

Evaluation of Existing Revegetation and Future Revegetation Potential at Leviathan Mine

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Fall 2013 field tasks:

1. Evaluation of plant cover: Pit, Pond 2 slopes, and Delta Slope
 - Line transects of live and dead plant litter
2. Evaluation of existing substrate growth conditions associated with plant transects at each location.
 - Infiltration (rainfall simulator and tension infiltrometer)
 - Moisture retention (lab analysis of water content)
 - Acidity (intensity and buffering), and
 - Nutrient availability (conventional soil fertility analysis with threshold values and interpretation appropriate for acid mine impacted substrates)
3. Prepare field plots demonstrating updated treatments and include monitoring recommendations



Pond 2S

Pond 2N

Pond 2 North

Pond 2 East

Pond 4

Delta Slope

Pit Area

Plant transect locations and types:

- Pit Area well vegetated (treated) and low vegetation (untreated)
- Pond 2 East (treated)
- Pond 2 North (untreated)
- Delta Slope (treated)

2012



1997



Previous revegetation activities provide clues for long-term plant growth sustainability

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Closer shot of Pond 2 East (treated) and Pond 2 N (untreated)



Vegetation cover on the most recently treated Delta Slopes plots



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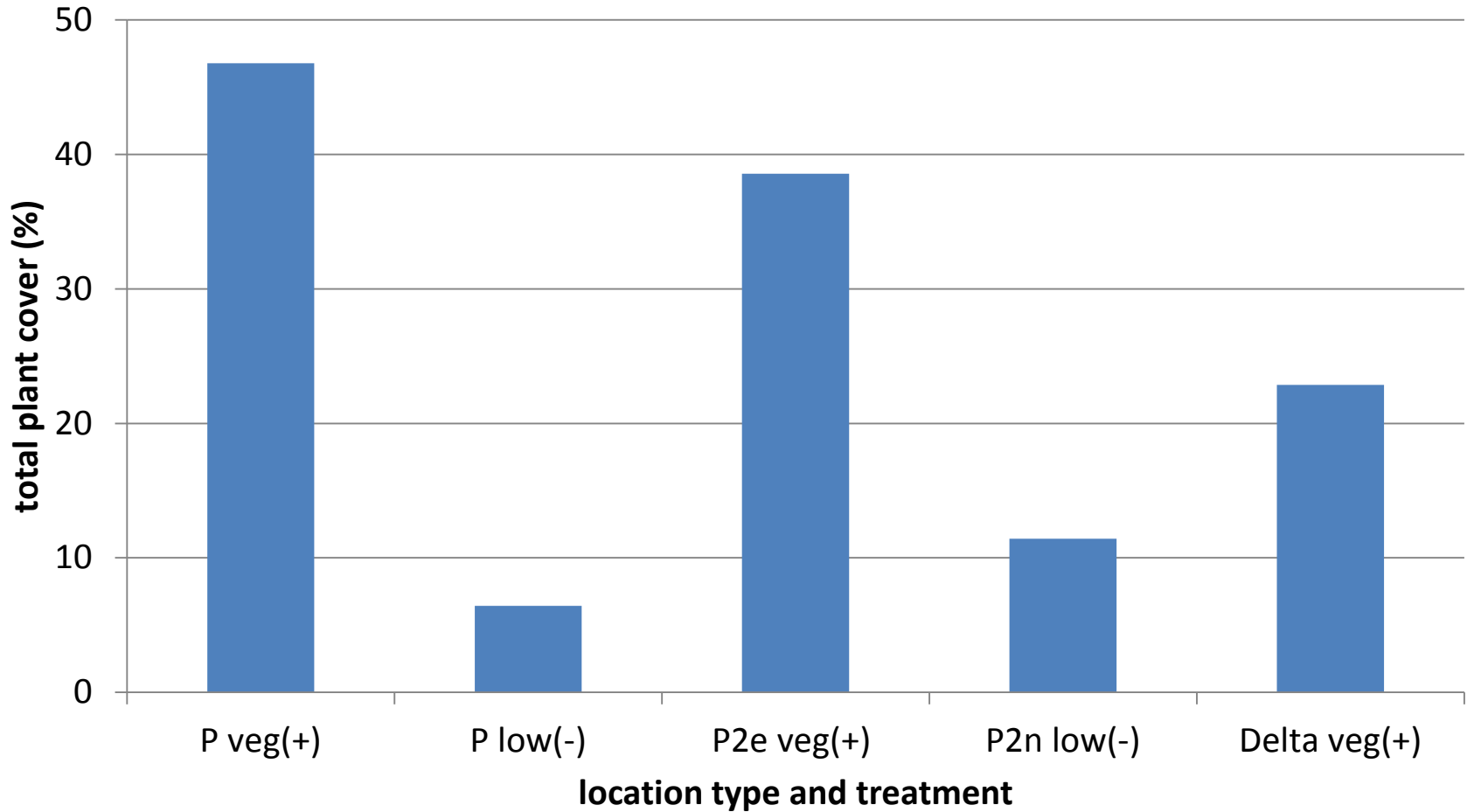
Ten years after treatment, pit benches have a range of vegetative cover. A series of paired vegetation and substrate evaluations were designed.

Objective: Measure plant cover between two contrasting conditions:
“vegetated/treated” versus “low vegetation/untreated” areas

Method: 7 meter point intercept line transect with 0.1 m intervals
70 hits per transect; four to eight transects per veg type



Vegetation cover at Leviathan mine Fall 2013



Total vegetation cover at the study locations as measured in August, 2013

Not all cues were above ground. Rooting depth was evaluated to check ability of plants to acquire moisture

Summary of rooting patterns

vegetation type: substrate depth	pit vegetated / trt	pit low veg / untrt	pond 2 east vegetated / trt	pond 2 north low veg / untrt	delta slope vegetated / trt
0-5 cm (0 – 2 in)	none; 'sandy'	none; + crust	none; gravelly	none; fines	none; rocky
10 -15 cm (4-6)	dense	few	dense	few	common
15-30 cm (6-12)	dense	few	variable	few	common
30-40 cm (12-16)	few coarse	rare	variable	rare	few
40 + cm (16+ in)	few coarse	none observed	variable	none observed	---

Root distribution in Delta Slope substrates. Note surface crust that can seal and sheet rainfall off as overland flow.



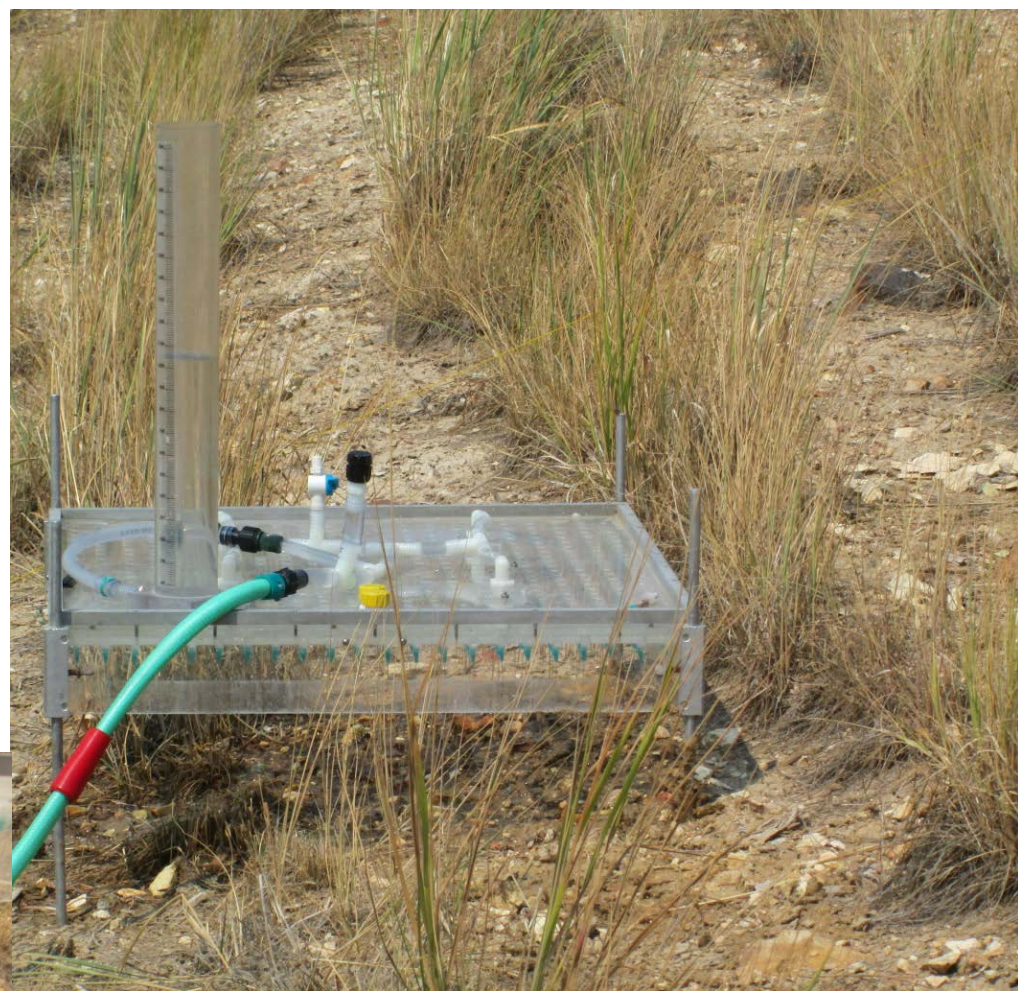
Rooting was variable by location and by row / inter row position, a substrate treatment effect.



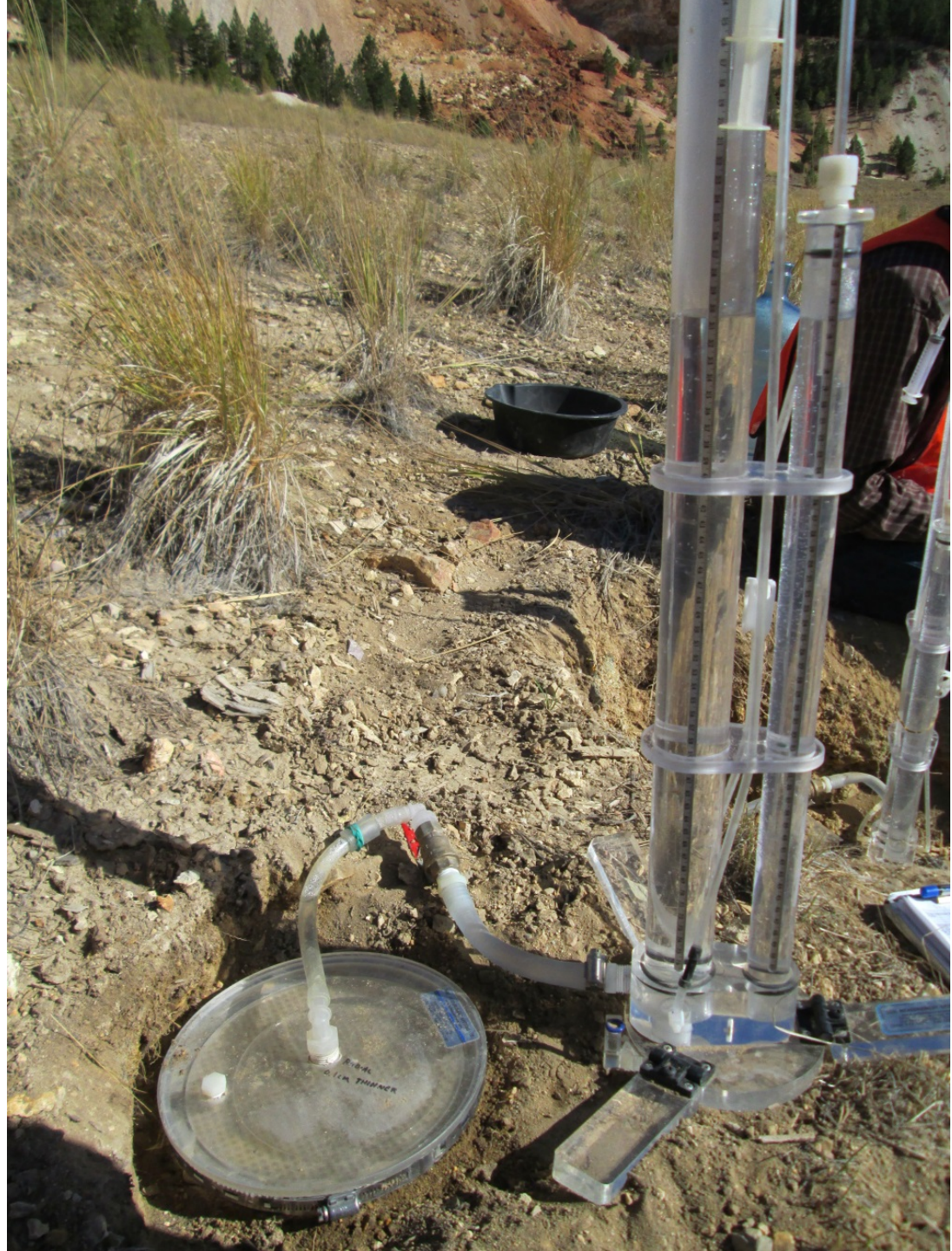
An additional observation was the formation of a substrate crust that increased with time through the summer season. An intense storm in August produced many incipient rills that suggests a threshold infiltration capacity and susceptibility to erosion.



Drop-forming rainfall simulators were used to measure infiltration of the surface horizons.

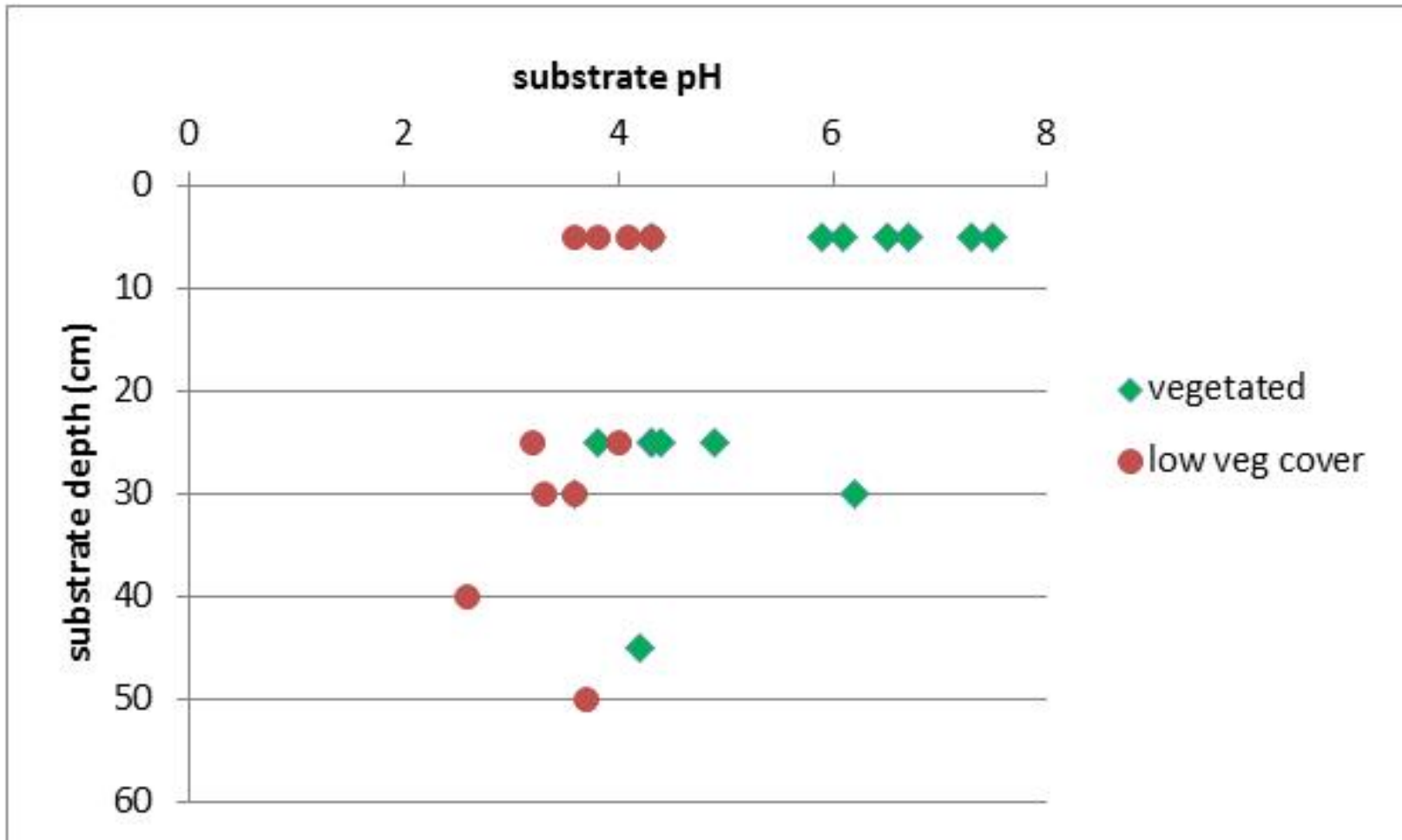


A tension lysimeter was used estimate non-saturated hydraulic conductivity at surface and sub-surface horizons for future analysis



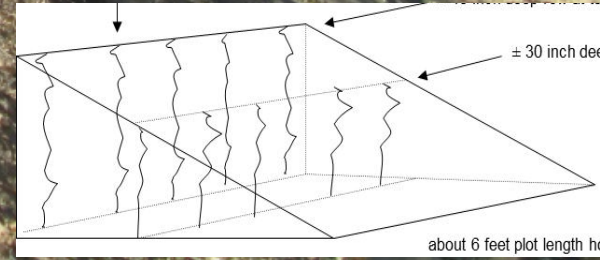
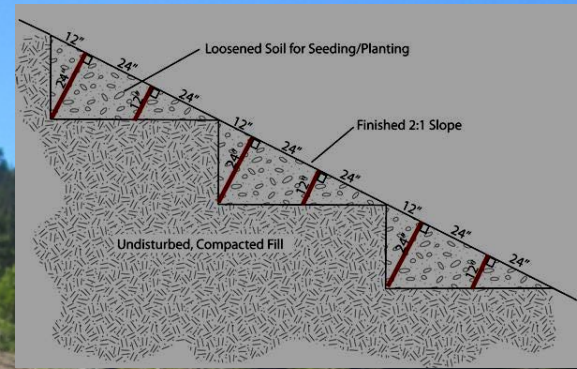
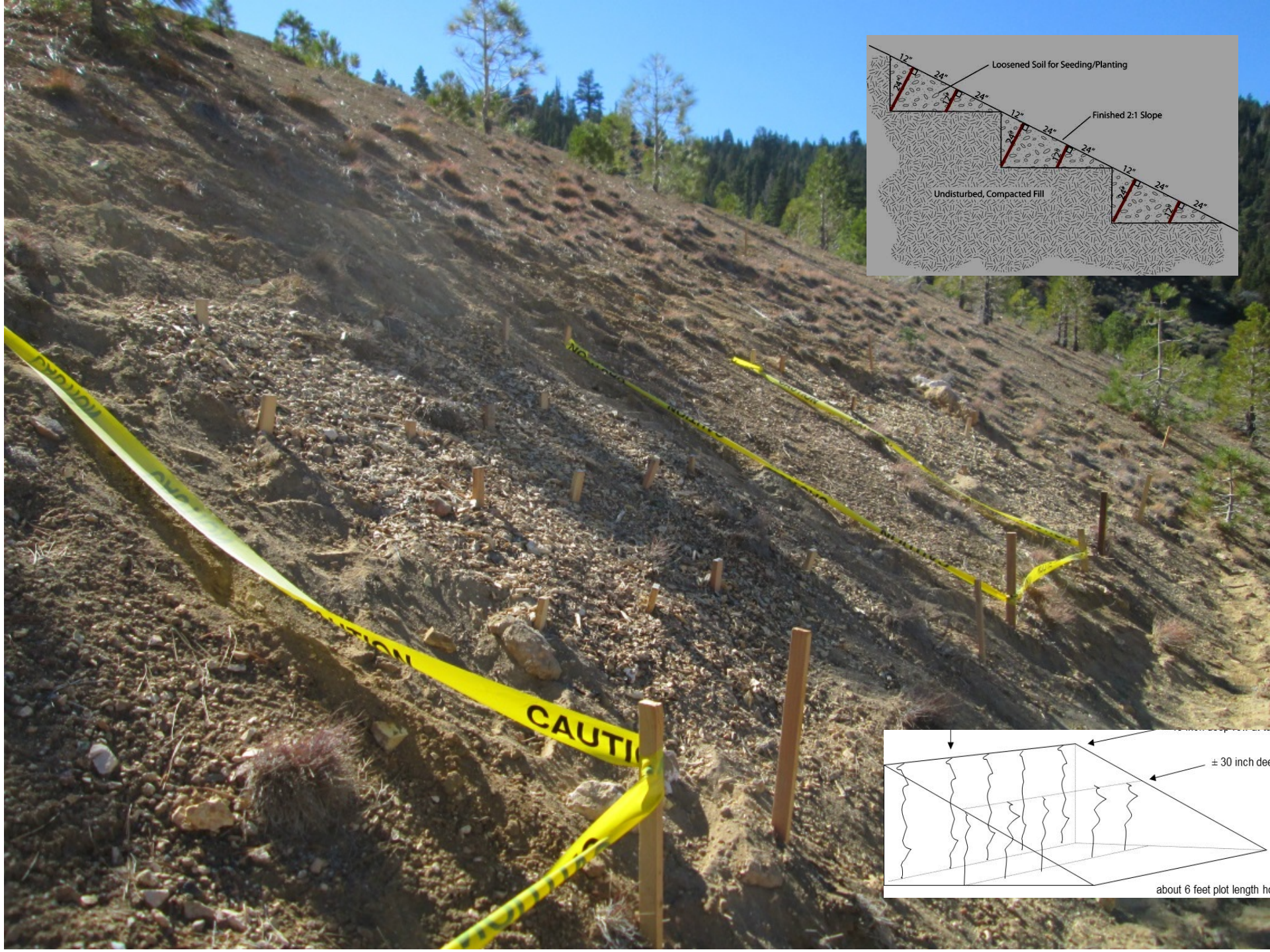
Substrates were evaluated with standard soil fertility tests.

Several marginally deficient conditions were observed, but a common overall theme was that sub-surface acidity limits rooting and therefore nutrient and moisture acquisition at many locations. The graphic below shows that areas with lower vegetation cover had the most extreme substrate acidity (all sample locations combined).









Anticipated Tasks: Spring and Summer 2014:

- Evaluate existing organic matter levels and potential amendments
- Evaluate substrate surface hydrology for design storms
- Generate substrate treatment recommendations for each location using historic and current field data
- Long term application will be improved revegetation maintenance and an updated, biddable specification for use at the mine site after the Remedial Action decision



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Questions?