RECLAMATION IN THE INTERIOR DRY BELT

BETHLEHEM COPPER CORPORATION LTD. Highland Valley
J.R. Walmsley 1977
The Interior Dry Belt of British Columbia's Southwest Interior is characterized by the "rain shadow" effect which exists on the east side of the Coast Range Mountains. It is a region of limited precipitation, reduced cloud cover, abundant sunshine and frequent, strong, surface winds. Summers tend to be very hot and dry in the lower valleys with moderation at the higher elevations. Maximum summer temperatures in excess of 100°Fahrenheit are not uncommon in the communities of Ashcroft and Spences Bridge. Annual precipitation in these communities varies between seven and ten inches. Natural vegetation along the Thompson River at these localities is sparse, consisting of sage brush, juniper, and small cactus, an assemblage typical of semi-desert conditions. Benchlands above the river are dotted with Ponderosa pine.

Just a few miles to the east lies the Highland Valley which geographically occurs within the Interior Plateau land form at elevations ranging from 3,003 feet to 5,000 feet above sea level. This is a forested area of gently rolling hills with grassy meadows along the valley floor. Precipitation here ranges between 9 and 25 inches per year, most of which occurs during the winter months in the form of snow. Summer temperatures here are moderate with average maximum temperatures of 82°Fahrenheit. Winters tend to be long and occasionally very cold. Strong southwesterly winds are prevalent during the months of April through June.

The valley borders two biogeoclimatic zones; the Interior Douglas fir zone of Douglas fir, Ponderosa and Lodgepole pine; and the Engelmann spruce-subalpine fir zone. Lower slopes of the drier north side of the valley are forested with Ponderosa pine and Douglas fir. Lodgepole pine are also present depending upon the fire history of the area. Higher up the north side of the valley, the forests are predominantly Lodgepole pine with an Engelmann spruce component. Native plant species other than those which have already been mentioned include dwarf juniper, willow, trembling aspen, sedge, pinegrass, bluebunch wheatgrass, bluegrass, soapberry, wild rose, white, hawkweed, lupine, chickweed, twin flower,
strawberry, timber milk vetch, and goldenrod, only to name a few. Mining is the predominant industry in the Highland Valley and currently employs in excess of 1,000 persons directly. Forestry and cattle ranching are also important industries in the area. The valley is not a primary recreational area but several small lakes in the district are very popular with tourists and sports fishermen.

Mining is not a newcomer to the valley. Records indicate the first staking of copper claims at the turn of the century in an area that is now a part of the Bethlehem Copper operation. This area saw limited production during the years 1915-1917. However, mining as we know it today, did not commence until 1962 when the present Bethlehem plant came on stream. Since then the Lornex property which is situated on the opposite side of the valley has also been brought into production.

With the advent of large scale open pit mining, selected areas of previously forested land are being disturbed in order to exploit the low grade copper deposits.

Current mine production at Bethlehem is 30,000,000 tons of ore and waste per year. Most of this material is waste and is deposited on the waste dumps during mining operations or in the tailings pond after processing and removal of copper in the concentrator. The open pit mines with their associated waste dumps, presently occupy 1,603 acres including the plant and tailings disposal area. Development of a reclamation program that will eventually include all of this disturbed land is now in progress.

Prior to the establishment of open pit mining in the valley, the predominant land use was that of a wildlife habitat, with the valley bottom being used for grazing domestic farm animals during the summer months. In view of the past land use and the poor soil conditions which exist on many of the disturbed land areas, the reclamation program at Bethlehem has concentrated upon the selection and development of self-propagating species.
of grass and legume that will help to speed up the formation of soil and, at the same time, provide a food source for wild or domestic ungulates. Once these grasses and legumes become established, a natural invasion of native shrubs and trees is anticipated. This would be supplemented with a tree planting program in certain areas.

The Bethlehem mine and plant site are located on the north side of the valley on a rounded summit approximately 1,500 feet above the valley floor. Most of the land areas which have been disturbed face toward the west or southwest directly in the path of the prevailing winds and the rays of the summer sun. Many sites although terraced have intermediate slopes approaching the natural angle of repose for the material from which they are constructed. Average annual precipitation during the time since record keeping has been maintained is 13 inches, most of which occurs during the winter months as previously mentioned. These factors combined with normal warm temperatures tend to create drought conditions throughout the summer. Disturbed land areas can be divided into three main groups: plant and service areas, including access roads; open pits and mine waste dumps; and tailings dams and ponds.

The first of these groups presents fewer difficulties for reclamation in that much of the original topsoil is still in place. Consequently, reseeding can be done with a minimum of site preparation. In some of the deeper excavations, the topsoil has been removed and the underlying glacial till exposed. This material, although relatively infertile and somewhat alkaline, can be satisfactorily reclaimed. The degree of success in reclaiming such areas can be related to the physical location of the site. Sites which have a north or easterly aspect are sheltered from the prevailing winds and direct sunshine. They generally exhibit better moisture conditions and consequently show evidence of more vigorous growth, whereas, the opposite is true for sites which have south or westerly aspects.
Reclamation of exhausted open pits and their associated waste dumps presents a difficult problem at Bethlehem. The Bethlehem operation consists of four separate mines or pits which will have final wall slopes varying from 38 to 50 degrees. Final depths of these pits will range between 400 and 1,000 feet. Wall material is essentially fresh unaltered bedrock. Three of these pits are presently in production, the fourth was exhausted in 1976 and is presently being backfilled with waste material. The close proximity of this exhausted pit to current production areas has provided an economical waste disposal site and will allow dumping space for an estimated 50,000,000 tons of waste rock. Reclamation of the final surface will be essentially the same as that required for a waste dump. No definite plans have been formulated as regards to the reclamation of the remaining pits upon their exhaustion. However, consideration is being given to the possibility of their being used to store tailings from the concentrator. Should this approach prove to be practical and meet with the approval of the Ministry of Mines and the Pollution Control Branch, final reclamation would be similar to that of a tailings pond.

Wherever mining plans permit, waste dumps are constructed in a terraced fashion with the berms providing future access for reclamation personnel and equipment. Unfortunately, this is not always possible because of space limitations and the mine configuration that results from the ore bodies being located on the top of a hill as opposed to a side hill or flat location.

Material composition of waste dumps is variable and ranges from overburden and topsoil to fresh shot rock. The blasted rock is normally coarse textured and contains only a small percentage of fines, often insufficient to provide an adequate seed bed. It also has poor moisture retention characteristics. For this reason overburden and topsoil removed during mining operations are stockpiled whenever possible for future use in resurfacing waste dumps which are lacking topsoil.

There are presently two tailings dams in use at Bethlehem, one has been constructed with mine waste rock in lifts similar to a waste dump. It is faced on the downstream side with overburden removed during mining operations and on the
upstream face with cycloned tailings sand. This structure is approximately 350 feet high at its deepest section and has an overall length in excess of 6,000 feet. The dam contains approximately 29,000,000 tons of waste rock. Near Bose Lake, a second smaller tailings dam has been constructed from compacted glacial till. It has a maximum height of 100 feet and a length of 2,000 feet.

Reclamation of the tailings pond beach upon the pond reaching design elevation should be straightforward. The final beach surface will be almost flat providing easy access to an area that can be farmed with conventional agricultural equipment. Until the tailings beach becomes stabilized with a grass-legume cover, the prevailing winds will continue to erode the beach surface. Particle movement will have extremely abrasive effects upon established vegetation. To minimize wind effects, a combination of windbreaks and irrigation will be used. Experimental work done on a one acre test site using this approach has provided encouraging results. Snow fencing was used for the windbreak, however, a windrow of waste rock or other stable material would have provided the same effect. The planting of Siberian Pea plants and Caragana shrubs have also been suggested for future windbreaks.

Conventional farming equipment is used for grass seeding and fertilizer spreading on all areas that are accessible. Recently a four wheel drive tractor of 45-50 hp. rating was used with a harrow for seed bed preparation. This was followed by seeding with a tractor mounted broadcast seeder and harrowing. Results obtained using this equipment have been good and less costly than alternative methods. Hydrosowing has been used extensively on those areas not accessible with conventional farming equipment. This method has proven successful providing that seeding is done when moisture conditions are not too dry. Under dry conditions, much of the seed is blown away by the strong winds which frequent the district. Our experience suggests that hydrosowing just after the disappearance of the last winter snow gives good results. Mulches are included in all hydraulic slurries and contribute to the effectiveness of the hydrosowing application. At the present time, sika-fibre mulch is used. Several chemical binders have been
investigated but none has been used very extensively.

Since the inception of our reclamation program several species of grass and legume have been investigated among which are the following: Nordan Crested Wheatgrass, Streambank Wheatgrass, Pubescent Wheatgrass, Tall Wheatgrass, Smooth Brome Grass, Siberian Wheatgrass, Timothy, Kentucky Bluegrass, Canada Bluegrass, Russian Wild Rye, Perennial Ryegrass, Sainfoin, White Blossom Sweet Clover, Yellow Blossom Sweet Clover, Rambler Alfalfa, Tall Fescue, Creeping Red Fescue and Crown Vetch.

Several of these varieties have proven successful including Nordan Crested Wheatgrass, Streambank Wheatgrass, Pubescent Wheatgrass, White and Yellow Blossom Sweet Clover, Tall Fescue and Hard Fescue. In the meantime, all varieties under test are reviewed periodically.

A recent hydroseeding application consisted of the following mixture:

- Nordan Crested Wheatgrass 30%
- Streambank Wheatgrass 30%
- Tall Fescue 20%
- Creeping Red Fescue 10%
- Rambler Alfalfa 10%

This mixture was applied at a rate of 50 pounds per acre along with silvafibre mulch at a rate of 800 pounds per acre. A 13-10-10 fertilizer was applied at 150 pounds per acre at the same time.

Fertilizers are applied in varying amounts at all reclamation sites at the time of initial seeding. The type and amount of fertilizer required (if any) are determined by the requirements at the specific site under review. Maintenance fertilizer is applied whenever it is necessary.

During the initial years of our reclamation program, several attempts were made at reforestation. Approximately 1,800 Lodgepole pine, Douglas fir and Spruce seedlings were planted on various disturbed sites where little or no site preparation had been done. Needless to say, the results were not good. Since these early trials, an additional 3,450 seedlings of mixed variety have been
planted at a site on which a good grass-legume cover was established prior to the tree planting. The results of this planting are very encouraging. On another site where good grass-legume cover has been established there is substantial evidence of natural invasion of willow and aspen species. This would appear to be the route to go.