

***SMA Environmental Forum 2016***

# **COMPENSATION LAKE DESIGN CONCEPTS AND CONSTRUCTION LESSONS LEARNED**

***A Tale of Two Lakes***

**NORWEST**  
CORPORATION

Pamela Kuipers, P.Eng., MSc



# Presentation Outline

**1.Introduction: Compensation Lake Concepts, Site Selection and Design Objectives**

**2.Construction of Shell's Jackpine and MRMe Compensation Lakes with Lessons Learned**

**3.Lake Performance to date**



**Shell Canada**



# Compensation Lake Concept

- To maintain the productive capacity of fish habitats, DFO adopted an offset policy based on Habitat Units (formerly “No Net Loss”)
  - Projects that will alter fish habitat required an authorization under Section 35(2) of the Department of Fisheries and Oceans (DFO) *Fisheries Act*
  - *The two lakes were constructed under authorizations granted prior to 2010, which specified a 2:1 HU offset*

Losses

x 2 =

GAINS



# Compensation Site Selection Process

- Background Inventory
- Site Scoping
- Detailed site investigations
- Multi-stage analyses were completed
  - Numerical weighting(K-T) decision matrix analyses were completed at each stage



# Compensation Site Location Attributes

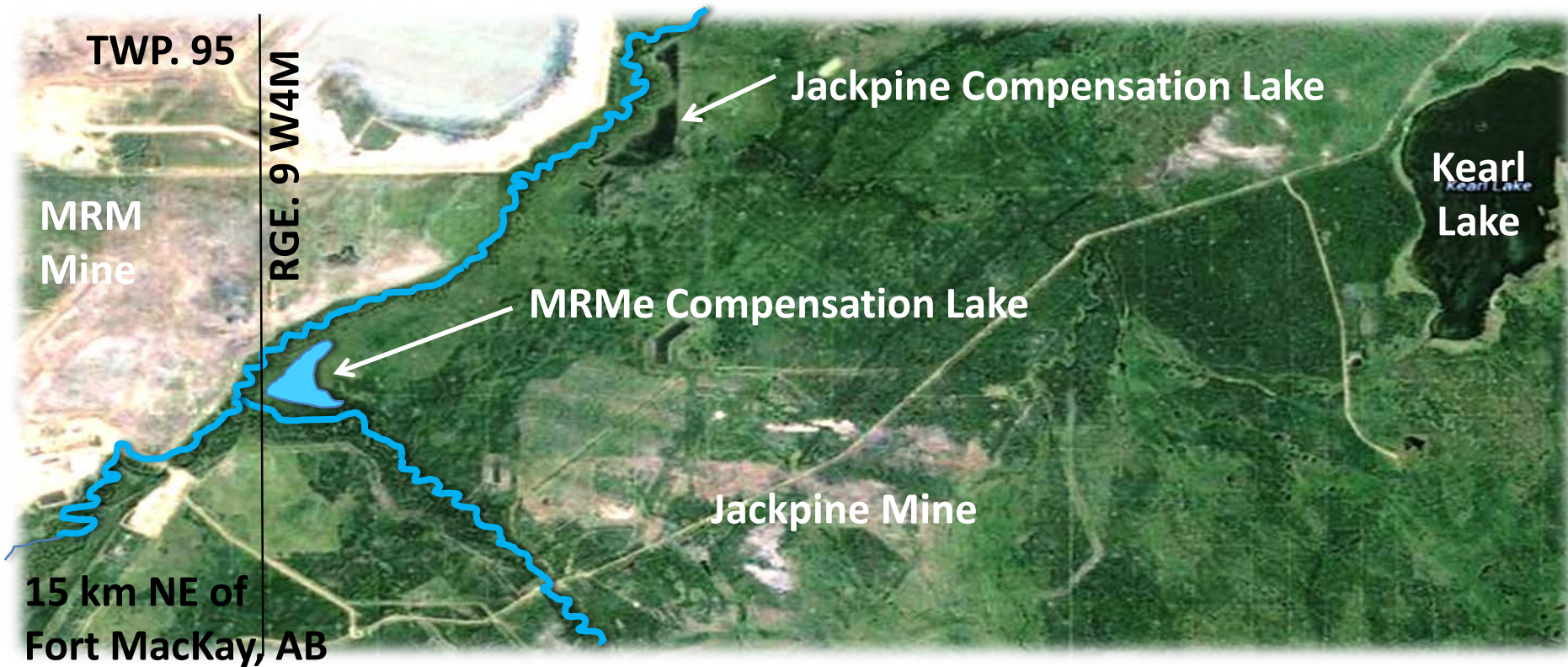
Evaluation metrics included:

- stakeholder concerns:
- ecological viability:
- technical and construction feasibility
- economic feasibility
- accessibility





# JPM and MRMe Compensation Lakes



# Design Objectives

- Creates fish habitat units (HU) required by DFO Authorization
- Made of natural materials

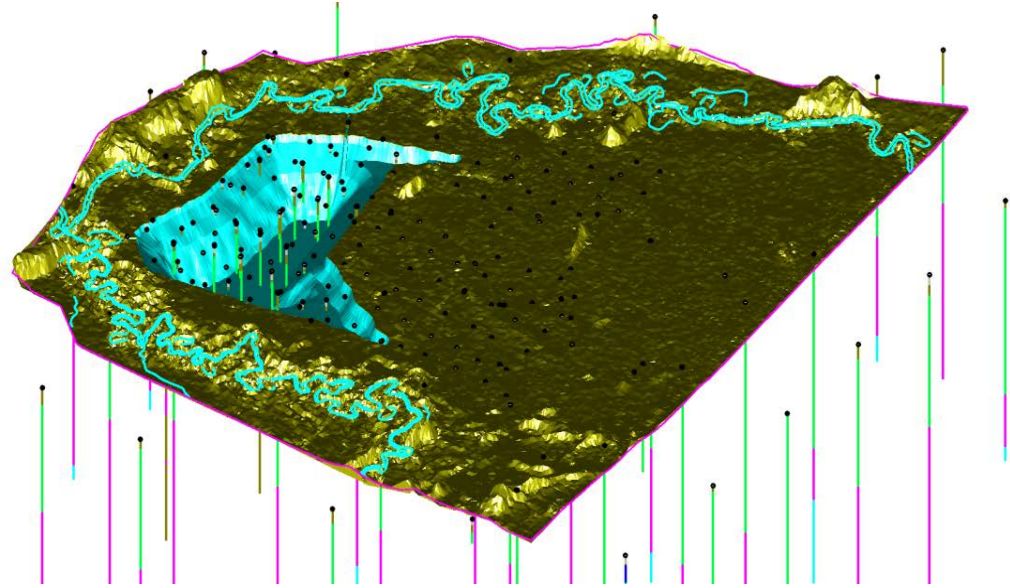
- Stable and permanent
- Supports target fish
  - Inlet and outlet accessible to existing populations
- Supports existing terrestrial habitat
- Executed Safely and in accordance with all regulations

JPM  
Compensation  
Lake Outlet (2013)



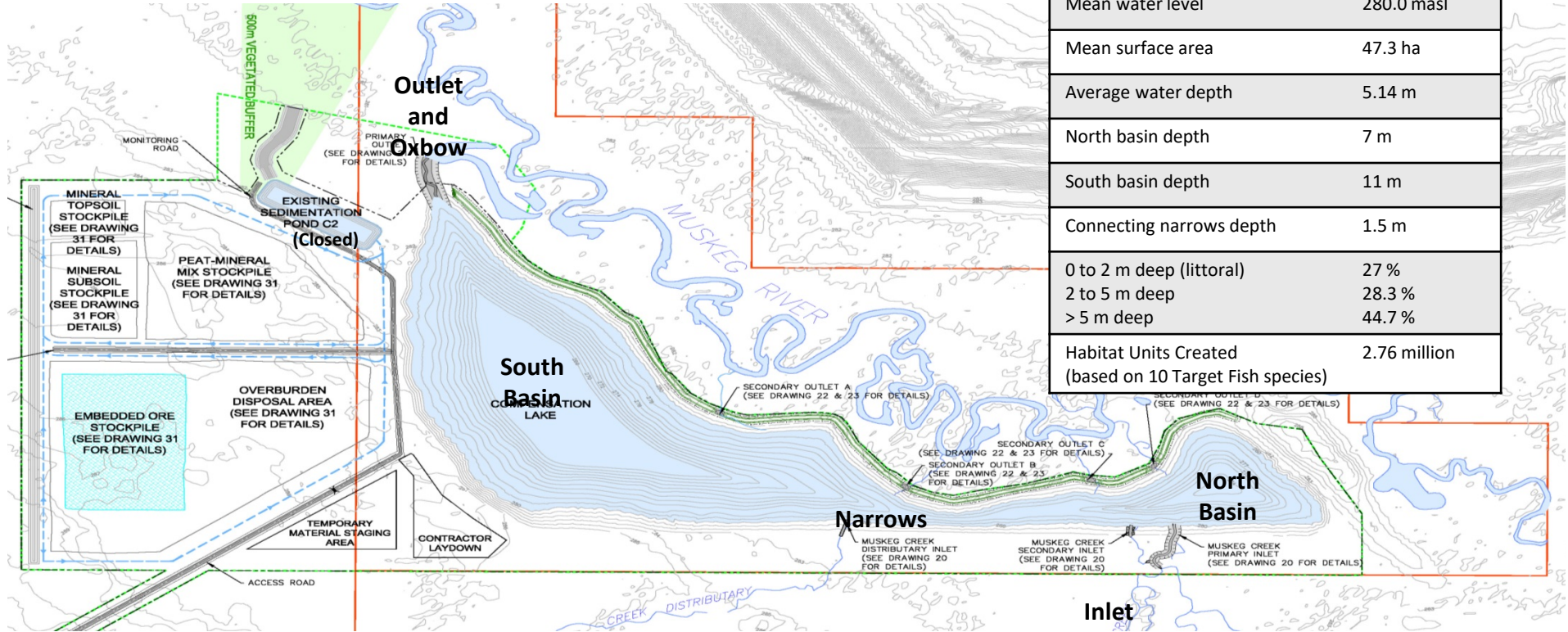
# Detailed Design Inputs

- Field investigations
- Geologic modeling
- Groundwater modeling
- Surface Water modeling
- Water quality modeling
- Flood modeling
- Iterative bathymetry and Suitability Index model process
- Consultation, First Nations and regulator review
- Fish surveys



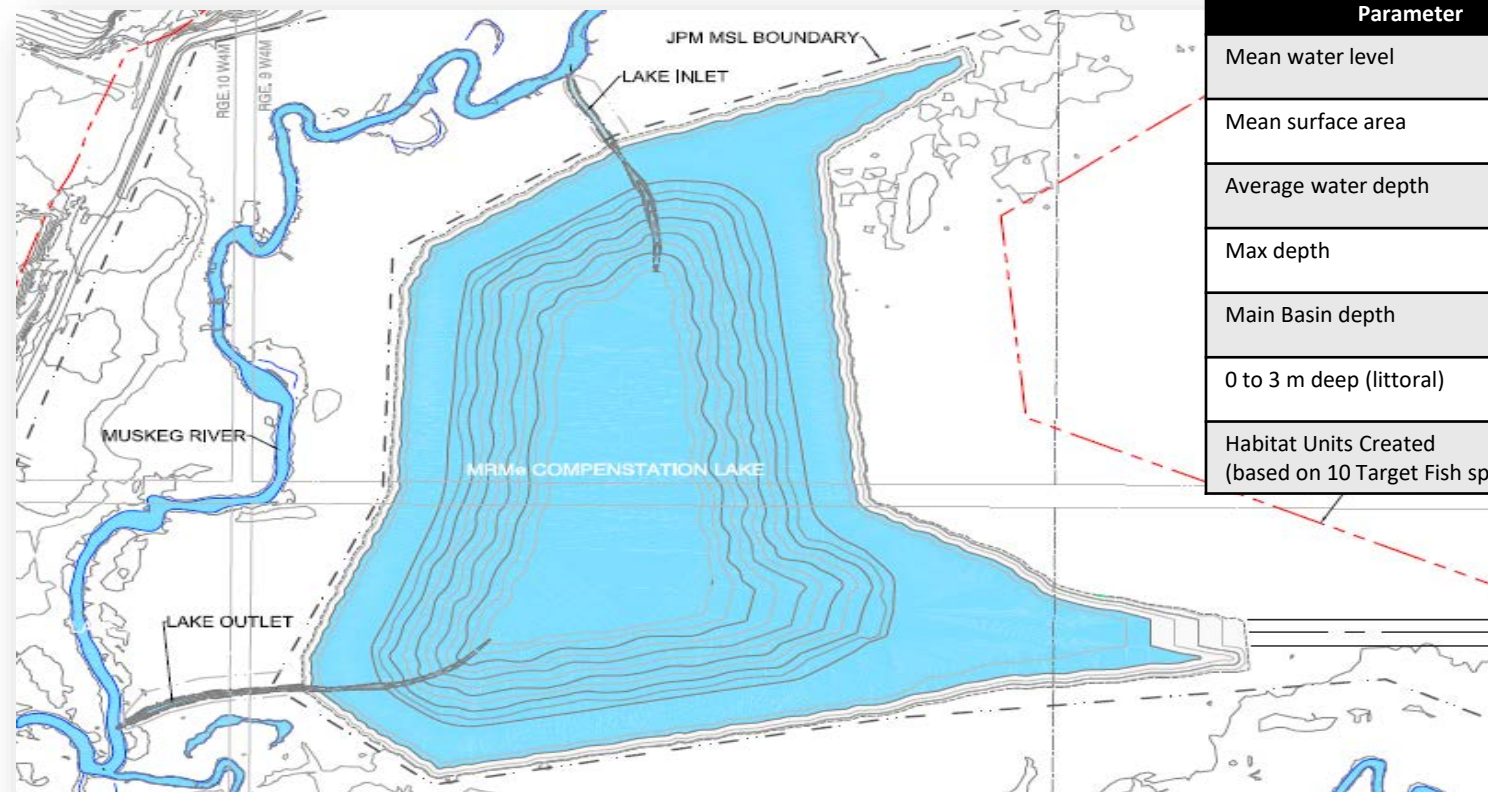


# JPM Compensation Lake Characteristics



Parameter	Value
Mean water level	280.0 masl
Mean surface area	47.3 ha
Average water depth	5.14 m
North basin depth	7 m
South basin depth	11 m
Connecting narrows depth	1.5 m
0 to 2 m deep (littoral)	27 %
2 to 5 m deep	28.3 %
> 5 m deep	44.7 %
Habitat Units Created (based on 10 Target Fish species)	2.76 million

# MRMe Compensation Lake Characteristics



Parameter	Value
Mean water level	278.2 masl
Mean surface area	41.4 ha
Average water depth	5.7 m
Max depth	12.2 m
Main Basin depth	11 m
0 to 3 m deep (littoral)	43.7 %
Habitat Units Created (based on 10 Target Fish species)	2.61 million



# Early Works- Both Projects

- Tree clearing and salvage
- Access and Haul Roads
- Soil salvage plans
- Dump and stockpile designs and permitting
- Drainage network and sedimentation ponds

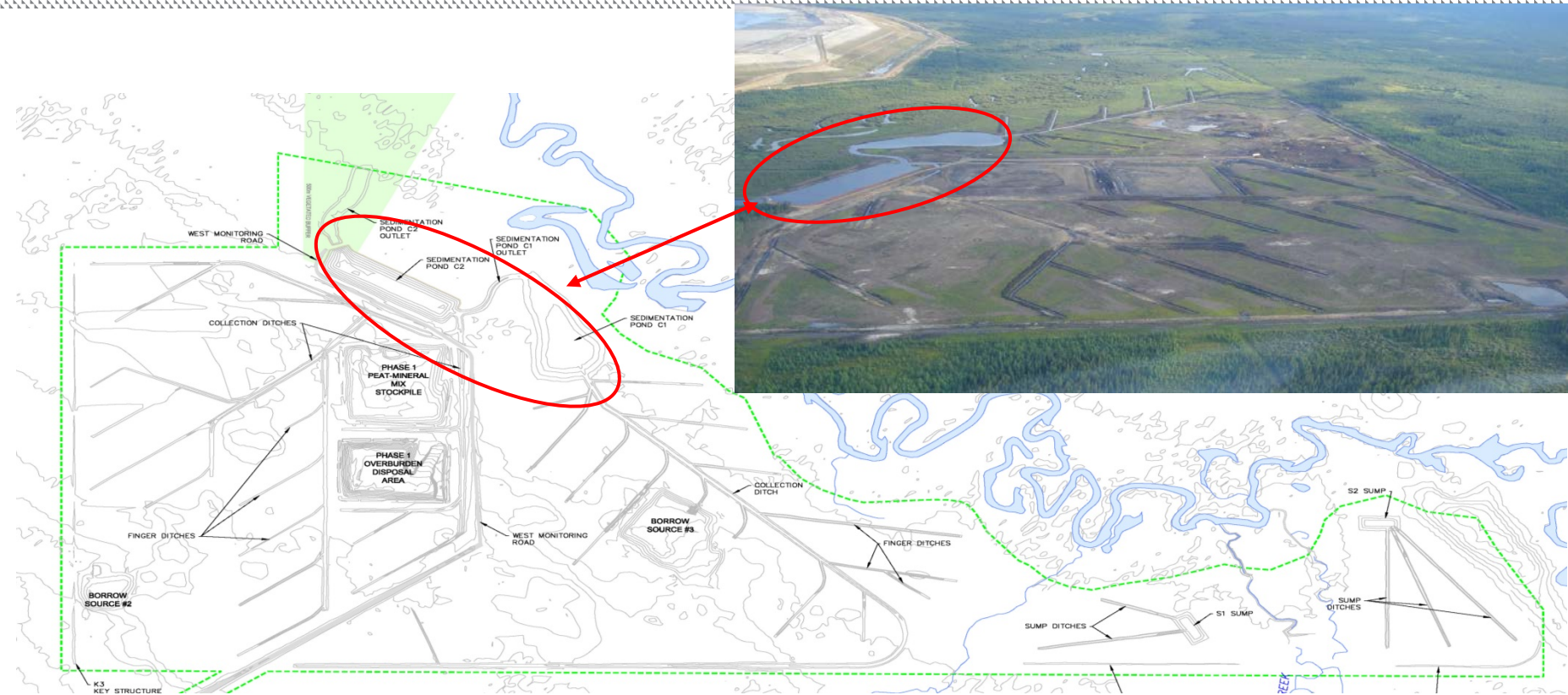


# Tree Clearing – Both Projects

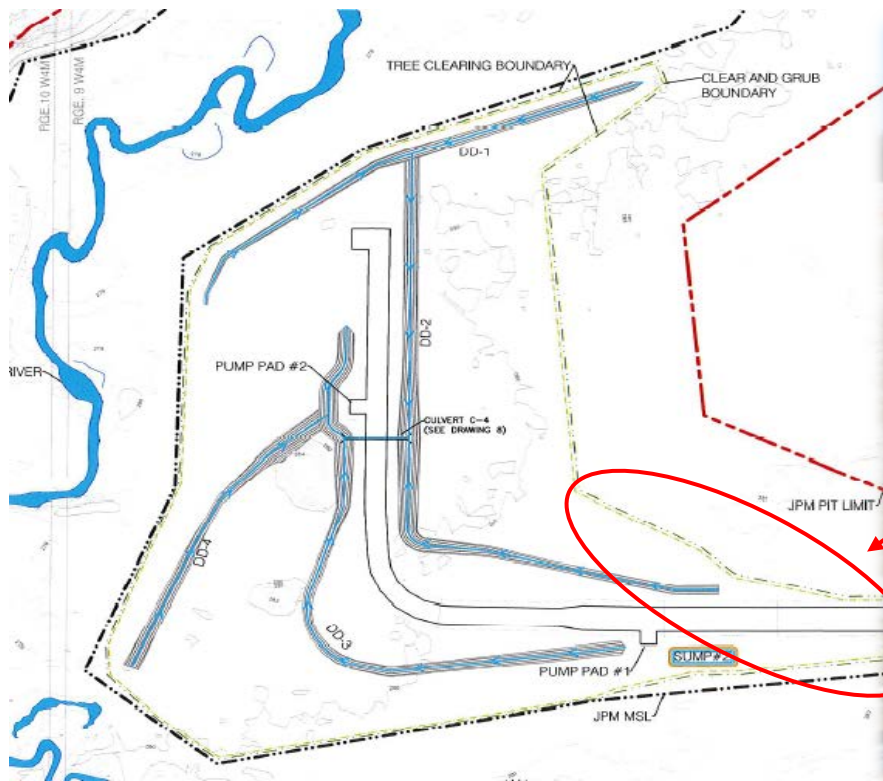




# JPM CL Early Works- Drainage Network

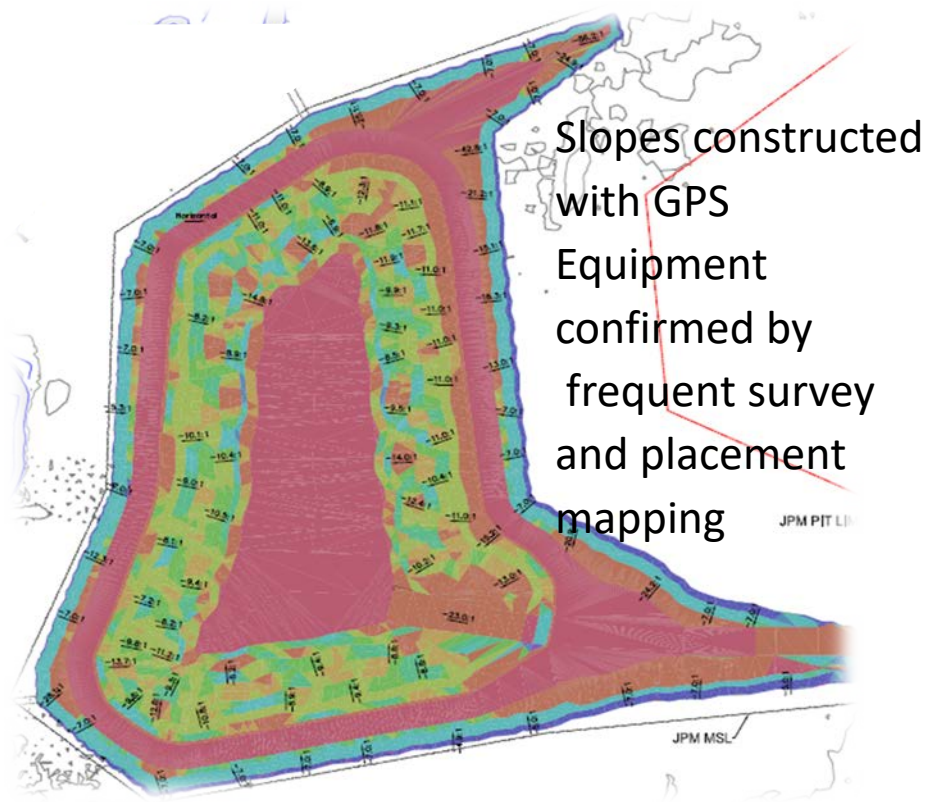
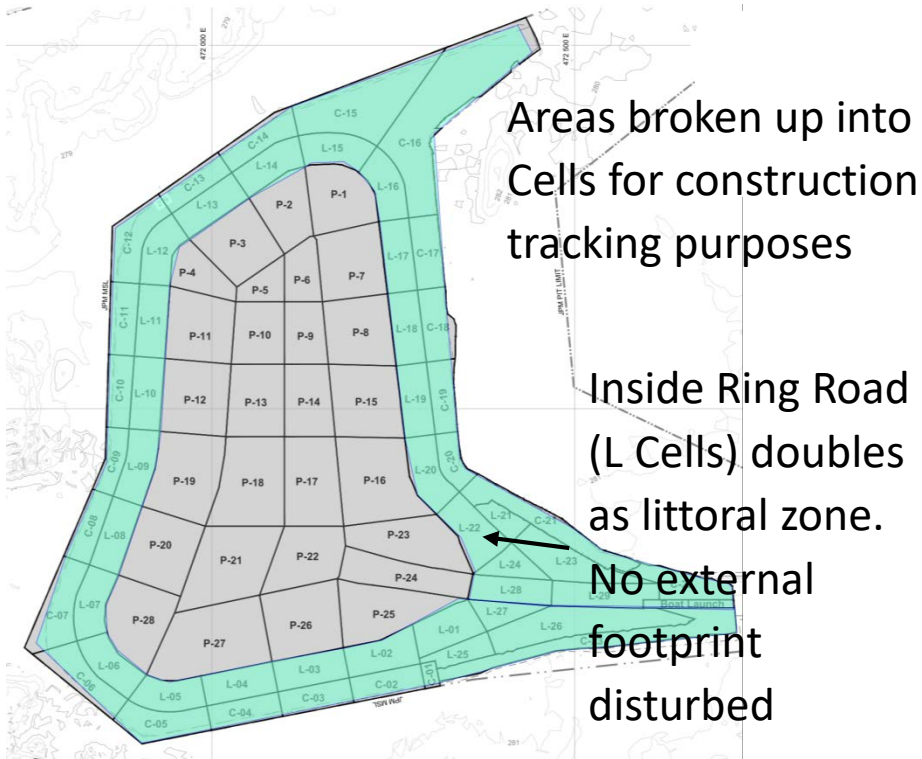


# MRMe CL Early Works – Drainage Network

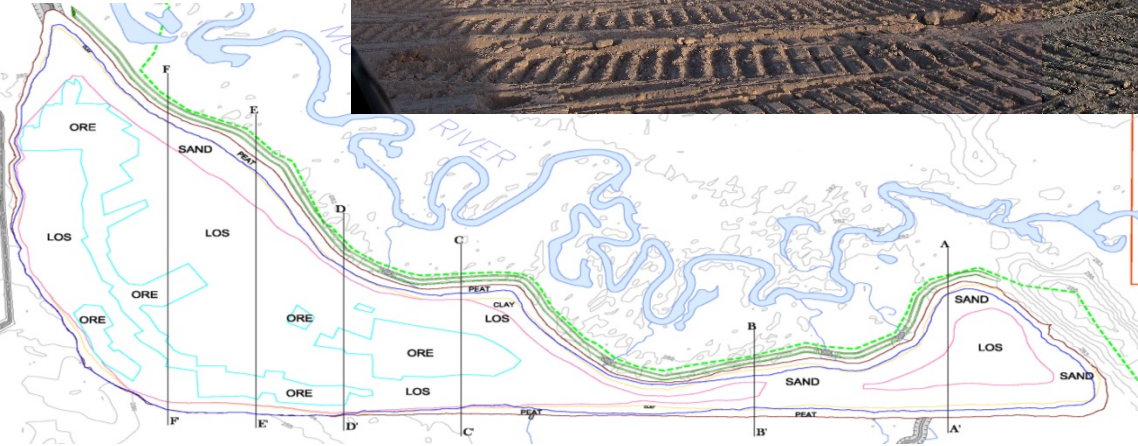




# Lake Bathymetry (Pit Geometry)



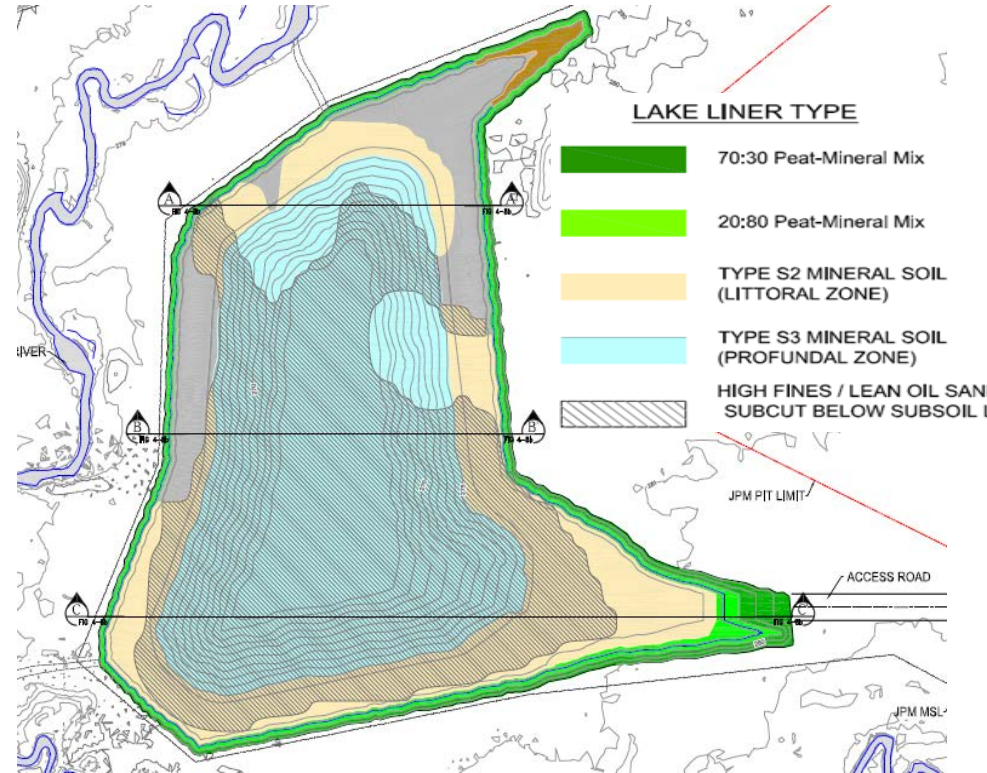
# JPM Compensation Lake Liner



- Hydrocarbon bearing soils capped with high fines material or LOS and mineral soil for biological buffer zone
- LOS capped with mineral soil

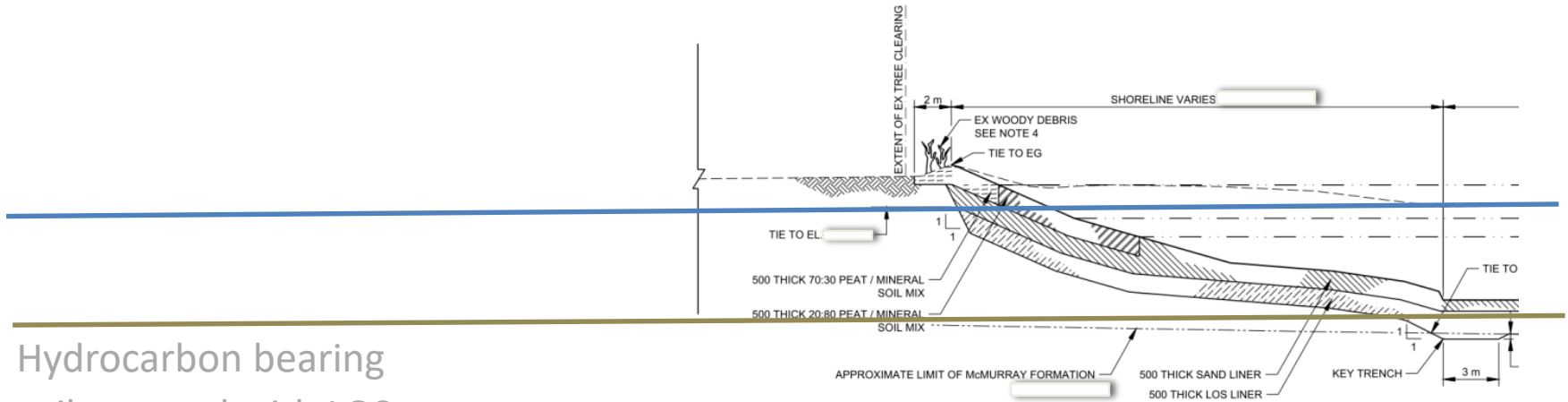


# MRM Compensation Lake Liner



- 20:80 Peat:Mineral soil mix placed up to high water line to avoid migration of organics during storm events
  - Lesson learned from Jackpine CL applied to MRMe CL
- Integration with Mine ops
- Design Adaptations for Construction Schedule and site constraints
  - Liner extended to act as seepage barrier in overburden

# MRMe Compensation Lake Liner



Hydrocarbon bearing  
soils capped with LOS  
and mineral soil



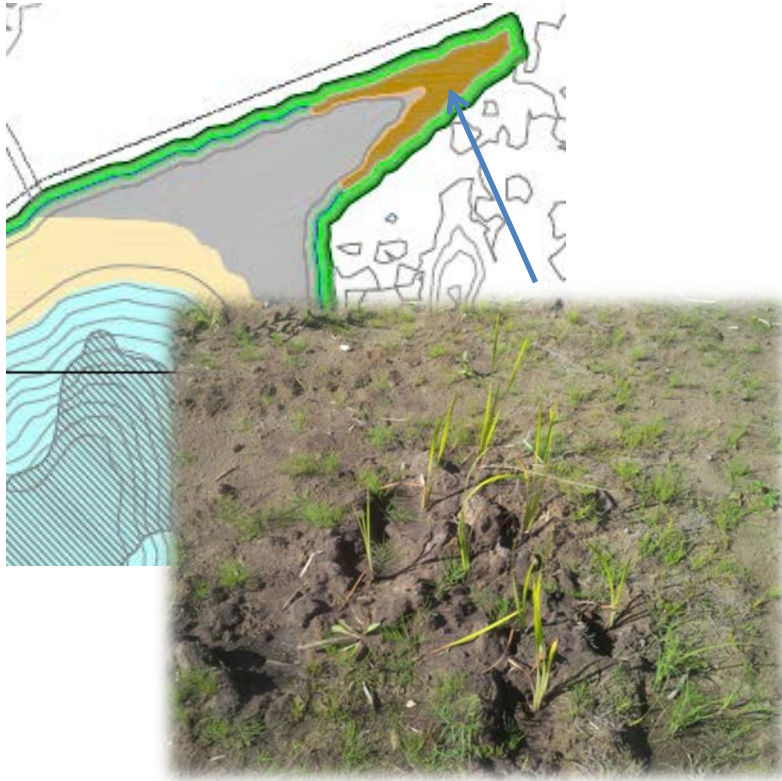
# MRMe Compensation Lake Liner



Overburden soils below the water table capped with LOS and mineral soil

Hydrocarbon bearing  
soils capped with LOS  
and mineral soil

# MRMe Compensation Lake Substrate



- Consultation with First Nations led to request to assign zone in MRMe Compensation Lake for rat root planting; a traditional medicinal species.
- Plans are for First Nations continued involvement in harvesting and planting of rat root in MRMe Compensation Lake (2017+) as in Jackpine Lake (2015)



# JPM Compensation Lake Substrate



# JPM Compensation Lake Substrate

Boulders and tree clusters placed in shallow areas at JPM Compensation Lake were found to be an **HSE navigation hazard** during monitoring visits and **blocked flow**.





# MRMe Compensation Lake Habitat Features

Large Rock clusters and series of smaller clusters create diversity at specific locations



Channel protection for lake filling doubles as habitat features



# Habitat Features at Shoreline




JPM Native grasses  
recolonizing

A photograph showing a shoreline with dry, yellowish-brown grasses in the foreground and a body of water to the right. A dense line of evergreen trees is visible in the background under a clear sky.




JPM Adaptive  
revegetation

A photograph showing green, leafy plants growing in a muddy, wet area near a body of water. The plants appear to be part of a revegetation effort.



MRMe Shoreline grasses  
recolonizing  
Weed species predominant in  
some areas. Adaptive  
reclamation planting of target  
species and willow may be  
required

A photograph showing a shoreline with a mix of green grasses and some bare, rocky patches. A dense forest of evergreen trees is in the background.

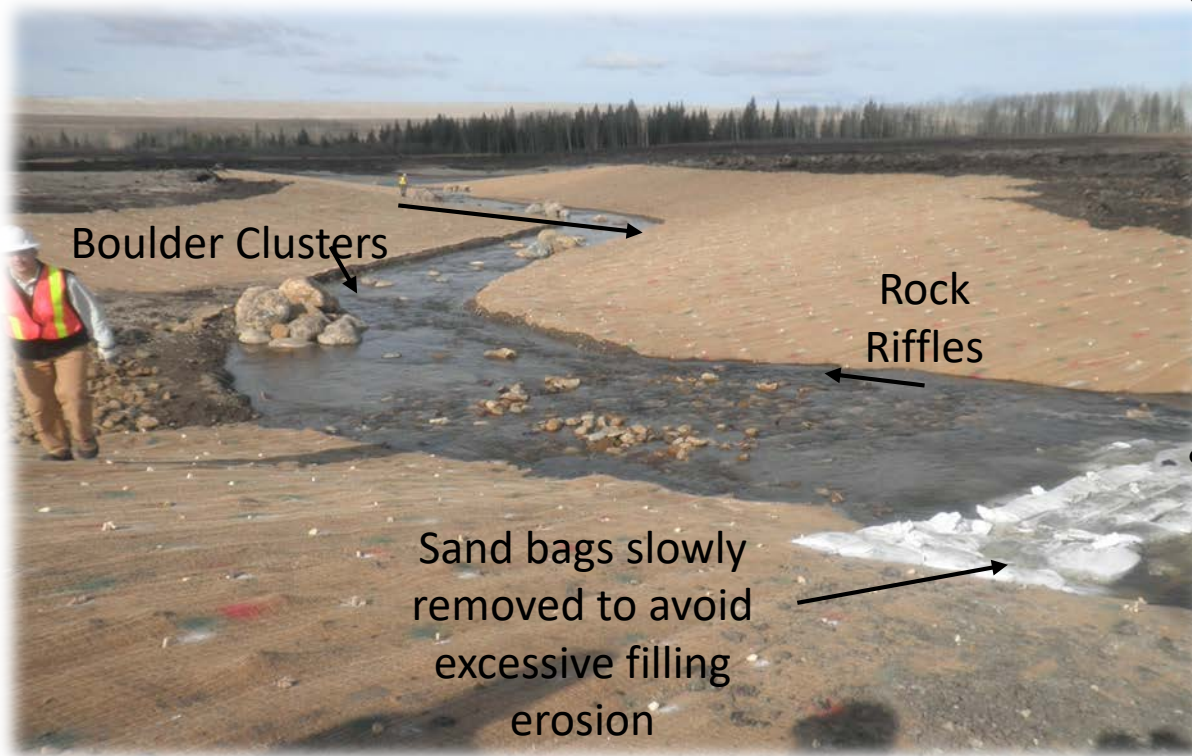


MRMe Habitat Mounds –  
Adapted from project  
monitoring well installations

A photograph showing a large, dark mound of soil or sediment in a wet, muddy area. A yellow excavator is visible in the background, working near the mound. A line of trees is in the far background.



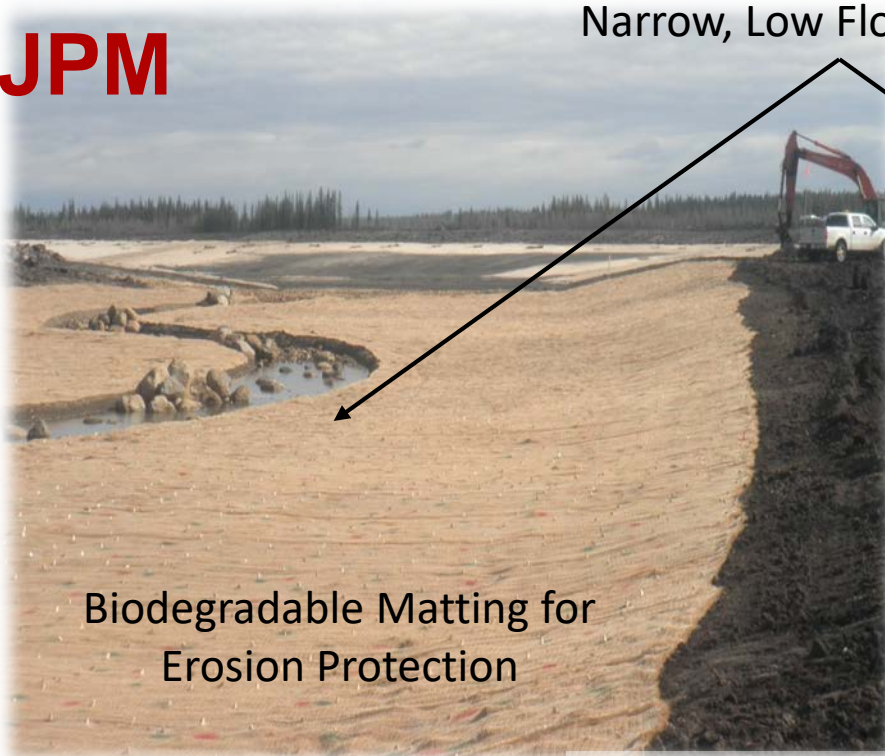
# JPM CL Inlet Construction and Lake Filling



- Filling progressed smoothly until spring freshet
  - braided nature of Muskeg Creek lifted matting and cut new channels.
  - Maintenance was not required and inlet has since stabilized.
- Lessons learned are further ground truthing of complex stream networks to plan for secondary channels, hard armouring, insitu materials and minimize disturbance

# Outlet Channel Construction

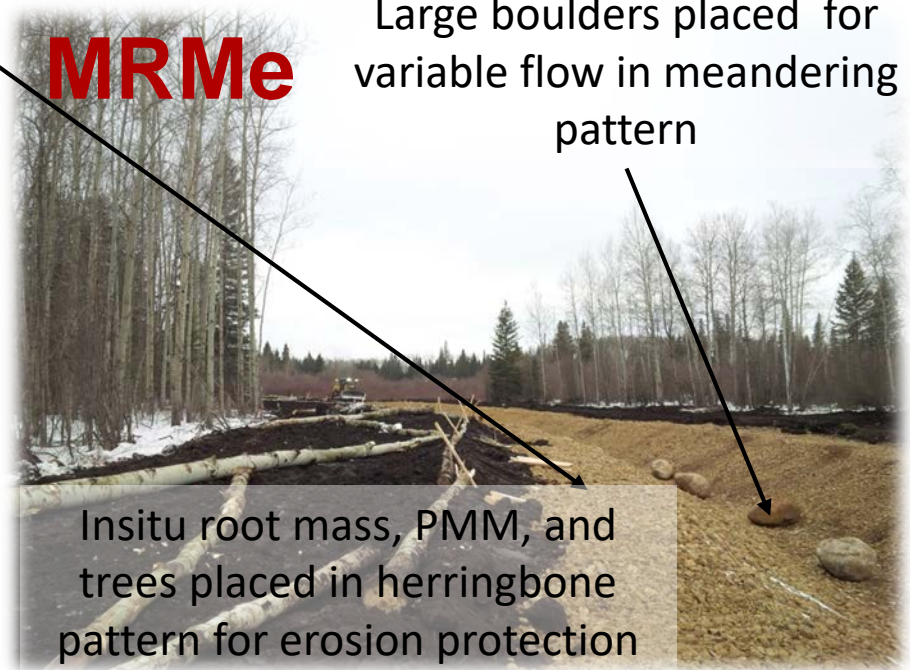
**JPM**



Biodegradable Matting for  
Erosion Protection

Narrow, Low Flow Channel

**MRMe**



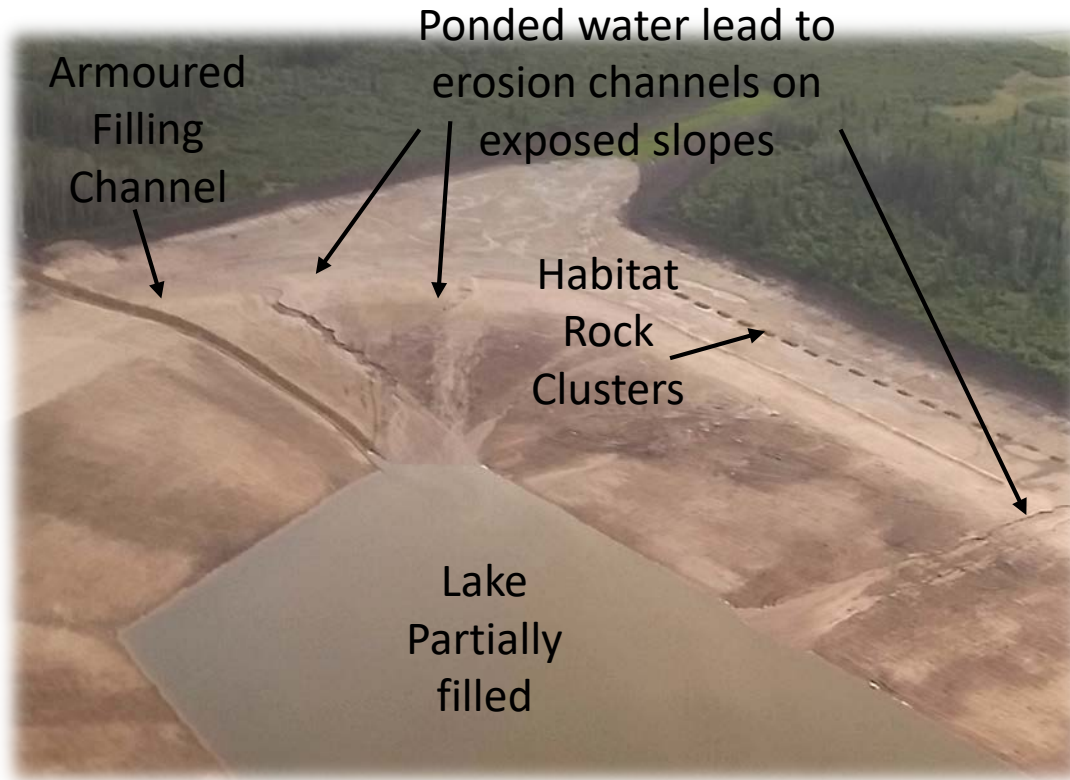
Large boulders placed for  
variable flow in meandering  
pattern

Insitu root mass, PMM, and  
trees placed in herringbone  
pattern for erosion protection

Wide High Flow Channel



# MRMe CL Lake Filling



- Filling progressed slowly through inlet channels
- Pooling of rainwater lead to concentrated flow and liner erosion
- Mitigation is ongoing, and includes temporary flow diversion infrastructure
- Lessons learned is more consideration to inactive filling periods at design phase, consider alternate sources

# Water Management- Both Lakes

- Both sites are located at the confluence of two streams where the water table is at or close to surface
- Lesson learned is to utilize in-pit sump and ditch networks, with lead time
  - Use existing mine infrastructure where possible
  - reduce pumping volumes by integrating design features (seepage barrier) and winter season construction



MRMe Site flooded  
between Phase 1 and  
Phase 2



JPM CL  
Groundwater  
seepage



# Winter Operations

- Challenges With maintaining continuous operation (frozen lines) and quality sampling
- Lessons learned were bury your lines deep, have repair parts on hand, and continuous operational oversight
- Challenges achieving compaction, especially on gravels
- Lessons learned were account for heating requirements
  - assess haul lengths and cycle times
  - be aware of supplier peaks
  - schedule impacts



# Environmental and Regulatory Requirements



- Project is adjacent to MSL Boundary and next to environmentally sensitive buffer
- Migratory Bird and Nesting Bird Regulatory Constraints (Schedule Risk).
- Key Wildlife Biodiversity Zone restrictions apply (Schedule Risk, equipment size constraints)
- Lessons learned were communication
  - Early
  - Often
  - Multiple Methods
  - Boots on the ground



# JPM Compensation Lake Progress

2013-05-29 5:40:34 PM M 2/3 19°C

- Comprehensive JPM Compensation Lake monitoring is indicating that the Lake is performing as designed.
- Fish populations and littoral zone vegetation area abundant.
- Natural revegetation is progressing well in tandem with adaptive revegetation.
- Terrestrial species are present at the Lake site



PC800 HYPERFIRE PRO



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# MRMe Compensation Lake Progress



- Comprehensive monitoring will commence once filling is complete
  - Interim monitoring is focussed on filling, basic revegetation, and erosion
- Natural revegetation is progressing
- Terrestrial species are present at the Lake site
- Ongoing mitigation against storm runoff erosion



# QUESTIONS?



# Thanks- Project Team



**Shell Canada**



**NORWEST**  
CORPORATION

 **Athabaskan**  
resource company



**Hatfield**  
CONSULTANTS



**ALBERTA  
PACIFIC**  
FOREST INDUSTRIES INC.

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