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RECLAMATION AT ISLAND COPPER

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ABSTRACT

Utah Mines Ltd. operates a large open pit copper mine located on the north shore of Rupert Inlet on the northern end of Vancouver Island.

Since 1970 the Environmental Department at Island Copper has been responsible for mine reclamation studies and operations. Initial studies included a detailed assessment of soils and forest productivity in the area. Initial operations included planting 60 acres of disturbed ground around the plant facilities and access road. Subsequent operations have included test plots and stabilization of waste dump outslopes.

RECLAMATION AT ISLAND COPPER MINE

Introduction

First I would mention that this is not a research or scientific paper but a general description of reclamation at Island Copper Mine.

Island Copper Mine is situated on the north shore of Rupert Inlet on the northern end of Vancouver Island and is the largest open pit operation located in coastal British Columbia. The mineral reserves indicate approximately 280 million tons of recoverable ore with a grade of 0.52% copper and 0.018% molybdenum.

The mine is capable of moving 160,000 tons of rock per day by the conventional truck and shovel method.

The milling operation can process 40,000 to 50,000 tons of ore per day and produce up to 1,000 tons of copper concentrate and 15 tons of molybdenum concentrate.

Recoverable by-products in the concentrate include gold, silver and rhenium.

The ore reserves are such that a single pit of approximately 8,000 feet by 4,000 feet with an eventual depth of 1,000 feet below sea level will be developed in the twenty year life of the mine. The total area occupied by the pit will be approximately 500 acres. The estimated average stripping ratio for the twenty year operation will be 2.42 tons of waste for each ton of ore.

In a low grade open pit operation large volumes of waste have to be removed and disposed of in an environmentally acceptable manner. To this end

engineering and environmental planning are of the essence for a successful mining venture.

A basic reclamation plan was developed at Island Copper with both short-term and long-term objectives.

The short-term objectives of the reclamation plan were to:

1) Reduce erosion and subsequent siltation of natural waters through stabilization of disturbed areas with vegetation, and,
2) Maintain asthetic quality around the mine site.

The long-term objectives or land use consideration for the area are:

1) Recreation
2) Wildlife habitat
3) Forestry
4) Watershed, and
5) A combination of the above.

The present land use in the intermediate area, other than the mine operation, is wildlife habitat and recreational fishing. The area surrounding the mine is designated as prime forest yield region and is presently utilized by local forest companies.

Before the mine started the topographic relief in the pit area was moderate with elevations ranging from sea level to slightly more than 400 feet above sea level. The area was covered by second growth hemlock with minor amounts of spruce, cedar and fir. The trees varied in size from 15 to 25-inch stumps and heights of 100 to 150 feet. These stands were merchantable timber. In the lower elevations there were minor stands of mature cedar, and fir associated with non-merchantable timber in the swampy area.

The ore body was overlain with varying thicknesses of overburden. The eastern end of the pit had over 300 feet of till cover.

General Discussion

The initial reclamation research was to assess the soil overlaying the till material.

The perhumid climate of the area, (80 inches of ppt/year) which includes a considerable amount of precipitation even during summer months, strongly engenders chemical weathering. Soil development occurs even on well drained sites because water, the medium for chemical reactions, is abundant. With a high moisture content, the end products of various chemical reactions are efficiently leached from the soil system. Moderate temperatures, year round, with only rare periods of ground freezing, further engenders the weathering of soil materials.

The north central area of the pit was a depression where restricted removal of soil water occurred. Due to the humid climate and the relatively flat landform, the soils were saturated for most of the year. As a result, anaerobic conditions prevailed and a considerable amount of organic material developed.

Truly xeric sites were not to be found on the rock outcrops that occurred on the west side of the pit. This is because soil water storage capacity is not absolutely necessary in such a humid climate.

Two groups of soils were encountered in the area: podzols and organic soils.

The dominant soil of the area is a moderately well drained Duric Humo - Ferric Podzol which developed in the glacial till. This soil is characterized by accumulation of surficial organic materials overlaying a meter or more of a reddish brown Bf horizon. The transition to relatively unweathered till is abrupt, although the uppermost ten centimeter of the till, the duric horizon, is more platy and harder than the till at greater depths.

The surface organic horizons, L, F and H contain little incorporated mineral compounds and are strongly acidic (pH of 3.0 to 4.0) and contain the bulk of nutrients available to the forest ecosystem.

The Bf horizon is loamy, somewhat finer textured than the parent till as a result of weathering. This horizon is acidic, low in bases, but enriched with iron and aluminum. Since in this podzol the organic matter — content of the B horizon is low, levels of nitrogen, sulphur and phosphorus are also low. Although the native vegetation is adapted to such an inherently low fertility status, the use of exotic species in reclamation obviously demands significant fertility amendments.

The organic soils are associated with relatively flat landform with the water table at or very near the surface year round. This type of soil T covers approximately 10% of the pit area. These soils are poorly drained Typic Mesisol and poorly drained Typic Fibrisol. The acidity of these soils ranged from a pH of 2.7 to 2.9.

The soil-vegetation relationships in the area are distinct. The podzol soils developed in till, support dense forest communities dominated by western hemlock and balsam fir with minor admixtures of Sitka spruce, red cedar and Douglas fir. The organic soils support red cedar and sedges.

The forest capability of the area according to C.L.I, forest capabilities maps, ranged from Id (258-300 c.f./ac-yr) for western hemlock in the podzols to 3W (major limitation to forest growth and excessively high water table) for red cedar in the organic soils. The site index for western hemlock in the area is up to 180 while the site index in poorly drained sites drops to 50 for red cedar.

Reclamation Operation

As mentioned earlier, the objectives of the reclamation program are in the short term, to stabilize the disturbed areas and to prevent erosion.
In an area of high rainfall with 3 inches in a day not uncommon, erosion is a serious problem.

In the spring of 1971 approximately fifty acres of the construction site area and 10 acres of road allowance were seeded by aircraft and hand-held cyclone seeders. The areas covered did not receive any special preparation prior to seed and fertilizer application. A mixture of annual rye grass, perennial rye grass, creeping red fescue, red top, northern perennial rye, white dutch clover, alsike clover, bent grass and meadow fescue was applied at a rate of 60 Ibs/acre. Fertilizer (20-20-10) was applied at a rate of 300 Ibs/acre at the time of seeding.

By fall, the first germinating plant species such as clover and annual rye had produced a viable seed and an excellent ground cover. A well developed root system had developed by the following summer.

In early 1971 pre-stripping of the pit area started. An attempt was made at stockpiling the organic soils from the lower regions of the pit. The soil being saturated was soupy and impossible to stockpile with the equipment that was used for the stripping. At this time it became evident that stockpiling organic topsoil in an area of high precipitation would be very difficult and even impractical.

A test plot was developed to establish the potential of till as a growth medium. The till used was representative of the material that would eventually cover dump surfaces.

The test plot was divided into 9 equal areas and treated with varying amounts of seed and fertilizer.

A general view of the macro plots after five years is shown here. No additional fertilizer was added to the macro plot after initial seeding. Good plant growth is evident in plots that were fertilized. Macro plot without fertilizer did not produce a good vegetation cover even with 80 pounds of seed per acre.

The test plot served to identify optimum seeding and fertilizer rates and established that till material can be used as a medium for revegetation.

This slide is of a rock causeway before it was seeded in 1971. The ground preparation involved spreading till on top of the rock base. This is the same causeway a year later. An interesting observation here is that alfalfa has taken over as the dominant species even though it was seeded at only 5 parts per 100 originally.

These slides taken last summer indicate that grass seeded in 1971 is continuing to be an effective means of erosion control without any major maintenance cost. Evidence of native species invading seeded areas is shown in these slides. As part of our reclamation program we have been documenting natural revegetation in areas disturbed but not seeded. The dominant tree species are red alder and western hemlock. The dominant shrubs include red elderberry and salmonberry. Some native grasses, forbs, sedges and ferns have been identified.

In the waste dump areas there has been an effort to reclaim dump surfaces as well as dump outslopes. Some of the work is for short-term benefits and documentation because most of the dumps are not in a completed form.

Approximately 15 acres of the beach dump has been prepared for seeding. The ground preparation consists of regrading the waste rock, covering

with a mixture of topsoil and till material and finally grading to a relatively smooth surface.

A six acre plot was seeded in 1976. This slide shows the plot as it looked this winter. The cost of preparing and seeding this area was approximately $1,200.00/acre.

Another area seeded in 1973 was a small waste dump north of the pit. This plot was prepared with organic soil and has a very thick growth of grass. The cost per acre of this reclamation effort was approximately $1,500.00

Research on revegetating steep outslopes of waste dumps greater than 37° is in progress. The method employed consists of over-burden material being deposited at the top of the dump and pushed over the side by bull-dozers. The overburden slides down the dump face filling in crevices between boulders on the way down. The dump face is then hand-seeded and fertilized at a rate of 60 and 200 lbs per acre respectively. A heavy matted growth of grass was established on slopes of 35° to 40° as is shown in this slide. On slopes greater than 55° failure occurred during a heavy rainfall in December 1976. The slopes that failed were areas that had a 3-foot layer of overburden and poor surface drainage. We found that it is important that a very thin layer of overburden be deposited along the slope and that water be diverted from the dump crest.

This winter a number of alder and hemlock seedlings have been transplanted along dump slopes previously seeded. The transplanting of alder during the winter has been very effective. Growths of over 200% a year have been documented. Transplanted hemlock seeding have also done well.

This dump was planted last September. This slide was taken three months later.

A program of collecting alder cones was started in 1974. The cones were processed to obtain some 2 million alder seeds a year. Laboratory tests on these seeds have indicated over 50% germination. The procedure is now to include alder seed with the grass at a rate of approximately 1 part per 100.

No attempts have been made in monitoring metal levels in the vegetation covering disturbed areas because of problems in standardizing an acceptable distribution of species to monitor. We do plan to monitor the forage that the deer have been grazing on and comparing it to some standard from a control area.

This is a salt lick station covered to protect the salt from dissolving in the rain.

Metal levels of rodents that inhabit revegetated areas are being monitored. The deermouse being the most abundant is used as an indicator. The tissue of the specimens collected have been analyzed for copper, molybdenum, lead, zinc, cadmium and arsenic.

The average copper is 2.50 ppm, molybdenum 0.35 ppm, lead 0.20 ppm, zinc 22 ppm, cadmium 0.05 ppm, and arsenic 0.50 ppm. There is no difference between animals caught in the revegetated areas compared to animals from the control site outside mine area.

Other chemical monitoring associated with reclamation has been the water quality program of surface runoff surrounding the pit area. A small lake
adjacent to the pit has been monitored for the past seven years without showing any impacts of the operation.

In conclusion the short-term objectives of erosion control and aesthetic enhancement of the plant site are being attained. In the longer term it is encouraging to note that in an area such as Rupert Inlet there is evidence that vegetation including trees can readily colonize even bare rock.