RECLAMATION TO WILDLIFE HABITAT IN ALBERTA'S FOOTHILLS

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ABSTRACT

The process to develop a reclamation plan with wildlife habitat as a primary end land use for the Cheviot Mine is described. Reclamation for wildlife habitat and the results of on-going wildlife monitoring on two open pit coal mines in Alberta's Foothills are also discussed.

INTRODUCTION

Wildlife habitat has been accepted as an end land use objective for reclamation of open pit coal mines in Alberta since Cardinal River Coals Ltd. submitted one of the first reclamation plans for wildlife habitat in the late 1970's. Reclamation of coal mines in the Alberta Foothills has produced habitat for a variety of wildlife. This paper discusses reclamation to wildlife habitat and wildlife response at the Luscar and Gregg River Mines, as well as reclamation planning for wildlife habitat for the Cheviot Mine. All three mines are open pit metallurgical mines located in west-central Alberta. Cardinal River Coals Ltd.'s Luscar Mine is situated 50 km south of the town of Hinton in west-central Alberta. Mining was initiated in 1969 and reclamation in 1971. The end land use is identified as watershed protection (for fish), wildlife habitat, recreation, and commercial forestry. Mining will be completed in 2004 with final reclamation to follow. The Gregg River Mine is located adjacent to the Luscar Mine and is separated from it by the Gregg River. The Gregg River Mine began mining activities in 1981 and reclamation in 1982. The mining phase was completed in 2000 and reclamation has been ongoing since that time. The end land use is identified as watershed protection, wildlife habitat and commercial forestry. The Cheviot Mine is located 10 km south of the Luscar Mine. It was permitted in 1997 and again in 2000 but has not yet been developed. A conceptual reclamation plan submitted with the project application identified five resource uses for the reclaimed landscapes: watershed protection, wildlife habitat, fisheries habitat, forest re-establishment and recreation.

Provincial reclamation requirements in Alberta have, as a basic objective, the return of lands disturbed by development to a capability equivalent to pre-disturbance conditions. This implies that the reclaimed lands should be able to support similar, but not necessarily identical, land uses to the predevelopment conditions. In Alberta, legislation and direction regarding mining and reclamation plans are found in: Alberta Environmental and Protection and Enhancement Act (AEPEA; Province of Alberta 1992); Conservation and Reclamation Regulations of AEPEA; Conservation and Reclamation Information Letter C&R/IL/95-1 (Alberta Environmental Protection 1995) and A Guide to the Preparation of Applications and Reports for Coal and Oil Sands Operation (Anonymous 1991).

Reclamation of open pit coal mines is carried out in a progressive fashion meaning that once mining of the first pit developments are completed, they are back-filled, sloped, overburden and topsoil replaced, seeded with a grass/legume mix, and planted to shrubs and trees. This results in a steadily increasing amount of reclaimed land over the life of the mine. Theoretically, at some point during the life of the mine the amount of reclamation would equal the amount of disturbed land, and, toward the end of the life of the mine, the reclamation would exceed the amount of disturbed land. Currently within the Luscar Mine's permit of 4,818 ha, there is 729 ha of disturbed area and 1,635 ha of revegetation areas of which 1,108 ha remains to be seeded. In 2002, on the Gregg River Mine lease of about 3,700 ha, there was 1,252 ha of disturbance of which 795.5 ha was seeded. The area initially proposed to encompass the Cheviot Mine was 7,430 ha of which 3,124 ha will be disturbed over the project life.

RECLAMATION TO WILDLIFE HABITAT

Mountain mining with truck and shovel techniques results in discontinuous surface disturbance so the working landscape quickly becomes a mosaic of lands being prepared for mining, active mining, blocks of undisturbed mature landscape and various stages of reclamation completion. The maintenance of mature landscape elements within the mining disturbance area is an important feature for wildlife reclamation planning. Complete restoration of disturbed areas is not usually possible given the scale of coal mining, so a pragmatic ecosystem approach is adopted that attempts to integrate procedures that restore premine habitat condition, replace habitat function, and exchange certain components for others of similar benefit (Tessman 1982). Initial priority is given to re-establish critical habitat that may be disturbed by the mining process e.g. ungulate winter range, raptor nesting habitat. Habitat needs for a broad range of wildlife that existed prior to mining are addressed by the use of umbrella species and by the integration of specialized habitat features into the reclaimed landscape.

Ungulates are often used as umbrella species for reclamation to wildlife habitat because they have large home ranges, require a variety of landform features and vegetation types to fulfill their annual life requirements, and are important prey for carnivores. These characteristics require the planner to work at the landscape level. As well, certain ungulate species can respond relatively quickly to reclamation even in an early development stage, therefore they provide a useful monitoring tool for reclamation success. This is important, as wildlife response to reclamation can be evaluated and design criteria modified if necessary during ongoing reclamation planning. Ungulates are a valued species in west-central Alberta (Alberta Forestry Lands and Wildlife 1990) which will help to ensure that these landscapes remain of interest to the public after mining and reclamation are completed.

In addition to designing habitat at the landscape level, specialized habitat features required by certain species may be identified in the pre-development wildlife inventory and assessment. The approach used for the Cheviot Mine reclamation plan demonstrates the integration of the use of umbrella species and specialized habitat features. The following procedures were developed by Cardinal River Coals Ltd. to guide future reclamation activities at the Cheviot Mine (Cardinal River Coals Ltd. 1996a and b):

1. Develop short and long-term strategies.

Short term strategies: Develop a post-mining landscape that is integrated into the existing undisturbed environment; initiate the development of an ecologically functioning post-mining landscape

Long term strategy: to integrate human use into the post-mining landscape.

2. Identify land use objectives.

The end land use objectives are: watershed protection, wildlife habitat, fisheries habitat, forest re-establishment including commercial timber production and human/recreation use.

3. Subdivide the mine disturbance into Biophysical Reclamation Units (BRUs) with different pre-development biophysical attributes and end land uses.

Four BRUs were developed to reflect varying ecological conditions and resource objectives across the property. Wildlife objectives were addressed by developing habitat assemblages based on sheep, elk/deer and moose habitat requirements. These assemblages were assigned different priority within each BRU. Specialized reclamation actions were also identified for grizzly bear, harlequin duck, raptors, fish, commercial timber and recreation.

4. Subdivide each BRU into landscape units to determine post-reclamation attributes.

Landscape attributes include topographic features and vegetation community types which are achievable within ecological and other restraints.

5. Design the reclamation program.

This program has three phases: pre-development, site manipulation and reclamation, and post-reclamation land management. In the pre-development phase, environmental impact studies identify resources that may require special mitigation. Mitigation, such as minimizing disturbance, conserving soils, leaving undisturbed vegetation, protecting displaced wildlife and avoiding sensitive sites where possible, are incorporated into the engineering plan. The site reclamation phase involves the operations aspects of soils handling, terrain manipulation and revegetation. The location of specific terrain, soil and vegetation types is identified. The site reclamation plan is modified throughout the reclamation period to address unanticipated changes in pit/dump design and adjacent features. Some techniques used to encourage wildlife use of reclaimed sites on the Luscar and Gregg River Mines are listed in Table 1. In the post-reclamation phase, appropriate human uses are re-established on the reclaimed landscape so that ecological integrity of the reclaimed landscape is maintained e.g., designated access routes, catch and release fisheries.

6. Determine how reclamation success will be evaluated.

Several monitoring programs were designed to provide on-going feedback on the effectiveness of the reclamation techniques during the reclamation program. Successes and limitations will be determined early in the reclamation process so adaptations can be made.

WILDLIFE RESPONSE ON THE LUSCAR AND GREGG RIVER MINES

Response by Bighorn Sheep

Reclamation of the Luscar and Gregg River mines has expanded the range and increased the population of bighorn sheep as well as providing new habitat for other species. These habitat developments take on more significance when put in context with range losses experienced by bighorn sheep in North America during European settlement (Wishart 1978). Once reclamation began at the Luscar and Gregg River Mines, bighorn sheep from adjacent alpine habitats voluntarily colonized the reclaimed landscapes, and incorporated the reclaimed areas into their annual movement patterns (MacCallum 1997). Mining activity is directed and predictable, bighorn sheep and other wildlife have the capability to learn to habituate to this type of human

behaviour. The reclaimed landscapes are used primarily as winter range by bighorn sheep, but other activities such as lambing, rutting and summer use also occur. The bighorn sheep using the Luscar and Gregg River Mines interact with a larger population composed of seven subpopulations, which are further subdivided into home range groups (MacCallum et al. 2000). The nursery herds on the two mines are discreet, the Luscar Mine ewes belonging to the Luscar subpopulation and the Gregg River Mine to the Drinnan/Sphinx subpopulation.

The common feature of bighorn range in North America is the presence of escape terrain in proximity to quality forage. The bighorn's anti-predator strategy involves visual detection of predators at distance and response by running to escape cover (cliffs or cliff-like terrain). MacCallum (1991) found that 75% of all observations of bighorn sheep at the Luscar Mine were within 300 m of escape terrain, and none were observed beyond 700 m of escape terrain. Escape terrain at the Luscar and Gregg River Mines is provided by benched highwall or footwall. Quality forage is provided by the variety of grasses and legumes used in the revegetation program. Other habitat requirements such as mineral licks, lambing locations and rutting habitat are provided by seepage on pit walls, benched highwalls and large flat areas near escape terrain on the reclaimed landscapes (MacCallum et al. 2000). The spatial configuration of reclamation on the Luscar and Gregg River Mines fulfill one of the primary criteria for bighorn sheep colonization i.e. the presence of unoccupied habitat in proximity to occupied habitat (Geist 1971).

The rate of population increase for bighorn sheep on the Luscar Mine between 1985 and 2002 was 3.8% per year despite a 12% annual ewe removal by means of non-trophy harvest (1984 to 1996), capture and export to various locations in the western US and Alberta (1989 to 2001), natural mortality, accident, poaching or other causes. The rate of population increase for bighorn sheep on the Gregg River Mine between 1993 and 2002 was 24% with no annual ewe removals other than natural mortality. This is near the theoretical limit for animals bearing young at three years (30%). The 2002 fall population combined for Luscar and Gregg River was 798 bighorn sheep. This is one of the largest bighorn sheep herds in North America.

The bighorn sheep population on the Luscar Mine experienced steady population growth between 1982 and 1993, then a leveling off. This growth accompanied a steady increase in the amount of reclamation (note that at this stage of successional development, all reclamation can functionally be identified as “grassland” even if trees and shrubs have been planted). A linear population response is expected early in the life of a mine as disturbed land exceeds the amount of reclamation meaning that all the available escape terrain in the form of active and inactive pit walls is in close proximity to grassland reclamation. As reclamation proceeds, the

bighorn sheep population would respond to newly planted grassland adjacent to pit walls, but toward the end of the life of the mine reclamation would primarily occur in areas designated as forest, or not associated with pit walls, making areas less attractive or unusable by bighorn sheep. Once all the area adjacent to highwalls left for escape terrain have been planted, it would be expected that the bighorn sheep population would reach its maximum size. Depending on the amount and location of reclamation every year, or series of years, the bighorn population could rise in a "stepped" fashion, reaching successive plateaus until reclamation is completed.

Response by Other Ungulates

Use of reclaimed habitat by elk on the Luscar and Gregg River Mines was initially limited by low regional population numbers (Bighorn 1996). The first use of the Luscar Mine by elk recorded during the annual surveys, were two cows in the winter of 1990/1991. The fall 2002 elk population was at Luscar 155. Elk were not observed systematically on the Gregg River Mine until the fall of 2002 when 17 elk were recorded. Elk primarily use the reclaimed landscape for winter range, but in recent years have expanded their activity to include calving, rutting and summer use. Elk are species of the grassland/forest edge. Their habitat can be modeled at the landscape level using three variables common to elk across ecoregions - forage quality, cover quality, and distance from the forage/cover edge (MacCallum and Morgantini 1999). Because open pit mining techniques create large area disturbances, most of the elk habitat at an early succession stage is created by reclamation at the forest edge and adjacent to undisturbed forest vegetation.

Mule deer are common on both mines and take advantage of the forage/cover interface in a fashion similar to elk. In 2002, 159 mule deer reported on the Luscar Mine and 54 on the Gregg River Mine. White-tailed deer and moose are uncommon on the Luscar Mine and very uncommon on the Gregg River Mine.

Response by Carnivores

The gray wolf, coyote and red fox are present on the Luscar and Gregg River mines. The presence of diverse prey (bighorn sheep, mule deer, elk and high concentrations of small mammals) and lack of human harassment contribute to carnivore use of the Luscar and Gregg River mines. Wolves did not systematically use the Luscar Mine until the elk population began to increase. This added a third ungulate species in significant numbers to the prey base in addition to bighorn sheep and mule deer. The status of wolves on the Luscar Mine changed from occasional to regular use in 1997. Grizzly bears are uncommon but regular

users of these mines. The Foothills Model Forest Grizzly Bear study has recorded one of its collared sows denning successfully on the Luscar Mine in the winter of 2001/2002 and 2002/2003. Grizzly bears travel through the disturbed areas, forage in the reclaimed areas and feed on bighorn sheep carcasses that melt out of the snow in the spring. At least one sow with a cub has learned to successfully hunt young elk calves and was observed capturing two calves on different occasions in June 2003. Black bears are very uncommon on the Luscar and Gregg River mines as are wolverine, cougar and Canada Lynx. Ermine and marten are uncommon, and generally associated with undisturbed parts of the mines.

Response by Other Wildlife

High numbers of small mammals in reclaimed habitat have been documented on the Luscar and Gregg River Mine reclamation. Small mammal species that have been documented include: deer mouse, southern red-backed vole, meadow vole, long-tailed vole, and western jumping mouse. High densities of small mammals provide a prey base for mammalian carnivores such as coyote and fox and for local and migrating diurnal raptors (northern harrier, American kestrel, red-tailed hawk, and rough-legged hawk), as well as for those owls which prefer to hunt the forest margin e.g. great horned owl. Other small mammals such as pika, snowshoe hare, least chipmunk, woodchuk, hoary marmot, golden-mantled ground squirrel, red squirrel, beaver, and porcupine are present in appropriate habitat on the these mines. Ninety bird species have been identified on the Luscar Mine and 62 on the Gregg River Mine.

ASSESSMENT OF WILDLIFE RESPONSE

Monitoring of wildlife response to reclamation at the Luscar and Gregg River Mines is population-based and has occurred simultaneously to mining and reclamation (habitat) development. This has allowed for information about existing wildlife use and unanticipated changes in wildlife response, pit/dump design and adjacent features to be incorporated into reclamation plans. This adaptive management approach improves reclamation and reduces the long-term impact of mining.

The following population characteristics are generated on an annual basis for bighorn sheep, mule deer and elk: population abundance, sex and age structure, seasonal use, spatial distribution, area of occupation, concentrated (core) areas of use and use of habitat. This information can be used to perform tests of site fidelity, range shifts and population trends and provides a direct measure of wildlife response to reclamation over time. Species occurrence associated with a particular site can be identified at any time during mine

development. Habitat availability during mine development can be identified by tracking the reclamation sequence.

SUMMARY

Production of diverse wildlife habitat is a key part of the reclamation associated with mining in the Subalpine ecoregion of Alberta. Ecological attributes are seldom the same throughout large area disturbances and different reclamation strategies recognize this ecological diversity. End land use wildlife values often use umbrella species like ungulates because they function at a landscape level which reflect the overall ecological condition of the pre-disturbance environment. Life requirements for many bird or smaller mammalian species can often be fulfilled within a narrow habitat range and therefore these species are not appropriate for assessing an overall ecological condition. Use of umbrella species does not mean that only the needs of these species will be considered in the reclamation program. Rather, habitat requirements for the umbrella species serve as a guide to landscape level decisions i.e amount, type and placement of tree vegetation, shrub vegetation, and grassland vegetation, as well as landform shaping. A variety of reclamation techniques are employed at the micro-site level to encourage diversity in the final landscape. Species with specialized requirements, such as riparian habitat or food plant requirements, are identified in the reclamation program and specific action taken to accommodate these needs. The long term and progressive nature of mining and reclamation means not all habitat will be disturbed at once and new habitats will become available before the end of the life of the mine. Wildlife diversity is maintained by an ecosystem approach to reclamation that restores pre-mine habitat condition, replaces habitat function, and exchanges certain components for others of similar benefit. Understanding the basic biology and habitat requirements of the umbrella species within the context of the mine development can lead to specific recommendations regarding the type and placement of landscape attributes in the site reclamation phase. On-going or periodic population monitoring maintains a continuous record of wildlife response to reclamation activities and can be used to integrate site reclamation techniques with adjacent undisturbed lands and previously reclaimed lands.

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Table 1. Wildlife reclamation techniques and their ecological benefit.	
Topographic manipulation. Shaping the surface and sides of dumps. "Design" dumping	Habitat Diversity; minimize impact of mining disturbance
Highwall retention	Raptor nests, escape terrain for bighorn sheep
Dump rock at natural angle of repose	Talus habitat for small mammals, i.e., marmot, pika, golden-mantled ground squirrel
Direct haul and rough surface topsoil placement	Native rhizomes, seeds and soil microbia
Rock and brush piles	Perches, small mammals, shelter
Establish impoundments	Still water habitat
Reconstruct stream channels, habitats	Riparian development
Select plants for revegetation with forage and cover value for wildlife	Consideration of wildlife needs during seed mix selection
Tree, shrub plantings on lee side of shelter	Additional snowpack moisture
Collection of local tree/shrub seed and cuttings	Promote native vegetation establishment
Designed mosaic of forest, shrub, grassland	Vegetation and wildlife diversity
Specialized structures, i.e., implanted dead trees, nesting structures	Habitat needs not provided by other techniques.