

Early physical, chemical and biological impacts of using stockpiled vs directly placed reclamation soils

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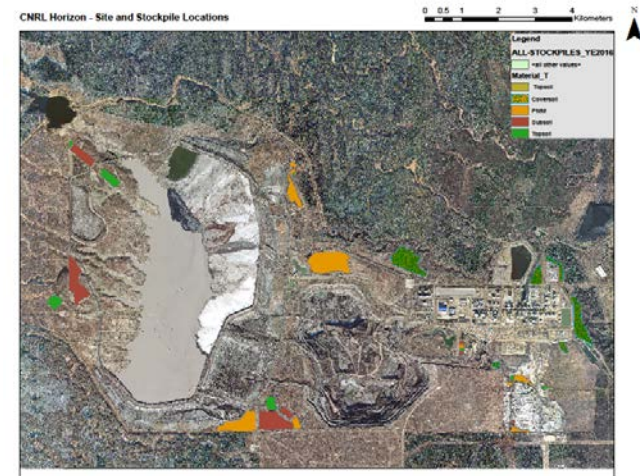
ASMR – June 2018

Stockpiled soil

- Mineable oil sands – 4,800 km²
- Approximately half will be reclaimed using stockpiled soils

Concerns

- Stockpiled soils are more compacted than direct placed soils
- Soil chemical and biological properties are altered
- Propagule bank is no longer viable



Stockpiled soils

- Specific concerns for the West Tailings site
- Planted trees looked unhealthy
- Compaction from summer placement
- Flooded areas
- Lack of vegetation



Red trees



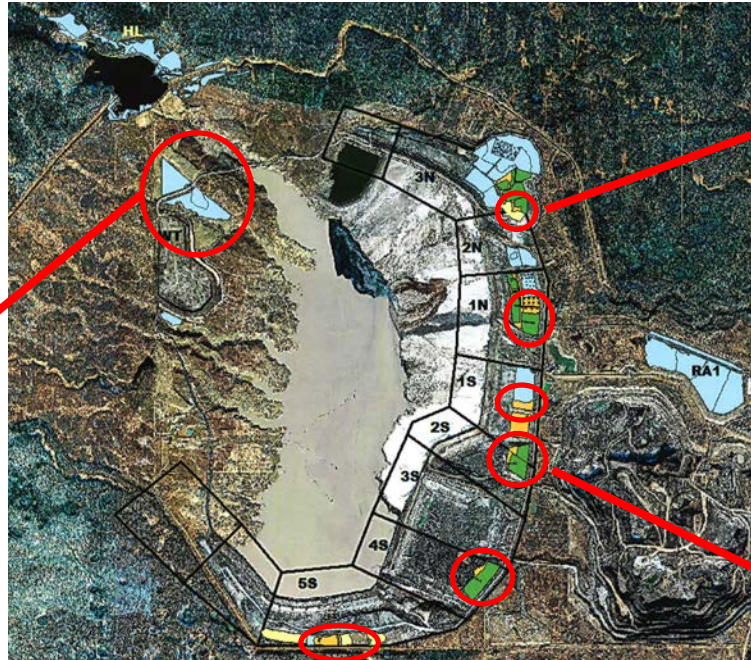
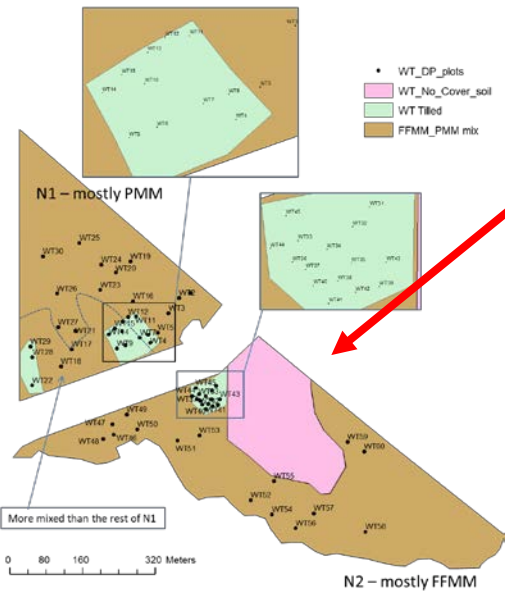
Experimental overview

- Directly placed vs stockpiled soils
- Plant, soil chemical and soil physical properties
- Stockpiled sites (WT) placed in summer 2016
- Direct placed FFMM and PMM placed in winter 2016/2017
- Measurements in summer 2017
- Functionally both in their first growing season



Study sites

West Tailings (WT) Stockpiled Placement



Directly placed soils

- Tailings dyke
- 2 types of soil
- Placed winter 2016/17



Stockpiled soil reclamation site

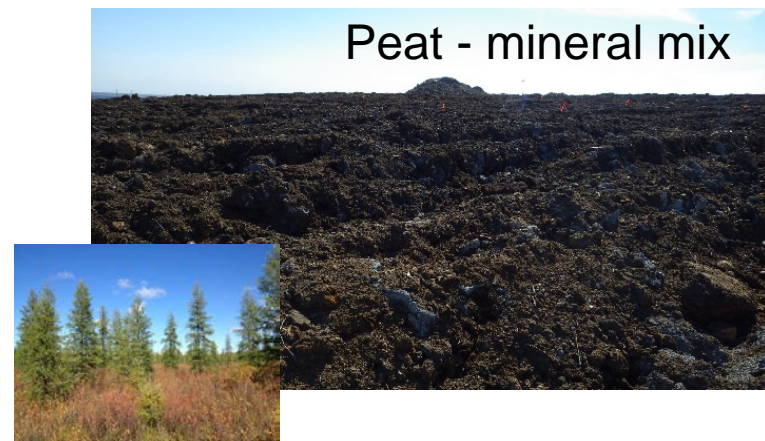
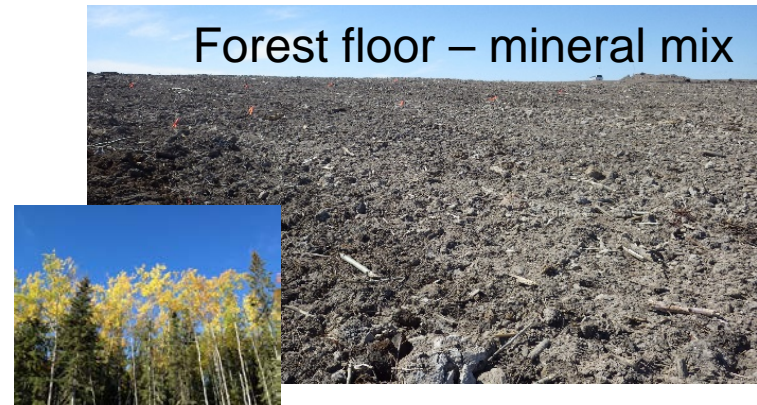
- West Tailings site
- Placed summer 2016

Soil types

- Stockpiled

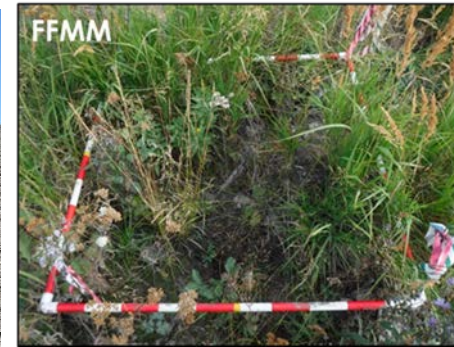


- Direct placed



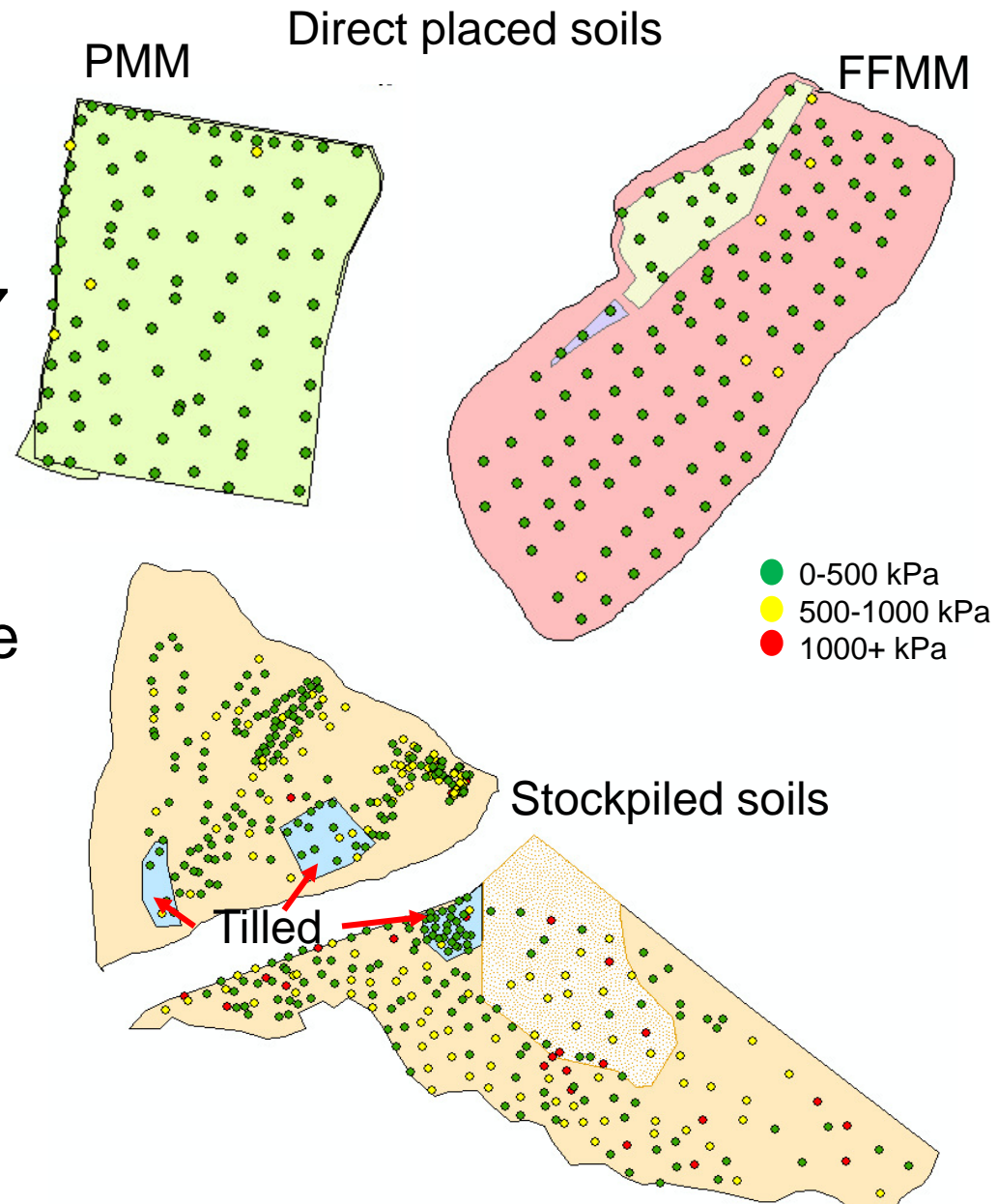
Site measurements

- Soil physical properties
 - Penetration resistance and soil moisture
- Soil chemical properties
 - Nutrient supply rates
- Plant community
 - Trees and plants



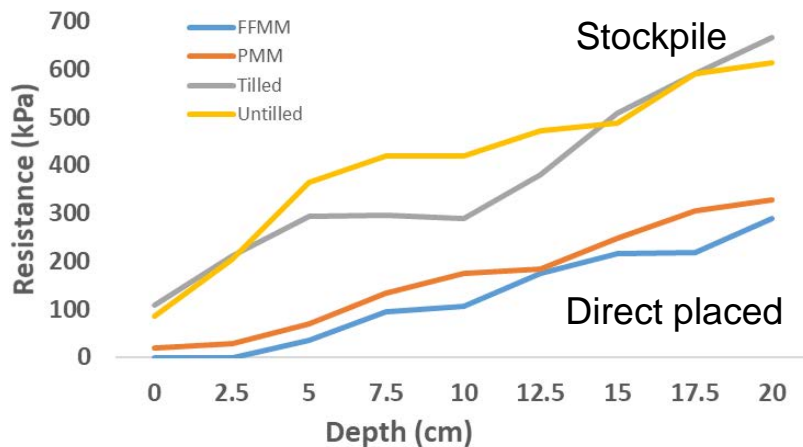
Penetrometer

- Measured in spring 2017 when soils at field capacity
- Root penetration
- Stockpiled soils are more compacted

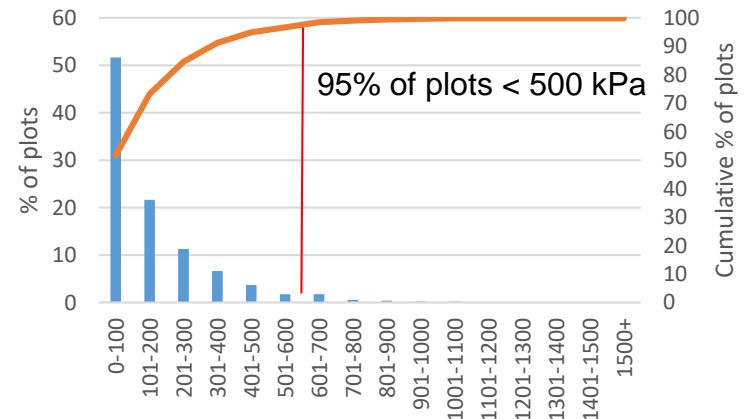


Penetration resistance

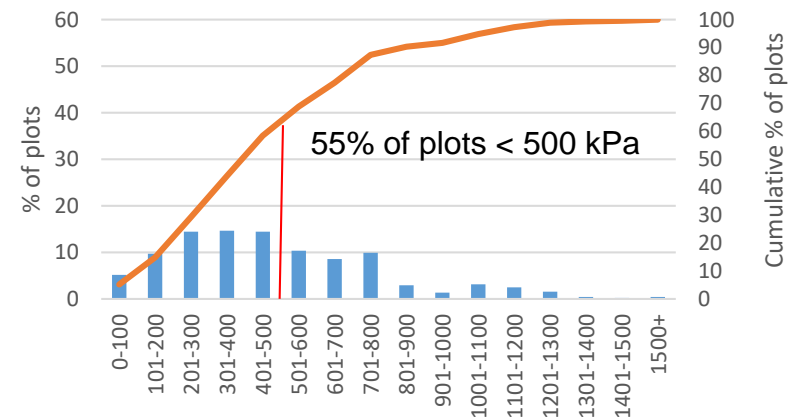
- Penetration resistance greatly increased with stockpiling
- Tilling does reduce resistance up to a depth of 15 cm
- Bulk density @ 15 cm
 - FFMM = 0.88 g/cm³
 - PMM = 0.64 g/cm³
 - Stockpile = 1.21 g/cm³



Direct placed soil - 10 cm

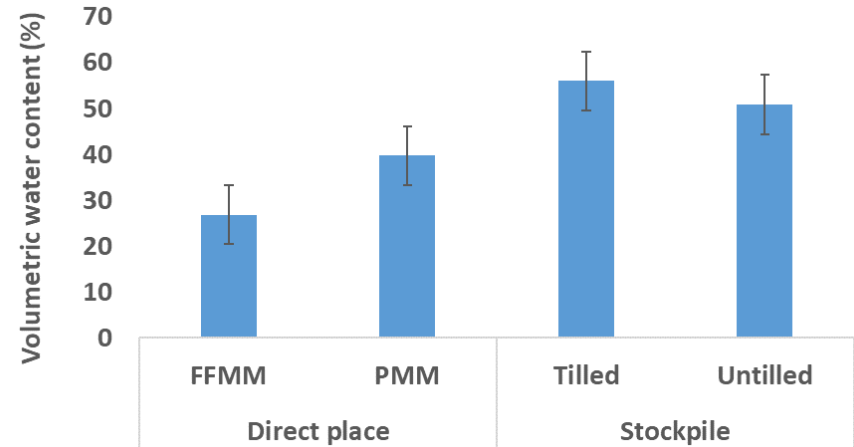


Stockpile soil - 10 cm



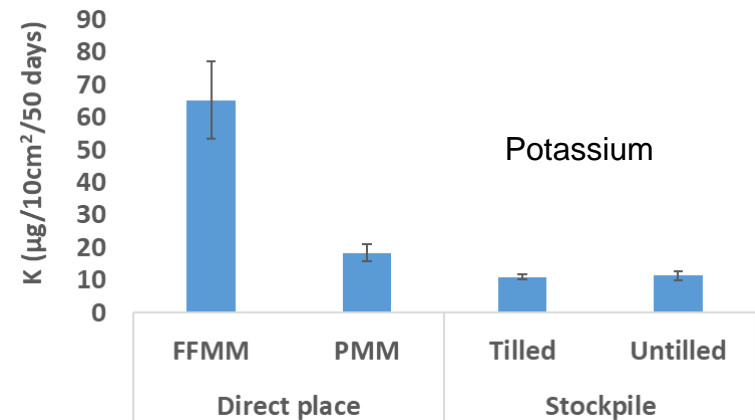
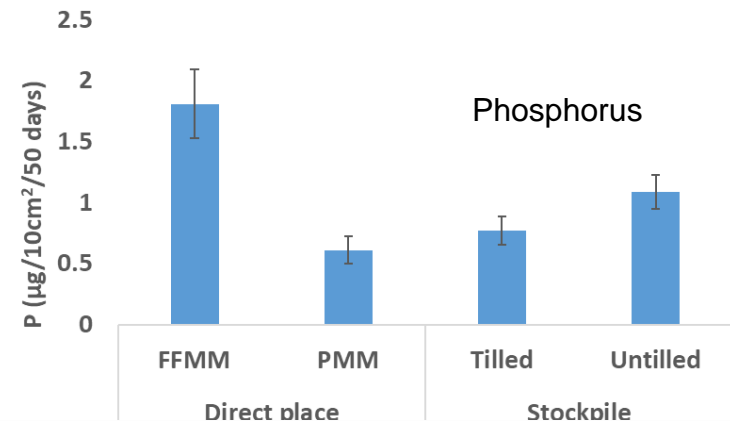
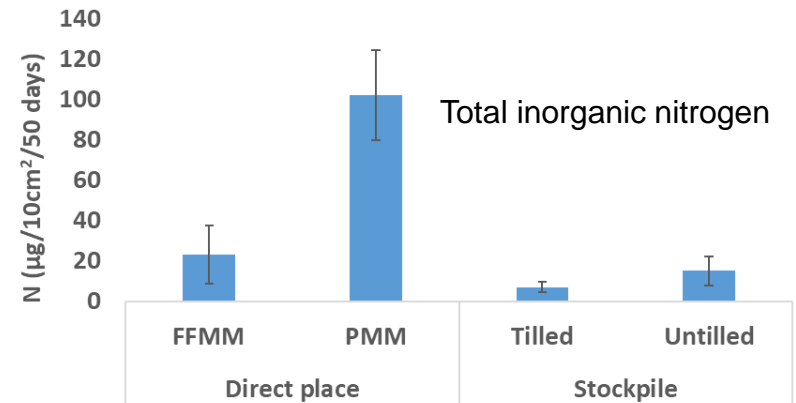
Soil moisture

- For direct placed soils PMM has greater water holding capacity
- Stockpiled soils have higher water content
 - Poor drainage
 - Compaction has reduced pore sizes
 - Flooding



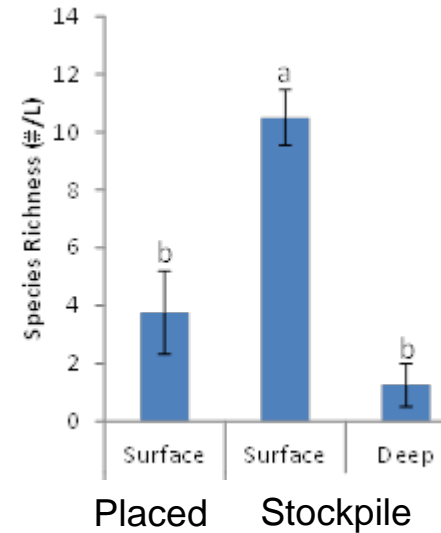
Soil nutrients

- Little difference in bioavailable soil nutrients due to stockpiling
- Stockpiled soil similar to one of the direct placed soils
- Tilling of stockpiled soil had no impact
- Soil origin has a bigger impact on nutrients than stockpiling does



Seedbank

- Stockpiles have greater seedbank at surface
- The seedbank character of the placed reclamation soil is like that of deep stockpile soil



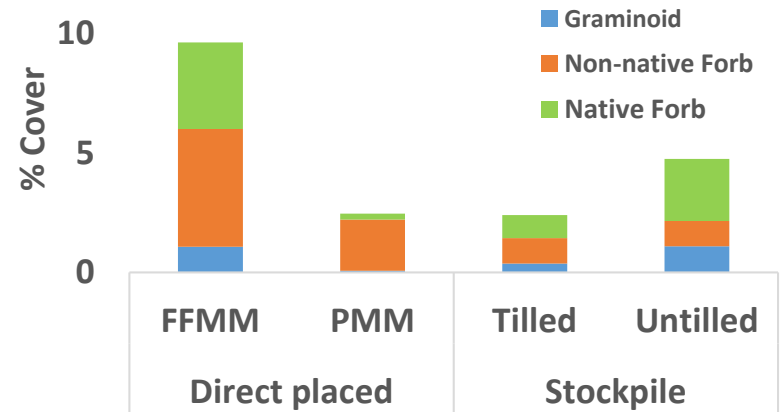
Soil seedbank



Vegetation

- FFMM had the greatest plant cover and diversity
- Stockpiled soil had plant cover similar to PMM
- Tilling reduces plant cover
- Native forb cover similar on stockpiled soils
- FFMM had the greatest weed cover

Vegetation cover



FFMM



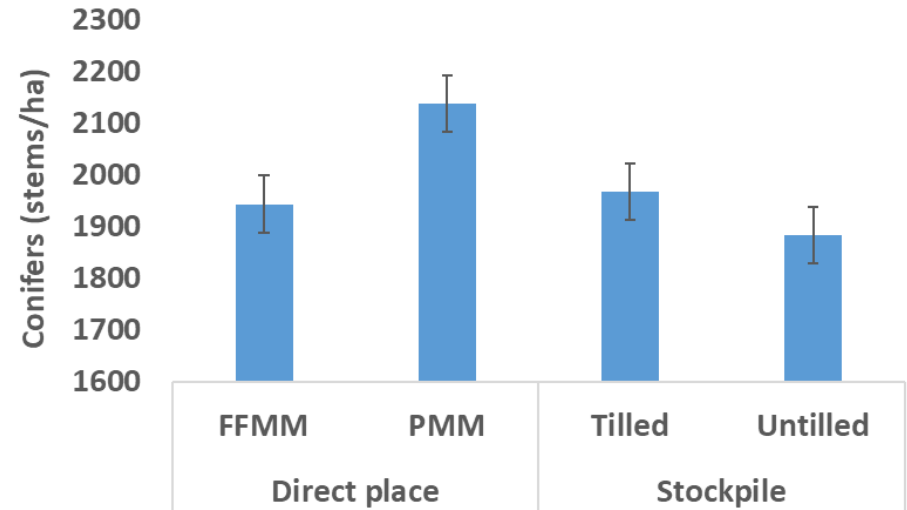
PMM



Stockpiled soil

Trees

- No difference in planted conifer tree density
- Deciduous trees on direct placed soils - none on stockpiled soil
- Surface roughness and water holding capacity related to seedling establishment



Aspen seedling



Recovered spruce

Summary

- Soil physical properties (i.e. penetration resistance and drainage) seem to be the biggest challenge with using stockpiled soils in the short-term
- Soil chemical properties (i.e. nutrients) are more impacted by soil origin than by stockpiling
- Tilling had minimal impacts on soil and plants
- What are the long-term implications for tree and plant growth?

Thanks!

