Design of a Landform and Cover System for a Waste Rock Facility

Larisa Doucette, B.Sc., P.Geo

Denise Chapman and Brittany Cranston

SMA Environmental Forum 2016

Saskatoon, Saskatchewan

October 19 - 20, 2016

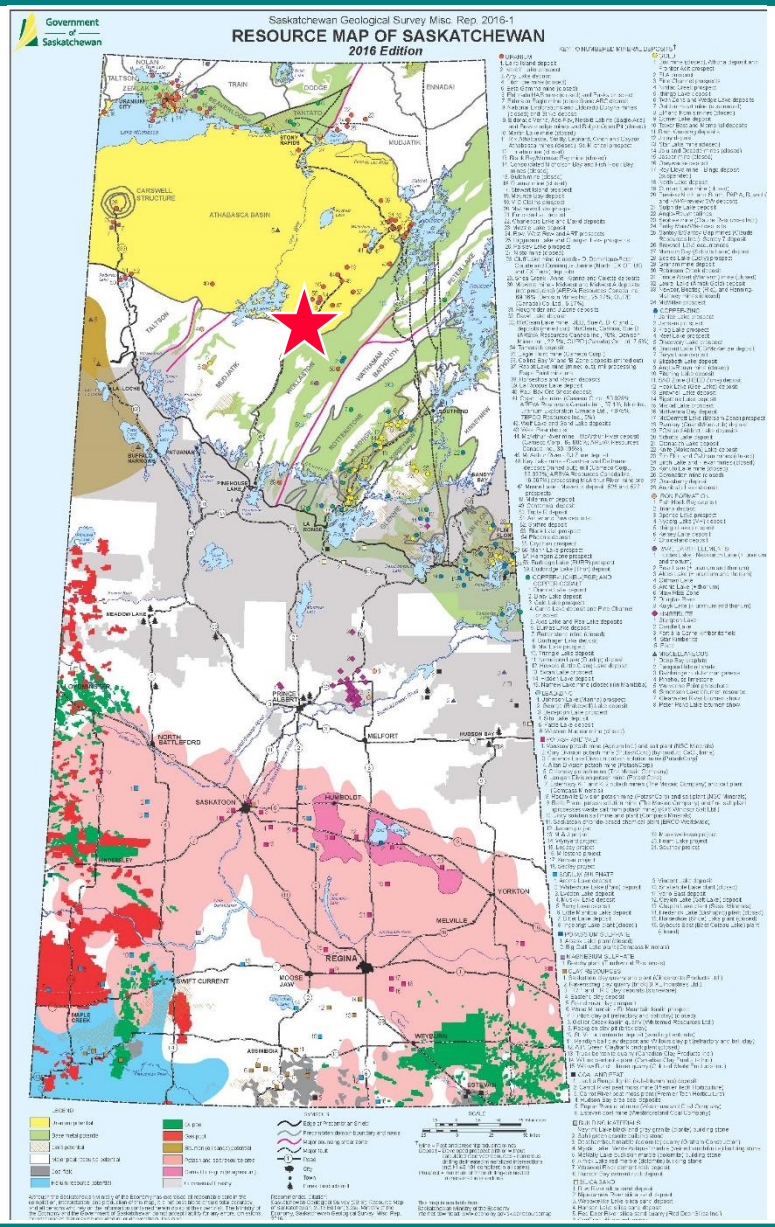
O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

Outline

- Background
- Cover System Field Trials
- Soil Amendment and Vegetation Trial
- Cover System and Landform Design Refinement
- Summary

Background



- Key Lake Operation, Cameco Corp.
- 575 km NE of Saskatoon
- Gaertner and Deilmann ore deposits mined up to late 1990s
- World's largest uranium milling operation, now processes McArthur River ore

Background

- Deilmann North Waste Rock Pile constructed 1984-1997
- Estimated 18 Mm^3 of material, 66 ha

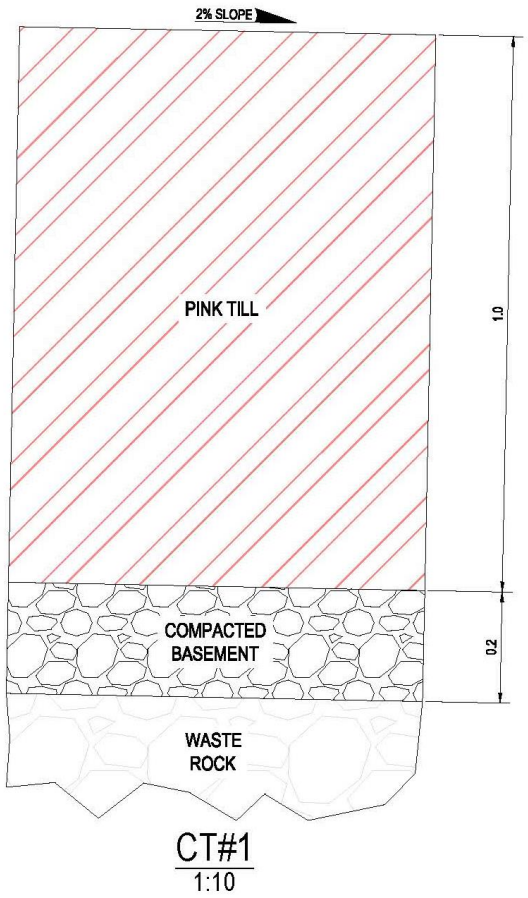
Background

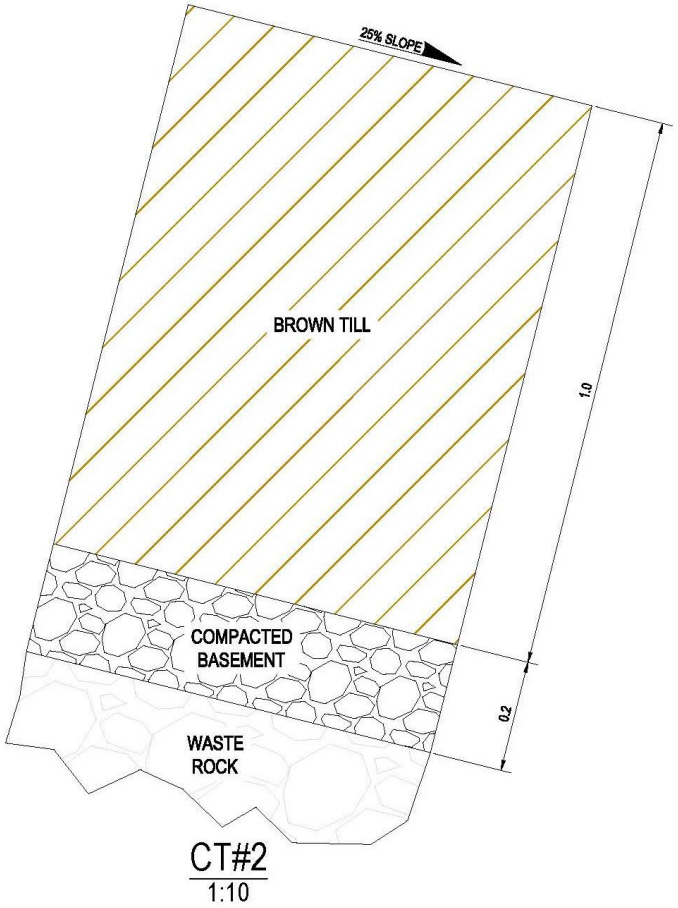
- DNWRP Reclamation Goals:
  - Ecosystem similar to surroundings
  - Mitigate effects to aquatic env.
  - 12% net percolation to reduce COPC conc.

Background

- Previous studies:
  - Water Quality Predictions
  - Cover Design Modelling
  - Borrow Source Investigation and Material Characterization Program
  - Workshops

Cover System Field Trials





- CT#1 – Pink Till, Plateau (2%)
- CT#2 – Brown Till, Sloped (25%)

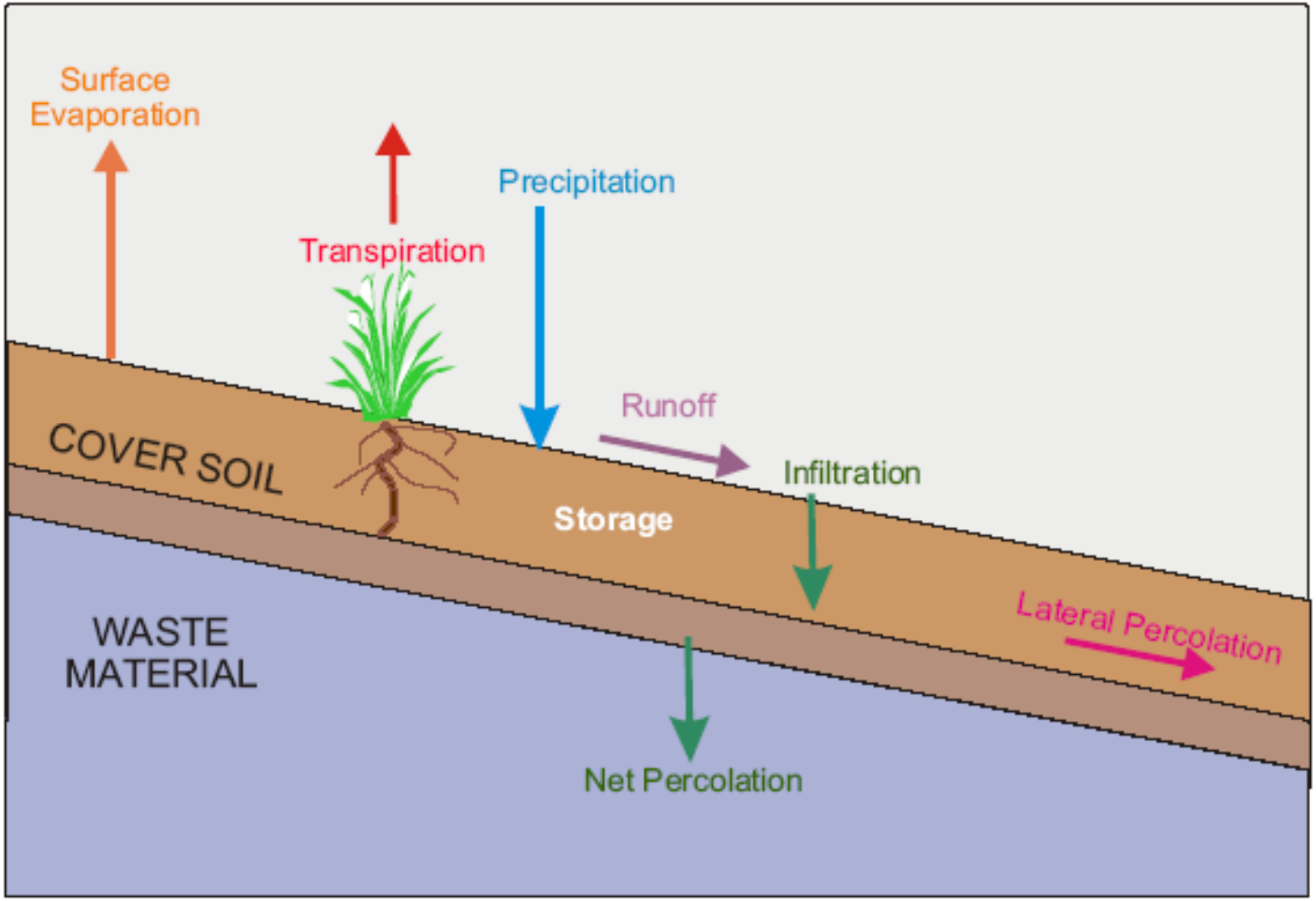
O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

Cover System Field Trials

Cover System Field Trials

Cover System Field Trials

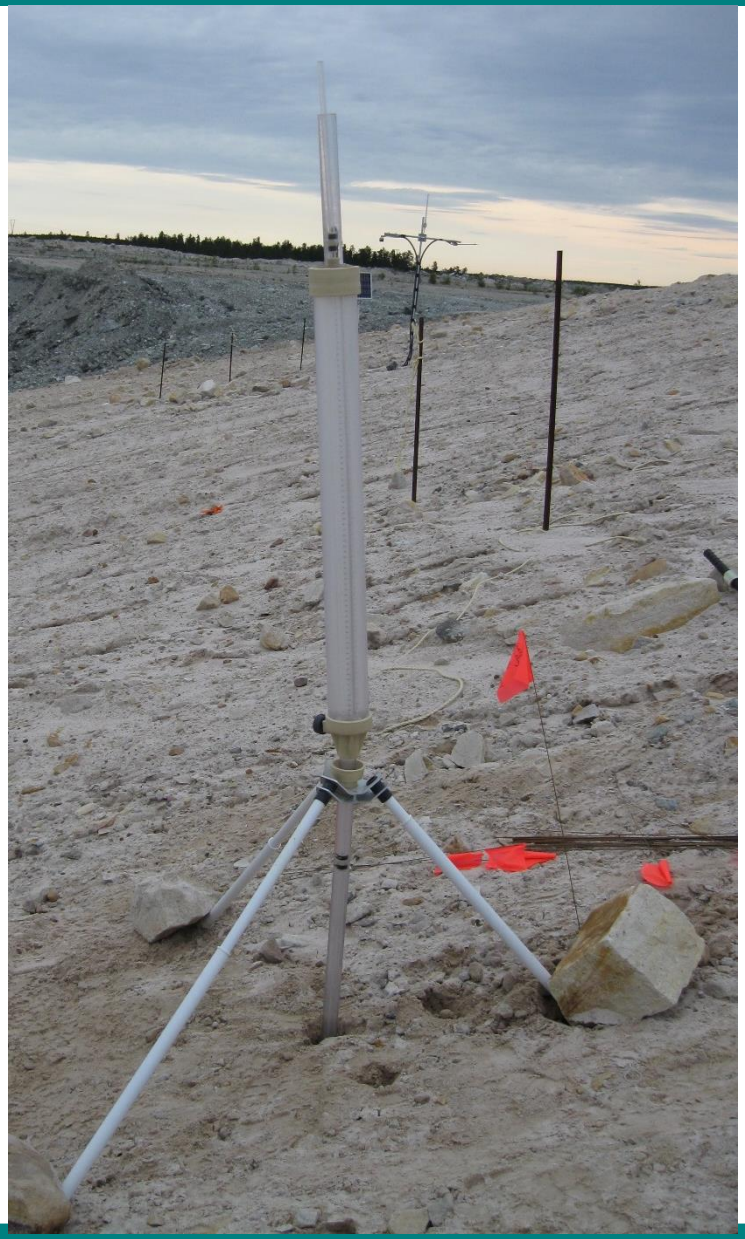


$$NP \equiv P - R - AET - I - \Delta S$$

Cover System Field Trials

- Automated Instrumentation
  - Weather station
    - Rainfall, AET
  - Soil monitoring stations
    - Soil Storage
  - Runoff
  - Interflow
  - Groundwater

Cover System Field Trials



- Manual monitoring
  - Snow surveys
  - K_{fs} testing
  - Soil pits – VWC verification
  - Erosion survey
  - Groundwater monitoring
- Ongoing

Cover System Field Trials

Average Annual Precipitation = 480 mm

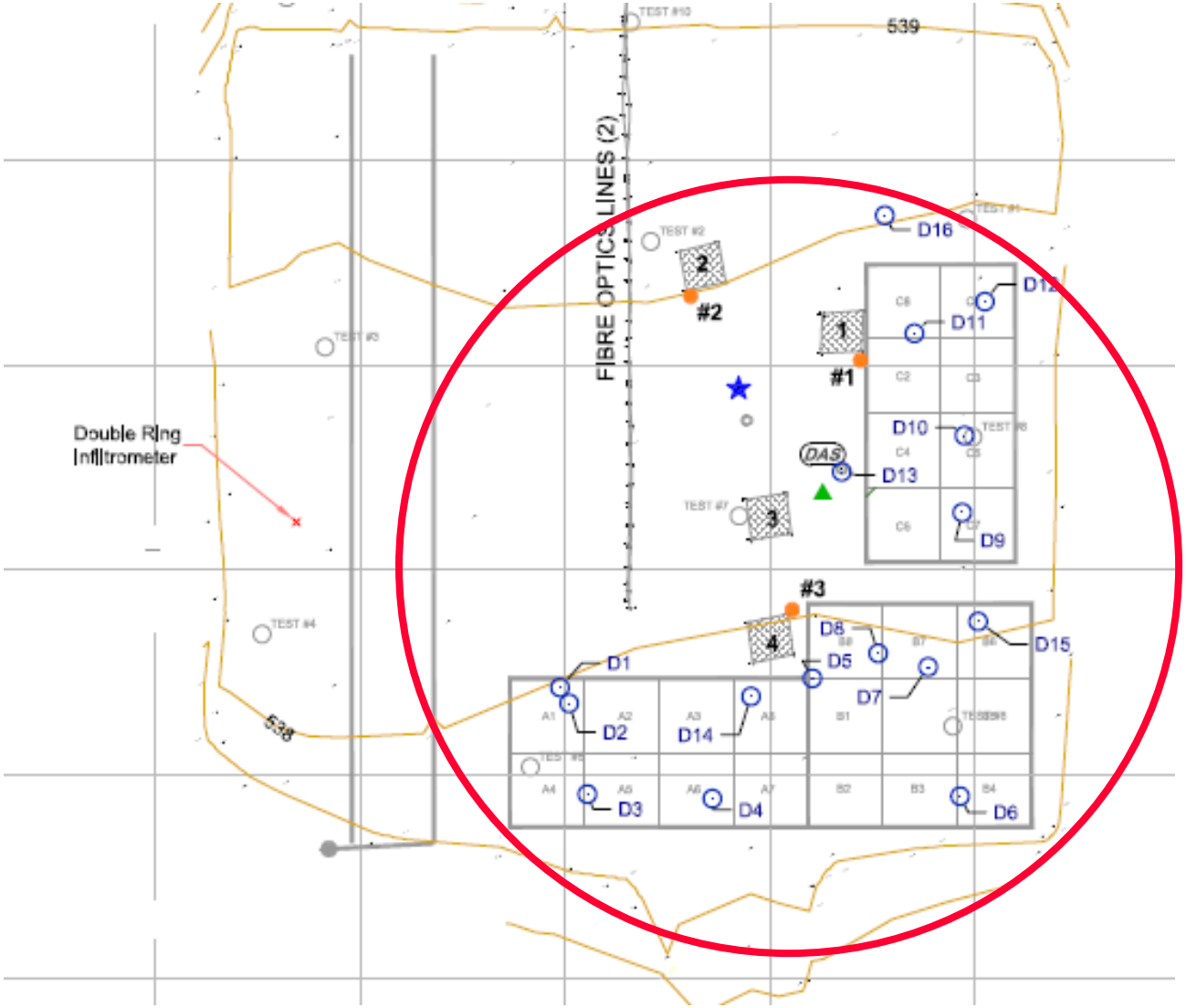
Year	Plateau Cover Trial (% of precip.)	Sloped Cover Trial (% of precip.)	NMS (% of precip.)
2011	24	16	12
2012	26	17	11
2013	21	16	12
2014	16	16	11

IF

O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

Soil Amendment and Vegetation Trial



O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

Soil Amendment and Vegetation Trial

- 3 replicates of each treatment
- 7 soil amendments and control
- 9 vegetation subplots

Soil Amendment and Vegetation Trial

- Peat
- Organic sediment
- Flax straw
- LFH
- NPK fertilizer
- Manure pellets
- Control
- Demonstration

O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

Cover System and Landform Design Refinement

- Design objectives:
  - Promote runoff
  - Minimize expansion and earthmoving
  - 3H:1V slopes
  - Natural looking

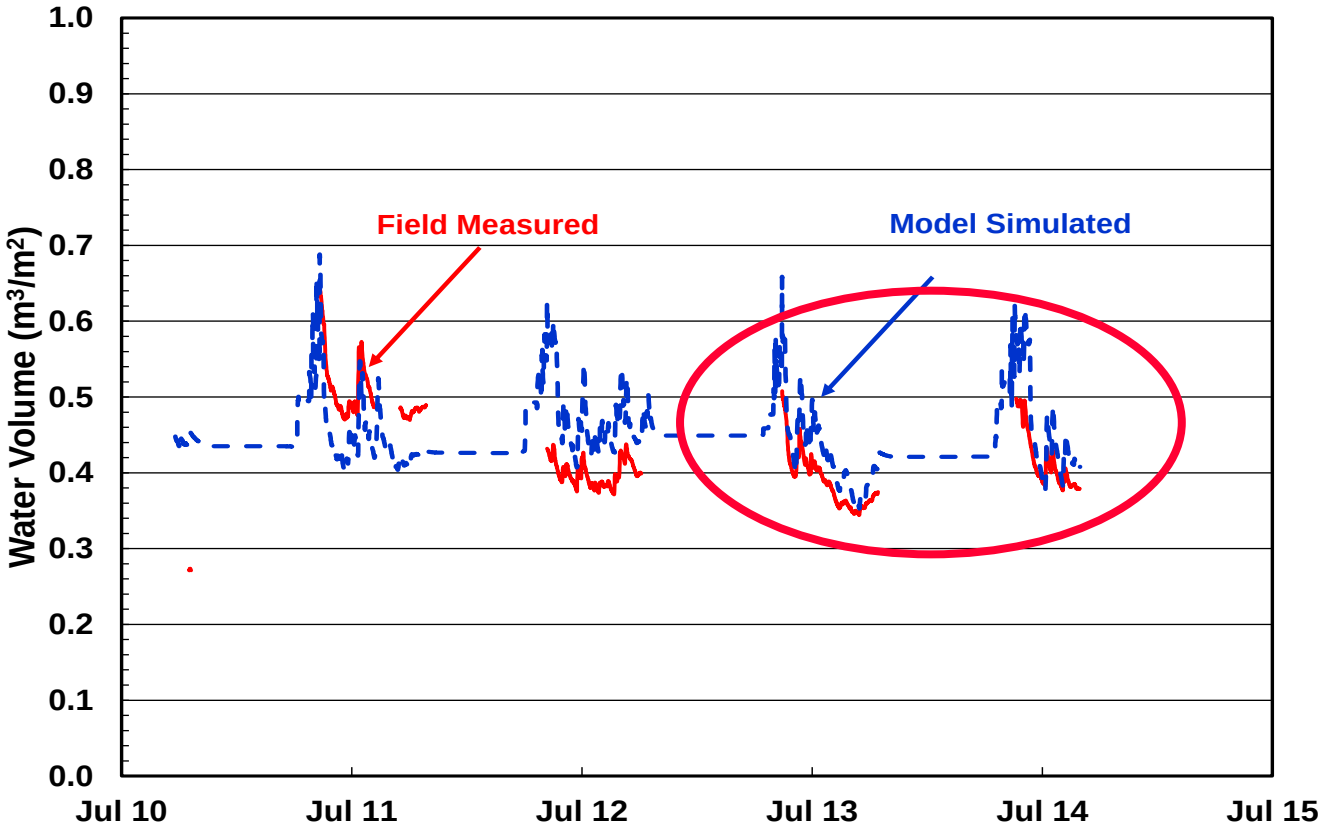
Cover System and Landform Design Refinement

- Soil-Plant-Atmosphere (SPA) model
  - Long term performance predictions
  - Sensitivity scenarios
    - Material types
    - Slope aspect
    - Scarification

Cover System and Landform Design Refinement

- Soil-Plant-Atmosphere (SPA) model
  - Sensitive to hydraulic properties
  - Calibrated model matched field responses

NP = 4 - 22%



O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

Cover System and Landform Design Refinement

- Erosion Assessment – WEPP model (uncalibrated)
  - Moderate soil loss from Brown Till (20 Mg/ha/yr)
  - Pink Till more susceptible
  - Scarification

Cover System and Landform Design Refinement

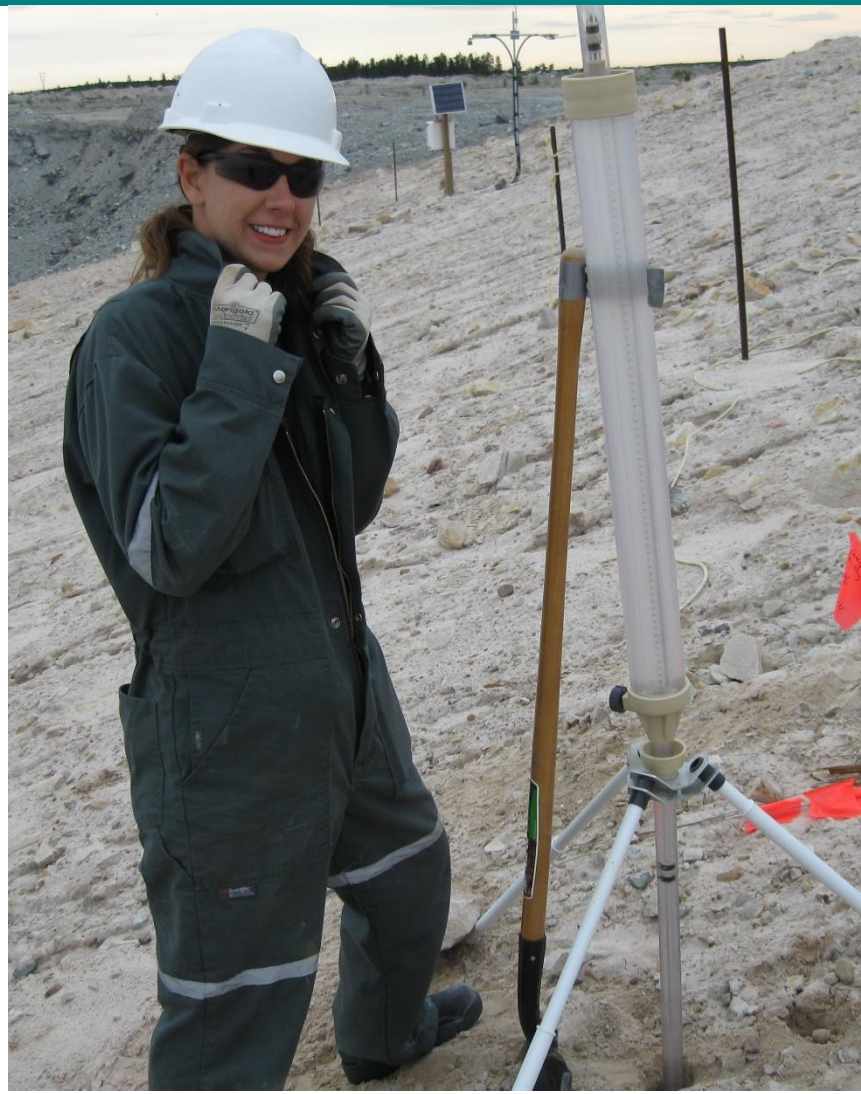
- Brown Till on south slopes, Pink Till on other slope aspects
- Surface water management system

Cover System and Landform Design Refinement

- Organic sediments and manure pellets
- Scarification, woody debris on slopes
- Vegetation from all successional stages

Summary

- Multi-disciplinary approach
- Research trials invaluable
- Field trial monitoring is ongoing.
- Further refinement of design will occur



Ask us for more information on

UNIVERSITY OF SASKATCHEWAN

Mine Overlay Site Testing Facility

GLOBAL INSTITUTE FOR WATER SECURITY

MOSTFACILITY.USASK.CA

Habitat for Humanity®

Rainbow of HOPE for Children

Rainbow of Hope for Children and, Habitat for Humanity Initiative

O'Kane Consultants

Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology