ASSESSMENTS OF THE REVEGETATION OPTIONS CONDUCTED AT THE WASTE ROCK DUMP AT CLINTON CREEK - YEAR ONE -

A healthy willow crown at Plot 1, July 21, 2009.

FOR

Yukon

ASSESSMENT AND ABANDONED MINES

ENERGY MINES AND RESOURCES

BY

Laberge ENVIRONMENTAL SERVICES

November 2009

TABLE OF CONTENTS

1.0 BACKGROUND

The Clinton Creek Asbestos Mine, located approximately 100 kilometres northwest of Dawson City was abandoned in 1978. The majority of the mine site has remained relatively undisturbed for approximately 30 years. Various revegetation test attempts were undertaken during the 2004 and 2005 seasons with apparent limited success.

A revegetation test plot program was implemented on the Clinton Creek waste rock dump during mid September, 2008 by Laberge Environmental Services (Laberge Environmental Services, 2009). Three separate test plot areas were designated as well as a small live staking site near the base of the waste rock dump along the shore of Hudgeon Lake. Test plot 1 is near the Porcupine Pit Lake, test plot 2 is located near the old shovel and drill, and test plot 3 is east and upslope from Hudgeon Lake (Figure 1).

Local vegetation species were used in a variety of revegetation techniques to determine what methods would potentially be successful in increasing the naturally occurring revegetation process. The intent was to augment the natural succession presently taking place on the waste rock disposal area. For further details on the methodologies used refer to *Clinton Creek Waste Rock Dump Trial Revegetation Techniques, September 2008,* Laberge Environmental Services, 2009.

Precipitation was relatively low during the snow free period between May 1st and July 20th with a total amount of precipitation of 31.4 mm (Appendix A). Temperatures were also warm as recorded by the weather station at the site and as evidenced by the number and severity of forest fires in the Dawson City area. However, the previous winter's snow pack was believed to be relatively deep according to anecdotal accounts, which would likely have provided soil moisture to aid in vegetation survival and growth. In addition, all plots were well watered after planting in September 2008.

The revegetation trial plots constructed in September 2008 were inspected on July 21, 2009 to determine the transplanted vegetation's first year survival rates as well as the overall vegetation health.

2.0 Results

2.1 Hudgeon Lakeshore site

A total of 55 live willow and balsam poplar live stakes were planted along the shoreline in 2008. In 2009, 12 appeared healthy with newly formed branches and leaves. However the majority of the remainder were beaver gnawed and showed no sign of life (Photos 1and 2, Appendix B). An additional five indicated both beaver gnaw marks as well as new leaves and branches.

2.2 Plot 1 near Porcupine Pit Lake

The vegetative islands in this plot appeared to be generally healthy and producing new growth. Several islands contained soapberry (*Sheperdia canadensis*) with new berries, and shrubby cinquefoil (*Potentilla fruiticosa*) with new flowers (Photo 3). Runoff related sedimentation had covered low lying ground cover such as grasses and kinnikinnick (*Arctostaphylos uva-ursi*) in several of the islands but did not appear to affect the taller shrubs and young trees (Photo 4).

The willow crown site had eight of the nine original crowns and three of the 25 poplar stakes growing. The poplar root cutting site had one of the original 16 cuttings growing and one willow stake of the 25 growing. Many willow stakes had originally leafed out and expired.

All stakes in the poplar trench were alive and producing new growth (Photo 5). The willow trench staking site had seven living plants and eight showing no life.

Survival rates have been calculated as percentages in Table 1.

Table 1: Plot 1 Survival Rates Near Porcupine Pit Lake

Revegetation Method	Percent Survival
Vegetative Islands	100
Live Staked Willows	4
Live Staked Poplar	12
Willow Crowns	89
Poplar Root Cuttings	6
Willow Trench Staking	47
Poplar Trench Staking	100

2.3 Plot 2 near old shovel and drill

The health of the transplanted vegetative islands in this plot appeared good overall. Similar to many of the other transplanted islands, several of the individual shrubs were in berry or flower during the July inspection (Photo #6). Ground cover vegetation such as grasses and forbs on several islands tended to be covered by sediment and showed minimal indication of survival. However, the taller shrubs and young trees in these same islands appeared relatively unaffected. Several trees did not survive within individual islands. It is difficult to determine if this mortality is related to initial transplanting or other factors.

Four of the original six planted willow crowns appeared healthy. The surrounding poplar stakes had originally leafed out but all had expired by the time of the inspection on July 21st, 2009.

The poplar root cutting site had no signs of life (Photo7). The surrounding willow stakes had leafed out but none survived.

The poplar trench staking site indicated 14 of the original 15 stakes survived and had healthy new growth. The willow trench staking had five of the original 15 stakes alive

and producing new vegetation. Survival rates have been calculated as percentages in Table 2.

Table 2: Plot 2 Survival Rates Near Old Shovel and Drill

Revegetation Method	Percent Survival
Vegetative Islands	100
Live Staked Willows	0
Live Staked Poplar	0
Willow Crowns	67
Poplar Root Cuttings	0
Willow Trench Staking	33
Poplar Trench Staking	93

2.4 Plot 3 near Hudgeon Lake

The island communities in this plot appeared relatively healthy with abundant new growth as well as berries and flowers on a number of species. Minor runoff induced sedimentation was evident on several islands but the island vegetation appeared relatively unaffected. One vegetative island (IC3-A) had been driven over at some point between September 2008 and July 2009 damaging the vegetation (Photo 8).

Both the willow trench and poplar trench staking appeared to be surviving well. In both applications 14 of the original 15 stakes had new healthy growth. (Photo 7).

All six of the planted willow crowns in plot WC-3 had fresh vegetation and appeared healthy (Photo 9). However, the surrounding live staked balsam poplar had a total of four growing of the 25 planted. A second willow crown plot at this site, WC-4, also had 100% survival with three of three willow crowns growing.

The poplar root cuttings showed no sign of life nor did the surrounding willow stakes.

Survival rates have been calculated as percentages in Table 3.

Table 3: Plot 3 Survival Rates Near Hudgeon Lake

Revegetation Method	Percent Survival
Vegetative Islands	100
Live Staked Willows	0
Live Staked Poplar	16
Willow Crowns	100
Poplar Root Cuttings	0
Willow Trench Staking	93
Poplar Trench Staking	93

3.0 Discussion

Based on first year observations, the transplanted vegetative islands and the poplar trench staking method have the best survival rates. The transplanted islands have a 100 percent survival rate while the poplar trench staking has a 95 percent survival rate (Table 4).

The willow crown transplants are also surviving well with an 85 percent survival rate. The willow trench staking has a 58 percent survival rate. The live staked willows have a one percent survival rate.

The live staked poplars have a nine percent survival. The poplar root cuttings survival rate is two percent. The root cuttings were buried 25 to 35 cm deep in September 2008. The true survival rates of this method may not be apparent for another year or more, in order to allow sufficient time for the cuttings to develop biomass above ground.

No survival rate was calculated for the Hudgeon lakeshore live staking site as it was heavily influenced by beaver action and therefore not representative of the survival rate had the stakes been undisturbed.

Table 4: Average Percent Survival Rates Per Method

Revegetation Method	Average Percent Survival Rate
Vegetative Islands	100
Poplar trench staking	95
Willow Crowns	85
Willow trench staking	58
Live Staked Poplar	9
Poplar root cuttings	2
Live Staked Willows	1

Natural revegetation is taking place in various locations within the waste rock dump with balsam poplar (*Populus balsamifera*) appearing to be the most well established tree species. However, small spruce have begun to appear as well but not in the same densities as the poplar. There is a distinct lack of forb related ground cover under the tree canopy and throughout the majority of the treeless areas. There are however, micro sites where forbs are beginning to establish in small numbers.

Several small areas of interest where natural revegetation is taking place are located on the north facing slopes overlooking the Clinton Creek channel, upslope from the gabion structure. Here, existing small brush piles are providing microenvironments primarily for fireweed (*Epilobium angustifolium*) to propagate (Photo 10). Fireweed is considered a primary succession species and can provide soil stabilization, biomass for soil rebuilding and shelter for various animal species. Brush piles appear to provide an ameliorated environment where conditions are conducive to plant propagation. These brush piles also retain animal droppings that provide a seed source as well as nutrients for vegetation growth.

4.0 Recommendations

It is recommended that a mesh fence enclosure be set up around any future live staking that is easily accessible to the local beaver population to limit the damage by beavers. Following this, it is recommended that live stakes be replanted within the enclosure to determine their success along the lakeshore area.

It is advised that appropriate signage indicating the presence of trial revegetation plots be installed to potentially limit damage to the test plots. These signs could explain to the public the importance of these sites and may help avoid future damage to the test plots.

Future test plots could incorporate the use of slash/brush piles laid over seeded areas in erosion prone sites to determine the effectiveness of reducing surface erosion as well as creating micro sites conducive to vegetation growth.

Annual monitoring of all the plots should continue for a minimum of five years.

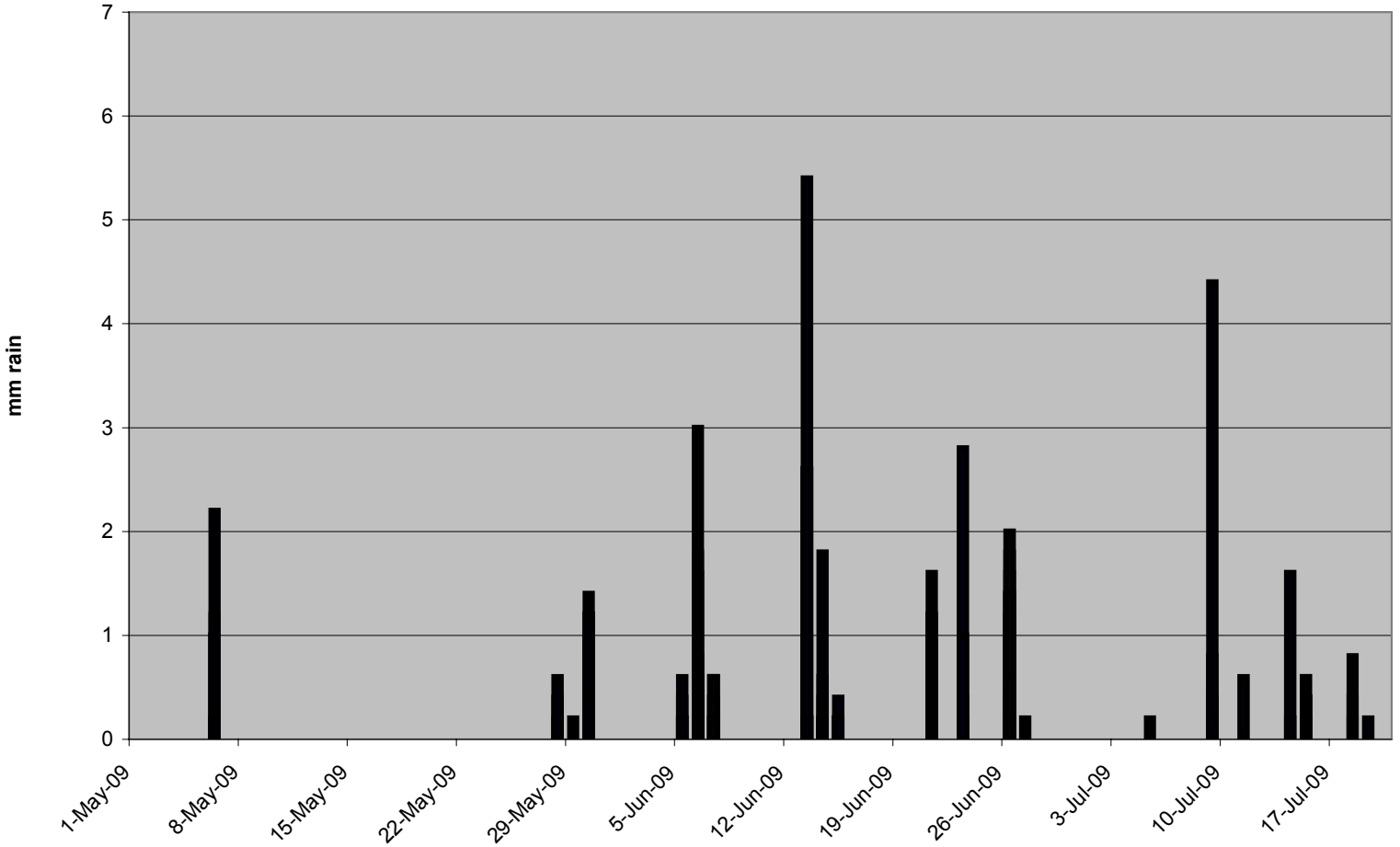
5.0 References

Laberge Environmental Services, 2008. *Clinton Creek Mine Waste Rock Dump Trial Revegetation Techniques, September 2009*, Prepared for Assessment and Abandoned Mines, EMR, Yukon Government, Whitehorse, Yukon.

APPENDIX A

CLINTON CREEK RAINFALL, MAY 1 TO JULY 20, 2009

Clinton Creek Rainfall May 1 to July 20, 2009



APPENDIX B

PHOTOGRAPHS, JULY 21ST, 2009