Mount Polley Mining Corporation

NEZ Dump Seed Plot Success Analysis 2011

Background information:

The NEZ Dump is an 80 ha area at Mount Polley Mine, just west of Polley Lake. In September 2010, re-vegetation reclamation research was conducted on 5 ha of this eastern aspect site. Three reclamation treatment units (refer to Figure 1) were established to determine the effectiveness of different soil treatments, seeding rates, and fertilizer rates for re-vegetation. The varying parameters of each treatment unit are described in Table 1.

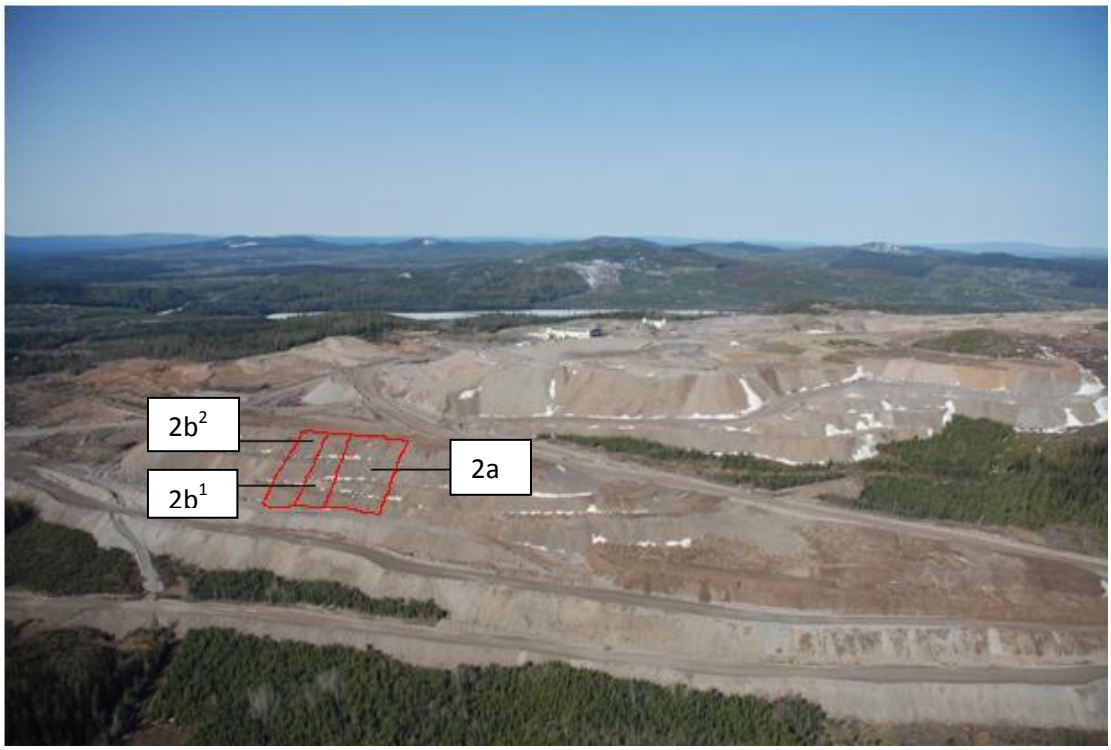

Figure 1. Mount Polley NEZ Dump (May 2008)

Table 1. NEZ Dump reclamation treatment unit parameters

Treatment Unit	Total Hectares	Seed Mixture	Seed Rate (kg/ha)	Fertilizer Rate (kg/ha)	Biosolid Application
2a	2.5	Native	45	283	No
$2b^1$	1.25	Native	34	0	Yes
$2b^2$	1.25	Native	34	71	Yes

Before seeding, treatment units had 0.4 m of till and soil applied. In addition, biosolids had been previously applied to $2b^1$ and $2b^2$. Unfortunately the till cover was applied to the top of the biosolids and not mixed in so it is likely the biosolids will not have any effect on growth rate of forbs species. Each

treatment unit was seeded with a native seed mixture containing eight (8) grasses (Mountain Brome, Native Red Fescue, Rocky Mountain Fescue, Wheat Grass-Blue Bunch, Blue Wild Rye, June Grass, and Tickle Grass) and two (2) forbs (Fireweed, and Lupines). Individual hand-seed trial plots of each of the nine (9) native seed types were also established in September 2010 on each treatment unit to investigate the re-vegetative success of each species (Figure 2).

Figure 2. Newly planted NEZ dump re-vegetation test plots

Field Assessment: July 13, 2011

Technicians: Colleen Hughes, Katie McMahen

For each of the nine plots on the three treatment units, percent of ground cover, the percent of other species present and vigor (0= poor, 5- very good) were estimated, photos were taken and any additional observations noted. General observations including growth success, invasive and non-planted species, and growth patterns were also made for the three treatment units.

It is also important to note that in the spring and early summer of 2011 MPMC recorded above average precipitation and below average temperatures, which may have influenced plant growth on the sites. This is shown in Figure 3 (note that July 2011 values are based on data from July 1 to July 18). Similarly, a

period of unusually cold weather in November 2010 may have had an effect, as the area was seeded in the fall. The average temperature was -4.7, compared to an average of -2.07 between 2006 and 2009.

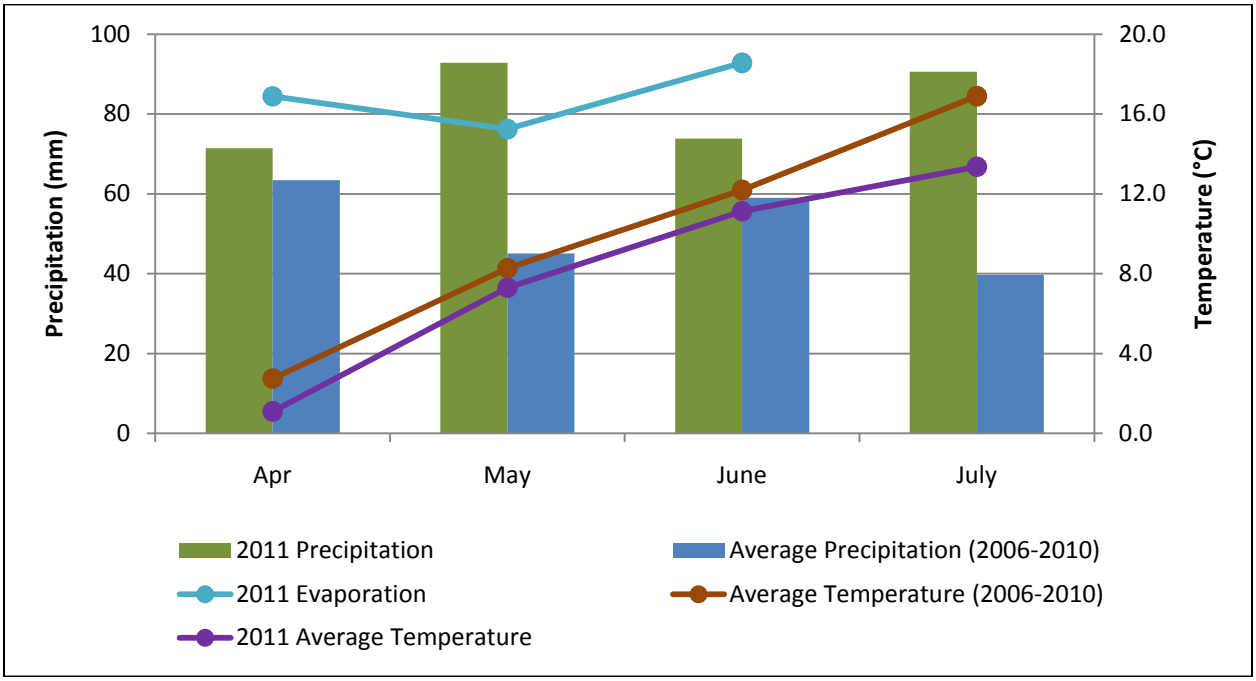

Figure 3. Mount Polley spring 2011 weather statistics

Treatment Unit 2a

Treatment unit 2a (2.5 ha) had a seeding rate of 45 kg/ha and a fertilizer application rate of 283 kg/ha. Biosolids were not incorporated into the soil.

Compared to treatment units 2b[1] and 2b[2], the soil at 2a was darker, softer and less compact. The soil at the 2b sites was also smoother and more till-like that at 2a. Greater seed growth was observed in towards the bottom of the hill. More growth was also observed in hummocky, ridged portions of the treatment unit.

Of the mixture planted, the grasses appear to be growing most successfully. Few lupines and very little fireweed were observed. Species present other than those planted include equisetum, clover, other grasses, dandelions, raspberries, and thistle (although very little thistle was observed compared to 2b[2]). A frog was also observed on the hillside.

Refer to Table 2 for the individual seed plot results.

Treatment Unit 2b[1]

Treatment unit 2b[1] (1.25 ha) had a seeding rate of 34 kg/ha and no fertilizer was applied. Biosolids were incorporated to the soil.

Much less growth was observed on this site, presumably because no fertilizer was applied, although slightly more growth was observed towards the bottom of the hill. The effects of fertilizer can be observed in the transition between sites 2b[1] and 2b[2], in Figure 4. Almost all of the plants growing are species from the native seed mixture. Mostly grasses were observed, although some small lupines were present.

Refer to Table 3 for the individual seed plot results.

Figure 4. Transition between sites 2b[1] and 2b[2]

Treatment Unit 2b[2]

Treatment unit 2b[2] (1.25 ha) had a seeding rate of 34 kg/ha and a fertilizer application rate of 71 kg/ha. Biosolids were incorporated to the soil.

2b[2] was relatively lush, especially towards the bottom of the hill. In addition to the grasses, lupines appear to be growing well. Species present other than those seeded include other grasses, columbines, dandelions, clover, and varieties of thistle, which are especially robust at this site.

Refer to Table 4 for the individual seed plot results.

Table 2. Treatment Unit 2a Individual Seed Plot Results

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
1	Mtn. Brome	70	5	4	v. few weeds, visible seeds	
2	Native Red Fescue	80	5	4	No seeds visible on grasses	
3	Rocky Mtn. Fescue	80	10	4	Very similar in appearance to the Native Red Fescue	

Table 2. Treatment Unit 2a Individual Seed Plot Results Cont'd

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
4	Wheat Grass-Blue Bunch	70	10	4		
5	Blue Wild Rye	80	10	4	Black soil visible	
6	June Grass	10	30	1	Not very healthy	

Table 2. Treatment Unit 2a Individual Seed Plot Results Cont'd

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
7	Tickle Grass	30	10	3	Some plants more vigorous than others; appears not to like damp micro sites	
8	Fireweed	5	20	1	Could this be a function of the way the seed was applied? Fireweed seed is very fine	
9	Lupine	40	10	3	No flowers	

Table 3. Treatment Unit 2b[1] Individual Seed Plot Results

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
1	Mtn. Brome	80	10	4	Rocky, more compact, till-like soil	
2	Native Red Fescue	75	20	4		
3	Rocky Mtn. Fescue	60	25	3		

Table 3. Treatment Unit 2b[1] Individual Seed Plot Results Cont'd

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
4	Wheat Grass-Blue Bunch	30	30	4		
5	Blue Wild Rye	70	10	4		
6	June Grass	5	30	1	Very poor growth and vigor	

Table 3. Treatment Unit 2b[1] Individual Seed Plot Results Cont'd

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
7	Tickle Grass	70	10	4		
8	Fireweed	40	30	3		
9	Lupine	30	30	3		

Table 4. Treatment Unit 2b^2 Individual Seed Plot Results

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
1	Mtn. Brome	70	5	4	Tallest and most dense of all 2b^2 plots	
2	Native Red Fescue	75	5	4		
3	Rocky Mtn. Fescue	60	10	3		

Table 4. Treatment Unit 2b[2] Individual Seed Plot Results Cont'd

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
4	Wheat Grass-Blue Bunch	30	10	4	Good vigor, but sparse and clumped (may be a function of hand seeding)	
5	Blue Wild Rye	50	40	4	Starting to go to seed	
6	June Grass	15	40	2	v. sparse and low to the ground	

Table 4. Treatment Unit 2b^2 Individual Seed Plot Results Cont'd

Plot	Species	% Cover	% Other Species	Vigor	Comments	Photo
7	Tickle Grass	80	20	4	Drastically more successful compared to the 2b plots	
8	Fireweed	70	10	2	Small compared to non-seeded fireweed	
9	Lupine	30	50	3	Not flowering	

Discussion

Plant growth was observed at all sites, as were ladybugs, indicating that re-vegetation is proceeding and habitats are developing. At all sites, growth appeared to be greater at the bottom of the hill, potentially indicating that seeds were transported by wind, rain, and snowmelt. Plant growth was also denser and more vigorous on contoured and ridged areas.

Overall growth appeared to be the greatest on $2b^2$ and the poorest on $2b^1$. The fertilizer applied to $2b^2$ appeared to have significantly improved growth compared to $2b^1$. On site 2a, increased fertilizer application (283 kg/ha compared to 71 kg/ha at $2b^2$) did not appear to be advantageous. This may have been caused by the higher seeding rate (45 kg/ha at 2a compared to 34 kg/ha at $2b^2$), which can stifle seed growth. These results at site 2a may be a function of the observed differences in soil. It is also of note that no biosolids were incorporated into the soil at 2a, but the application of biosolids at 2b was likely too deep to have affected plant growth.

Growth on the nine (9) individual seed plots for each treatment unit was greater compared with the rest of the treatment unit, possibly due to the hand-seeding, although in some plots plants were clumped, likely due to uneven hand seeding. Tall grasses, in particular Mountain Brome, Rocky Mountain Fescue, and Native Red Fescue were the most successful species. The forbs, fireweed and lupine growth cannot necessarily be compared with that of grasses, and while the plots had less coverage and the plants were small, they may grow and develop over time, and complement grass growth in reclamation areas.

Recommendations

Based on these results the lower seeding rate of 34 kg/ha is recommended. 71 kg/ha of fertilizer appears to be sufficient for sites similar to the NEZ Dump. The native seed mix should be adjusted, and June Grass and Tickle Grass removed (so that it contains Mountain Brome, Native Red Fescue, Rocky Mountain Fescue, Wheat Grass-Blue Bunch, Blue Wild Rye, Fireweed, and Lupines). Reclamation areas with a rougher surface, contours and debris will exhibit more successful plant growth.

Using a hydroseeding method for seed application will be advantageous providing more even seed distribution, better erosion control, and protection against invasive species.