Surface Soil Handling and Storage Impacts on Plant Propagules and Establishment of Native Plant Communities



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Land Reclamation Challenges

- Diversity of native and local propagules is not commercially available
- Understanding the ecology of a site and reclamation materials we want to use
- Dormancy and germination requirements for many native plant species is not well understood



Forest Surface Soil (LFH/FFM)

- Abundant diverse source of propagules
- Economical source of a diverse mix of native species
- Nutrients
- MacKenzie 2013 & 2006, MacKenzie and Naeth 2010





- Seed and root abundance decrease with depth
- Organic matter content and nutrient concentrations decrease with depth
- Propagule bank varies with forest stand type (ecosite)



Jack pine (xeric) Aspen-jack pine (submesic) Aspen-spruce (mesic)



• Affects biological, physical and nutrient capital









Salvage Timing

• Environmental variables influence quality of soil properties (e.g. season, frost, moisture)



Salvage Timing

 Salvaging immediately after timber harvest can increase tree establishment densities (aspen and poplar)



Placement Depth

• Placement depth has more influence on plant productivity versus number or species emerging



Placement – Ecosite and Substrate

 Mesic ecosites and placement on peat-mineral substrate resulted in greater species richness, density, canopy cover for most plant groups



Placement – Ecosite and Substrate

- Better quality substrates require less topsoil
- Topsoil from mesic ecosites could sustain shallower placement depths



Placement

 Plant establishment and diversity are enhanced when surface is left rough





Placement - Amendments

- Control moisture and erosion, capture seed
- Can be beneficial or detrimental





Placement – Islands

- Maximize surface area and promote egress of native species
- Initial 2 yrs egress limited to grasses and forbs seed dispersal 2 to 4 m from edge
- Vegetative expansion slow





Placement – Islands

- Larger islands (400 m² vs 100 m² and 25 m²) have more species (quadrat and plot)
- Smaller islands were more susceptible to ingress from species outside islands





Stockpiling

Stockpiling

 Negative effects of stockpiling occurs regardless of stockpile size, soil texture or season of construction





Stockpiled

Direct Placed

Stockpiling – Propagule Viabilty

 Stockpiling quickly reduces seed and root viability





Dead Seed



Viable Seed

Stockpiling – Propagule Viabilty

 Seed viability declined (up to 100%) shortly after storage at most depths for 24 species, regardless of stockpile size





Stockpiling – Atmosphere

- Large stockpiles anaerobic to anoxic below 1 m
- O₂ decreased with depth and time



Stockpiling – Temperature

- Large stockpile remains above 0°C below 1 m
- Winter constructed stockpiles eventually thaw



Stockpiling – Woody Material

 Volume and size of woody material can change physical and chemical properties of stockpiled soil



Stockpile Management

- Maximize surface area
- Create more smaller piles vs. fewer larger piles
- Free dump on top of stockpiles (leave rough and non compact)
- Stockpile on existing reclamation areas near existing roads
- Cap topsoil on top of subsoil and peat stockpiles



Adaptive Management



Summary

- Direct placed surface soil most effective method establishing diverse native plant communities
- All stages of soil handling methods will influence success
- Soil conservation and reclamation best practices in oil sands can be applied elsewhere

Best Management

For Conservation of Reclamation Materials in the Mineable Oil Sands

For the Terrestrial Subgr

Practices

Region of Alberta



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Thank You

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