

MPERG Report 2007-4

Shrub Trial Plots – Brewery Creek Mine 2006 Follow-up Monitoring Report

By

Laberge Environmental Services

MPERG is a cooperative working group made up of the Federal and Yukon Governments, Yukon First Nations, mining companies, and non-government organizations for the promotion of research into mining and environmental issues in Yukon.



MPERG (Mining and Petroleum
Environment Research Group)
reports are available at the
Geoscience and Information
Sales Outlet, Room 102, Elijah
Smith Building, 102-300 Main
Street, Whitehorse, Yukon.

Mailing Address:
Box 2703, Whitehorse, Yukon
Y1A 2C6
Phone: (867) 667-5200
Fax: (867) 667-5150

The reports are also available electronically
at the Yukon Geological Survey website:
<http://www.geology.gov.yk.ca/mperg>

Shrub Trial Plots – Brewery Creek Mine

2006 Follow-up Monitoring Report

Submitted to:



Mining and Petroleum Environment Research Group

and



ALEXCO

Alexco Resources Corporation

Prepared by:

Laberge
ENVIRONMENTAL SERVICES

March 2007

Summary

In order to determine which shrub species might be useful in revegetating Yukon mine sites at the time of closure, eleven species of shrubs were transplanted at three open disturbed sites at the Brewery Creek Mine in the Central Yukon in the fall of 2000.

These sites included a steep north-facing slope, a steep south-facing slope, and a lower nearly level area. All three of these areas had been recontoured and seeded in 1996-97, and there was a thick growth of grasses and clovers at the time the shrubs were planted in 2000. To determine if this thick growth interfered with the survival of the newly planted shrubs, the grasses and clover were first removed from one-half of each of the test plots.

Six years after the shrubs were planted, it appears that black spruce and Alaska birch are the most successful species transplanted on the north-facing site, trembling aspen and Alaska birch the most successful on the south-facing site, and dwarf birch, prickly rose and trembling aspen the most successful on the nearly level site. The planting of willow stem cuttings was not successful.

After six years, the previously cleared half of each plot was once again covered with a thick growth of seeded and naturally occurring plant species. The clearing of vegetation before the transplanting of shrubs does not appear to have much of an effect on the ultimate survival and growth of the transplanted shrubs.

Contents

Summary		i
1.0	Background	1
2.0	2006 Survey Results	4
2.1	Site C-1 (Canadian Zone – North-facing)	4
2.2	Site C-2 (Canadian Zone – South-facing)	6
2.3	Site LP-1 (Below Leach Pad)	8
3.0	Conclusions	10
4.0	Acknowledgements	12
5.0	References	12

Appendix A: 2006 Photographs - Brewery Creek Mine Shrub Trial Project

List of Tables

1	Site C-1 (Canadian Zone – North-facing)	5
2	Site C-2 (Canadian Zone – South-facing)	7
3	Site LP-1 (Below Leach Pad)	9

List of Figures

1	Plot Locations at the Brewery Creek Mine Site	2
---	---	---

1.0 Background

In a project funded by the Mining Environment Research Group and Viceroy Minerals Corporation, experimental plots were established at the Brewery Creek Mine in mid-September 2000 for the purpose of determining which locally-occurring shrub species would be useful for revegetating large open disturbed areas on Yukon mine sites.

The Brewery Creek Mine, currently owned and operated by Alexco Resources Corporation (Alexco), is located in central Yukon approximately 55 kilometres east of Dawson City. The mine site is currently being decommissioned and all disturbed areas are undergoing reclamation.

The purpose of using shrubs encourages the quick establishment of seral stages of vegetative succession. Once it is determined which species thrive and propagate the most successfully, these can be planted in strategically located "islands" throughout a large reclaimed area. The placement of an array of islands results in diverse communities of native species embedded within the matrix of seeded (usually agronomic) species. The role of the islands is to allow for the dissemination of seed by wind and other natural means, to the areas adjacent to the islands, therefore facilitating and accelerating natural succession, and naturally revegetating the land to a self-sustaining state.

Eleven species of shrubs were planted at three sites (Figure 1) with differing ecological characteristics such as elevation, slope and aspect. All three sites had been previously seeded with a cover of grasses and legumes.

At each site, six two-metre X three-metre plots were situated abutting each other in a line perpendicular to the slope. Existing vegetation was removed from one half of each plot but was retained on the other half. Shrubs (transplants, stem cuttings and root cuttings) were collected from nearby areas and planted in the test plots, with the number of

specimens placed in each half of the plot recorded. Black spruce seeds were sown in one plot at each test site.

In early July and again in August of 2001, the shrub propagation trial plots were surveyed. At each plot the number of surviving plants was recorded. The details on plot locations, site characteristics, the shrub species used at each site, and the results of the 2001 survey are presented in a report submitted to MERG (Withers 2002).

In mid-July 2002, the shrub trial plots were resurveyed. The number of shrubs surviving in 2002 were recorded and compared to the numbers planted in 2000 and the numbers surviving in 2001. The results of the 2002 survey are presented in a report submitted to MERG (Withers 2003).

In order to further update the status of the shrub propagation trials at the Brewery Creek Mine, the plots were resurveyed in mid-July 2006. The results of the 2006 survey, funded by MPERG and Alexco, are presented in this report.

2.0 2006 Survey Results

The results of the monitoring survey of July 20, 2006, are described below and photographs of the conditions are presented in Appendix A.

2.1 Site C-1 (Canadian Zone – North-facing)

Since the last survey, there has been a significant increase in the growth of clover and alfalfa throughout the plots. The transplanted species are discussed individually, with a summary of the survival in each plot over time presented in Table 1.

Alaska Birch Transplants

Most of the Alaska birch transplants were surviving on both the cleared and vegetated portions of the trial plot. They appear to be healthy and well established, with a maximum height of 60 cm. No flowers/seeds were evident, although seven small birch seedlings were observed growing on the adjacent plots. Birch seedlings were also observed growing nearby outside of the plots.

Bebb's Willow Stem Cuttings

None of the Bebb's willow stem cuttings had survived when first surveyed in 2001, and the original dead plant material was still evident. There were however several volunteer willows growing in this plot and adjacent plots, as well as in the general area. These young plants were not in flower and could not be readily identified.

Prickly Rose Transplants

The surviving prickly rose transplants do not appear to be healthy. The maximum height was 21 cm. Although there was a good survival rate up to 2002, the rose plants do not appear to be thriving.

Black Spruce Transplants

The black spruce transplants have a high survival rate and are well established on both the cleared and vegetated portions of the plot. The maximum height of these transplants is 31 cm. Three new seedlings were observed growing in the vegetated half of the plot and a few seedlings were growing outside of the plots.

Beauverd's Spiraea Transplants

Although all of the Beauverd's spiraea transplants have survived until 2006, they do not appear to be healthy. Although they look to be barely alive two plants were in flower at the time of the survey. The maximum height was 55 cm.

Black Spruce Seeds

Approximately 20 black spruce seedlings were growing on the vegetated portion of the plot at the time of the 2006 survey. Some of the seeds had germinated when surveyed in August 2001, the majority in the cleared half of the plot, and a few of these were still alive when surveyed in July 2002.

<i>Plot</i>	<i>Species</i>	<i>Cleared Area</i>				<i>Vegetated Area</i>			
		Number Planted 2000	Number Surviving 2001	Number Surviving 2002	Number Surviving 2006	Number Planted 2000	Number Surviving 2001	Number Surviving 2002	Number Surviving 2006
A	Alaska birch transplants	15	15	15	14	18	16	15	14
B	Bebb's willow stem cuttings	10	0	0	0	10	0	0	0
C	Prickly rose transplants	13	13	13	10	12	9	9	5
D	Black spruce transplants	11	11	11	10	11	11	11	13
E	Beauverd's spiraea transplants	8	8	8	6	6	6	6	6
F	Black spruce seeds	4 grams	a few	a few	0	4 grams	a few	a few	20

2.2 Site C-2 (Canadian Zone – South-facing)

Since the last survey (July 2002), there has been a significant increase in the growth of clover and alfalfa throughout the plots. The transplanted species are discussed individually, with a summary of the survival in each plot over time presented in Table 2.

Black Currant Transplants

There was a fairly good survival rate, most notably in the cleared portion of the plot, up to the survey conducted in July 2002. However, none of the black currant transplants were surviving in 2006.

Black Spruce Seeds

A few of the black spruce seeds had germinated in the cleared half of the plot in August 2001, and a few of these had survived to July 2002. There were no black spruce growing on the plot at the time of the 2006 survey.

Raspberry Transplants

Only one of the raspberry transplants was still growing on the cleared portion of the plot in 2006 indicating that six had perished since 2002. Six were growing on the vegetated portion indicating that one additional rose plant has grown since 2002. The maximum height was 55 cm.

Alaska Birch Transplants

In 2006, only one of the ten Alaska birch transplanted on the cleared portion of the plots was surviving, following a 100% survival rate up to July 2002. Five of the seven transplanted on the vegetated portion were growing well, along with five new seedlings. The maximum height of the birch transplants was greater than one metre.

Trembling Aspen Transplants

In 2006, only two of the ten trembling aspens transplanted on the cleared portion of the plots was surviving, while one of the eight transplanted on the vegetated portion was growing along with eleven new seedlings. The maximum height of the aspen transplants was greater than one metre.

Little-tree/Blue-green Willow Stem Cuttings

None of the willow stem cuttings planted on the cleared portion of the plot had survived at the time of the 2001 survey, while one was still growing on the vegetated part of the plot in 2006.

<i>Plot</i>	<i>Species</i>	<i>Cleared Area</i>				<i>Vegetated Area</i>			
		Number Planted 2000	Number Surviving 2001	Number Surviving 2002	Number Surviving 2006	Number Planted 2000	Number Surviving 2001	Number Surviving 2002	Number Surviving 2006
A	Black currant transplants	9	8	8	0	6	5	3	0
B	Black spruce seeds	4 grams	a few	very few	0	4 grams	0	0	0
C	Raspberry transplants	8	8	7	1	7	7	5	6
D	Alaska birch transplants	10	10	10	1	7	5	5	10
E	Trembling aspen transplants	10	10	8	2	8	6	1	12
F	little-tree/blue-green willow stem cuttings	10	0	0	0	10	1	1	1

2.3 Site LP-1(Below Leach Pad)

There was an increase in the growth of clover throughout this area. The volunteer aspens and willows growing beyond the plots show robust growth and are propagating and spreading naturally. The species transplanted in the plots are discussed individually, with a summary of the survival over time presented in Table 3.

Trembling Aspen Root Cuttings

The trembling aspens (five in the cleared portion of the plot and 4 in the vegetated portion) are growing well with a maximum height of 2.5 metres. In 2002, only one aspen was growing in the vegetated area, so these aspens are likely reproducing through root suckering.

Blue-green Willow Stem Cuttings

None of the Blue-green willow stem cuttings had survived at the time of the 2001 survey.

Prickly Rose Transplants

The surviving prickly rose transplants are growing well with a maximum height of 45 cm. These transplants are reproducing, probably from seed, with eight additional rose plants observed growing throughout the plot.

Bebb's/Little-tree Willow Stem Cuttings

None of the Bebb's/Little-tree willow stem cuttings had survived when first surveyed in 2001.

Dwarf Birch Transplants

The surviving dwarf birch transplants are growing well with a maximum height of 120 cm. The transplants on the vegetated portion of the plot are reproducing, probably from seed.

Black Spruce Seeds

None of the black spruce seeds had germinated by the time of the 2006 survey.

<i>Plot</i>	<i>Species</i>	<i>Cleared Area</i>				<i>Vegetated Area</i>			
		Number Planted 2000	Number Surviving 2001	Number Surviving 2002	Number Surviving 2006	Number Planted 2000	Number Surviving 2001	Number Surviving 2002	Number Surviving 2006
A	trembling aspen root cuttings	11	5	5	5	11	1	1	4
B	blue-green willow stem cuttings	10	0	0	0	10	0	0	0
C	Prickly rose transplants	10	8	8	15	11	3	3	4
D	Bebb's / little-tree willow stem cuttings	8	0	0	0	9	0	0	0
E	Dwarf birch transplants	7	5	4	3	8	3	2	4
F	Black spruce seeds	4 grams	0	0	0	4 grams	0	0	0

3.0 Conclusions

Six years after the shrub trial plots were established at the Brewery Creek Mine, the following conclusions can be made:

- A few of the shrub species are growing well and are reproducing. As well as propagating within the plots, several species have also spread to adjacent areas. Those species recommended for establishment of islands at the Brewery Creek Mine Site include:

Northerly facing sites: black spruce transplants
Alaska birch transplants

Southerly facing sites: trembling aspen transplants
Alaska birch transplants

Near level sites: trembling aspen root cuttings
prickly rose transplants
dwarf birch transplants

- Those sections of the plots that had been cleared of vegetation before planting (at all three test sites) are now once again heavily vegetated with both seeded and naturally occurring plant species. Clearing of the plots of vegetation does not appear to have a significant effect on the survival and growth of the transplanted shrubs. Initially, several species (aspens, rose, Alaska birch and dwarf birch) had a greater survival rate on the portion of the plot that was cleared compared to the portion of the plot that was left vegetated. By 2006 however, survival had decreased, sometimes significantly. The majority of the propagation of these species has generally occurred within the vegetated portion.

- Establishing willows through the planting of stem cuttings does not appear to be effective at the Brewery Creek Mine, although several species of willow are naturally colonizing the reclaimed areas.

4.0 Acknowledgements

Laberge Environmental Services would like to thank the Mining and Petroleum Research Group and Alexco Resources Corporation for providing the funding for this project. The logistical support provided by Alexco Resources Corporation was greatly appreciated.

Stu Withers and Bonnie Burns conducted all field work and prepared the final report. Heather Desmarais of Access Mining Consultants prepared Figure 1.

5.0 References

Withers, Stu. 2002. Experimental Reclamation Project Shrub Trial Plots – Brewery Creek Mine. Prepared for the Mining Environment Research Group, Whitehorse, Yukon. MERG Report 2002-1.

Wither, Stu. 2003. Follow-up Monitoring: Shrub Trial Plots at Brewery Creek Mine and Bioengineering Trials at Noname Creek. Prepared for the Mining Environment Research Group, Whitehorse, Yukon. MERG Report 2003-3

Appendix A:

**2006 Photographs – Brewery Creek Mine
Shrub Trial Project**



Site C-1. Looking west along the plots during transplanting, September 2000. Alaska birch plot in foreground.



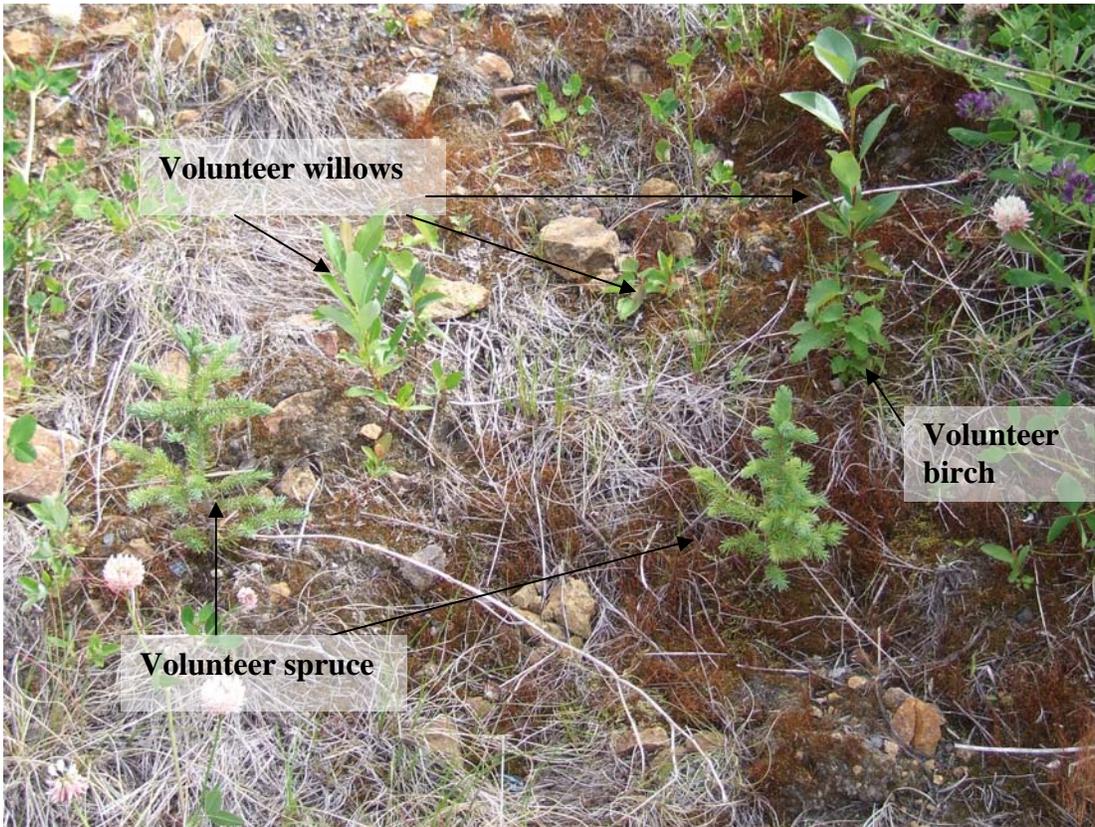
Site C-1. Looking west along the plots, Alaska birch plot in foreground, July 20, 2006. Note the increase in growth of clover and alfalfa throughout the area, which has covered the cleared half of the plots as well.



Site C-1. Volunteer willow plants growing in the plot, July 20, 2006.



Site C-1. Rose transplants are surviving but not thriving.



Site C-1. Volunteer spruce, willows and Alaska birch growing just upslope of the plots, July 20, 2006.



Site C-2. Volunteer aspen and willow growing adjacent to the plots, July 20, 2006.



Site C-2. Looking east along plots during transplanting, September 2000.



Site C-2. Looking east along plot. Stu is standing by one of the aspens, July 20, 2006. Note increased growth of clover and alfalfa.



Site C-2. The lone willow survivor, July 20, 2006.



Site C-2. The Alaska birch transplants are doing very well, July 20, 2006.



Site LP-1. Looking along plot, July 2002.

**Same clump
of trees**



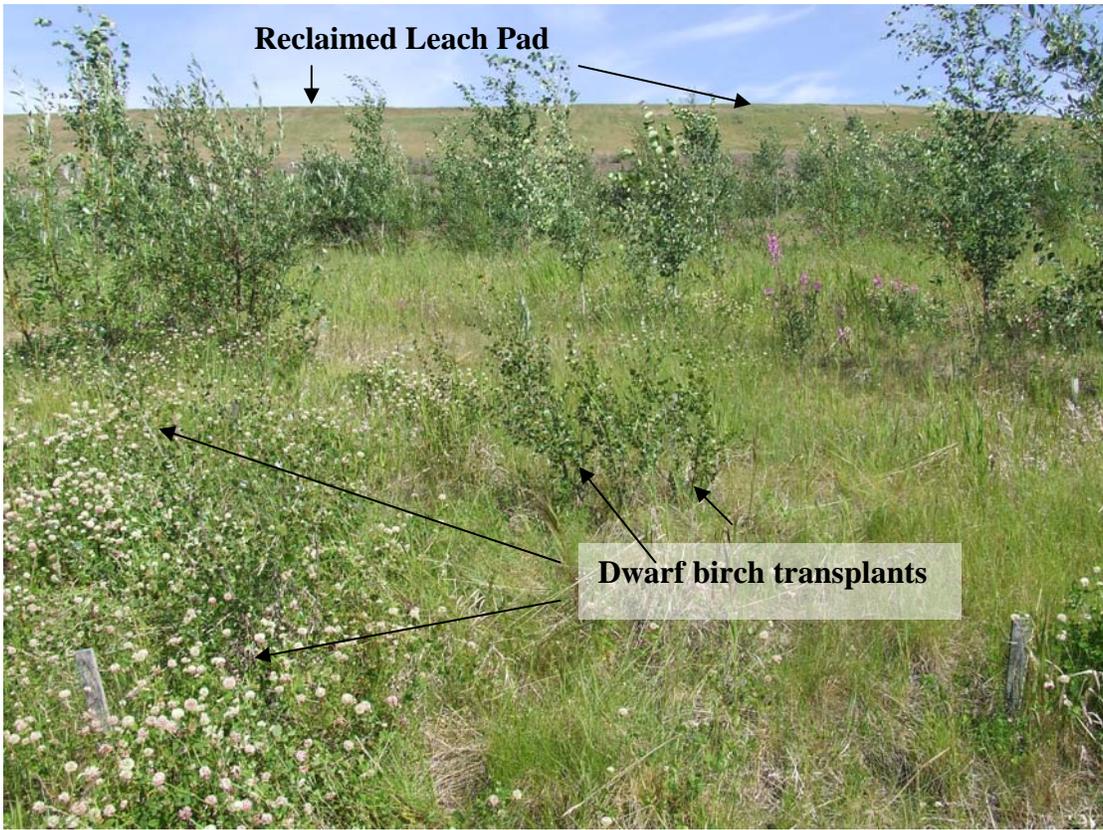
Site LP-1. Looking along plot, July 20, 2006. Growth of clover and aspens is much thicker and more robust than in July 2002.



Site LP-1. One of the aspen trees which has grown from a root cutting is now well over 2 m high. July 20, 2006.



Site LP-1. Healthy rose plants in the plot, July 20, 2006.



Site LP-1. Healthy dwarf birch plants thriving in the plot, July 20, 2006.



Site C-1. Black spruce seedlings grown from seeds, July 2006.