THE RECLAMATION PROCESS AT
BULLMOOSE OPERATING CORPORATION

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ABSTRACT

The ex-pit mined rock piles at Bullmoose were designed as 50 m end dump lifts with 30 m wide safety berms. These lifts are bounded by a steep slope declining to West Bullmoose Creek. A method was developed that would place soil on the slopes of the mined rock piles to a depth of 0.5 m, create sustainable growth, promote slope stability, and produce animal habitat for end land use that was equivalent to or better than what was here before the mine. This method had to be compatible with pit operations to allow mined rock piles to be reclaimed as they reached their final limits to minimize costs and promote progressive reclamation. Once in place, the soil and vegetation has to be assessed to demonstrate that end land use objectives are attainable. Polygons are established and monitored for stability, sustainable growth and native encroachment.

INTRODUCTION

Bullmoose Operating Corporate (BOC) began coal production in October 1983 from coal leases located 87 km south of Chetwynd, B.C. and 40 km west of Tumble Ridge, B.C. in what is generally known as the Northeast Coal Block (see Figure #1). BOC is presently mining coal from the South Fork deposit located on the north facing slope of Mount Collier. Mining operations are situated between the 1300 m and 1800 m elevations which include northern boreal forest to alpine areas. The plant site is situated in the valley at the 1100 m elevation.
Figure 1: Location Map

Objectives:

Pre-mining land uses included habitat for wildlife, exploration for gas, oil and coal, recreation (fishing and hunting), and forestry in the valley areas. The planned end land use for the mine site is wildlife habitat, this being our primary reclamation objective. The basic components of wildlife habitat including food, hiding and thermal cover, water and space must be provided (Shaw, 1985). This is accomplished by
providing ground cover that can supply forage and protection for species both large and small. Our secondary objective is to create an agronomic vegetation cover to stabilize and enhance soil conditions. This will provide erosion protection in the reclamation area and along with the water management program will provide a stable environment. In addition, this will provide sheltering sites to promote natural succession from grass and legume to shrub and tree cover.

**Reclamation Process:** The reclamation program at BOC is an integral part of mine planning and pit operations. Short term planning decides where the reclamation material will be placed as it becomes available in the mining process and coordinates with operations to ensure that it happens. The majority of the soil used in reclamation is recovered when excavating equipment reaches original ground at the end of each bench. The excavator operators are trained to recognize reclamation material (more than 50% soil) in the face and dispatch each truck to the appropriate destination. This material is sent to a planned stockpile area or onto a prepared final mined rock pile slope. The short term mine plan must account for this as the truck hauls for reclamation material are usually significantly longer than the rock hauls.

**Site Preparation**
When the mined rock piles reach their final design limits, a trained reclamation dozer operator moves onto the final crest limit to start the rounding process. The dozer operator travels at right angles to the crest pushing material down and over the slope. This material has a high fines content, as during the end dump process of building the mined rock pile the large boulders migrate to the bottom of the slope. The rounding will help stabilize the slope in a 'S' curve format, less than the angle of repose. The operator then moves to the toe of the slope to pile the large boulders that rolled away from the toe. The piles of boulders provide hiding cover for smaller mammals and
removes a line of obstacles that could prevent ungulates from utilizing the slopes. Where possible localized depressions or even valleys are created.

**Soiling**

Reclamation material can now be free dumped against the toe and dozed up the slope. This material is contoured by the operator to produce the bottom part of the 'S' curve slope. While in this area the operator also develops hiding contours for wildlife. The crest and slope can now be soiled. Material is dumped on the berm and pushed over until there is 0.5 - 1.0 m of cover over the entire slope. The operator then drags a weighted chain over the sloped surface to ensure even coverage. During this stage the reclamation medium is broken up to enhance the ability of the soil to hold the seeds until germination. A side benefit of this stage is the dozer tracks on the berm are parallel to the crest which aids in erosion control and produces micro sites for the seed to germinate on the berm area.

**Seeding and Fertilizing**

Helicopter spreading is used to seed over the freshly chained areas at a rate of 75 kg/ha. In the mid elevation areas the following seed mixture is utilized:

- Peace Alfalfa: 20%
- Creeping Red Fescue: 20%
- Timothy: 20%
- White Dutch Clover: 15%
- Cicer Milkvetch: 15%
- Meadow Foxtail: 10%
The content of this seed mix may vary slightly depending on aspect of the slope, moisture availability in the area and availability of the seed at the time of application. To enhance initial growth the seed is coated with a fertilizer and inoculated for the legume content. Special care is taken to ensure the slope is completely covered with the mixture at the proper rate of application.

The rate of application for fertilizer is 100 kg/ha. A mixture of 10-30-10 N-P-K is used for maintenance fertilizing every other year for three applications. This may vary in certain areas depending on assessments of growth and legume development. The initial application takes place in the same season as the seeding to maximize the initial development of the plants.

**Tree Planting**

To develop hiding and thermal cover selected areas are planted with spruce and pine seedlings. Areas of high moisture content are planted with willow and aspen cuttings to enhance forage. Encroachment of native species into some reclaim areas has been noted and a program to monitor and measure this is being developed.

**Water Management**

Having established a reclaim area the key to maintaining this development is a strict water management plan. Runoff control must be maintained in the development stage to avoid unnecessary damage. This can be managed by end land use activities and landscape design. These practices reduce the time and area exposed to erosion forces. An advantage to surface featuring is that water is detained in reclaimed areas. By increasing soil moisture, a continuous supply of water can be provided for vegetation.
Assessment:
Polygons are established by year planted, elevation and aspect. There are four general vegetation zones within the mine site. The polygons were laid out such that only one vegetation zone exists within the polygon. A data base was established to handle information gathered on surveys of each polygon. To date information has been used to designate weak areas for enhancement. Information on encroachment of native species is being gathered and combined with survey data will be used to update the long term reclamation and closure plans.

Conclusions:

Bullmoose Operating Corporation has committed itself to fully rehabilitate the entire mine site. Reclamation practices have been an integral part of the mine scheduling process, and plans have been made for the rehabilitation of the mine before and after closure. Reclamation techniques have been based on assessment of rehabilitation since 1983. The success of vegetation growth and application techniques on mined rock piles have been the basis for new reclamation trials within the rehabilitation plan.

The rehabilitation plan for the mine is a comprehensive strategy for reclaiming the entire mine and maintaining a suitable low maintenance site after closure. The re-establishment of wildlife habitat is of the utmost importance, in terms of the reclamation program. Landform modifications (eg. modifying existing roads and leaving them as travel corridors) will be made to accommodate the movement of wildlife through out the site. Seeding, fertilizing, tree and shrub planting have been
done on all available sections of the mine since 1984, and will continue until the mine is revegetated completely. Approximately 347 hectares of the 770 hectares of land disturbed by Bullmoose Operating Corporation has been reclaimed/recontoured as of December 31, 1996. The BOC rehabilitation plan is evolving and further assessment of existing and future projects will be needed. The program has had many successes and will result in a sustainable vegetation cover for wildlife habitat, free of significant erosional features.
References
