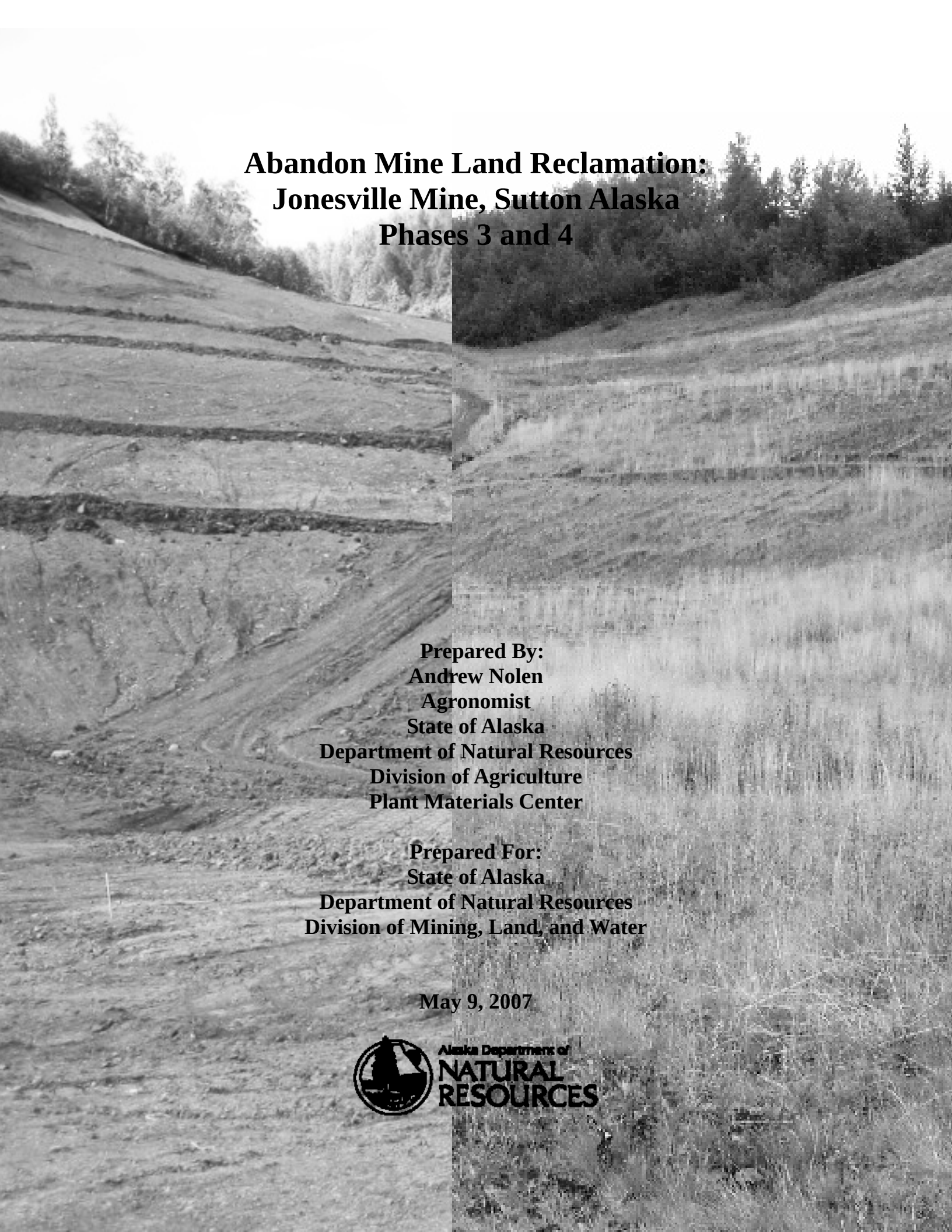

Abandon Mine Land Reclamation: Jonesville Mine, Sutton Alaska Phases 3 and 4

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Abstract:

Several years of collaboration between the Alaska Plant Materials Center (PMC) and the Division of Mining, Land and Water Abandon Mine Land (AML) program culminated in 2003 with the implementation of revegetation activities at phases III and IV of the Jonesville coal mine near Sutton, Alaska. The PMC was responsible for the revegetation planning aspects of the reclamation effort as well as supervising the installation of the plant materials. The PMC also performed follow up monitoring and maintenance. Previous experience with other phases of the Jonesville and Knob Creek mines aided in the development of the revegetation plan for this last remaining disturbance. The revegetation plan included multiple treatments including aerial seed and fertilizer applications and the use of dormant cuttings as brush layers and brush bundles. Monitoring the success of the treatments occurred in 2003, 2004, and 2006. Plant establishment has proceeded well and the goals of the effort appear to have been achieved.

Introduction

Several years of collaboration between the Alaska Plant Materials Center (PMC) and the Division of Mining, Land and Water Abandon Mine Land (AML) program culminated in 2003 with the implementation of revegetation activities at phases III and IV of the Jonesville coal mine near Sutton, Alaska (Photo 1). The PMC was responsible for the revegetation planning aspects of the reclamation effort. Previous experience with other phases of the Jonesville mine and the Knob Creek mine aided in the development of the revegetation plan for this last remaining disturbance.

The revegetation plan included multiple treatments including aerial seed and fertilizer applications and the use of dormant cuttings as brush layers and brush bundles. Straw wattles were also selected to be used on the steep slopes to slow downhill water movement and capture sediment.

Monitoring the success of the treatments occurred in 2003, 2004, and 2006. Plant establishment has proceeded well and the goals of the effort have been achieved.

Key participants in the planning and execution of this rehabilitation effort were Bruce Novinska, Division of Mining, Land and Water, AML Program and Nancy Moore, Alaska Plant Materials Center.

Photo 1. Aerial View of Jonesville Phases III and IV Prior to Restoration

Project Goals

The Jonesville mine is located approximately 5 miles northwest of Sutton, Alaska, in the Matanuska Valley Moose Range. The project is included in the scope of the AML reclamation goals of the Division of Mining, Land and Water. General goals associated with AML projects include:

1. Protection of public health, safety, general welfare and property from extreme danger resulting from the adverse effects of past coal mining practices.
2. Protection of public health, safety and general welfare from adverse effects of past coal mining practices, which do not constitute an extreme danger.
3. Restoration of eligible lands and waters and the environment previously degraded by adverse effects of past coal mining practices, including measures for the conservation and development for soil, water (excluding channelization), woodland, fish and wildlife, recreation resources, and agricultural productivity. (Abandoned Mine Lands Program. 2007)

Matanuska Valley Moose Range Management Plan Goals:

1. To maintain, improve or enhance moose populations and habitat either through forestry practices that also provide for personal and commercial firewood harvesting; or direct habitat manipulation by fire or mechanized means.
2. To maintain, improve or enhance other fish and wildlife populations.
3. To provide opportunities for coal mining and mineral development.
4. To improve and enhance moose populations through reclamation of coal mined lands to productive wildlife habitat, primarily beneficial to moose.
5. To preserve opportunities for materials extraction.
6. To provide for grazing opportunities.
7. To improve legal access on existing public roads and trails.
8. To protect local lifestyles, scenic qualities and reduce trespass and public interference on private lands.
9. To provide for dispersed outdoor recreational opportunities within the range and camping and picnicking facilities along the roadside. (Matanuska Valley Moose Range Management Plan.1986)

The Revegetation Plan

AML and Matanuska Valley Moose Range goals were of primary consideration during the development of the revegetation plan. The site is "characterized by gravelly, rocky material mixed with finer particles of clay, silt or sand. When wet, the substrate was slippery, sticky and easily eroded. When dry, the substrate was crusty with cracks that formed as it dried. Past revegetation efforts have demonstrated that planting combinations of willow brush layers, bundles and live stakes along with transplants and seedings with native grasses and forbs are appropriate techniques for revegetating sites with steep slopes and erosive soils" (Moore, N. J. 2005). Planted species and planting techniques were chosen to provide for soil stabilization as well as natural reinvasion of native plant species. Techniques chosen for this project included aerial seed and fertilizer applications and installation of dormant cuttings.

The PMC recommended a commercially available seed mixture consisting of:

25% 'Arctared' Red Fescue	25% 'Norcoast' Bering Hairgrass
25% 'Gruening' Alpine Bluegrass	25% 'Wainwright' Slender Wheatgrass

Additional seed was supplied by the PMC for added diversity to the mix. These included paper birch and wormwood. The seeding rate recommended was 20 pounds per acre. Fertilizer with an analysis of 20-20-10 (N-P-K) applied at 450 pounds per acre was also recommended for the project. Aerial application of the seed and fertilizer was selected due to steepness of the terrain and lack of accessibility of the site.

Dormant cuttings of willow and cottonwood were selected as the woody component of the revegetation effort. The two techniques selected for installing the cuttings were brush layers and brush bundles. Straw wattle (coir logs) were selected to be utilized in conjunction with the brush layers on the contour of steep slopes to aid in stabilization and improve sediment capture and water holding capacity. Dormant cutting techniques were recommended as described in Streambank Revegetation and Protection: A Guide for Alaska (Hughes, D., Moore, N., and Walter, J. 2005).

Past experience with similar projects in the area indicated that alder seedlings have naturally invaded the wetter areas of disturbances fairly readily following revegetation efforts. This led to the addition of 5000 alder transplants to the plan for specific areas as a strategy to improve the overall rate of vegetation establishment.

Materials Acquisition

Seed

The primary components of the seed mix and the fertilizer were acquired from local commercial sources. Other components were provided by the PMC from field production and wild collections. The analysis of the final seed mix prepared for the project is presented in table 1. The supplier mixed the components and prepared 50 pound bags of the seed. 800 pounds of the seed was delivered to the Palmer airport for aerial application and 150 pounds was delivered to the PMC that was intended to fill in gaps not able to be reached with the aerial application.

Table 1. Seed Mix Analysis

Description	Percent of Mix	Germination	Origin
'Arctared' Red Fescue	23.86	85%	Canada
'Gruening' Alpine Bluegrass	24.10	80%	Alaska
'Norcoast' Bering Hairgrass	24.32	90%	Iceland
'Wainwright' Wheatgrass	23.96	84%	Alaska (PMC)
Paper Birch (lot# Northwoods)	0.07	34%	Alaska (PMC)
Paper Birch (lot# Lockwood)	0.07	51%	Alaska (PMC)
Paper Birch (lot# Bodenburg)	0.23	50%	Alaska (PMC)
'Caiggluk' Wormwood	1.98	63%	Alaska (PMC)
Other Crop Seed	0.07		
Inert Matter	1.09		
Weed Seed (No Noxious Weeds)	0.24		

Alder

Alder seed (*Alnus viridis)* was collected October 22, 2002, from the Jonesville mine site and access road for the greenhouse production of the 5000 seedlings for the project. Two agronomists and nine laborers were able to collect 13 pillow case sized bags of alder cones in four hours. This resulted in approximately 10 pounds of seed after cleaning.

Fertilizer

18,700 pounds of the 20-20-10 fertilizer was aquired from local commercial sources. This was packaged in 2000 pound bulk sacks for delivery to the Palmer airport for the aerial application except for 2000 pounds which was packaged in 50 pound bags for delivery to the PMC to fill in gaps not able to be reached by the aerial application.

Dormant Cuttings

25,000 dormant cuttings of willow and poplar were acquired from local commercial sources for the brush layers and brush bundles needed for the project. The specifications for the cuttings were as follows:

1. 3 to 4 feet in length and ¼ to 2 inches in diameter
2. At least 60% or 15,000 of Feltleaf, Pacific or Sitka willow
3. Less than or equal to 20% or 5,000 Barclay willow
4. Less than or equal to 20% or 5,000 poplar/cottonwood
5. Must be cut prior to March 31, 2003
6. Must be stored in cold storage to maintain dormancy
7. Must be protected from drying during transport

The cuttings were delivered to the PMC and stored in a cold storage until implementation June 2003.

Straw Wattle

7800 linear feet of straw wattle was also acquired from local commercial sources. California Straw Works manufactured the 9-inch diameter, 25-foot long rice straw tubes incased in UV degradable plastic net. The plastic netting was intended to maintain the wattle integrity for 3-5 years. The project estimate for straw wattle was 5800 feet. The additional amount was purchased for unforeseen overages and use on future projects.

General Tools

General tools necessary to complete the implementation were provided by the PMC or purchased/hired from local suppliers. Tools required included:

Spade shovels
Pick Axes
Gravel Rakes
Hand Held Broadcast Spreaders
Planting dibbles
Engineers Hammers
1” x 1” x 18” Sharpened Wooden Stakes
Open Top Water Holding Tank
Water Truck with hose and nozzles
2 Four Wheel Drive Four Wheelers with trailers
Pickup Truck
Porta-Potty

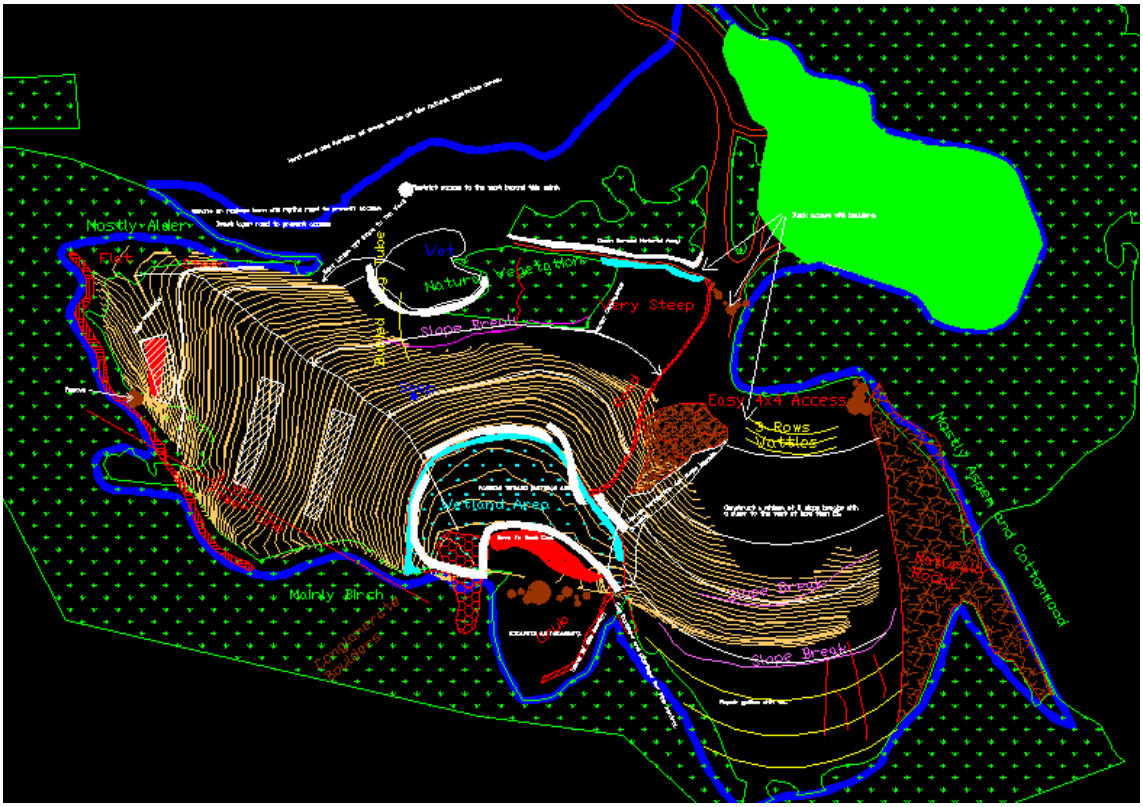

Figure 1. AML Layout of Work for Phases III and IV

Mobilization and Implementation

Prior to revegetation activities, the site was contoured and graded to reduce slope length. Accessible areas were ripped on contour or track walked with a dozer to create catchments for seed, fertilizer and moisture. This work was completed by the Division of Mining Land and Water AML program and is presented in Figure 1.

The initial phase of the implementation of the project was the greenhouse production of 5000 alder seedlings. Following cleaning and testing, the seed collected in October 2002 was planted in greenhouse flats and cold stratified in a cold storage building for 3 months. The flats were placed in the greenhouse February 2003. Good seedling emergence

Photo 2. Delivery of Straw Wattle

was evident in a few weeks. The seedlings were moved outside to harden off in June 2003.

The dormant cuttings for the project were delivered to the PMC in May 2003. These were stored in a cold storage building to maintain dormancy until they were needed for installation. Approximately 25% of the cuttings were tied into bundles in order to reduce the on-site labor requirements.

Mobilization to the site began on May 27, 2003. A hired crew of five laborers converged on the site to aid two PMC agronomists. Straw wattle installation was the initial task. The PMC staff used a pickup to transport two pallets at a time from the PMC to the site. (Photo 2) The laborers trenched along the contour of the steep faces of phases III and IV (Photo 3). The wattles were installed at three steep locations of the project spaced at intervals of 15 feet of elevation (Photo 4). Wood stakes were used to secure the wattle in the trenches (Photo 5).

A large open top water tank was filled and used as a holding tank for the dormant cuttings. The goal was for 24 hours of soaking prior to installation. The cuttings had to be weighted so they would be completely submerged. Cuttings were delivered to the site on a daily basis.

The installation of the brush layers occurred after the completion of the wattle. Brush layers were installed on approximately 1/3 of the length of each row of wattle. They consisted of approximately 7 cuttings per linear foot trenched in as deep as was reasonable to dig with hand tools, generally 18 inches. The cuttings were trimmed back after installation so that ¾ of each cutting was below ground. The layers were offset in a discontinuous fashion from row to row to result in minimal overlap up and down slope. A higher concentration of brush layers was installed in existing gullied areas of the slopes to reduce the rate of water flow.

Brush layers were also installed in a parabolic fashion in the main down drains designed in to the project. These consisted of 12-foot long layers also spaced at 15-foot intervals in elevation change. The water truck with hoses was used to water in all the cuttings after installation.

Photo 3. Contour Trenching for Wattle installations

Photo 4. Wattle Space on 15-foot Intervals

Brush bundles were installed at 30-foot intervals along the slope breaks perpendicular to the direction of water flow. These were intended to be vegetative check dams. These cuttings were also watered in following installation. Installation of all dormant cuttings was completed July 2, 2003.

Aerial applications of seed and fertilizer occurred July 30, 2003 (Photo 5). The seed was applied first because wind at the site, which could drift the light weight mix, tended to be calm in the morning hours. The application appeared to be very uniform with few light areas (Photo 6). The fertilizer application was also very uniform. The plane was not loaded to capacity due to the highly variable terrain of the site and risk of adverse weather conditions. All of the applications were complete in the early afternoon.

Photo 5. Aerial Application

Photo 6. Uniform coverage of seed and fertilizer

PMC staff returned to the site on August 11, 2003 to plant the alder seedlings and apply seed and fertilizer to the areas not able to be reached with the airplane. Prior to arriving on site, the alders were removed from their planting trays and placed in tubs to reduce the on-site labor demand. The crew of five laborers and two agronomists split into two groups, one to start staging and planting alders and the other spreading seed and fertilizer to the skipped areas. The seed mix was applied at 20 pounds per acre and the fertilizer at 450 lbs per acre. Once the seed and fertilizer crew completed the applications, they joined the planting crew. Alder planting continued on August 12 with two additional laborers making a crew of nine. The alder seedlings were planted using dibbles and pick axes to create holes slightly larger than the plugs. The seedling plugs were placed in the holes and packed to provide good contact between the roots and soil. The seedlings were spaced 1-2 feet apart. The alders were fertilized at 450 lbs per acre after planting. Approximately 6000 alder seedlings were planted by 4 pm.

Monitoring

Photo points were established for long term monitoring of the revegetation success. The photo point locations are presented in the following pages.

Photo Point 1: N 61° 44’ 19.7” W 148° 56’ 29.8”

9-7-03

7-21-04

9-6-06

Photo Point 2: **N 61° 44’ 19.7” W 148° 56’ 29.8”**

9-4-03

7-21-04

9-6-06

Photo Point 3: N 61° 44’ 19.7” W 148° 56’ 36.5”

9-4-03

7-21-04

9-6-06

Photo Point 4: N 61° 44’ 15.2” W 148° 56’ 21.5”

9-4-03

7-21-04

9-6-06

Photo Point 5: N 61° 44’ 15.2” W 148° 56’ 21.5”

9-4-03

7-21-04

9-6-06

Photo Point 6: N 61° 44’ 18.4” W 148° 56’ 16.4”

9-4-03

7-21-04

9-6-06

Discussion and Conclusions

The revegetation of Jonesville Mine phases III and IV brought together many years of experience working on the complex of coal mines north of Sutton, Alaska. The plant material selection and installation were those that had been proven with long-term success on previous projects. The seed and dormant cuttings planted on this project have thrived since planting. A high level of species diversity and plant cover has established on the site during the short monitoring period. Individual species of the seed mix have adapted the most suitable locations to thrive within the microenvironments of the site. Natural re-invasion of non-planted species is evident.

Paper birch seed was added to the project due to observations of high levels of natural seed dispersed prior to the final grading. Birch seedlings have not been observed as a major component of the species establishing on the site. The surrounding birch forests are expected to continue dispersing seed across the site in the future.

The alder seedlings survived well through the first winter but did not thrive the next growing season. Several woody species including alder, willow, and cottonwood have naturally moved into that planting area. It may have been more beneficial to include the collected alder seed in the seed mix.

The straw wattle has remained intact and appears to be aiding in the stabilization of the steep slope of phase IV. Sedimentation is evident behind the wattle and a large percentage of the dormant cuttings are well established.

Though some sloughing and gulling has occurred, sediment has been contained on the site. Some of the brush layers on the main down-drain have failed due to gulling and ATV trails established within the area which have also damaged some of the brush bundles on the slope terraces. However, general off-road traffic has been contained to limited areas without negatively affecting the overall success of the project.

The goals of the project appear to have been achieved and long-term success is expected. Wildlife habitat and recreational opportunities have been improved. What was once a hazardous eyesore is on the way to becoming a desirable destination.

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