

**A SUSTAINABLE LEGACY: UTILIZING MINE ASSETS POST-CLOSURE
ISLAND COPPER MINE**

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ABSTRACT

The Island Copper Mine operated by BHP Minerals Canada Ltd., a subsidiary of BHP International of Australia, ceased operations on December 31, 1995 on depletion of the copper-molybdenum orebody on the northern tip of Vancouver Island. BHP subsequently carried out a comprehensive plan to achieve an environmentally sensitive mine closure while also initiating the utilization of the site for sustainable commercial and industrial operations providing an ongoing economic benefit to the host community of Port Hardy.

INTRODUCTION

Sustainable Development: "Development which meets the needs of the present without compromising the ability of future generations to meet their needs. " - "Our Common Future." World Commission on Environment and Development - 1987 (Brundtland Commission).

It is relatively easy to see how the Brundtland Commission definition of "sustainable development" might be applied to renewable resources such as forestry, fisheries and agriculture where the resource can be renewed and sustained through good resource management practices. In the case of the mining industry, however, the resource is permanently removed except insofar as the returns from reuse and recycling can be counted as a form of mineral reserve.

In terms of literally providing future generations with the benefits of today's mineral-dependent products, we have two basic options. Either new sources of minerals must be found; or replacement technologies and materials must be developed. Both options are being pursued. Conventional mineral discoveries continue to be made. Larger and more efficient mining equipment lowers production costs and allows the economic mining of lower grade ore bodies. Equipment technology also permits access to more difficult and remote exploration sites such as the ocean floor.

Technological innovations also produce new processes and new materials that supplement or replace existing resources. One example is fibre optic technology that permits copper, a relatively scarce commodity, to be replaced by silica, a very common commodity. The lowly ingredients of pottery and glass, coupled with modern techniques, have created a new range of materials. From the nose cones of rockets to the real possibility of ceramic automobile engines, modern ceramics will make significant contributions to a sustainable future.

Donald Cranstone, Ph.D., Senior Mineral Economist, Minerals and Metals Sector, Department of Natural Resources, has noted that metals lend themselves to continuous recycling and as such remain available for future generations. For example, he notes that some 40 per cent of current world copper consumption comes from recycling. This does not mean that 60 per cent of copper is wasted—only that, on average, it takes decades for copper to complete its useful life and be recycled. By that time, world production has risen, creating the illusion that only 40 per cent is being recycled. In fact, the actual percentage is probably close to 90 per cent.

Those assessments give cause for optimism when considering the mining industry's potential for arriving at a "literal" model of sustainability through technology or through the ability to access more mineral reserves. More recently, however, the concept of sustainability has been expanded to include a mine's legacy of community improvements in such areas as infrastructure, health and education - "sustainable improvements in people's lives" as one CEO put it.

That may be the only realistic application of the principles of sustainability for many mine sites, but other sites may present an opportunity to develop a sustainable *economy*. For example, when the Island Copper Mine closed in 1995, the mine was instrumental in attracting and supporting entrepreneurs who purchased buildings, dock facilities and the tailings thickener ponds to establish wood processing and aquaculture operations - "sustainable" industries made viable by the availability of the mine's infrastructure. That was in addition to the return of 480 hectares of disturbed land to productive woodland and wildlife habitat.

Similarly, miners point to Victoria's Butchart Gardens and Vancouver's Queen Elizabeth Park -reclaimed quarries that are major tourist attractions in British Columbia. The Highland Valley Copper operation in the British Columbia interior has raised rainbow trout in a former tailings pond and has trial programs for wetlands and for grasslands to provide cattle forage. Many mine sites are replanted to produce commercial forests. Many popular ski hills in British Columbia and the western United States are former mine sites.

This paper presents the Island Copper Mine as a case history of how "sustainability" in the broader sense of providing a continuing socio-economic benefit to society - and particularly to the local, most affected community - can be achieved after mine closure.

MINE OPERATIONS

The Island Copper Mine, operated by BHP Minerals Canada Ltd. as part of the BHP Copper Division of BHP International of Australia, began production in 1971 adjacent to Rupert Inlet on northern Vancouver Island in the Province of British Columbia and closed in December 1995 on depletion of the ore body. Island Copper was Canada's third largest copper mine. At its peak in 1980, the mine employed 900 men and women from countries around the world. The work force stood at 450 people when open pit operations ceased.

The orebody was mined by conventional open pit truck-and-shovel methods and ultimately contained 400 million dry short tons of ore averaging 0.41 per cent copper and 0.017 per cent molybdenum. More than one billion tons of material was excavated at a maximum rate at peak production in 1982 of 170,800 tons per day. Mining produced an oval-shaped open pit 2,400 metres long, 1,070 metres wide and 400 metres below sea level - perhaps the deepest surface depression on earth.

Special features of the operation included the submarine disposal of mill tailings below the surface of Rupert Inlet; construction of a 1,219-metre long plastic concrete wall - only 86 centimetres wide but up to 33 metres deep - as a seepage barrier along the original Inlet shoreline; and installation of an in-pit, semi-mobile gyratory crusher station and conveyor system which conveyed ore through a 915-metre tunnel to the concentrator.

The concentrator employed six primary, semi-autogenous grinding mills and five secondary ball mills which recorded their best average daily production in fiscal 1992 - 58,568 tons per day. The ground ore in slurry was processed through banks of flotation cells employing reagents that floated off the copper and molybdenum. Infrastructure included maintenance and warehouse facilities, a 138-kV power line supplying 90 megawatts from a public power utility, an 86-centimetre pipeline conveying water from a river 21 kilometres from the mine and a deep-sea dock accommodating vessels up to 35,000 deadweight tons.

The mine ultimately produced concentrates containing 1,432,980 tons of copper, 34,171 tons of molybdenum, 1,118,165 ounces of gold, 11,851,851 ounces of silver and 59,523 pounds of rhenium. During the 1970s, Island Copper was Canada's largest gold producer. Copper and molybdenum concentrates were sold to custom smelters in Japan, South Korea, Taiwan and mainland China. Molybdenum concentrate was sold through domestic brokers to markets in the United States, Europe and South America.

Island Copper's environmental program comprised a number of major elements. The marine tailings disposal and oceanographic monitoring system was a model for similar systems around the world. Another precedent was set prior to startup when a group of university professors were assigned by the federal and provincial governments as an Environmental Technical Advisory Committee to review and critique the tailings disposal system and monitoring of Rupert Inlet. This advisory committee was in addition to the staff environmental scientists. Five members of the committee continue in this role some 30 years later and their guidance has been invaluable to both BHP and affected government agencies.

A comprehensive water management program controlled runoff from waste rock dumps, maintained pit dewatering and recycled all site drainage through the concentrator. Reclamation of disturbed land and waste rock deposits began in the early 1970s and continued through mine closure. Island Copper received five environmental performance awards from the British Columbia government and the Mining Association of British Columbia and a national award post-closure from the Prospectors and Developers Association of Canada.

MINE AND COMMUNITY

Most Island Copper employees and their families lived in the town of Port Hardy, 14 kilometres from the mine site, which prior to their arrival in 1969 was a small, isolated logging and fishing centre with a population of about 700. The mine was the catalyst that created the modern community with a permanent population of some 5,300 residents that exists today.

The mine's economic contribution to the community and region was generated from a payroll of \$900 million and spending on supplies and services of more than \$1.2 billion (of a total of \$2.9 billion) over its 25 years of operation. This included municipal and regional tax payments of some \$3 million annually after the acreage housing Island Copper's mill and other buildings was brought within municipal boundaries.

At startup, the mine purchased more than 40 hectares of municipal land, most of which was developed as residential subdivisions for its employees with the mine paying all the costs of roads, water, sewage and other services and amenities. By 1976 the mine had constructed more than 400 houses, townhouses, duplexes and apartments while the municipality and other developers had provided another 600 units and Canada's first strata title mobile home park.

The building boom also exhausted the capacity of the municipal water system and the mine financed and constructed an upgrade of an existing dam, new trunk lines and new storage tanks. The increased tax assessments from the new homes, together with an issue of municipal debentures purchased by the mining company, permitted construction of a \$1.5 million sewage treatment plant. The mine's contributions of cash, land, equipment and manpower assisted in the construction of a new hospital, ice arena, swimming pool, theatre and parks among the public amenities added over the years.

With approximately half the population of Port Hardy directly dependent on Island Copper's payroll, it was inevitable that mine employees would become actively involved in all aspects of community life. Island Copper provided two mayors, a number of municipal councillors, school and hospital board members, and members of a wide range of community organizations.

MINE CLOSURE

Laying the Groundwork

Planning for the closure of the Island Copper Mine was evident even while the site was being cleared for construction in 1969, with some five million tons of overburden and glacial till being stockpiled and used to recontour and revegetate the mine's waste rock deposits in a progressive program over 25 years of operation.

An initial mine closure plan covering the four main areas of operation - open pit, waste rock deposits, marine environment and physical plant - was developed and submitted for discussion with the provincial regulatory authorities in 1990 and an upgraded plan was submitted in 1994. Copies of the closure plan were distributed to municipal and regional governments and to public libraries. The mine also held public Open House events and bus tours of the mine site.

To prepare the workforce of some 560 employees for the future, the company implemented job training, education upgrading, early retirement and job transition programs in 1992 - three years before closure. An Industrial Adjustment Committee was established with representatives from the company, federal and provincial governments and the mine's two unions, the International Union of Operating Engineers and the Office and Technical Employees Union.

Mine managers had provided the Port Hardy municipal council and Chamber of Commerce with regular updates on operations, market conditions and life expectancy throughout the mine's life. Planning to mitigate the economic impacts on the community was initiated with the formation of an Economic Development Committee in 1985 to accommodate the original closure date of 1991. (Mine life was extended through 1995 by a project that gave access to an extension of the orebody).

Island Copper also initiated a program in 1993 to identify potential commercial or industrial tenants for the mine site utilizing the buildings, dock facilities and power and water infrastructure. A number of development concepts were considered.

Mine Closure

A unique feature of the closure plan was the decommissioning of the open pit by flooding it with seawater from adjacent Rupert Inlet in July 1996, creating a 300-metre deep lake covering 215 hectares. This stabilized the pit walls and provided an effective receiving environment for drainage from waste rock deposits that produce a moderate amount of acid rock drainage. ARD is collected in two ditch systems and discharged via two polyethylene pipelines at depths of 200 metres.

The drainage is diluted by the huge volume of water and heavy metals are precipitated to the bottom through sulphate-reducing bacterial action. Precipitation and surface water runoff has formed a cap of fresh or brackish water on the lake. Since this meromictic lake has a limited euphotic zone it is not naturally productive but may well be suitable for aquaculture. Monitoring is currently scheduled until December 2000 with a possibility of an extension to 2002.

Land reclamation included the recontouring and planting of four waste rock land deposits covering some 200 hectares and a 260-hectare landfill created by the deposit of waste rock in Rupert Inlet. Replanting of the land areas had been continuous throughout the operating years and 600,000 alder seedlings and lodgepole pine have been planted to date. These eventually will produce a cedar-hemlock forest common to the region.

A popular habitat for wildlife throughout the operating years, the Island Copper site normally hosts a population of some 30 deer, 500 Canada geese and a contingent of black bear, cougar, eagles and other wildlife. Environmental monitoring of the reclamation will continue until it is clearly demonstrated that the newly created forest is sustainable. The property will then be returned to the provincial government.

The waste rock landfill on Rupert Inlet was graded to the low tide mark and six bays sculpted into the shoreline to create a varied habitat for marine organisms which is now indistinguishable from a reference station. Physical, chemical and biological monitoring of the marine environment - ongoing since startup in 1970 - was continued through December 1998. Benthic recolonization and diversity in the mine tailings at the bottom of the Inlet are at pre-mining levels, as are populations of juvenile salmon, dogfish shark, rock cod, Dungeness crab and other species.

The final element of the closure plan was the disposal of the mine's physical assets and cleanup of the 90 hectare plant site. All fuel, chemicals and any designated special wastes were removed from the property and disposed of according to regulatory standards. Areas contaminated by fuel, product concentrate or other materials were rehabilitated to government standards. An environmental performance bond of \$4 million remains in effect.

Buildings, operating machinery and mobile equipment were sold through an international disposal firm. Structures not purchased for continued use "in situ" were dismantled and their sites reclaimed to wildlife habitat. BHP has received a Certificate of Compliance for the plant site (an industry first) by meeting the standards of the contaminated sites legislation.

Employee Transition Programs

The company implemented two programs to assist employees in job retraining and educational upgrading: an enhanced version of its Educational Assistance Program initiated in October 1992 and the Industrial Adjustment Committee established in January 1993 with a mandate to recommend programs and monitor the closure impacts. In mid-1994, eligible staff over the age of 55 were offered a voluntary retirement option.

The educational program provided reimbursement of 100 per cent for successful completion of approved course fees for both job-related courses and courses focused toward a future career. The program was coordinated by the company and made available through classroom instruction at the regional community college, correspondence courses and mobile training units.

Academic courses - high school upgrading, university level programs and professional courses - were arranged through universities and community colleges. Industrial training for mechanical trades, computer technology and similar vocations was provided through the community college and training consultants. Over-all, the company provided educational training with a value of more than \$360,000. There were a total of 700 registrations for these programs in 1994, the last year registrations were recorded.

In August 1994, the company opened a Transition Centre in a Port Hardy shopping mall to provide employees with job counselling services, financial planning, resume writing, interviewing techniques, Internet access and assistance in job searches. Employees had access to facsimile, photocopiers and telephones that could be used to make long distance calls for job searches. A total of 155 employees found employment through the Centre.

Official lay-off notices were given many months in advance of actual lay-off dates and employees who found work were generally permitted to leave Island Copper's employ in advance without losing severance entitlement. This allowed a large number of employees to capitalize on job opportunities they might otherwise have missed.

Severance for union employees was enhanced several times, recognizing that if all employees left early the mining and mill operations would be severely affected. Medical benefits were extended for an additional month after lay-off to allow time to purchase individual benefit plans. Personnel still on the payroll after January 31, 1996 were offered a \$1,000 completion bonus if they stayed to their lay-off dates.

Preparing the Community

Planning for the community's future began in the early 1970s when the municipality's long term debt was tailored to the mine's operating lifespan. As a result, at closure in 1995 the community had few debts and sufficient reserve funds to cover any outstanding debentures up to 1998.

As closure neared, the municipal council pressed the provincial government for political and financial support for its efforts to attract new businesses and enhance tourism opportunities. Projects included the initiation of a new, tourist-oriented ferry service in the area and construction of a seaplane base, wood processing operations, expanded fish processing facilities and marina. The municipality purchased and serviced a number of land parcels to create an industrial park and presently is negotiating the purchase of the jet-capable airport from the federal government.

In addition, the mayor and council, together with the provincial government, were proactive in supporting the reuse of the mine site. A leading environmental organization, the Sierra Club of British Columbia, also supported the reuse of the site to provide "increased community benefits derived from sustainable local initiatives" such as wood products facilities.

SUSTAINABLE DEVELOPMENT AT ISLAND COPPER

A Pro-Active Approach

As Island Copper entered the final operational phase there was a third major area of activity in addition to the planning for the actual physical closing of Ae mine and the program to assist employees in preparing for the future.

In 1991, one of the mine's senior managers was assigned to the task of identifying other industrial or commercial enterprises that might be attracted to utilize the mine's considerable assets - mine buildings, a 90 MVA power line, fresh water pipeline, deep sea dock and some 325 hectares of cleared, flat land.

Proposals which crossed the project manager's desk included a newsprint de-inking plant, an iron smelting plant, pulpwood chipping and lumber kiln facilities, aquaculture facilities and specialty milling of ore shipped in from overseas producers.

In 1992 the company initiated a project to determine the viability of utilizing the open pit as a municipal solid waste landfill to service communities on the British Columbia coast and in Washington State. Interestingly, the company contracted with Dr. Patrick Moore, one of the founders of Greenpeace who had opposed the mine's construction in 1970, to act as the facilitator for a community Round Table review of the landfill proposal. Despite widespread support of the concept, the company was unable to secure a market large enough to support the project.

The company also initiated an international marketing program, soliciting the participation of agencies of the provincial government in distributing copies of a sales brochure through government and BUP offices worldwide. Another initiative was to invite representatives from all sectors of business and industry operating on northern Vancouver Island to a presentation promoting the availability of the mine's assets. In the end, the effort attracted both regional and international prospects to the site.

M&E Enterprises Ltd.

In June 1997, a group of individuals active in the wood processing industry on Vancouver Island established a company to purchase the plant site and some of the physical facilities in order to establish forest products and aquaculture operations.

M&E Enterprises Ltd. purchased the 43 hectares of provincial Crown land that BHP had leased for its mill, maintenance, warehousing and shipping facilities. They also purchased from BHP the deep-sea dock, the two tailings settlement ponds and all buildings except the concentrator. By mid-1999, M&E had established the first phases of commercial crayfish and sturgeon production with four employees.

M&E's plans also call for construction of a pulpwood chipping plant on the site in 2000 which would generate six direct and spin-off jobs. Future plans call for construction of a sawmill and, possibly, an electrical co-generation facility utilizing waste wood from the region's extensive logging operations.

The plant site is now in the process of becoming a well diversified light industrial site which M&E has renamed the "Hoyalas Business Park."

Alpha Processors Ltd.

In 1999, BHP was approached by Omega Salmon Group Ltd. with a proposal to utilize the flooded open pit to raise Atlantic salmon smolt. Omega holds fish farm tenure licences on Vancouver Island and at Anacortes, Washington and also operates two hatcheries.

The company's existing facilities currently produce two million smolt annually and Omega purchases an additional one million smolt from other operators in order to meet its market demand. Production from fry to the smolt stage requires a freshwater or brackish water habitat and suitable locations are very difficult to obtain, with only two such sites being licenced in British Columbia.

An Omega subsidiary, Alpha Processors Ltd., plans to begin installation of facilities for a four-year pilot program in the pit lake in 2000. An operation of the size contemplated - two million smolt annually - would provide 10 full-time jobs related to production, maintenance, grading and handling, and transportation. In order to provide a single corporate entity to deal with the business arrangements, BHP will make the lake available to M&E Enterprises which will then sublease to Alpha Processing.

GTN Copper Technology Ltd.

In November 1999, GTN Copper Technology Ltd. of Sydney, Australia announced its intention to develop a \$117 million copper processing plant employing approximately 70 persons at the Island Copper site. GTN has preferential access to the Intec copper process, a new hydrometallurgical technology, and has participated in a demonstration plant in Sydney utilizing the technology.

GTN Copper agreed to lease seven acres of land and some of the former mine maintenance facilities from M&E Enterprises. GTN would import copper concentrate from mines in western Canada, the United States and South America. The plant initially would produce some 50,000 tons of refined copper annually but could be expanded to 150,000 tons.

The company is expected to initiate an application for the required environmental and operating permits in the near future and to proceed with detailed engineering and marketing studies. Project design, permitting and construction is expected to take about three years.

LESSONS TO BE LEARNED

"It is anticipated that future mine closings, at least in North America, will be similar to Island Copper in their scope and level of effectiveness... illustrative of what a responsible company can accomplish in an environmentally sensitive area."—Jerrold J. Marcus, Consulting Editor, Engineering and Mining Journal, February 1997.

In an article published in the February 1997 issue of the Engineering and Mining Journal, Consulting Editor Jerrold Marcus suggested a number of elements as key factors in achieving a successful closure of the Island Copper Mine. His comments were as follows:

1. Shutdown, closure and post closure costs should be a capital expenditure item beginning with the prospect-approval feasibility study. While in the present value sense it may be inconsequential, nevertheless the importance of early environmental planning for reclamation and closure must be spotlighted.

2. The direct closure impact in terms of tailings handling, disposal of chemicals and hydrocarbons, and pit shutdown should be an integral part of the design criteria employed during the detailed engineering phase of the project. Specifically, location of dumps should not only be dictated by transportation costs but also by reclamation and final closure suitability/plans. Ongoing reclamation and the last stage of production should be integral parts of the final closure plan.

3. The selection of key reclamation and closure alternatives should be backed up with a full suite of technical information generated by in-house experts and competent credible consultants. Supporting information should be open for inspection and both company and consulting experts should be available to provide corroborating testimony.

4. At times, a catch-22 condition may arise in that regulators can require a finalized closure plan to approve a mine project's startup. On the other hand, company management tends to be reluctant to authorize detailed engineering of any facet of a project without prior regulatory approval.

5. Closure is a distinct phase of the mine life. During construction and operations it is taken for granted that plans must be modified to allow for changing conditions. Similarly, the Closure Plan, no matter how detailed, should be sufficiently flexible to allow minor adjustments and even major changes as the unfolding circumstances warrant.

6. Constant communications with regulators are essential, and all efforts should be made to keep them fully informed of decisions and problems. They must also be protected from either surprise and/or embarrassment. Whenever possible, it pays to take the initiative before being asked to do so by the regulators. Island Copper's frequent response was: "been there, done that, here's the report." This attitude cannot be bettered.

7. Before the fact, constructive criticism should be actively sought from environmentalists for the following reasons:

- They may notice anomalies while the project is still in the planning stage, therefore saving on costly retrofitting.
- It is better to have people working with you than against you.
- It provides background credence to the effort.
- It supplies a good public relations message.

8. Even if not mandated, a sufficient closure fund/bond should be established when either construction starts or production begins.

9. Top management special skills differ with the life of a mine. For example, during:

- Startup - a hard driving martinet is required.
- Conventional operation - a tight-fisted optimizer or "tweaker" is essential.
- Shutdown and closure - a clergyman is needed.

10. Where possible, personnel employed during the operation should be involved in the closure process. They usually have a deep abiding interest and knowledge of the operation. However, closure, almost as much as construction, can be a time of greater than usual personnel risk; consequently health and safety must be paramount issues. Often, operating personnel must be retrained to regain former skills to participate in closure.

11. When final shutdown appears imminent, the employees and the local community should be fully informed and kept up to date. (Bringing them into the decision process should also be considered). The result at Island Copper was strong support for the company and "buy in" by the work force and the town inhabitants during the difficult time of staged shutdown and preparation and achievement of closure. In retrospect, it is felt that by giving the employees plenty of time to react helped lessen panicky decision-making.

12. Company experts and consultants should be continually involved in relevant governmental hearings, workshops, seminars, round table discussions, etc., on reclamation and closure. This should provide the following benefits:

- Getting the company's position across at the ground floor, not after the fact.
- Building up a reservoir of integrity, goodwill, and acceptance.
- Debunking ideas that have no technical merit or economic basis.

13. The post-closure monitoring requirements can only be fully defined during the latter stage of the actual plant closure effort. Full post-closure definition is dependent upon the results of closure and ongoing observations to identify site areas of lasting concern.

14. The public relations aspects of closure should not be forgotten or omitted. Island Copper actively pursued a successful three-pronged public relations strategy aimed at maintaining open communications with employees, government regulatory agencies, and the local community. In particular, the company took pains to keep employees and their families informed on all matters affecting the mine's operations such as final shutdown. This was done through regular crew meetings, personal letters from the manager, bulletin board notices, and an employee newspaper that began publication in 1974. This latter campaign proved to be very effective.

15. The idea of closure is dynamic in scope, and it is now being rapidly expanded to include the related social aspects of a mining venture. Successfully applied at Island Copper were retraining and counseling courses and a placement center for ex-employees. Liberal cash layoff benefits, above union agreements, softened the shutdown effect and were repaid by employee loyalty.

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