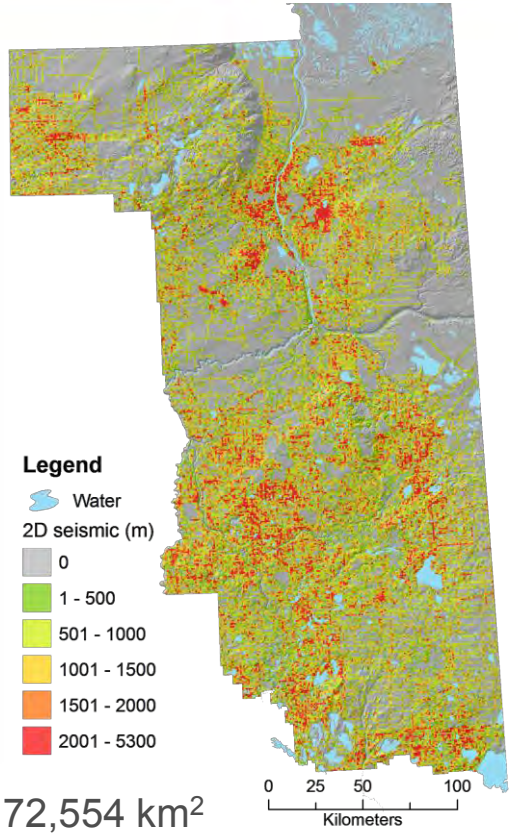


Regional planning of line restoration

BUILD (LMP) project (phase 1):

- 54,893 km of 2D seismic lines
- 101,101 ¼ sections (~66 ha)
- Active vs. passive restoration
- Consider restoration constraints & biodiversity
- Prioritize restoration

BUILD: **B**iodiversity **U**sing **I**ntegrated **L**and **D**esign
LMP: **L**andscape **M**anagement **P**lan (GoA)



Study area: 72,554 km^2

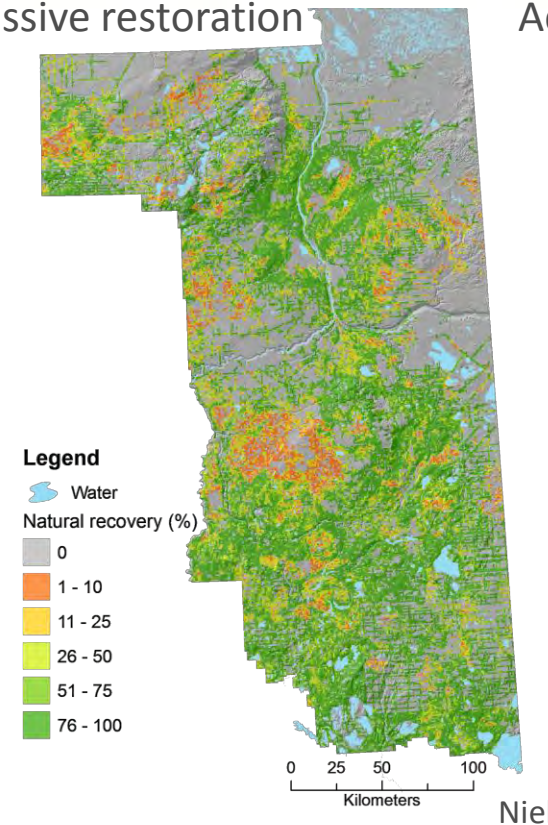
Passive vs. Active 2D line restoration

Predictions of 3m recovery model:

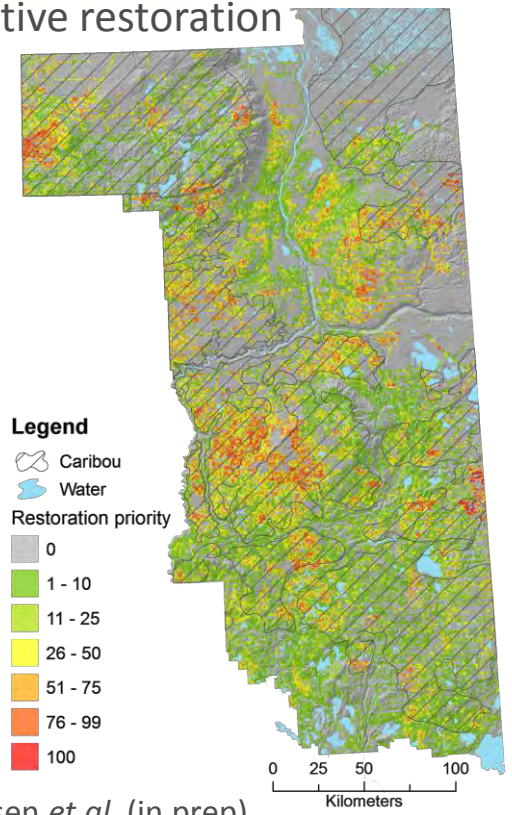
- **21%** in **arrested** succession (11,581 km)
- **66%** predicted to **recover** <30 years (36,179 km)
- **13%** in **non-forests** (7,133 km)

Model: years to recover to 3 m height post 30 year disturbance

Passive restoration



Active restoration

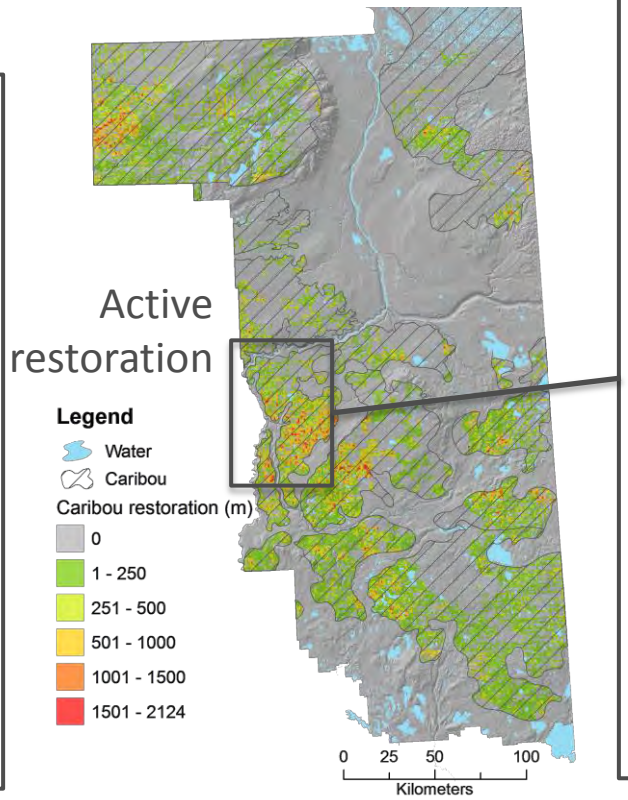


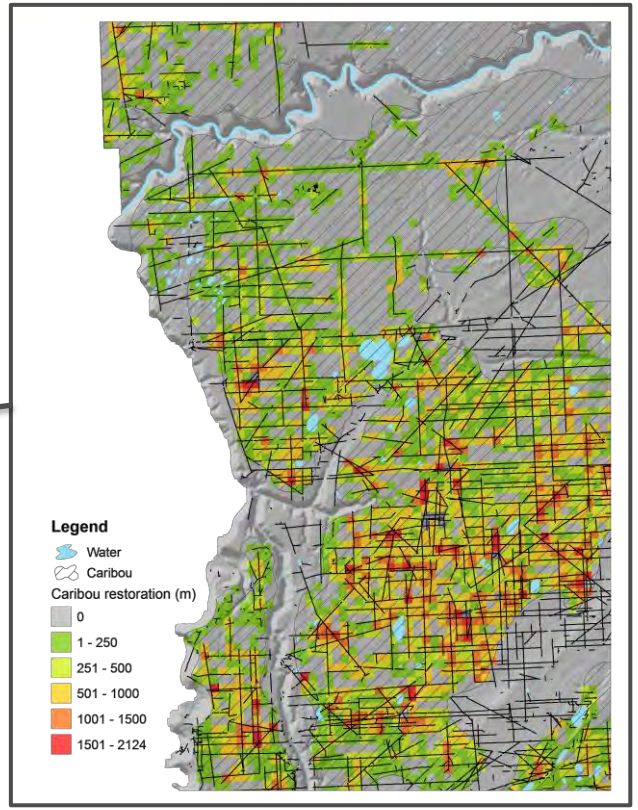
Nielsen *et al*. (in prep)

Caribou-focused 2D line restoration

Targeted restoration

1. Length (m) within ¼ sections of 2D lines in arrested succession
2. Inside caribou ranges
3. Weighted towards areas of low human footprint (most benefit to caribou)



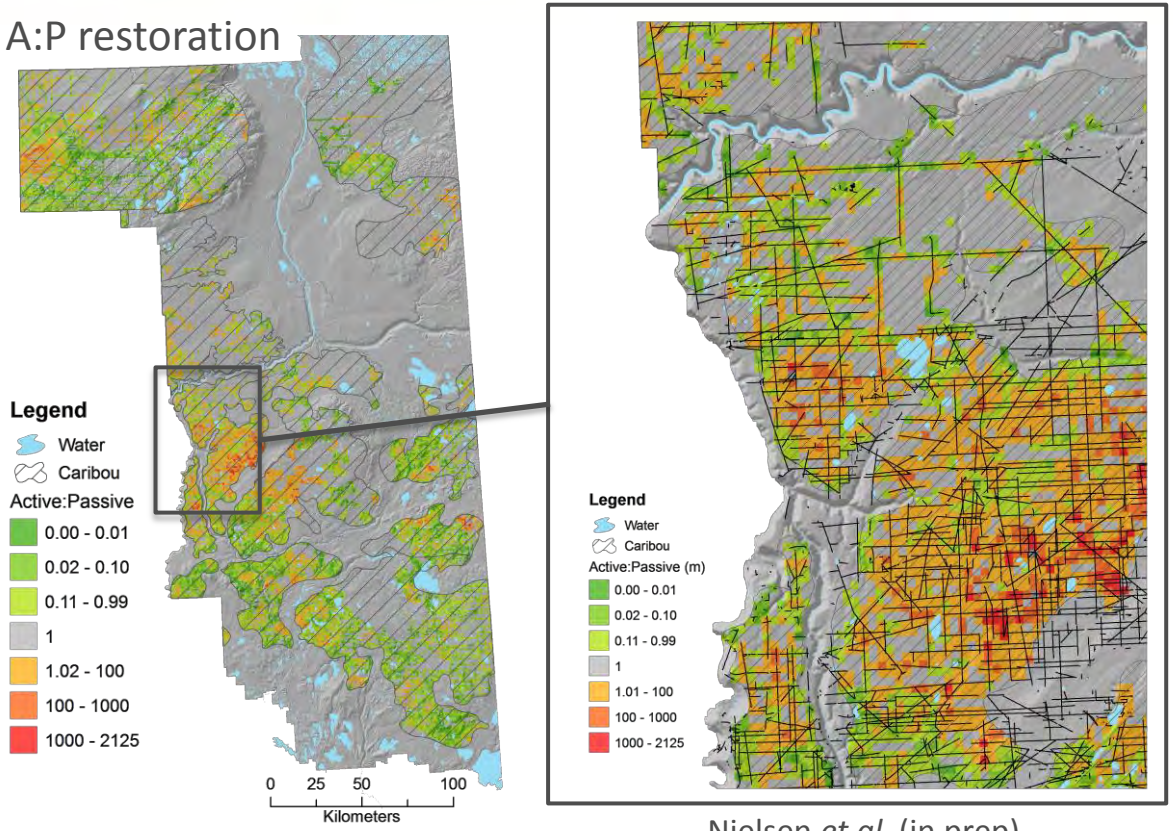


Nielsen *et al*. (in prep)

Caribou-focused 2D line restoration

Active to passive restoration ratio (A:P)

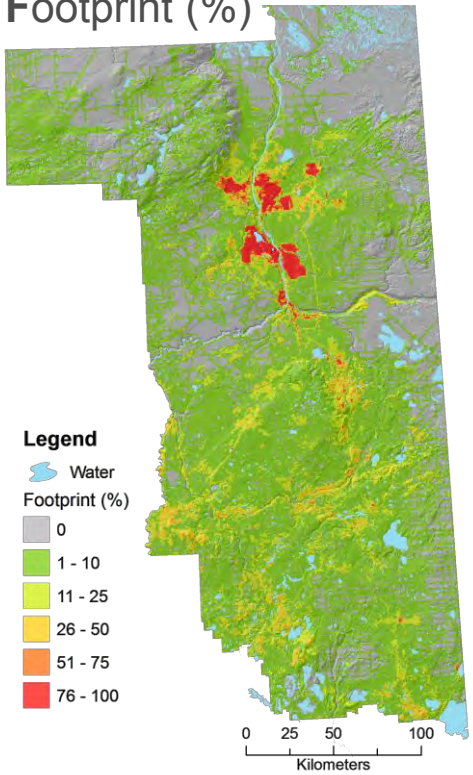
1. Identify areas where most line length is classified as active restoration
2. Weighted towards areas of low human footprint (most benefit to caribou)



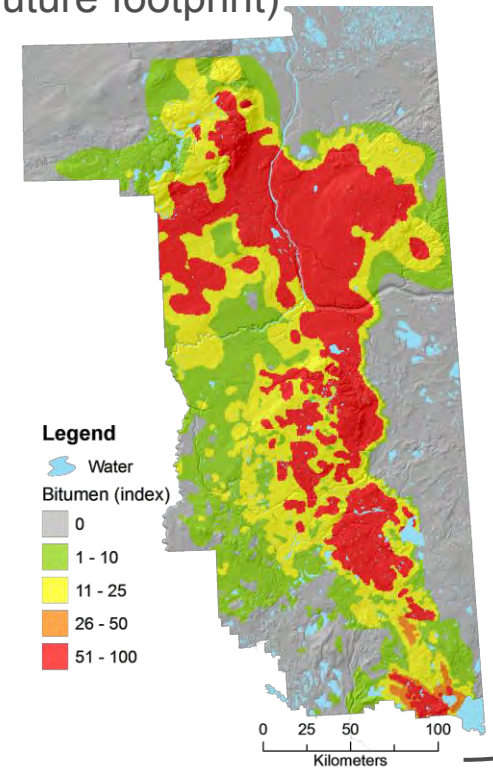
Nielsen *et al*. (in prep)

Constraints to restoration

Current human **F**ootprint (%)

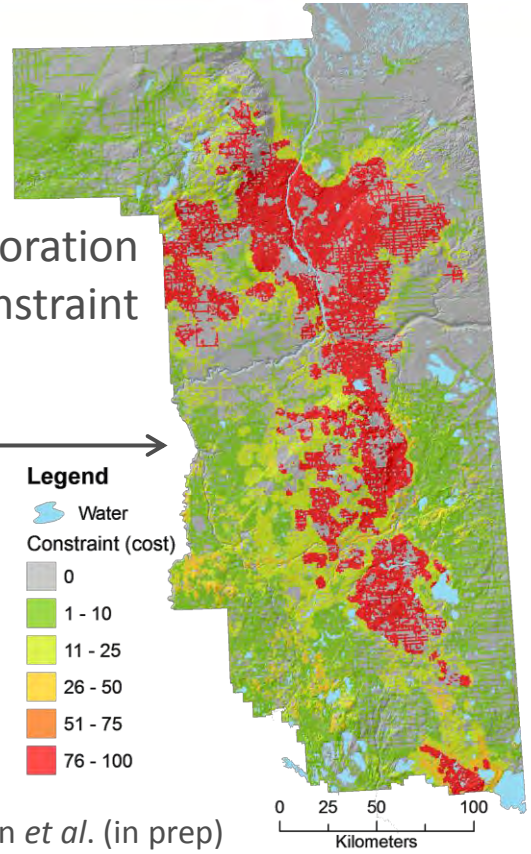


Bitumen thickness (future footprint)



Restoration constraint

Max =



Nielsen *et al*. (in prep)

Consider other biodiversity values

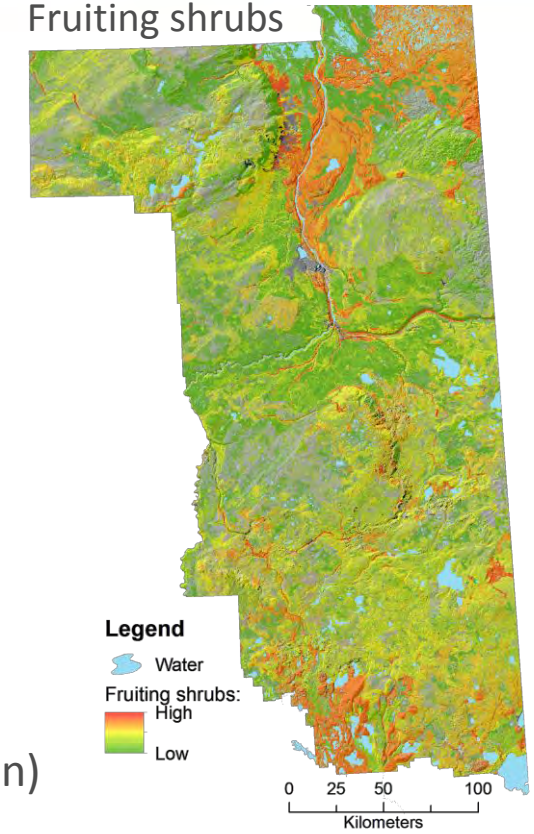
Coarse & fine filter:

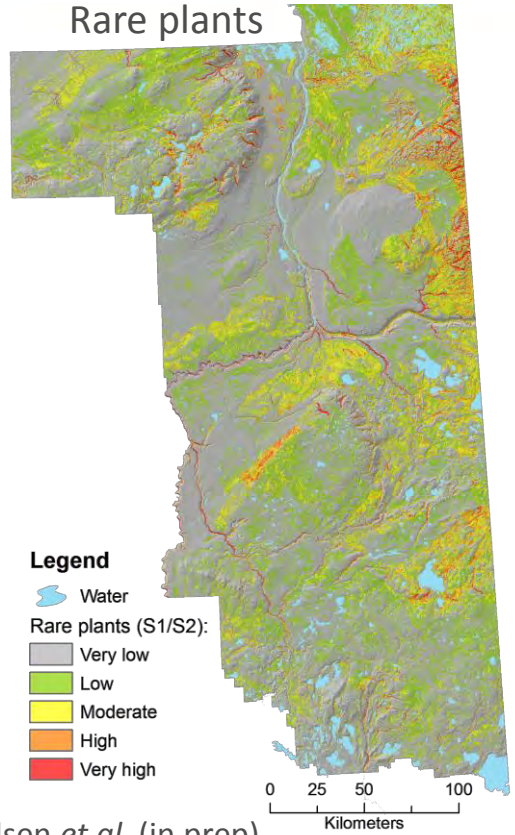
- Habitats (fens)
- Mammals (6)
- Forest birds (19)
- Fruiting shrubs (16)
- Rare plants (19)

= 61 species (indicators)

Habitat models from:

- Fens (GoA)
- Mammals/birds (ABMI)
- Plants (EMCLA & CEMA, Nielsen)

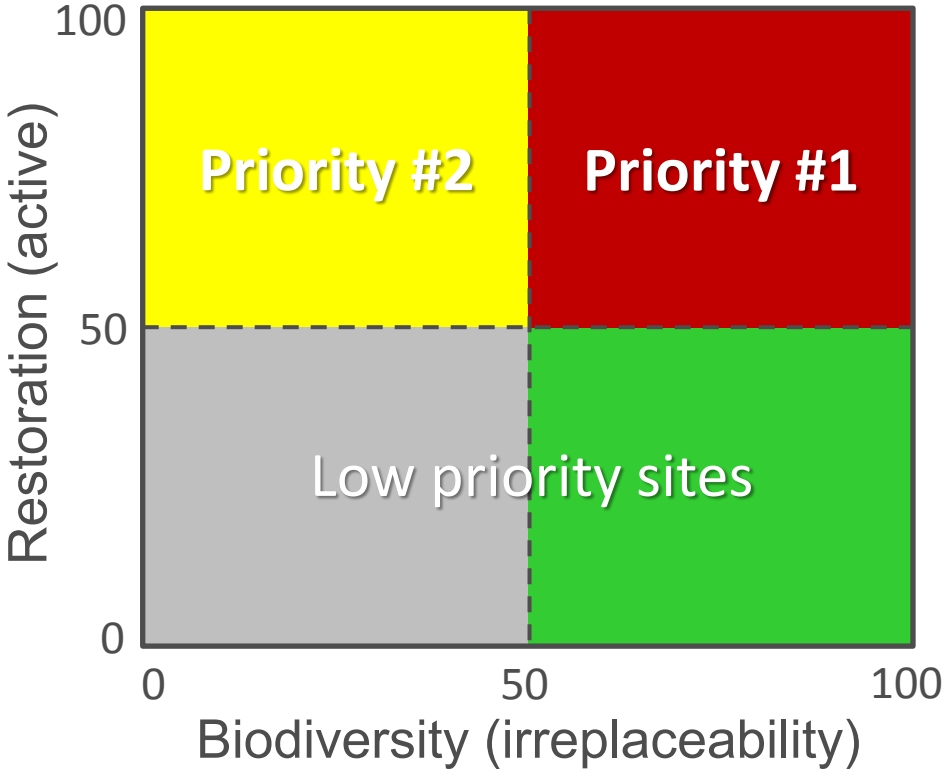




Nielsen *et al.* (in prep)

Prioritize 2D line restoration

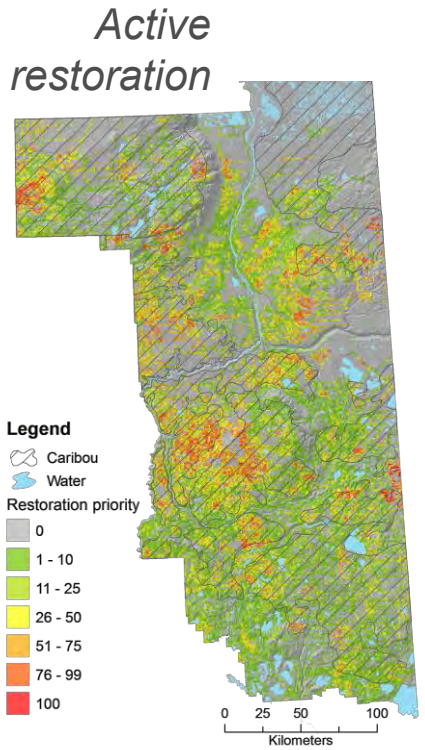
2-dimensional prioritization matrix:

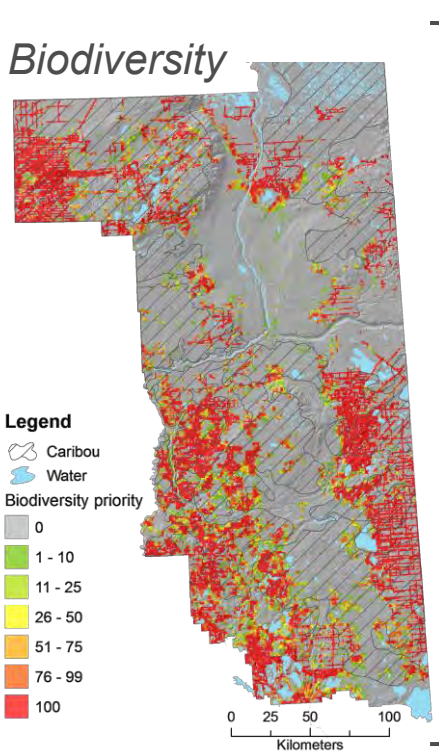


- Rank (prioritize) 'active' restoration sites
- Rank (prioritize) biodiversity value as irreplaceability score (Marxan)
- Develop 2-dimensional prioritization matrix
- Map locations to target regional restoration priorities

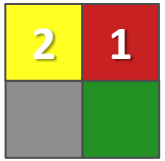
Nielsen *et al*. (in prep)

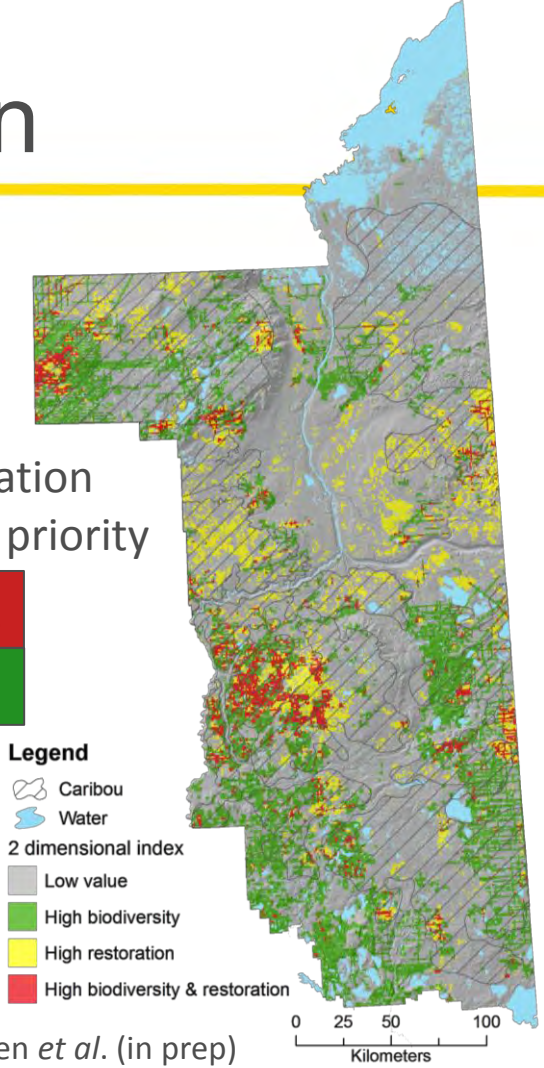
Prioritizing 2D line restoration





Restoration matrix priority

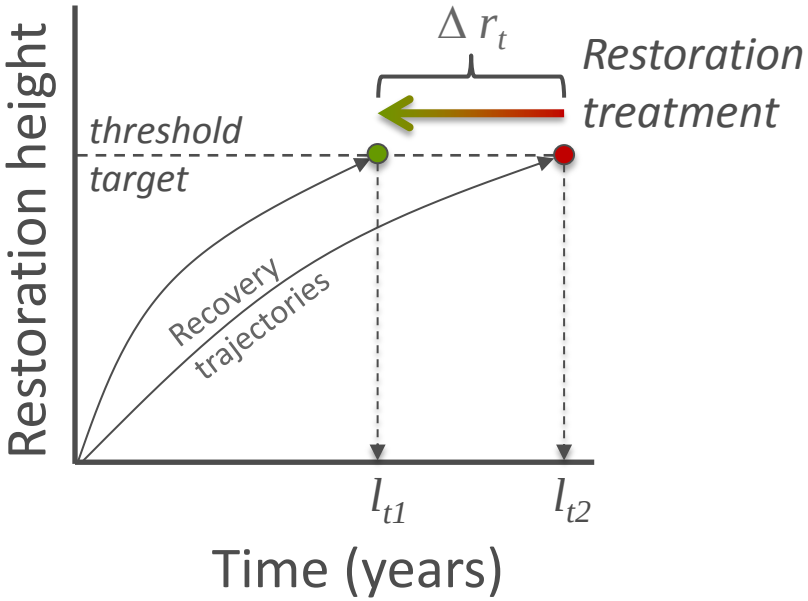




Nielsen *et al*. (in prep)

Restoration time lags & offset ratios

Line recovery trajectories, time lags & net benefit



1. Time to threshold recovery height (recovery time lag, l_t) defines one parameter for offsets
2. To manage footprints of linear disturbance at a specified threshold, recovery lag has to be considered (informing offset ratios)
3. Difference in recovery time (Δr_t) is the net benefit of restoration treatments

Nielsen *et al*. (in prep)

Final thoughts & opportunities

- Managing footprint & biodiversity necessitates restoration
- Ad hoc approach is common
- Places vary in their value & threats, so prioritization (& coordination) is needed
- Monitoring natural & treated sites is needed (effectiveness monitoring)
- Models can be used to target restoration & inform lags to recovery & offset ratios

Collaboration

DART: Cassidy van Rensen, Tim Vinge, Vic Lieffers, Barry White & Jeremy Reid

BUILD (LMP): Tim Vinge, Robert Savage, Cassidy van Rensen & Jim Herbers

Sponsors (support):

cosia CANADA'S OIL SANDS INNOVATION ALLIANCE

Alberta Innovates Energy and Environment Solutions

Alberta Environment and Sustainable Resource Development

UNIVERSITY OF ALBERTA

EMCLA Ecological Monitoring Committee for the Lower Athabasca

nexen

Alberta Innovates Bio Solutions

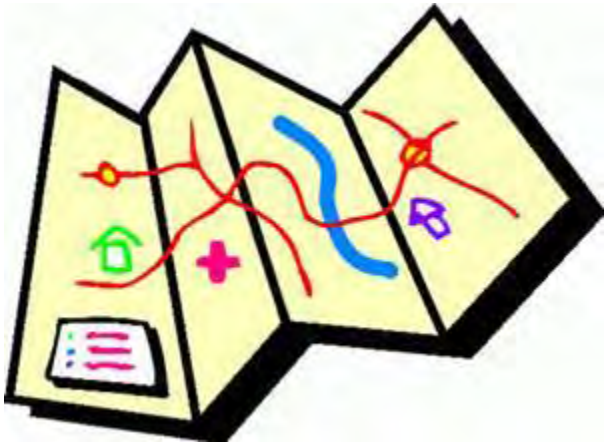
NSERC CRSNG

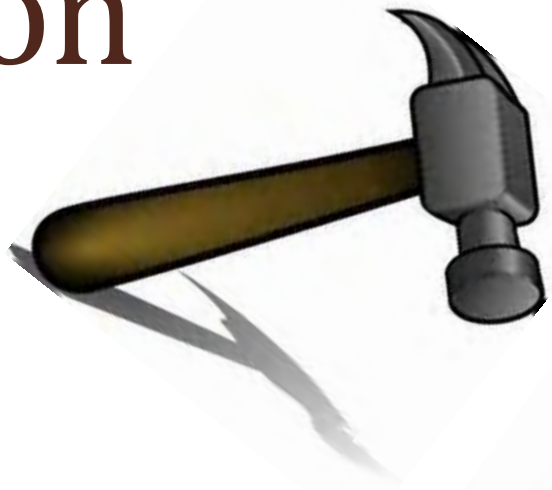
INNOVATION.CA CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

CEMA Studying Cumulative Effects in Wood Buffalo

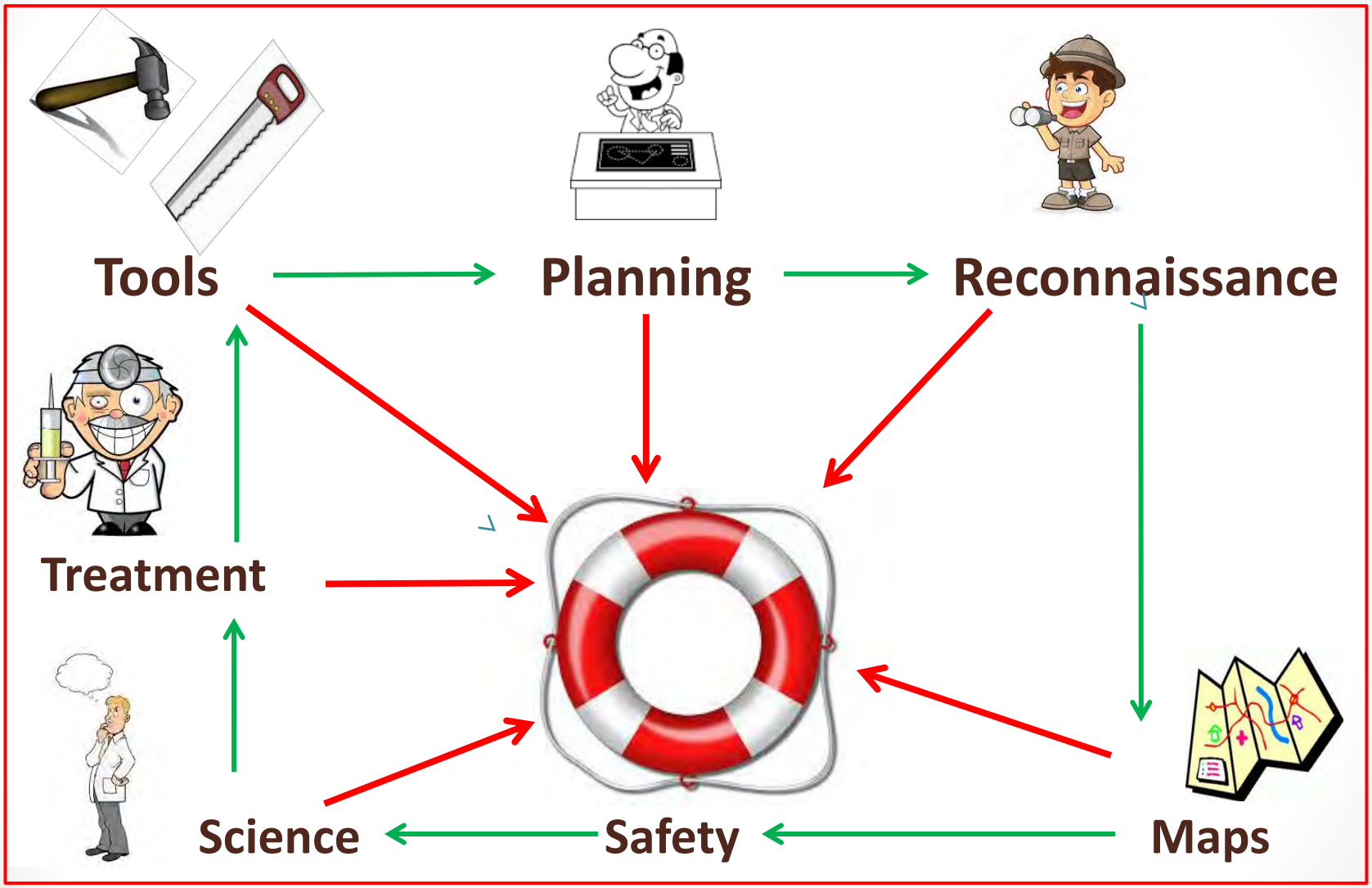
Scott Nielsen, Associate Professor
Alberta Biodiversity Conservation Chair
scottn@ualberta.ca www.ace-lab.org

Operational Planning & Tools for Habitat Restoration





Efficiency & Safety Start & End With Good Planning



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Planning

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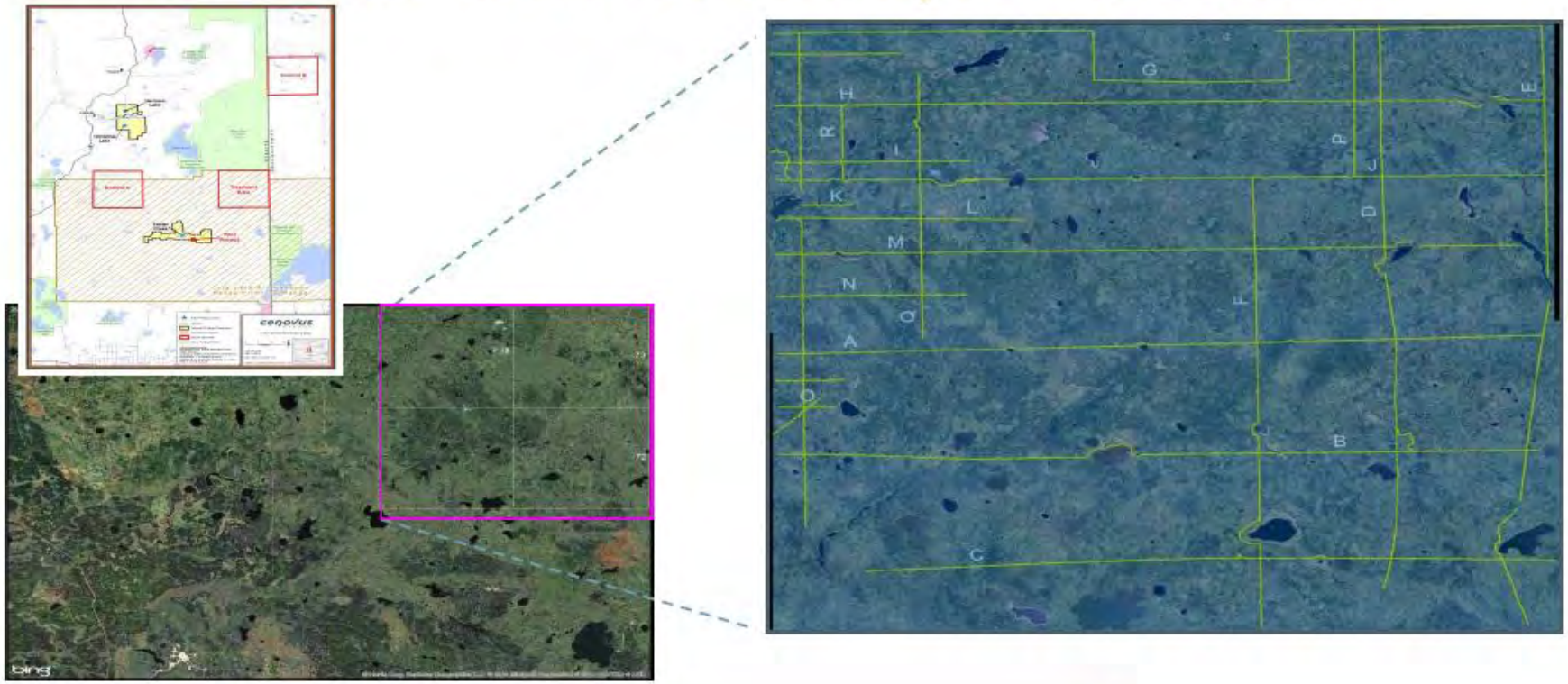
252 km Treated in 37,000 hectares



Planning & Operations

Questions you'll want to ask as a client or contractor:

- Have the objectives been communicated clearly?
- Are all permits in place?
- Is the start & end dates lining up with the amount & conditions of lines being treated?
- Has a thorough risk assessments been completed?
- Communication
- Emergency response plan in place to deal with this type of work
- Do you have the right equipment for the site conditions?
- Do you need to have a pre-job orientation?
- Who's responsible for quality control?
- Has safety been given a high enough priority?

Reconnaissance

Site viewing of access & Lines
360 Areal Imagery
Forest cover map
Wetland mapping (Lidar)

Use the Information to Determine:

Line and or sections of lines

Vegetation Prescriptions

Site Preparation Techniques

Risk Assessments

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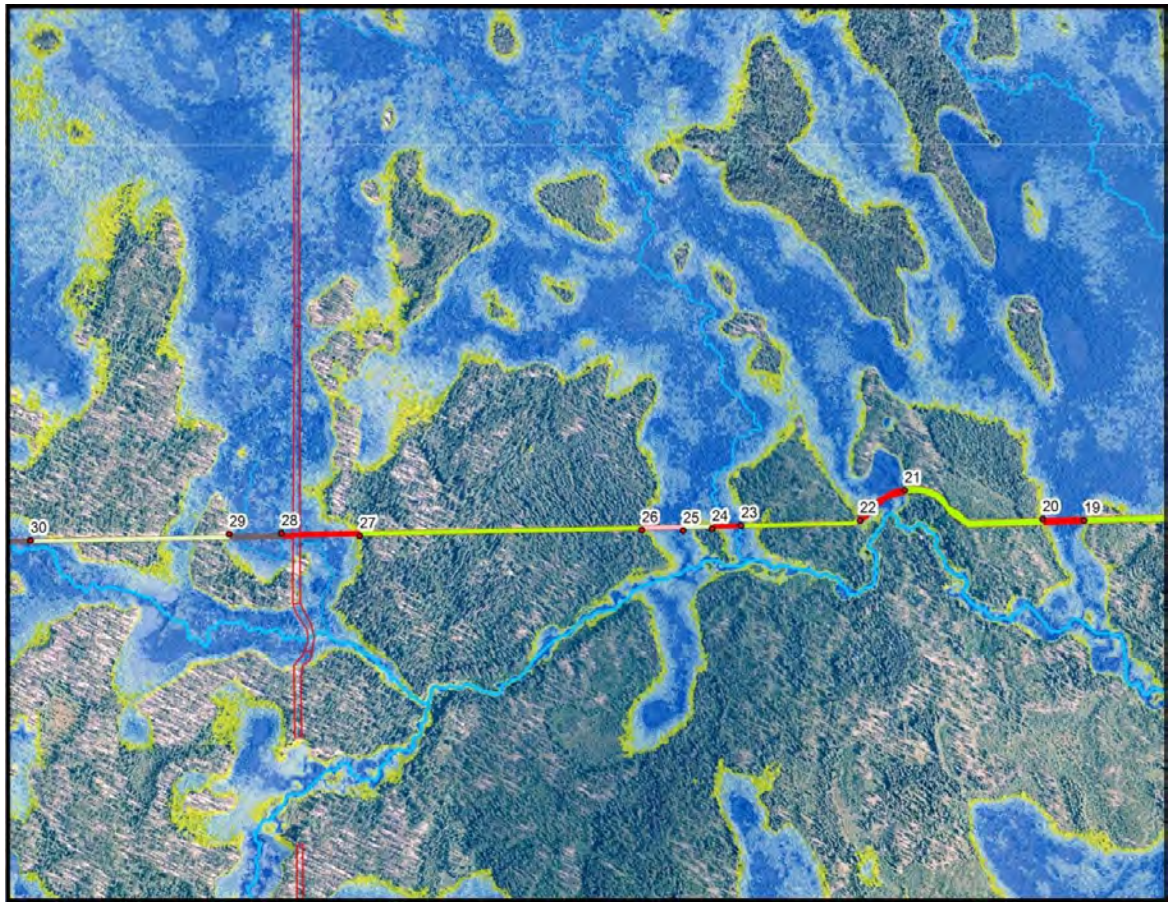
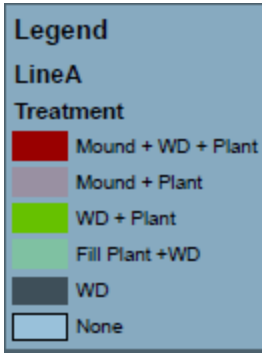
Develop Prescription Map





Prescription & Risk Assessment Map




Depicting;

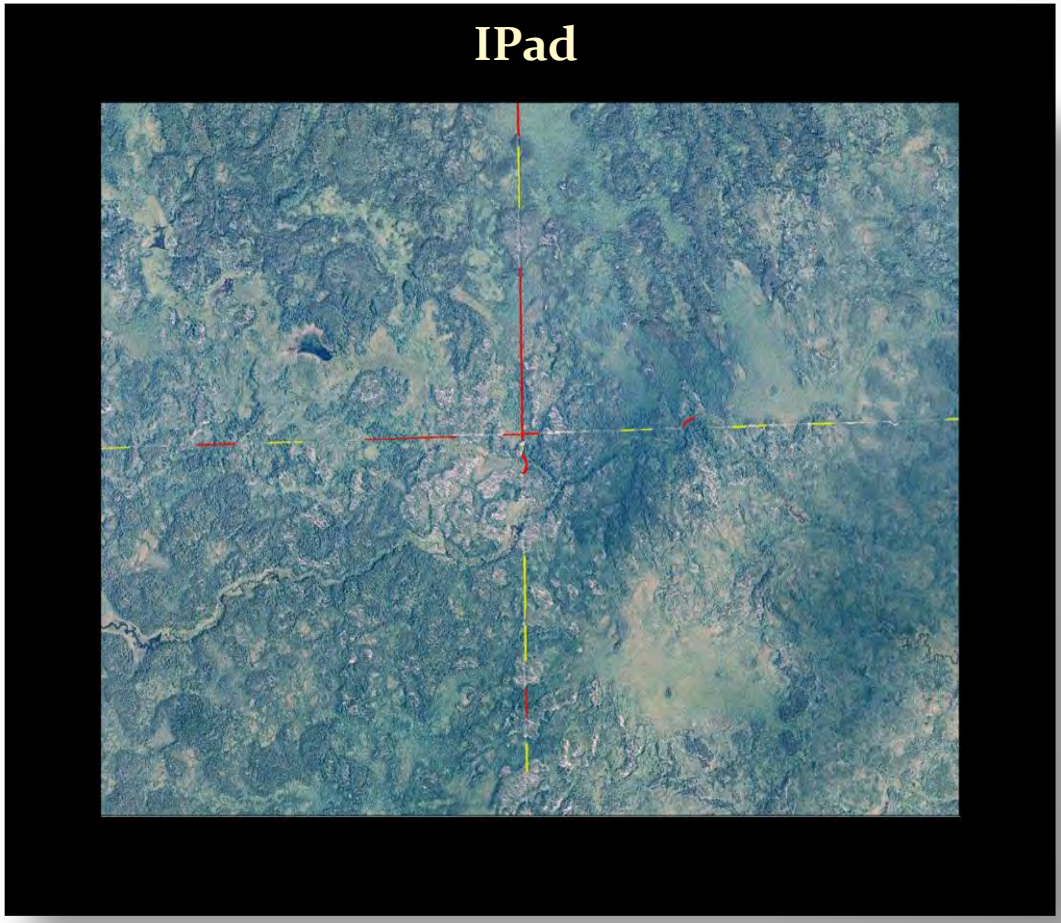
Risk (High Medium Low)

Utilities

Creeks

Prescriptions

Muster Point Etc.



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Safety Systems

Emergency Response
IPad
Frost assessment & documentation
Operating procedures
Environmental
Communication

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Freeze in Access and Higher Risk Areas

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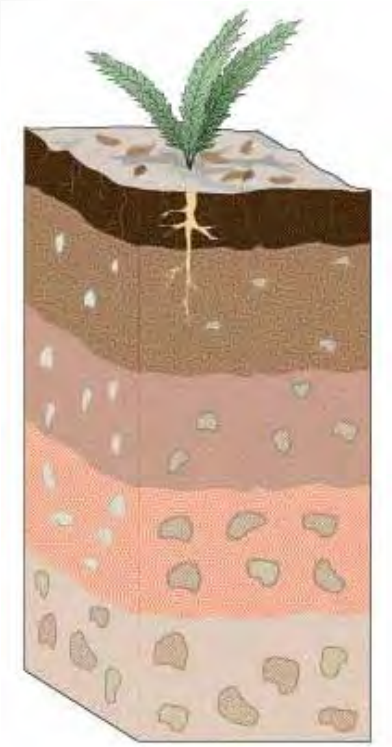
Treatment Methods

- Mound
- Woody Debris
- Winter Tree Planting on Mounds
- Stand Modification
- Transplanting
- Scarify/Screef
- Seed
- A combination of any of the above.

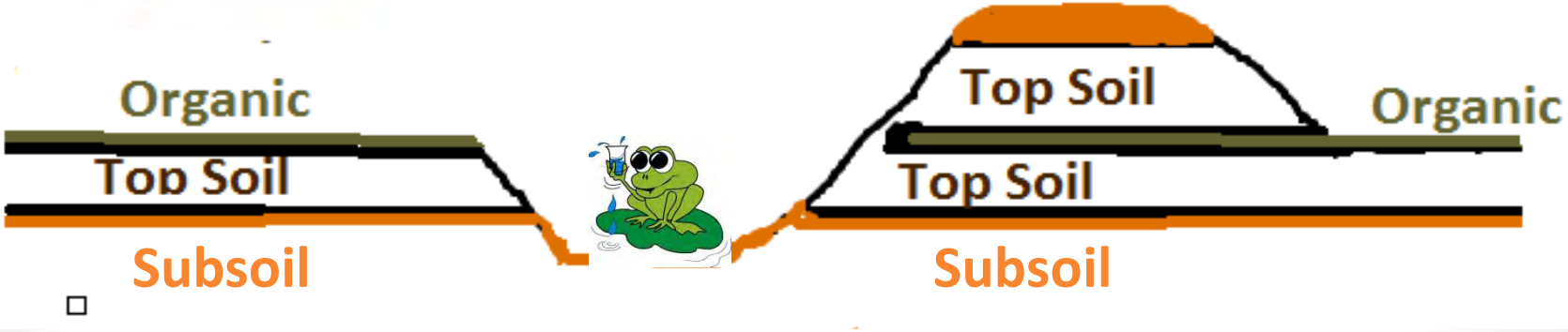
Typical Mound Profile



Organic

Top soil

Subsoil Clay/Sand



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Is Mounding In Wetlands A Viable Option?

Mounding Trial Cold Lake AB

Slide Provided by; Michael Cody
Cenovus

Global Restoration Corp

Wetland Mounding Trial 2014

With silviculture

7 years following mound + plant

cenovus ENERGY

Slide Provided by; Michael Cody
Cenovus

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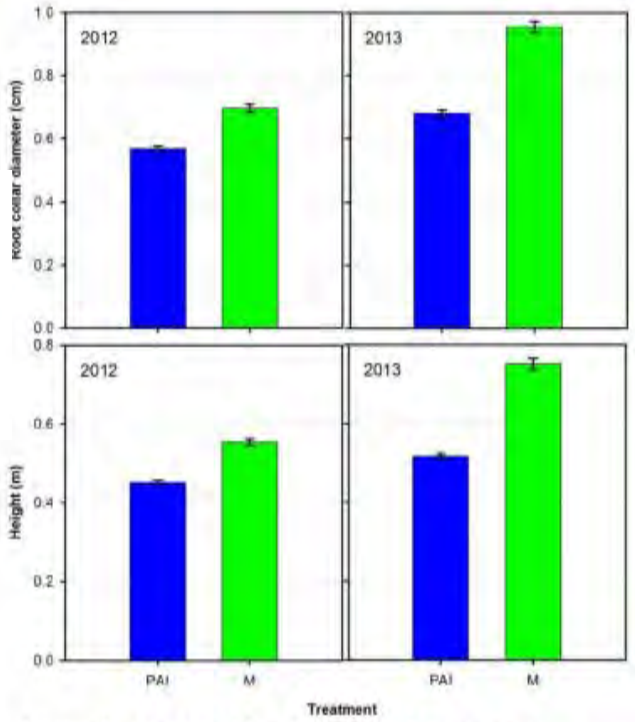
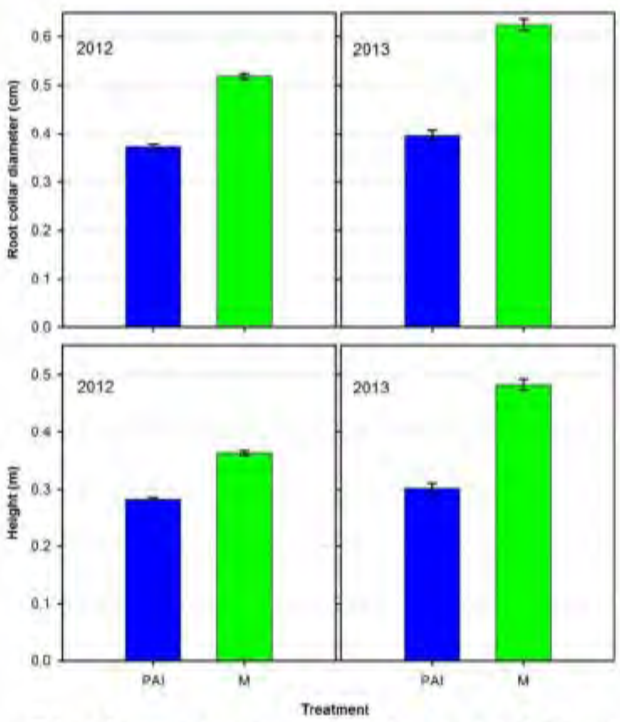
Does mounding work? Growth is better…



Larch growth 4 and 5 years following plant-as-is (PAI) and mound/plant (M)



Black spruce growth 4 and 5 years following plant-as-is (PAI) and mound/plant (M)

cenovus ENERGY

Slide Provided by; Michael Cody
Cenovus

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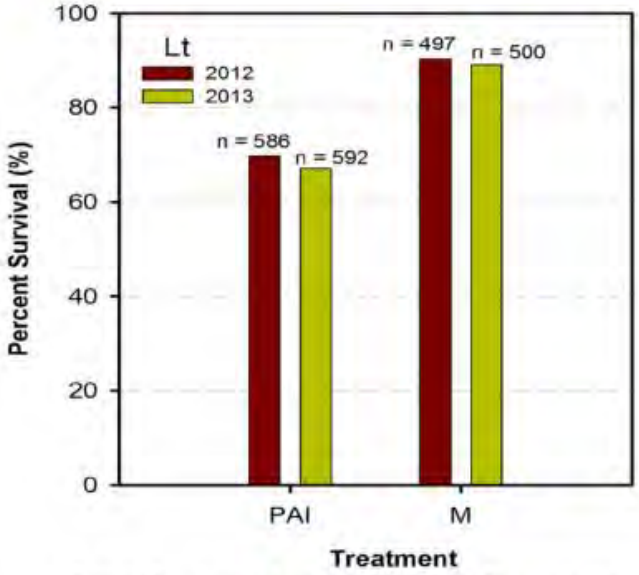
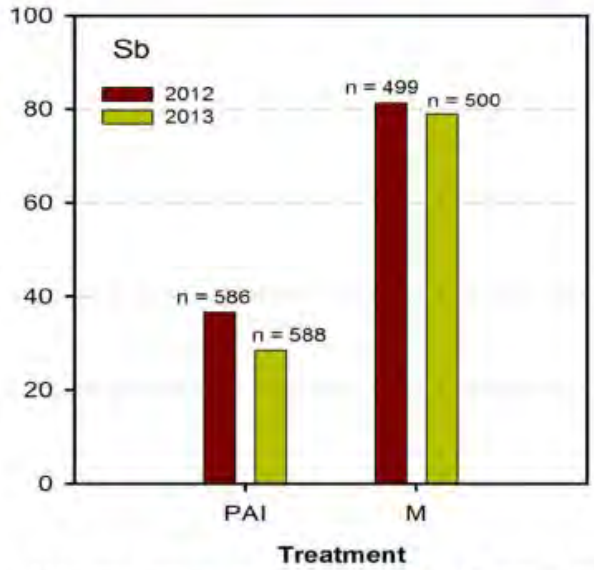
Does mounding work? Survival is better…



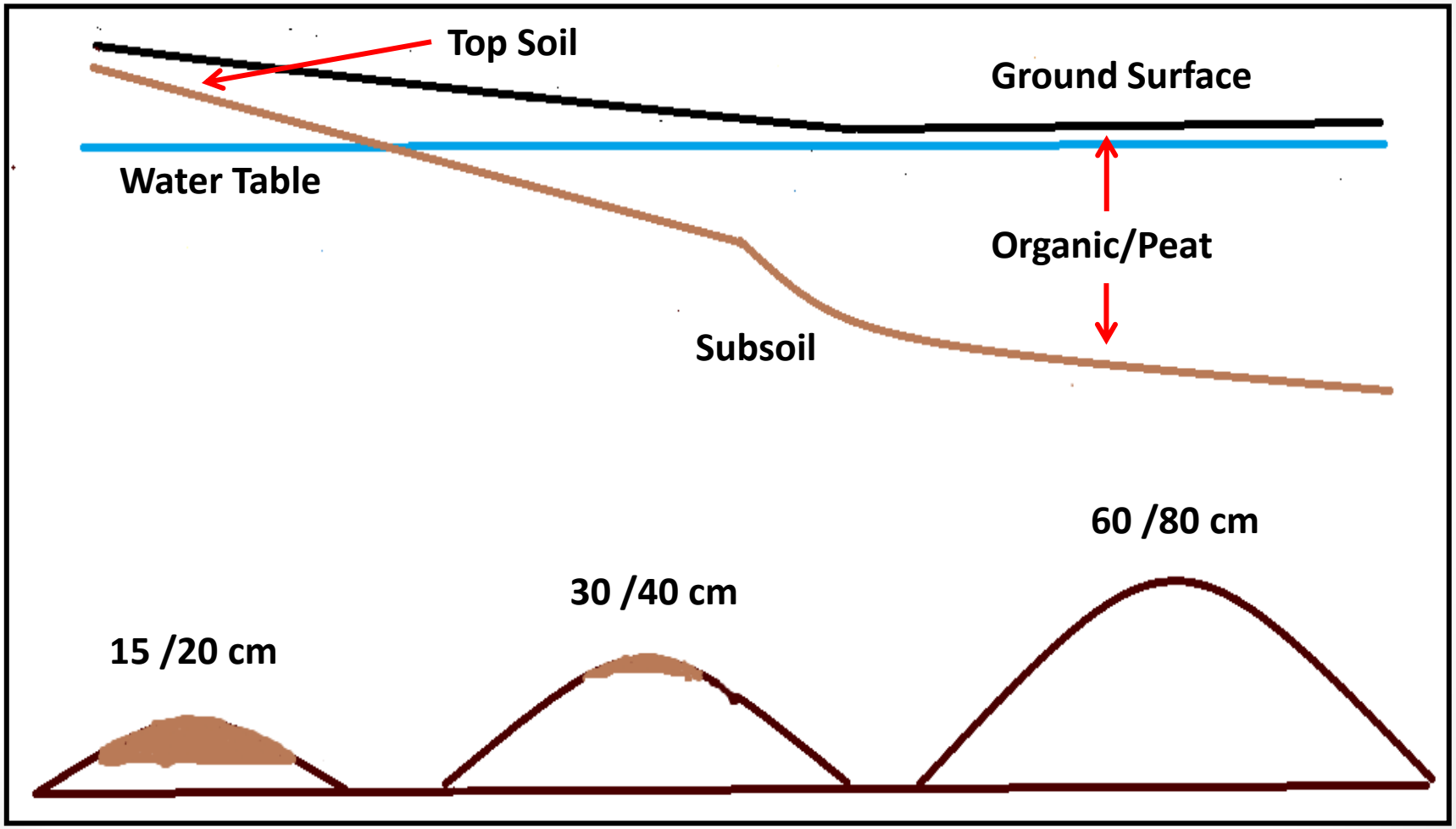
Larch survival 4 and 5 years following plant-as-is (PAI) and mound/plant (M)



Black spruce survival 4 and 5 years following plant-as-is (PAI) and mound/plant (M)

cenovus

Water Table Determines Mound Size



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Mounding Benefits

- Lengthens amount growing days through increased soil temperatures
- Reduces competition and influence from surrounding vegetation
- Reduces mortality in areas with high water tables
- Provides optimum rooting zone
- Increased tree growth will reduce line of sight faster
- Reduces large animal and human traffic

Is it Possible to Plant Black Spruce in the Winter?

Trial Location; Evergreen Centre for Resource Excellence and Innovation

Black Spruce Winter Plant 94 Percent Survival

Planted at -17C Feb 2011

Three Years Later Summer 2014

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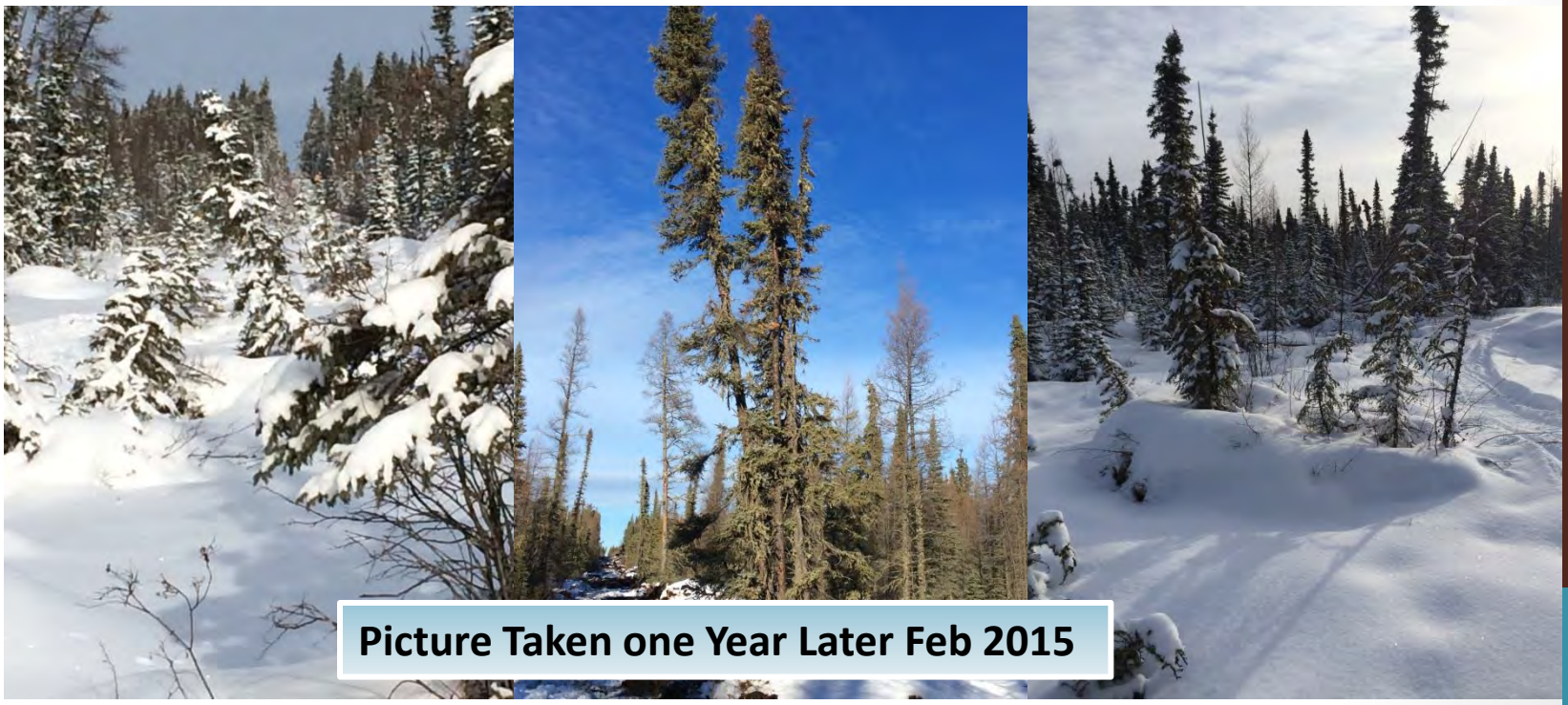
Results of Winter Plant

		Winter Planting (4 cm)	Winter Planting (8 cm)	Spring Planting
Total Number of Planted Seedlings		246	255	241
Seedlings Survived	**Number**	232	250	240
	Percentage	94.4% b	98.0% a	99.5% a
Seedlings with Dead Terminal Bud	**Number**	103	115	14
	Percentage	44.4% a	46.0 a	5.8% b
Seedlings with Dead Branch(es)	**Number**	200	144	25
	Percentage	86.2% a	57.6% b	10.4% c

Is Winter Transplanting Possible?

Transplanted Feb 2014



Picture Taken one Year Later Feb 2015

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Winter Transplant 2015

Before

After

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Winter Transplanting 2015

Before

After

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Treatment Tools

Mounded Seismic Line

Woody Debris

Combining Mounding & Woody Debris

Woody Debris

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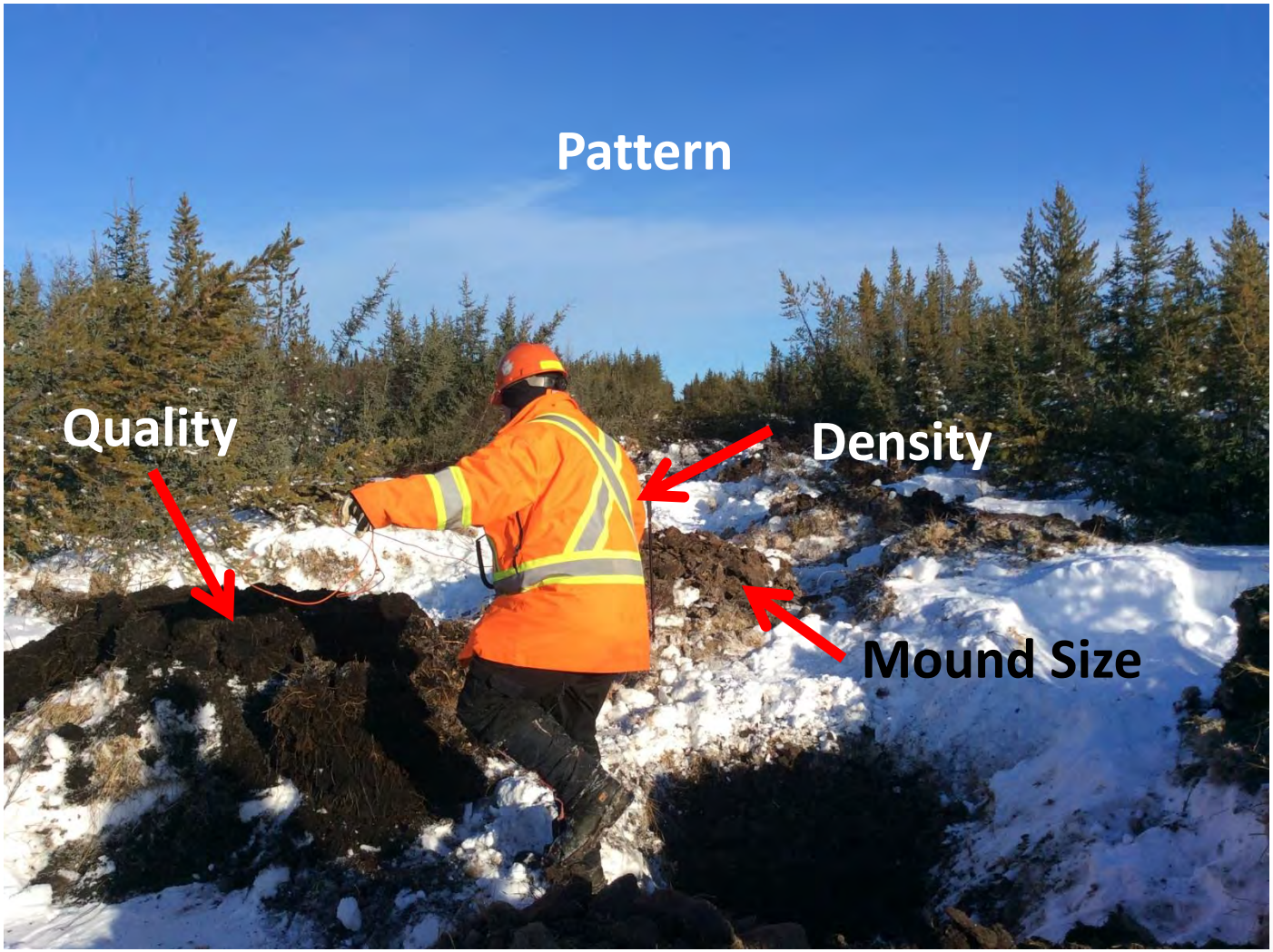
Effective Treatments



Line of Site Break
Tree Tipping

Pipeline Right-of-Way Mounded & Winter Planted 2014

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Pipeline Right-of-Way

Mounded & Planted to Back Spruce

Scarified &Seeded to Pine

Old Lease Road North Western Alberta Mounded Only

Before Treatment

One Year After Treatment

Year Three/ No Planting

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Wetland Lease

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assisting

the natural restoration of our forests and animal habitats

Overview of the Restoration Toolkit: Planning Considerations

April 28, 2015

Habitat Restoration: Planning

- Recently abandoned access roads
- Active pipelines
- Transmission Lines

- Legacy features
  - Seismic lines
  - Decommissioned pipelines
  - Much more difficult!
    - More Remote
    - Baseline data deficiencies

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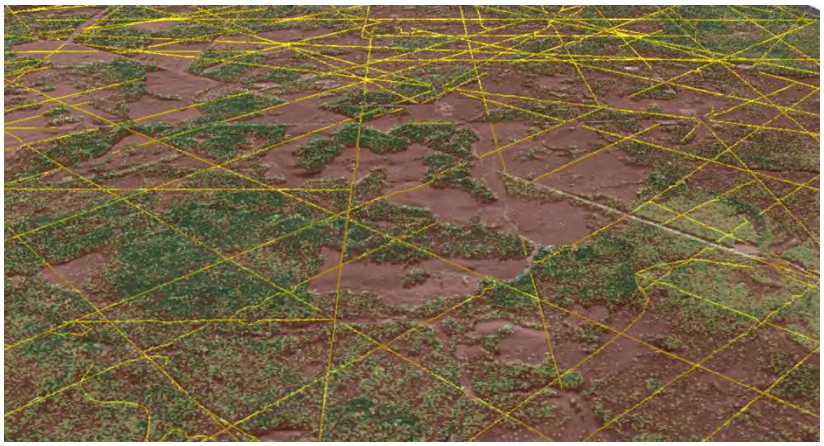
Implementation - Operational Planning

How do we select the area?

- Linear Feature (and Polygon) Inventories
  - **Remote sensing** to spatial map lines and level of natural regrowth
  - Classify type of disturbance



- LiDAR?
- High Resolution Imagery Linear Inventory Classification?
- Combination?
- 360 Camera Technology and Linear Inventory Classification?
- Drones?

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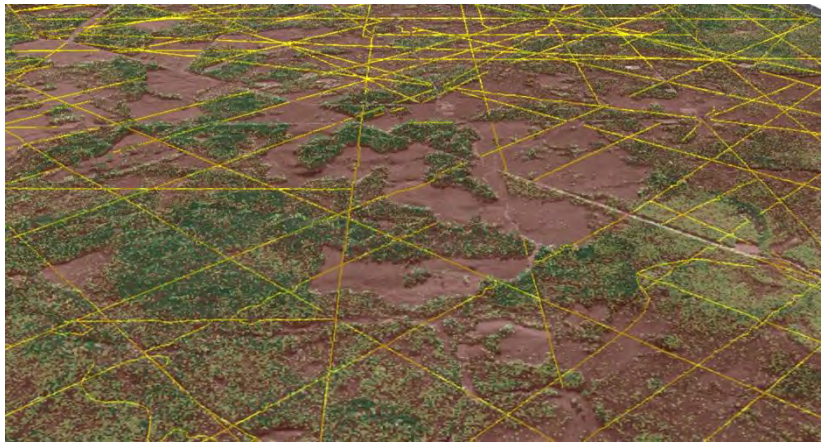
Implementation - Operational Planning

How do we select the right lines?

- Consider:
  - Future Development Plans
  - Provincial Priority Areas
  - Focused on creating large, contiguous, intact habitat areas
  - Operationally Viable Methods
  - Regulator Approval, land user inputs



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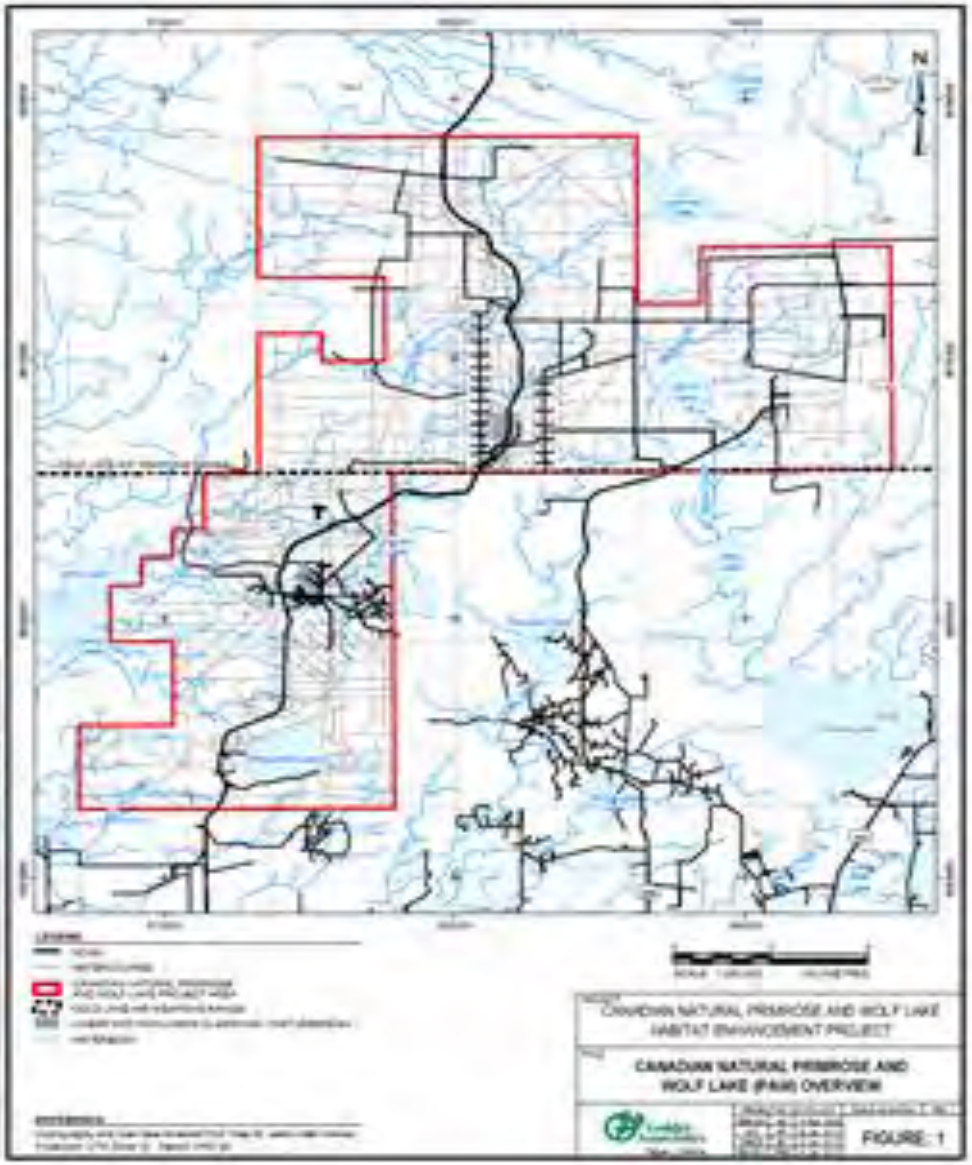
CNRL PAW LEASE: CASE STUDY



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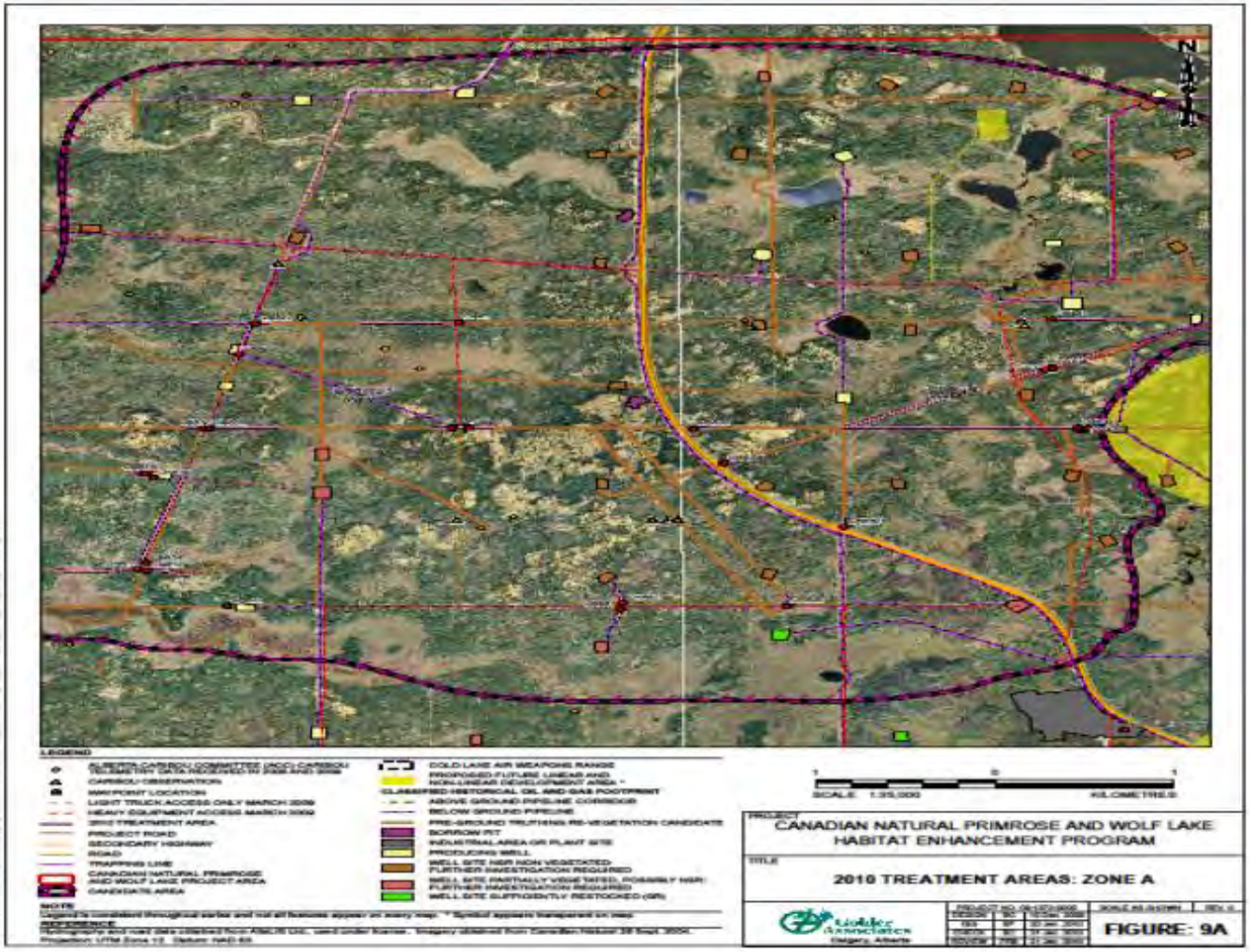
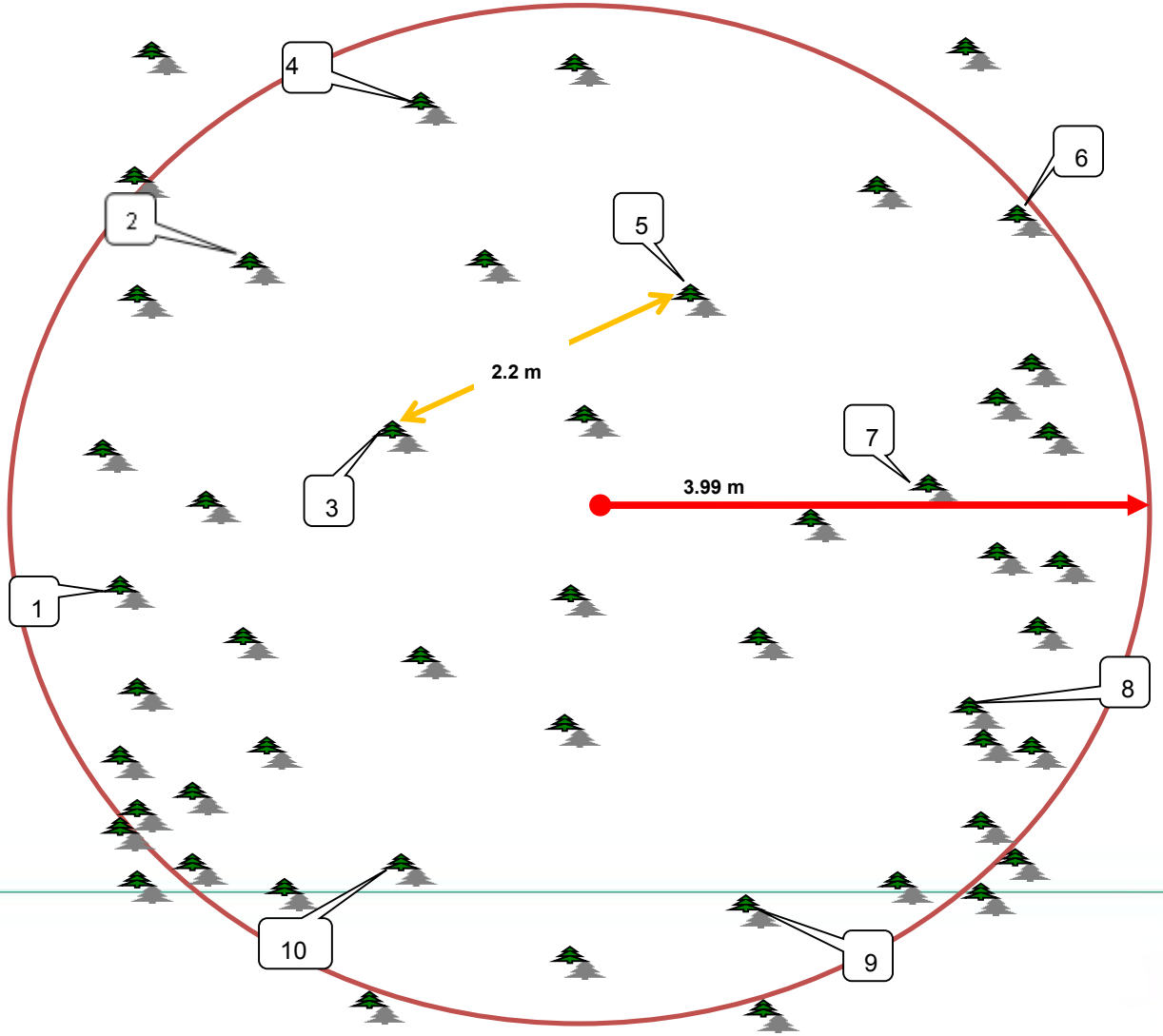
Habitat Restoration – What's Out There?

Habitat Restoration: What's Out There?



Ground Truthing

- Field Truthing of Candidate Sites



Ground Truthing

Permitting and Consultation Requirements

- Regulatory Requirements for Reclamation
  - Lisa's Earlier Talk
- Consider Consultation Requirements for Access Control and Woody Debris Use
- First Nations Consultation
- Trap-line Holders
- Pipeline Crossing Agreements

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Pipelines

- Abandoned and Decommissioned Pipelines: Rare
- Active Pipelines and Restoration
  - Access Considerations
    - 3 m on each side of pipe?

    5? 10?
  - Integrity Issues?
    - Site considerations, vegetation type

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Pipelines

- Access Corridors

- Re-use as ROW or TWS for Parallel Lines

Pipelines

- Do they need restoration?
  - Wider than seismic
- Same considerations using the treatment matrix as for seismic
- Level of disturbance / moisture/nutrient regime / type of clearing

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Pipelines

- Do they need restoration?

Pipelines

- Access Control

SCEK REMB Caribou Habitat Restoration Toolkit

Restoration Monitoring

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Why Monitor Restoration?

- Project approval condition
- Increased knowledge of techniques' effectiveness can refine efforts and costs at next site (what works, what does not work)
- Improves future permit/license applications by including long-term monitoring commitment and experience
- Increased social license – able to report success stories to the public and regulators

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What? – Monitor Based on Objectives

Canadian Association of Petroleum Producers (CAPP)

“Application of techniques on anthropogenic disturbances that deter predation, primary prey and human use in the near term, that supports long term habitat recovery“.

Monitoring – Response Metrics

Multi-Species
Multi-Level

Short Term ⟷ **Long Term**

Key Outcomes

- Monitoring should:
  - Start as soon as restoration begins
  - Occur on treated and naturally re-vegetated areas
  - Measure growth, density, diversity of plant community
  - Evaluate effectiveness of access control
  - Frequency: first and third growing season for vegetation, longer? (TBD)

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Sampling Monitoring Datasheet (Appendix D)

Seismic Line Regeneration Survey

General Plot Information								* Datum is NAD83
Project No:	08-1372-0019	Plot/Waypoint ID		Date (dd/mmm/yy)	/ AUG / 08			
Time (24-hr)		UTM Zone		UTM E *		UTM N *		
Ecoregion		TM7		Gen. Veg Class	☐ Pine ☐ Aspen ☐ Sb-upland ☐ Sb-wetland ☐ _____			
Surveyor		Field QA/QC		Camera		Plot Type	☐ Seismic Line ☐ Control	

Seismic Line Information		Photo No. / Direction			Site and Soils Information	
S/L Age Class (years)	☐ <5 ☐ 20 ☐ 40	Ground Surface			Slope (%)	
S/L Width (m)		Robel 1			Aspect (deg)	
Robel 1 (cm)		Robel 2			Hummocks Height (cm)	
Robel 2 (cm)					Subsisdence (cm)	
Line-of-Site Distance Class (m)	☐ <20 ☐ 20-50 ☐ 50-100 ☐ 100-200 ☐ 200-400 ☐ >400	Oblique Aerial			Surface Organic Thickness (cm)	
		Incidental Wildlife Observations			Surface/Effective Texture	/
Evidence of Seismic Line Use	☐ none ☐ ATV ☐ Truck ☐ Heavy Machinery ☐ Other_____		Species	Sign	Slope Position	C U M L D T V
		Sp. 1			Moisture Regime	vx x sx sm m sg hg sd hd
Trail Width (m)		Sp. 2			Drainage	
Compaction Within Macroplot (9)					Moltles/Gley	
Compaction Adjacent Ecosite (10)					Soil Class	
					Ecophase/Wetland	

Surface Substrate - % cover of non-living matter; adds to 100% within 1.78 m radius plot									
Water		Mineral Soil		Cobbles & Stones		Bedrock		Decaying Wood		Organic Matter	

Regeneration Plot - 1.78 m radius												
Tallest Regeneration (or tallest tree within seismic line plots)				Regeneration <1.5 m				Regeneration 1.5-4.9 m [a]			Trees ≥5.0 m [a] (seismic line plots only)		
Species	Ht. (m)	Diameter at Base (cm)	Total Age	Plot Size	Tally	Total	Mean Ht. (m)	Tally	Total	Mean Ht. (m)	Tally	Total	Mean Ht. (m)
				full 1/4									

Monitoring Datasheet (Appendix D)

Adjacent Tree Canopy Attributes		
	Adjacent (NE)	Adjacent (SW)
Ecosite Phase		
Overstory/Understory AVI		

Vegetation Cover - within 1.78 m radius plot

Vegetation Strata Cover			Dominant Species by Strata		All Other Shrubs			Other Species		
Strata	Daubenmire Cover Classes [c]	Mean Ht. (m)	Species Code	% Cover	Species Code	Strata	% Cover	Species Code	Strata	% Cover
Tall Shrub (1.5-4.9 m) (T)	1 2 3 4 5 6 7									
Low Shrub (<1.5 m) (S)	1 2 3 4 5 6 7									
Herb (H)	1 2 3 4 5 6 7									
Grass (G)	1 2 3 4 5 6 7									
Moss (M)	1 2 3 4 5 6 7	X								
Lichen (L)	1 2 3 4 5 6 7	X								
Epiphytes (E)	1 2 3 4 5 6 7	X								
Comments										

[a] Full plot size only; [b] Recorded from leading species in control plots only; [c] Daubenmire classes: **1** = <1%; **2** = 1-5%; **3** = 6-25%; **4** = 26-50%; **5** = 51-75%; **6** = 76-95%; **7** = 96-100%.

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Moving to a Restoration Monitoring Framework

- No existing framework or guidelines for consistent approaches to monitoring
- Sharing knowledge about methods and results will save money in the long-term
- Consistent approach will increase power of results
- Collaboration and knowledge of treated areas within larger landscapes (regional spatial scales) will increase effectiveness of implementation

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Monitoring Framework (SCEK REMB 2015)

- To develop a long-term habitat restoration monitoring framework for assessing the success of caribou habitat restoration. Framework document will include:

  - Outline of short term and long term objectives of restoration;
  - Draft minimum measurable targets for restoration sites (active and passive restoration);
  - Monitoring plot layout;
  - Monitoring plot datasheets;
  - Monitoring frequency;
  - An outline of adaptive management tools and process;
  - Data management considerations; and
  - Clarity in roles for data management and analysis.

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Key Outcomes

- Need operating guidelines for how and when monitoring should occur
- Need mechanism in place to track from start to finish of restoration program
- Need mechanism in place to share amongst operators where and what restoration is occurring
  - Online tool
  - Spatial data
  - Annual commitment to update progress?
- Voluntary, or embed in permits

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