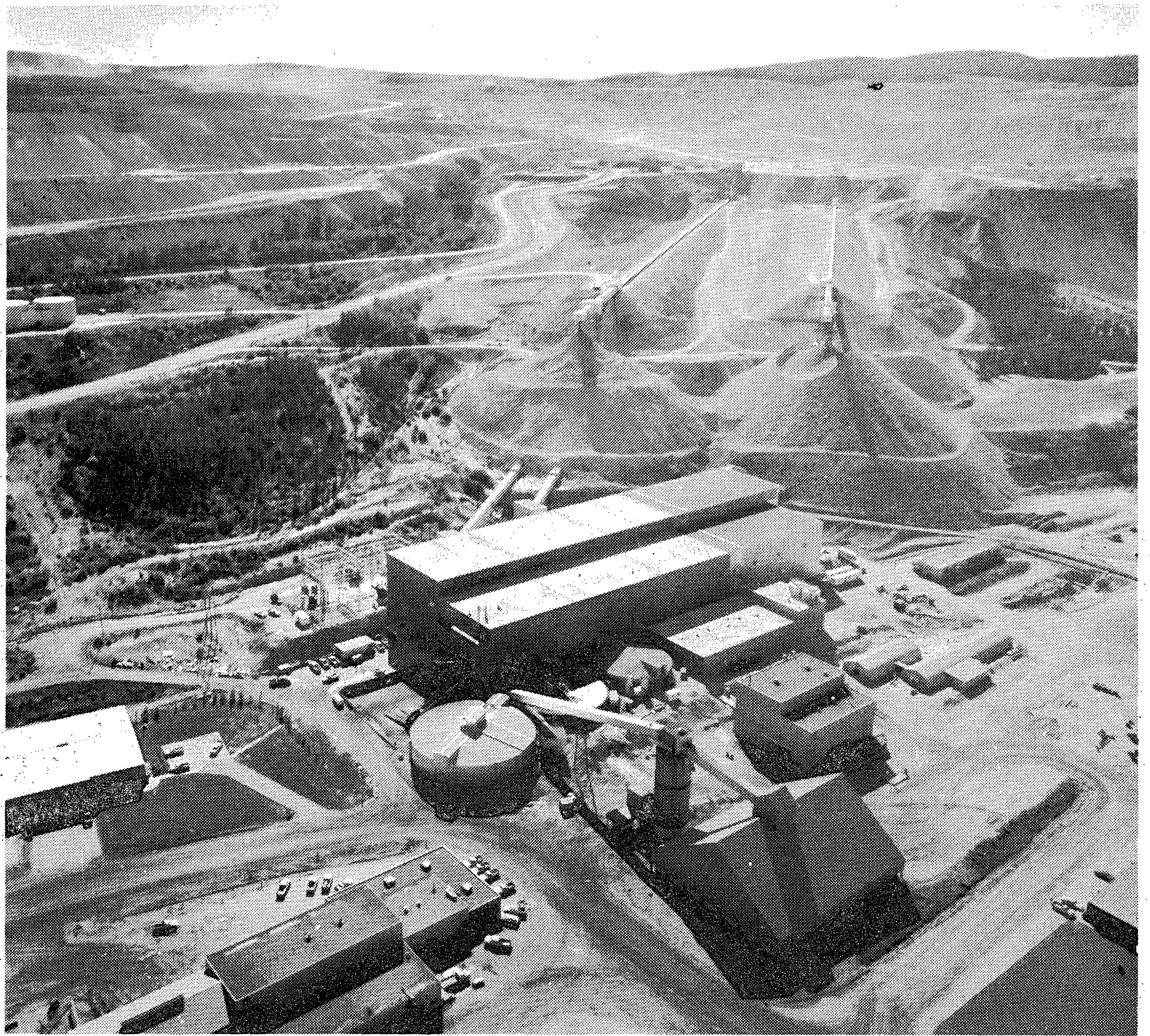
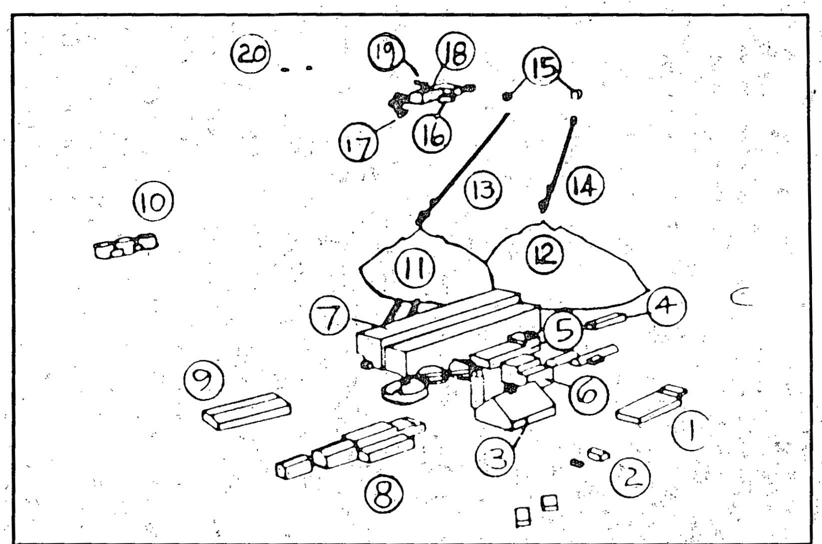
92ISW45

010929

Lornex





1. Administration Office
2. Gatehouse - Weighscale
3. Copper Concentrate Storage
4. Assay Laboratory
5. Reagent Mix Building
6. Moly Leach Plant
7. Concentrator Building
8. Services Shops
9. Warehouse - Storage Yard
10. Potable and Reclaim Water Tanks
11. Stockpile for A & B Mill Lines
12. Stockpile for C Mill Line

13, 14 } Coarse Ore Conveyors

15. Crushers
16. Mine Maintenance Wash Bay
17. Mine Operations Building
18. Mine Maintenance Shop
19. Tire Shop
20. Slurry Explosive Building

Lornex Mining Corporation Ltd.

History

Lornex is located in the Highland Valley in British Columbia, in a 3,500 foot high basin lying 74 kilometers southwest of Kamloops and 62 kilometers north of Merritt. The valley throughout this area is commonly referred to as a Valley of Copper.

The presence of copper in these hills has been known for several centuries. There were traces of workings by native Indians when the first settlers arrived. These settlers undertook some laborious and not very rewarding efforts to recover the metal, never realizing the magnitude of the deposit. Full realization of the extent of the deposits has come only in the past quarter century.

The initial workings in the early 1900's were patches of exposed high grade ore which was extracted, loaded into carts and hauled to the tiny Thompson River community of Ashcroft, some 46 kilometers to the northwest, for crushing and processing. Through the distractions of two world wars, divided by a global depression, there was no real mining activity in the valley.

Then came the 50's, a decade of significant technological and economic progress. Metal markets were strong and prices rose to meet growing demands. Costs were lowered through the utilization of large shovels and huge trucks, and highly efficient milling systems were developed. The almost forgotten valley now became the focus of prospector interest.

Lornex Mining Corporation Ltd. was formed by Egil H. Lorntzsen in the early 1960's, to hold and hopefully develop copper mining claims that he had staked in this Highland Valley. It was clear from the beginning that the Lornex ore body was large, but of low grade and covered by considerable overburden and waste. It was evident that extensive investigation would be required to determine the viability of the property and that substantial technical, financing, marketing and managerial resources would be needed to develop it, if it should warrant development.

Several major companies investigated the Lornex property and for a variety of reasons decided not to proceed with development. Rio Algom first became involved in 1965 when it undertook to carry out a comprehensive investigative program on the Lornex property. If Rio Algom completed the program and declared Lornex to be viable, it became committed to use its best efforts to arrange financing on the best available terms.

The investigative work on the property was carried out over the years 1965 to 1968 at a total cost of \$6.8 million. It was financed by Lornex shares, purchased for cash by Rio Algom, to a total of \$4.6 million. Under an earlier agreement with Rio Algom, the Yukon Consolidated Gold Incorporation Ltd., purchased 40% of the shares acquired by Rio Algom. A rights offering in the amount of \$2 million was made to all Lornex shareholders in 1967 to provide additional funds for this program.

Because it was clear that the low grade Lornex ore body would have to be mined on a large scale if it were to be viable, the evaluation program was complex and exhaustive. Preliminary plant design studies were carried out and capital and operating cost estimates were prepared. Discussions were also held with potential buyers of the Lornex products and with financing institutions.

In addition to the valuation of Lornex as a mine producing and selling concentrates, comprehensive supplementary evaluations were carried out by an independent consulting firm to determine the economic feasibility of processing the copper concentrate to blister or refined metal. The evaluation demonstrated conclusively that a smelting and refining plant was not a viable extension of the Lornex mine and that the mine itself could not subsidize the construction and operation of these supplementary facilities and remain viable.

The British Columbia authorities were kept fully informed of the progress and results of the whole Lornex investigation program. This exhaustive evaluation process was completed late in 1968, and a formal decision to develop Lornex, subject to concluding satisfactory financing arrangements, was made in the spring of 1969. Negotiations were carried on during 1969 and final sales and financing documents were signed with a group of Canadian banks and Japanese smelter and trading companies on December 22nd of that year. The Japanese consortium agreed to buy Lornex's total copper concentrate output for a period of twelve years and to provide certain financing.

The project was formally released for construction on August 14, 1970, with mine ore production commencing in the second quarter of 1972, about seven years after the initial studies began.

Geology

The Lornex porphyry copper-molybdenum deposit is situated within the concentrically zoned Upper Triassic Guichon Creek batholith. The batholith is approximately three kilometers wide and 65 kilometers long and is one of a series of plutons which form the northwest trending Cordilleran Intermontane Belt, which extends from southern B.C. to southwestern Yukon. The batholith is dated at 202 + 8 million years (W. J. McMillan, B.C. Department of Mines, 1980) and is comprised of four intrusive phases ranging in composition from diorite or quartz diorite to quartz monzonite.

The Lornex ore body is approximately 2100 meters long and 700 meters wide. It has a maximum elevation (A.S.L.) of 1640 meters in the south end and plunges northwesterly at approximately 20 degrees to a minimum elevation of below 700 meters in the north end. The ore body is still open at depth. An overburden layer varying between two and 75 meters covers the deposit and an oxide zone averages three to 30 meters in thickness.

The Lornex deposit occurs in the Skeena Quartz Diorite, an intermediate variety between the Bethlehem and Bethsaida phases of the batholith. This slightly porphyric, medium to coarse grained rock consists of approximately 20% quartz, 50% plagioclase, 10% orthoclase, 5 to 10% biotite and 5 to 10% hornblende with accessory minerals such a sphene, apatite, zircon and magnetite.

The major structural features at Lornex include the Lornex fault, the west wall fault zones in the Bethsaida Granodiorite, the pre-mineral quartz porphyry dyke and the intense fracturing and faulting and vein systems of the Skeena Quartz Diorite ore host rock.

The Lornex fault strikes northerly and dips 45 degrees to 65 degrees west in the south and 85 degrees west in the north. This fault cuts off the ore and it juxtaposes Bethsaida Granodiorite on top of Skeena Quartz Diorite. Apparent movement is right lateral and reverse. An incompetent zone of intensely faulted rock and intensely hydrothermally altered but barren rock near the Lornex fault, ranging from 50 to 90 meters in width follows the Lornex fault from the north to the south, in Bethsaida Granodiorite.

The structural grain within the Bethsaida Granodiorite in the pit west wall is N20 degrees and N30 degrees E, truncated by the Lornex fault. Swarms of major faults with ½ to 3 meters of gouge strike within this trend and dip mainly at 60 degrees to the northwest. They alternate with zones of fresh, mildly fractured Bethsaida Granodiorite.

The Quartz Porphyry dyke cuts the Skeena Quartz Diorite in the south-eastern corner of the pit. Its width appears to reach 300 meters in that area, including some large zenoliths of partly digested Skeena Quartz Diorite. It ramifies into two arms as it enters the south central pit area. These arms vary in width from 45 to 150 meters.

The western arm disappears in intensely argillic Skeena Quartz Diorite near the Lornex fault and the eastern arm extends further north. The overall dyke trends N45 degrees. It appears that the dyke is better mineralized (ore grade) along the arms than in the main body to the southeast.

The Skeena Quartz Diorite itself is intensely jointed and faulted and the higher ore grades occur in the more intensely jointed, veined and faulted rock. Mapping has shown that ore zones usually trend along pervasive joint-stringer trends or as halos along the major quartz veins. One quartz-chalcopyrite-molybdenite vein in the south central pit area has been followed for 365 meters along strike and 48 meters vertically and is possibly correlatable to diamond drill holes to another 95 meters in depth. It strikes about N05 degrees W to N10 degrees W and dips westerly at 40 degrees, sympathetic to and within 60 meters of the Lornex fault. Ore zones straddle it for most of its length consistently from bench to bench. A footwall halo along this vein is well altered and mineralized.

Four types of hydrothermal alteration associated with sulphide mineralization have been recognized. These are potassic, phyllic, argillic and propylitic. Potassic alteration exists erratically as 5 millimeter veins of K-feldspar. Phyllic alteration consists of quartz-sericite envelopes typically a few millimeters in width. These frequently occur with sulphide minerals. Argillic alteration is pervasive throughout the ore body in varying intensities and is characterized by the presence of quartz, sericite, kaolinite, montmorillonite and chlorite. Kaolinite and seracite are the dominant alteration minerals and tend to give the quartz diorite a cream-coloured or green tint respectively. Propylitic alteration occurs principally as epidote, chlorite and carbonates along the margins of the ore body. The quartz porphyry dyke is affected by these alteration types to a much lesser degree than the Skeena quartz diorite.

Sulphide mineralization occurs primarily as fracture filling with quartz. The principal hypogene sulphide minerals in order of abundance are chalcopyrite, bornite, molybdenite and pyrite, which occur with minor amounts of sphalerite, galena, tetrahedrite and pyrrhotite. Only about 5% of the copper minerals occur as disseminations. Molybdenite normally occurs as thin laminae in banded quartz veins. Copper minerals in the oxide zone alter predominately to malachite, but azurite, cuprite, chalcocite, covellite and native copper also occur.

The copper mineralization has been subdivided into five zones which together represent an anticlinal-like structure which trends N23 degrees W very continuously throughout the length of the ore body. The most westerly zones are cut off by the northerly trending Lornex fault. Concentric zoning of the sulphide minerals has been recorded with bornite in the centre, flanked by chalcopyrite, with molybdenum zone overlapping both of the copper sulphide zones.

Ore boundaries in the pit are determined through the use of rotary blast hole assays. Ore is outlined with the use of ribboned lines and numbered signs corresponding to maps issued daily to the foremen. Ore hardness (alteration, structure, etc.) is checked at each shovel face daily and contour maps showing the grinding rates (in the semi-autogenous mills) in tons per hour are compiled for forecasting purposes. Shovels are scheduled daily to produce a blend of ore with the desired copper and molybdenum grades and a uniform hardness which enables the mill personnel to maintain efficient operation of the semi-autogenous mills and good control of the grinding circuit.

A rock quality control mapping program has been implemented to help in the design of blast patterns and to provide rock mechanics data. For optimum blasting, hard and soft zones are delineated by a combination of mapping, contouring toe elevations and observing shovel performance. These zones are projected down dip one bench height (40 feet) and then drilled and blasted according to their rock quality by varying the pattern spacing, sub-grade, powder factor and type of powder to achieve better fragmentation and toe control. Favourable results include less wear and tear on the shovels, less re-drilling and more economical use of explosives and drills.

Geological mapping done on active faces and on temporary and final walls, together with diamond drilling information, enables the geologist to develop a three dimensional picture of the geology of the Lornex ore body. This knowledge is used to optimize the slopes of the pit design and to ensure the stability of the walls.

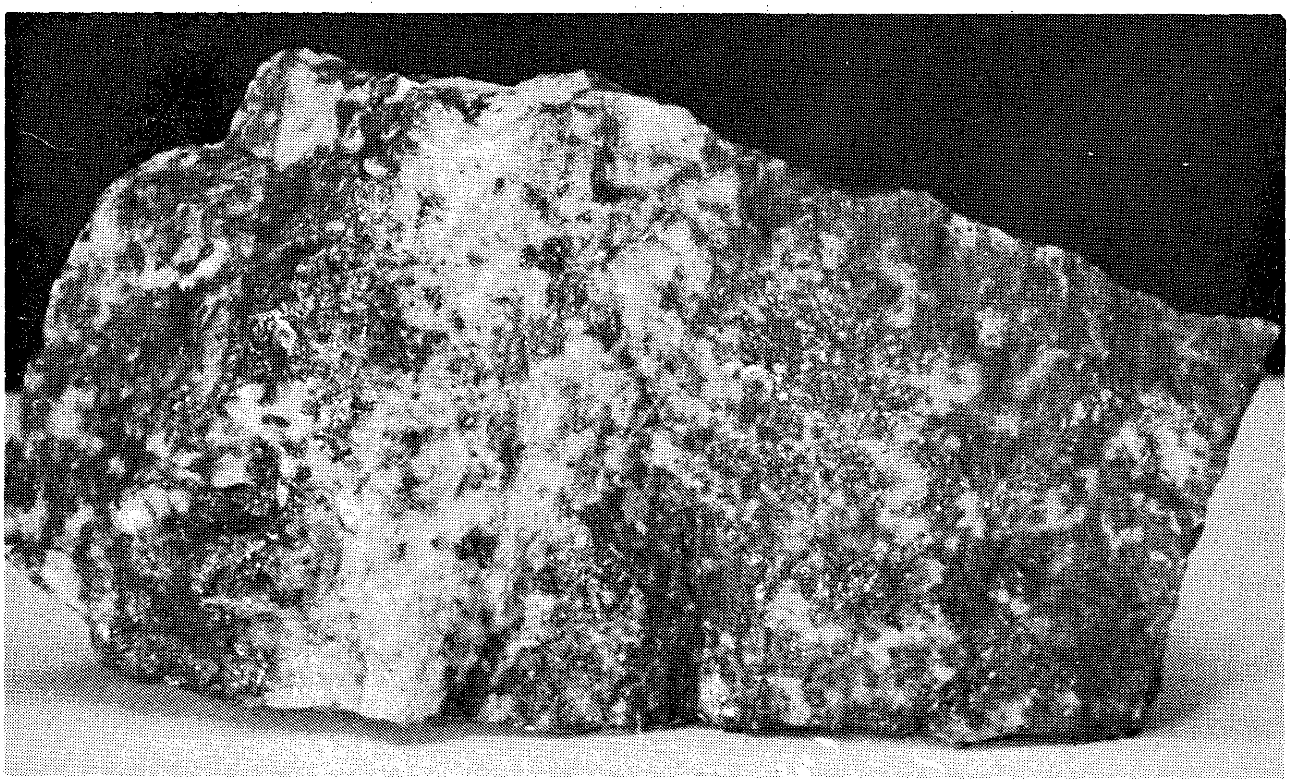
Computer Geology Model

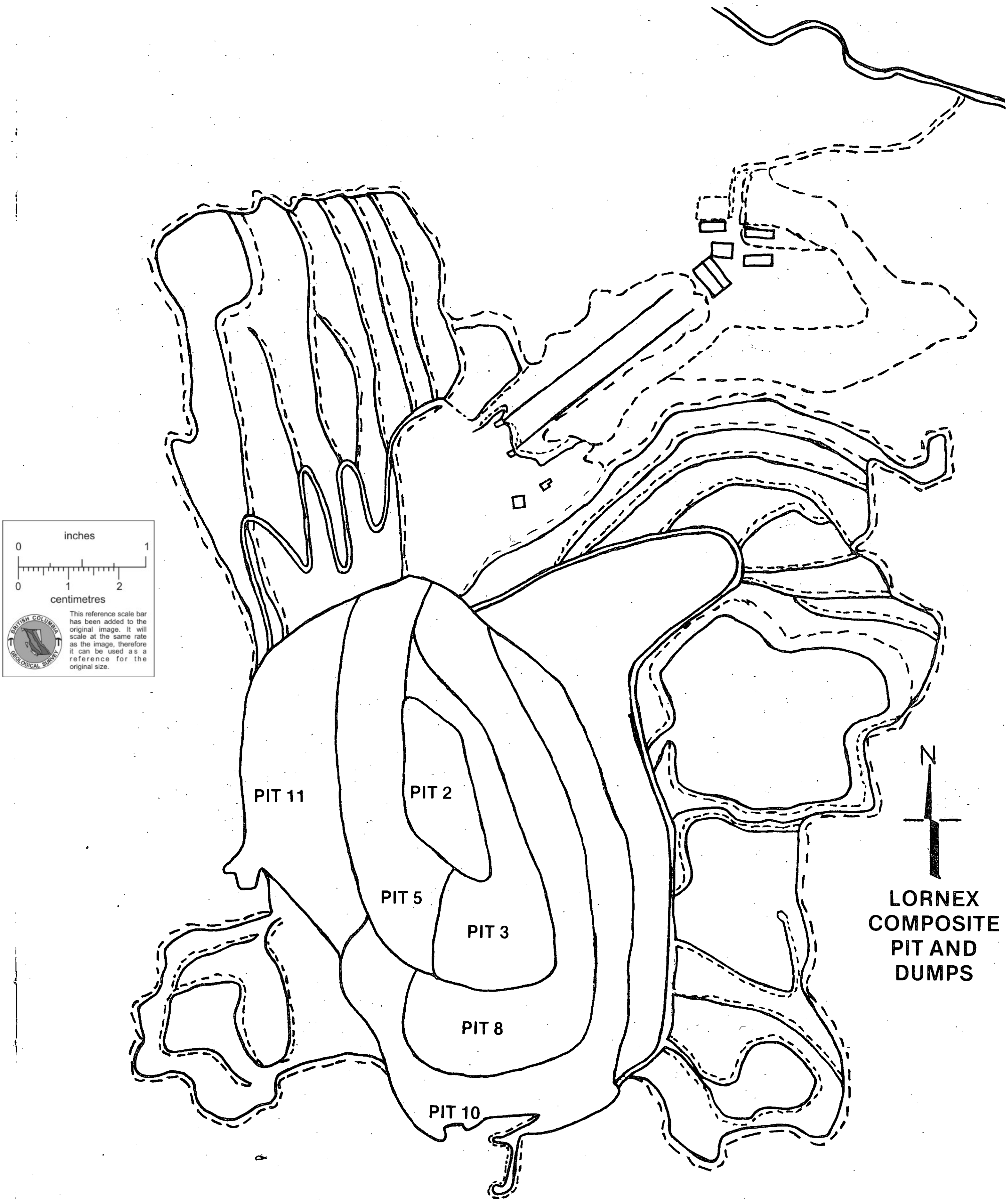
All diamond drill hole data, including rock types, degree and type of alteration and assay values, are stored in a computerized geological model. The property is divided into blocks each 100 feet square and 40 feet deep (bench height). Each block is assigned a value for copper, molybdenum and a hardness rating.

The metal content is calculated by "searching" by computer for 40 foot composite diamond drill hole assays up to 450 feet in strike and dip directions and up to 180 feet in the direction perpendicular to the strike dip plane (or an appropriate intermediate distance). Assays that are located within this disk-shaped search volume are then weighed by a factor defined as the inverse of its distance from the block to the sixth power. Assays located near the block are weighed much more than those located further away. In addition to the distance weighing, those assays encountered during the computer "search" which are in preferred directions (along strike or dip) are weighed up to six times more than assays encountered in other directions. The combined biases of direction and distance make up a weighing matrix. The Lornex ore body has been subdivided into four areas, each with different preferred directions, and therefore, each with a unique weighing matrix.

Hardness values assigned to each block in the geological model are assigned manually. Generalized hardness trends are compiled from the hardness contour maps drawn by the geologist and from the alteration descriptions in drill hole logs. Each trend is assigned a hardness value representing the grinding rate in a semi-autogenous mill, expressed in tons per hour. The hardness trends plotted on bench plans are then coded for the computer model using row, column and bench designations. Computer programs accessing this data can then calculate mill throughput for future blends of ore.

The geological model is updated from time to time as new information becomes available through mining or through diamond drilling. The model is routinely assessed by mine engineering personnel to determine future grades, milling rates and ore reserves.




PIT 11
PIT 2
PIT 5
PIT 3
PIT 8
PIT 10
N
LORNEX
COMPOSITE
PIT AND
DUMPS
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
BRITISH COLUMBIA
GEOLOGICAL SURVEY

Mine Planning

Open pit mine planning personnel are responsible for developing mine plans which will provide the best return on investment for the company over the life of the mine.

Mine planning is conducted in two phases - long range and short range. Long range planning is conducted by year for the mine life while short range planning deals with the detail planning from daily scheduling through three month plans. Once a long term mine plan is agreed upon, a detailed month by month plan is developed for the first year. These detailed plans are reviewed quarterly to establish if changes in mine plan are required.

Two separate data bases are used for planning. The long range mine plans are developed for the computerized geological model. Short term mine planning uses current rotary blast hole assay information and current geological rock grindability information to develop one to three month mine plans. At times, this short term information can be projected for six months depending on the rapidity with which benches are being mined.

Design Parameters

Long range mine planning design parameters involve maximizing head grade and mill throughput while trying to maintain relatively constant truck and shovel requirements. Where possible, maximum truck fleet requirements are maintained for five to seven years. Minimum waste stripping ratios are maintained wherever possible.

Pit slope parameters are currently set at 36 degrees interbench and 34 degrees overall. Pit slope parameters are reviewed on a regular basis as field conditions change and as new stability information is developed.

Roads are designed to provide a 100 foot width travel surface. Overall allowance in design for ramps is 120 feet.

On interim pit walls, variable width berms are left approximately every five benches to allow access. On final walls, no additional berms, other than those required by government regulation, are incorporated. The Lornex pit is designed as a multi-slice mining operation. Within the ultimate pit shell are a series of smaller pits with minimum working widths of approximately 400 feet. The original contour surface of the pit, the current outline of the mine, and the final outline of each individual pit with the ultimate mine outline, are carried on the computer.

Using data from the geological computer model and the information from the individual mining shells, mine planning personnel use an inter-active mine scheduling program to develop alternative mine plans by year for the mine life. By varying the mining parameters, i.e. mill throughput desired, head grade desired, mining cutoff grade, maximum mine tonnage output, and truck fleet requirements, maximum tonnage per mining shell, cost of production, value of product produced, a series of mining alternatives can be quickly analyzed. The more favourable mining alternatives are then evaluated in greater financial detail to establish the most favourable plans.

As new information is added to the geological mine model, the mine plans are updated.

Recently, a new in-house computer system has been purchased and plans are being made to do much of the computer work on site. Both the working programs and the mine planning facilities will be much enhanced with the availability of the computer hardware at the mine.

Short range mine planning involved the development of monthly mine schedules for a three month period. This amount of detail allows the planning and operational personnel to establish practical working plans which establish mining priorities, drilling priorities and determine potential problem areas in the release of the required type of hardness of ore.

Once the monthly mining plan is established, daily and weekly planning meetings are held between geology, mine planning and mine operations personnel to develop the schedule. The mill operations personnel are then advised of the expected mill ore feed for the next period of time.

Because of the variable size of the loading equipment - 12 cubic yard to 22 cubic yard; the haulage trucks - 120 ton to 235 ton; the necessity to blend ore from the pit for the mill and the necessity to maximize all equipment productivities, short term planning plays a major role in effective mine operation.

Long and short range dump planning is an integral part of the overall mine plan. As with the mine plan, the dump plans seek to optimize present dump hauls without jeopardizing the long term viability of the operation. Low grade dumps are located to optimize their current placement and future retrieval. Waste rock is utilized where possible to establish a base for low grade dumps.

Pit Operations

The pit is being mined by conventional truck and shovel mining methods. The operation is a 12 hour on four by four continuous shift basis and moves approximately 270,000 tons per day of ore, waste and overburden. Of the total, approximately 83,000 tons per day are ore.

Design Parameters

Mine operations work to the following design parameters:

Bench Interval Height	- 40 feet
Safety Berm in Rock	—between 25-75 feet
Road Width	- 100 feet
Roadway Gradients	- 8%
Temporary Ramp Gradients	- up to 10%

Drilling and Blasting

All production drilling is done with four electric powered and one diesel powered Bucyrus-Erie 45R rotary drills, equipped to drill 9 7/8 inch diameter holes. A combination of steel tooth and carbide tooth bits are used. Average bit life is about 8,500 feet. The majority of the present drilling is done in rock. Average penetration rate is 100 feet per hour.

Drill holes are laid out on a square pattern. The Quartz Diorite rock (mainly ore) is drilled on a 36 foot by 36 foot pattern. Overburden is drilled on a 34 foot by 34 foot pattern. The Bethsaida Granodiorite rock is presently being blasted on a 28 foot by 28 foot pattern.

Subgrade drilling ranges from three feet to 10 feet in rock, and five feet to 10 feet above grade in overburden. No allowance is made for overbreak. Patterns are laid out contiguously. In ore, essentially all blasting is cushioned. In waste rock, no more than four rows are blasted to a free face. This is done for wall control and to gain better blasting results in the hard rock areas of the pit.

Blasting is being done with a watergel slurry explosive in wet holes and AN/FO in dry holes. At present, we do not dewater drill holes. Regular drill hole cuttings are used as stemming. This is accomplished by back filling utilizing a small skid steer loader.

All holes are double primed in the powder column using plain primacord with one pound primers attached. In the powder column, primers are placed one at the bottom and one raised six feet off the bottom. A single line of plain primacord is used as trunk line, 25 M.S. relays are used between rows.

For wall control, a Toe Det Delay System is used. Period No. 8 is utilized with 75 M.S. relays. Angle tie-in is used to reduce vibration on final walls. The densely fractured rock enables powder factors of 0.15 to 0.35 pounds per ton to be effective, with an overall powder factor of .20 pounds per ton.

Loading and Hauling

Primary excavation in the pit is carried out by five 15 cubic yard and four 22 yard electric shovels. Power for the shovels is conducted by trailing cable from portable substations located adjacent and within the pit perimeter powerline. Trailing cable voltage for the equipment is 4160 volts.

The average production rate for an operating hour is about 1800 tons for the 15 yard shovels and 2500 tons for the 22 yard shovels.

The haulage fleet is made up of 23 - 120 ton and 22 - 170 ton two-axle trucks, along with 11 - 235 ton three axle trucks. In summer, three of the 120 ton trucks are converted to water trucks and in winter, one 120 ton truck is used as a sanding unit for pit haulage roads.

Seventeen 120 ton trucks have a horsepower capacity of 1000 H.P. Six 120 ton trucks are rated at 1200 H.P., with all 170 ton trucks rated at 1600 H.P. The 235 ton trucks are rated at 2475 H.P. All haulage units are electric drive. The 120 ton and 170 ton trucks have motorized rear wheels while the 235 ton units have a traction motor on each drive axle which in turn provides conventional power distribution through a differential and planetary arrangement to the wheels.

The 120 ton units are equipped with six 30.00 x 51 - 46 ply tires.

The 170 ton units are equipped with six 36.00 x 51 - 50 ply tires.

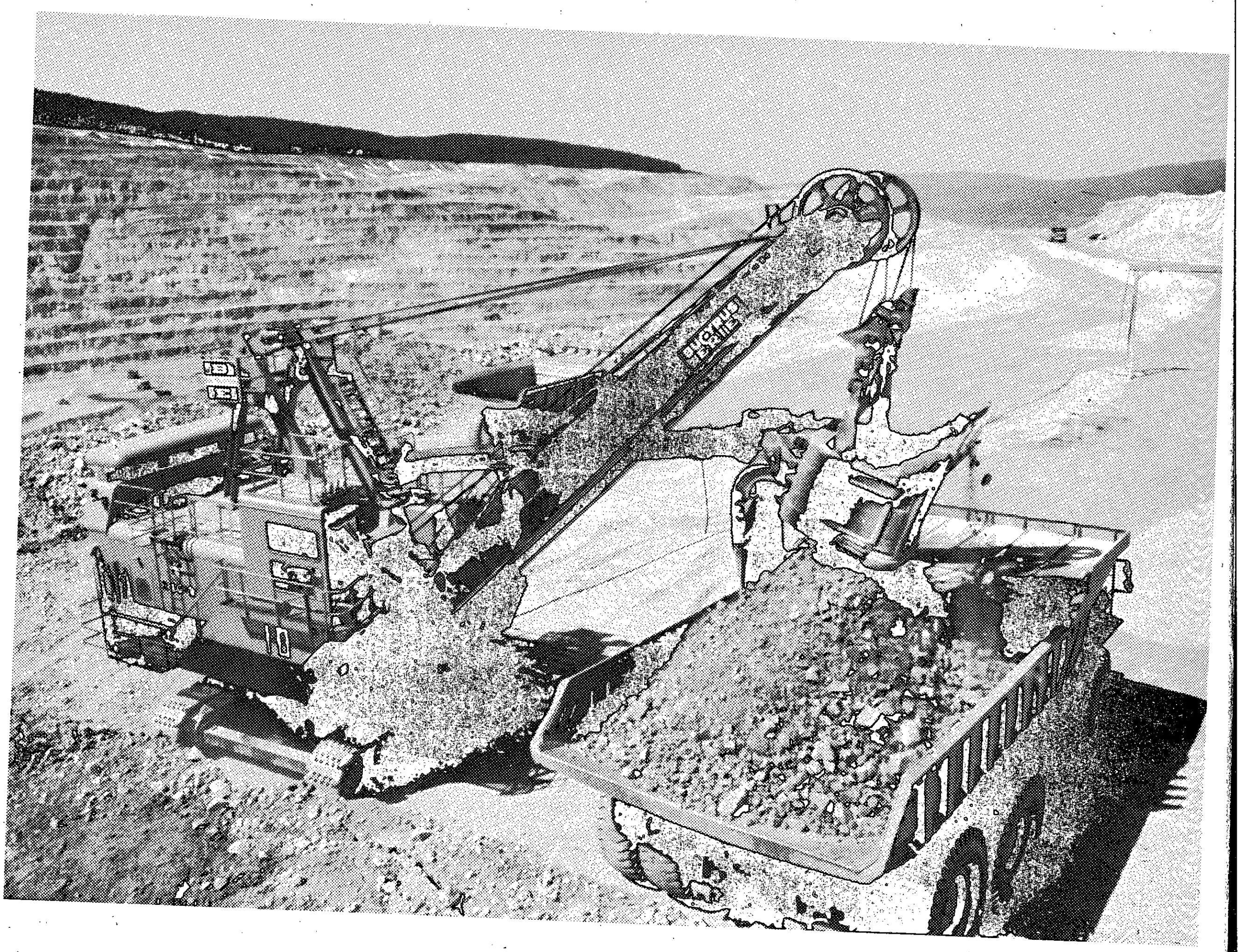
The 235 ton units are equipped with ten 36.00 x 51 - 50 ply tires.

Average tire life on the 120 ton and 170 ton units is 2,500 hours and 3,000 hours for the 235 ton trucks.

Auxiliary Open Pit Equipment

Waste dumps and stockpiles are maintained by 10 bulldozers, all equipped with rippers. The cleanup around the shovels and spillage on the roads is handled by seven Cat 824C rubber-tired dozers and seven Cat 16G graders. Miscellaneous work and small excavation jobs are handled by two front-end loaders with five and one-half cubic yard rock buckets. These loaders generally work with one 35 ton haulage truck. Another 35 ton truck is equipped with a 6,000 gallon water tank and is used for supplying water to the rotary drills and for fire protection.

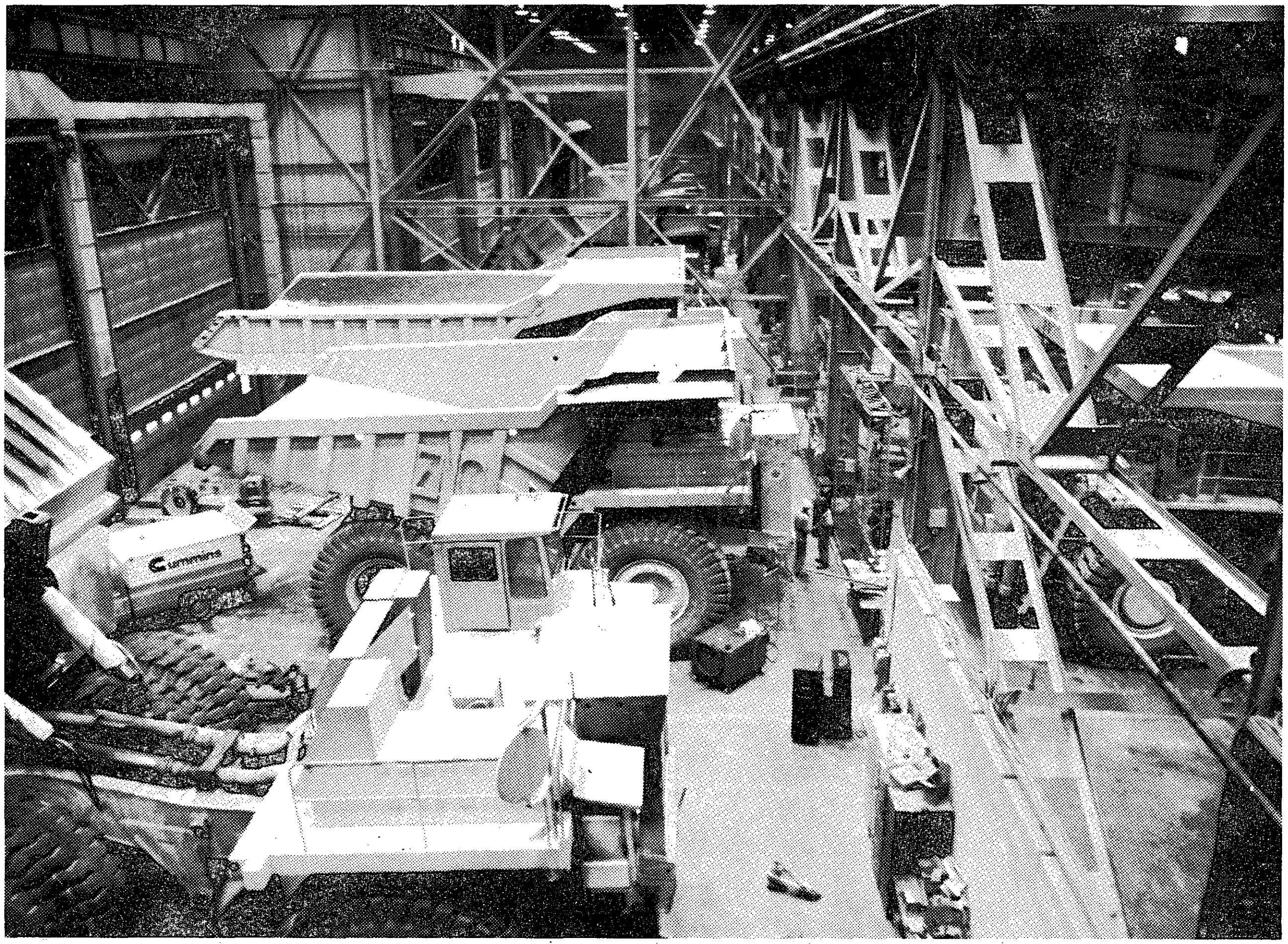
Three Dart D-600 front-end loaders equipped with high lift arms and 13 cubic yard buckets are used for ore blending.



Mine Equipment Maintenance

The Mine Maintenance Department operates around the clock and utilizes 276 maintenance personnel, 61 service vehicles and an effective shop facility of 30 bays in three buildings for the maintenance of its mining equipment. These various shops, which are located within the same area, provide the maintenance staff with an effective work space of approximately 84,000 square feet.

Excluding all but a few positions, maintenance crews work 12 hour continuous shifts. To expedite repairs, most major and all minor repairs are carried out on this basis, resulting in improved availability of major equipment.



The 30 bay shops have been sub-divided for special functions:

Three bays have been allocated for haulage truck and support unit preventative maintenance checks. These areas have grate covered pits for the draining of oils and anti-freeze. They are also fully equipped with lube, oil and anti-freeze reels to facilitate the P.M.'s (6,730 square feet).

Two bays are reserved for overhauls to shovel and drill components excluding major welding overhauls. This area is serviced with a 30 ton overhead crane (3,100 square feet).

Three bays are designated for welding. The space provided allows for one dipper overhaul, two dump body overhauls, plus miscellaneous welding repairs to be carried out simultaneously. The area has been closed off from the main shop with 12 foot walls to cut down noise and flashes. It also provides a slight stack effect to remove excessive amounts of smoke and fumes quickly. The bays are provided with one 50 ton overhead crane, plus one 2 ton jib crane (7,770 square feet).

Four bays are available for support equipment repairs. One of the four bays is provided with a grated pit for "dropping" various oils as required. One bay has steel rails embedded into the floor for the use of track equipment. Also provided are one 30 ton and one 5 ton overhead crane (6,200 square feet).

Two bays have been set aside for storage of major overhaul truck spares, such as engines and wheelmotors (3,700 square feet).

One bay is provided for edge changes to the various bladed support equipment. Storage space is provided for the various edges and hardware to expedite changeouts (15,050 square feet).

Twelve bays are set aside for general and major repairs to the haulage truck fleet (31,130 square feet).

Two bays, which are located in a separate building, are specifically reserved for tire changes. Ample space is available for both tire changes and tire repairs (5,180 square feet).

One bay, which is also in a separate structure, is used for unit and component washes. It is a drive-through type building which has a high pressure steam cleaner as well as high pressure water facility. The size of this building allows us to wash any unit excluding a shovel (2,590 square feet).

All shovel and drill repairs are completed in the field as these shops do not provide an area for inside repairs to an entire shovel. A large outdoor overhaul pad facilitates any major shovel repairs.

Dexteriously handling statistics and job scheduling is an on-line computerized maintenance work order system, designed and programmed by Lornex personnel. The system allows maintenance planning to input any number of cyclic or specialized jobs which are reset via work order. The weekly scheduling of unit preventative maintenance in conjunction with other outstanding specialized tasks is accomplished with a minimum of manpower. Being an on-line system, it allows the department to provide accurate scheduling due to instantaneous response to data input.

A further advantage provided by this computer system is a consistent monitoring of warrantable repairs. It compels the numerous vendors to provide better quality controlled products which ultimately results in improved machine productivity at lower costs. All major components are serialized and do not undergo repair or overhaul without knowing whether warranty consideration is expected. The system is currently keeping permanent statistics such as repairs, movements and overhauls on more than 1,400 serialized items.

Mineral Processing

The Lornex mill was designed to process 38,000 tons of ore per day, with an on-stream efficiency of 90%. Operating experience proved that a full capacity throughput rate of 48,000 tons per day with an operating factor of 94% was a realistic level. In June, 1981, the addition of a third mill line increased capacity by 35,000 tons per day to 83,000 tons per day.

A general description of the process is as follows:

Crushing

Two coarse ore stockpiles at the concentrator are fed from two parallel and similar crushing and conveying systems which are not cross-connected. The only essential difference between the two systems is that the older, No. 1 crusher, uses a 96 inch link belt apron feeder to meter ore from the ore pocket to the conveying system, while No. 2 crusher uses a 96 inch belt feeder. The ore is reduced to nine inch material in a single pass through Allis Chalmers 60 inch by 89 inch gyratory crushers, and discharges to 300 ton surge pockets beneath the crushers. Material is then fed from the ore pockets to 72 inch collection belt conveyors and thence to 60 inch belt conveyors which discharge to the coarse ore surge piles. The nominal capacity of the piles is 500,000 tons each and the live capacity is approximately 100,000 tons.

Grinding

Crushed ore from the first coarse stockpile is reclaimed by two parallel lines of four variable speed 48 inch by 13 foot apron feeders. This coarse ore is fed directly to two parallel grinding circuits. Feed for the third circuit is reclaimed from No. 2 stockpile by a single line of five 48 inch apron feeders.

Primary grinding is achieved by two 32 foot diameter by 15½ foot D.E.W. mills and one 34 foot diameter by 16 foot D.E.W. semi-autogenous mills. The mills are equipped with a grate discharge. Discharge from the 32 foot mills is pumped to a splitter, then to two 8 foot by 20 foot grizzlies. The oversize is laundered to the feed end of the autogenous mill. The undersize reports to the ball mill discharge pumps. The 34 foot diameter mill circuit differs from the others, in that the mill discharge reports directly to a 10 foot wide by 16 foot grizzly, and the undersize is laundered to a splitter and from there to the ball mill discharge pumps.

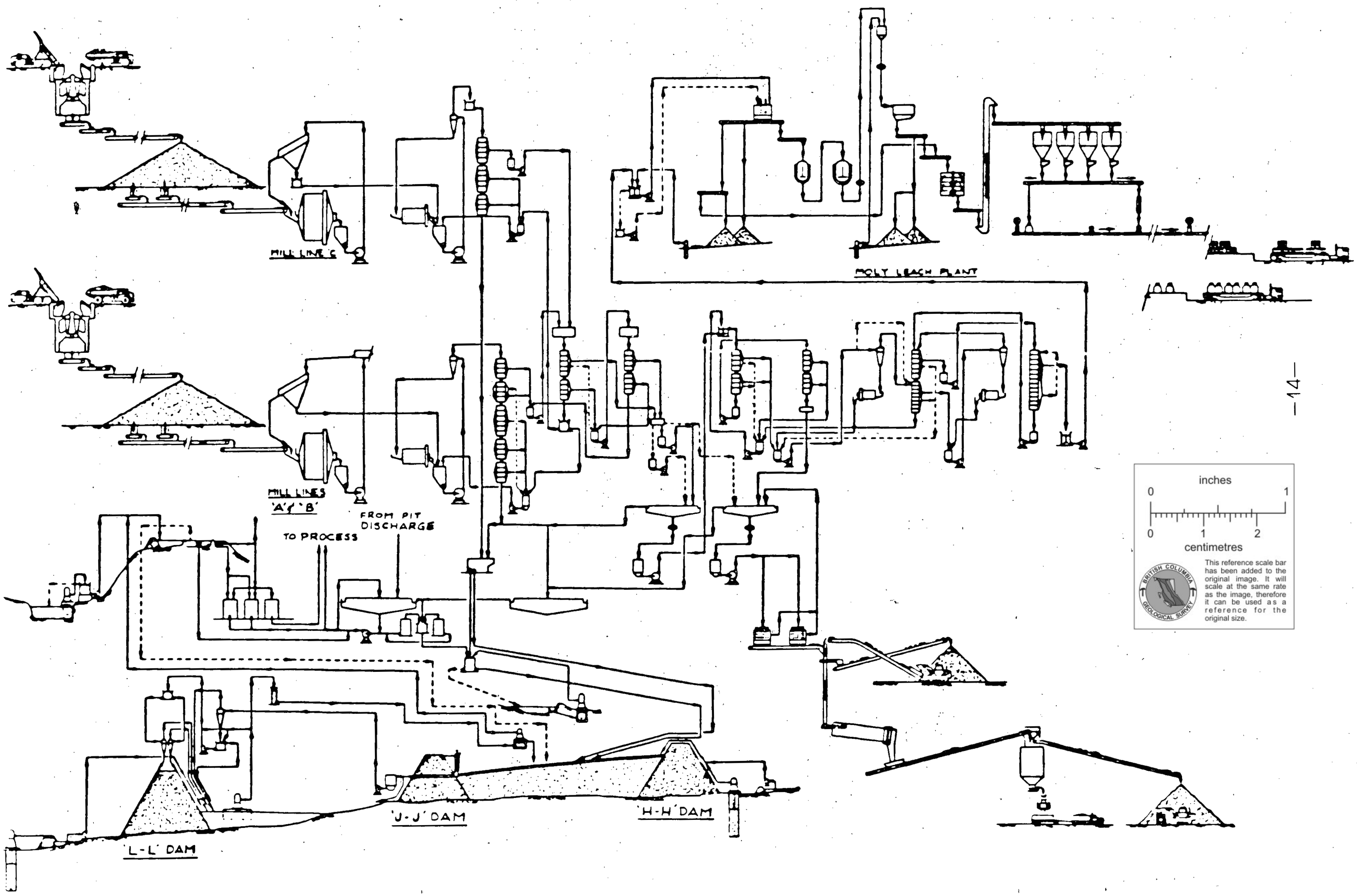
The 32 foot diameter semi-autogenous mills are driven by two 180 rpm, 4500 horsepower quadratorque motors. The mills rotate at 10.0 revolutions per minute or 73.2% of critical speed.

The 34 foot diameter mill is powered by two 6250 horsepower variable speed direct current motors, with maximum speed of 200 rpm corresponding to 81% of mill critical speed.

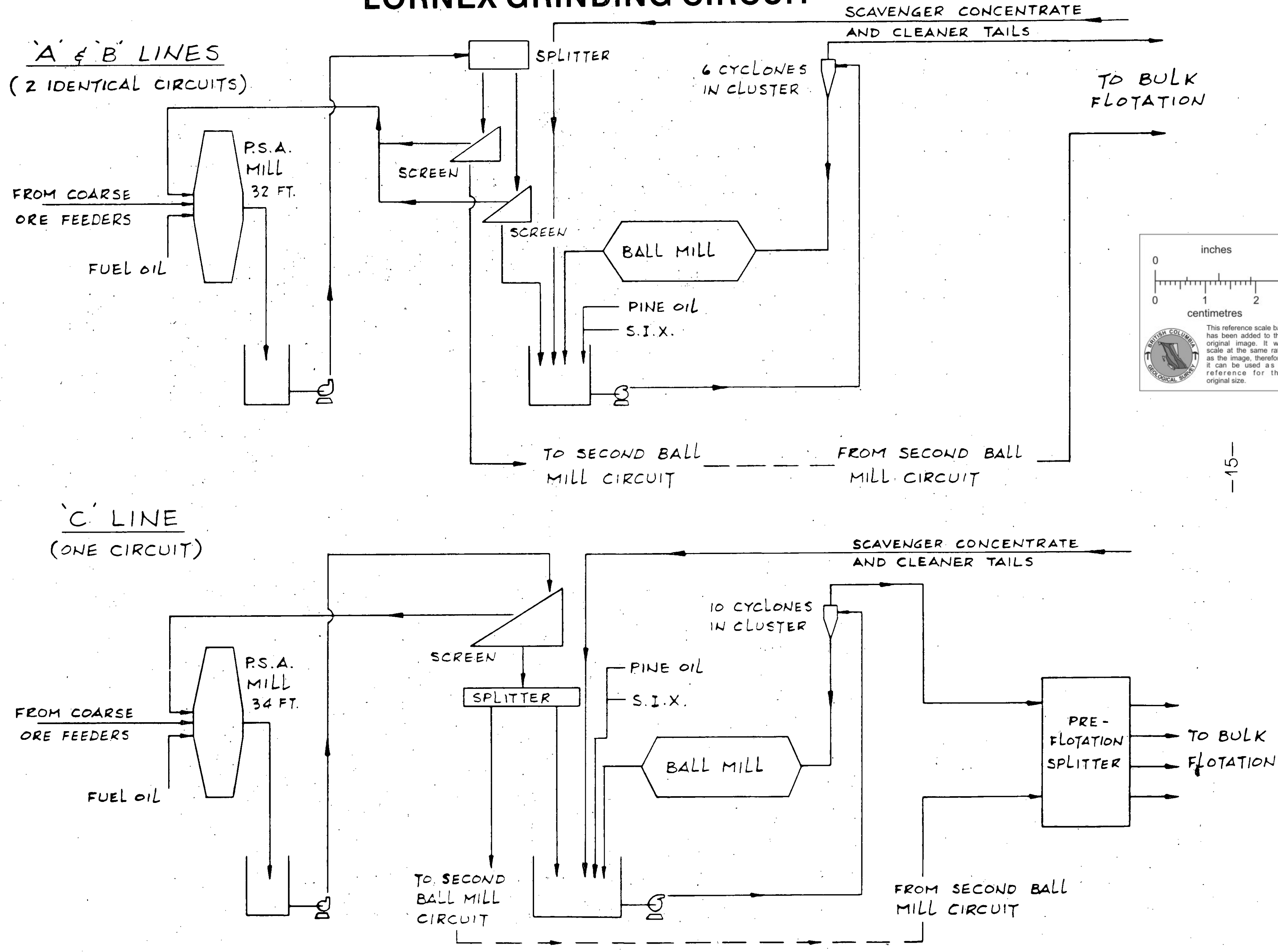
The secondary circuit is comprised of two 16½ foot diameter ball mills for each primary mill; the ball mills associated with the 32 foot diameter primary mills are 23 feet long, and 27 foot long mills are associated with the 34 foot primary mill. Each ball mill is operated in closed circuit with a cyclone cluster containing 30 inch Linatex cyclones, seven in each cluster for the 23 foot mills, and 10 in each cluster for the 27 foot mills. The overflow, nominally at 38% solids (with 70% passing the 100 mesh screen) reports by gravity to two bulk sulphide flotation circuits.

LORNEX MINING CORPORATION LTD.

GENERAL PLANT AREA - PICTORIAL FLOWSHEET

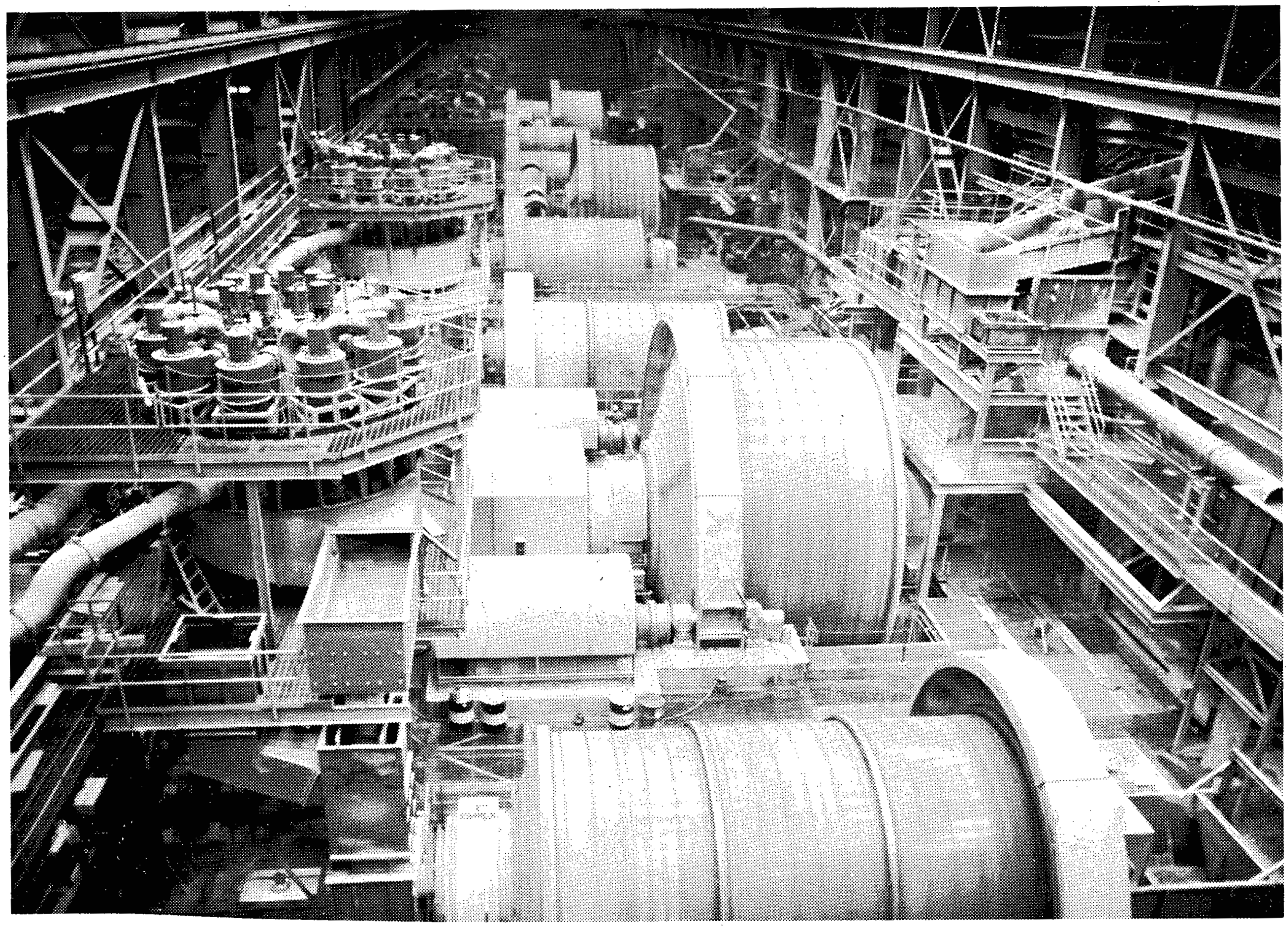


LORNEX GRINDING CIRCUIT



inches 0 1
0 1 2 centimetres
BRITISH COLUMBIA GEOLOGICAL SURVEY
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

The 23 foot ball mills are driven by synchronous 180 rpm 4500 horsepower motors through Fawick air clutches. One of the 27 foot mills is driven by a 180 rpm 4500 horsepower quadratorque motor and the other by a 6250 horsepower D.C. variable speed drive; these two motors are spares for the primary mills.



Bulk Flotation

Diesel fuel, sodium isopropyl xanthate, potassium amyl xanthate, dowfroth 250 and norpine 65 are used in the Lornex bulk sulphide flotation plant to produce a concentrate containing both copper and molybdenum values.

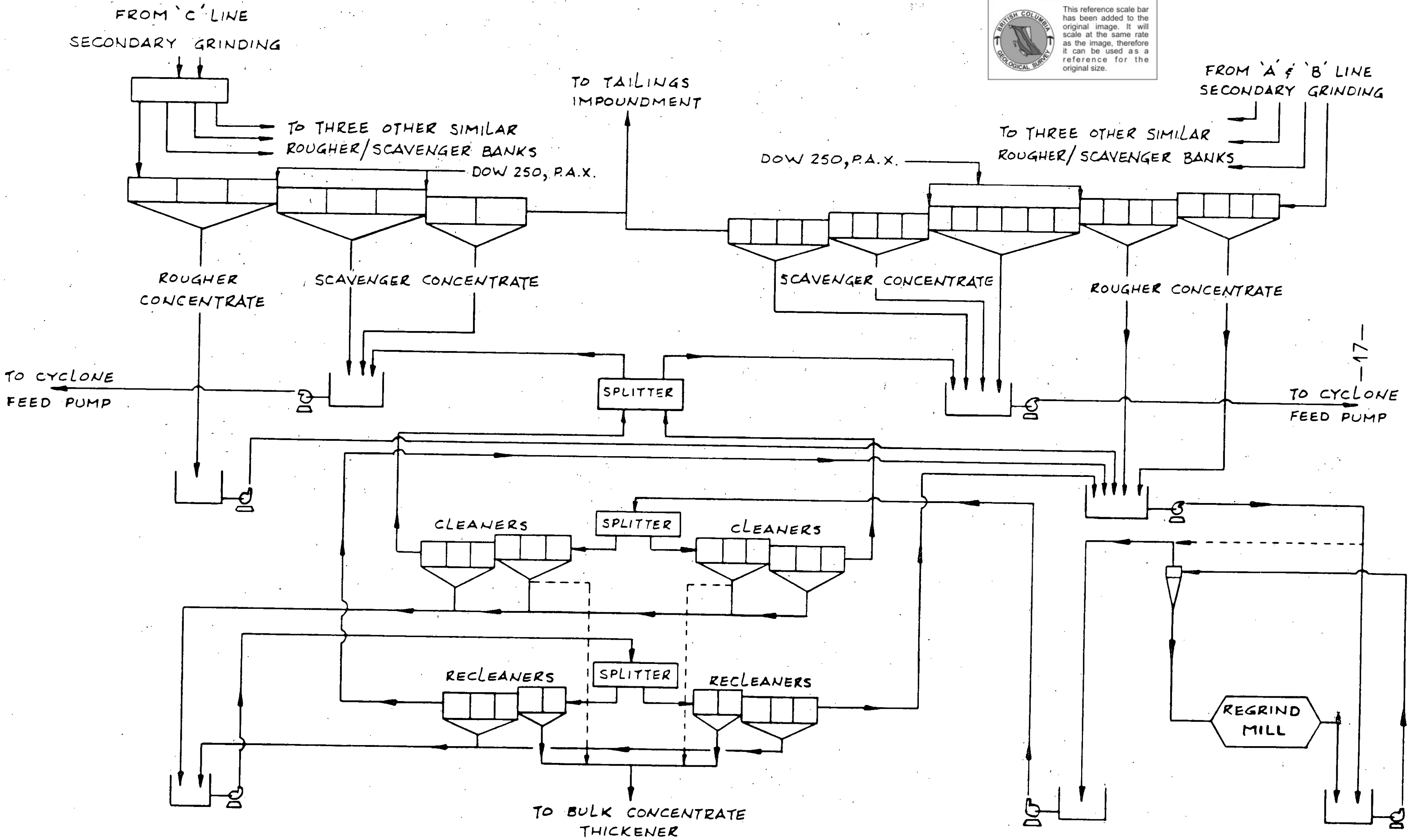
From the 'C' line ball mills (those associated with the 34 foot primary mill), the cyclone overflow reports to a splitter and thence to four parallel banks of eight Denver 1275 DR flotation cells, three of which produce a rough concentrate, the remainder scavenging. From the other ball mills, the cyclone overflow reports directly to one of four parallel banks of 22 Denver 600-H-DR cells, comprised of 8 roughers and 14 scavengers.

Tailings from the eight rougher-scavenger banks are collected in a common sump and flow by gravity to the tailings impoundment.

The scavenger concentrate is returned to the grinding circuit and the rougher concentrate reground in an 11 foot by 14 foot, 900 H.P. mill in closed circuit with seven 20 inch cyclones. Cyclone overflow is cleaned in two banks of six Denver 300 DR cells, then recleaned in two banks of five similar cells. The recleaner tails report back to the ball mill discharge pump boxes via a splitter, the recleaner tails go to the cleaner feed, and the last three cells of the reclean bank are recycled to the recleaner feed.

LORNEX BULK FLOTATION CIRCUIT

inches
0 1
0 1 2
centimetres
BRITISH COLUMBIA GEOLOGICAL SURVEY
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.



Final recleaner product is dewatered in a 125 foot thickener, the overflow of which is returned to the grinding circuit, and the thickened pulp is pumped, together with the overflow liquor from the molybdenum separation plant tailings thickener. The underflow from this thickener, now pretreated with excess depressants, becomes the feed to the molybdenum separation plant, while the overflow is clarified in a 325 foot diameter settling pond before flowing by gravity to the tailings impoundment.

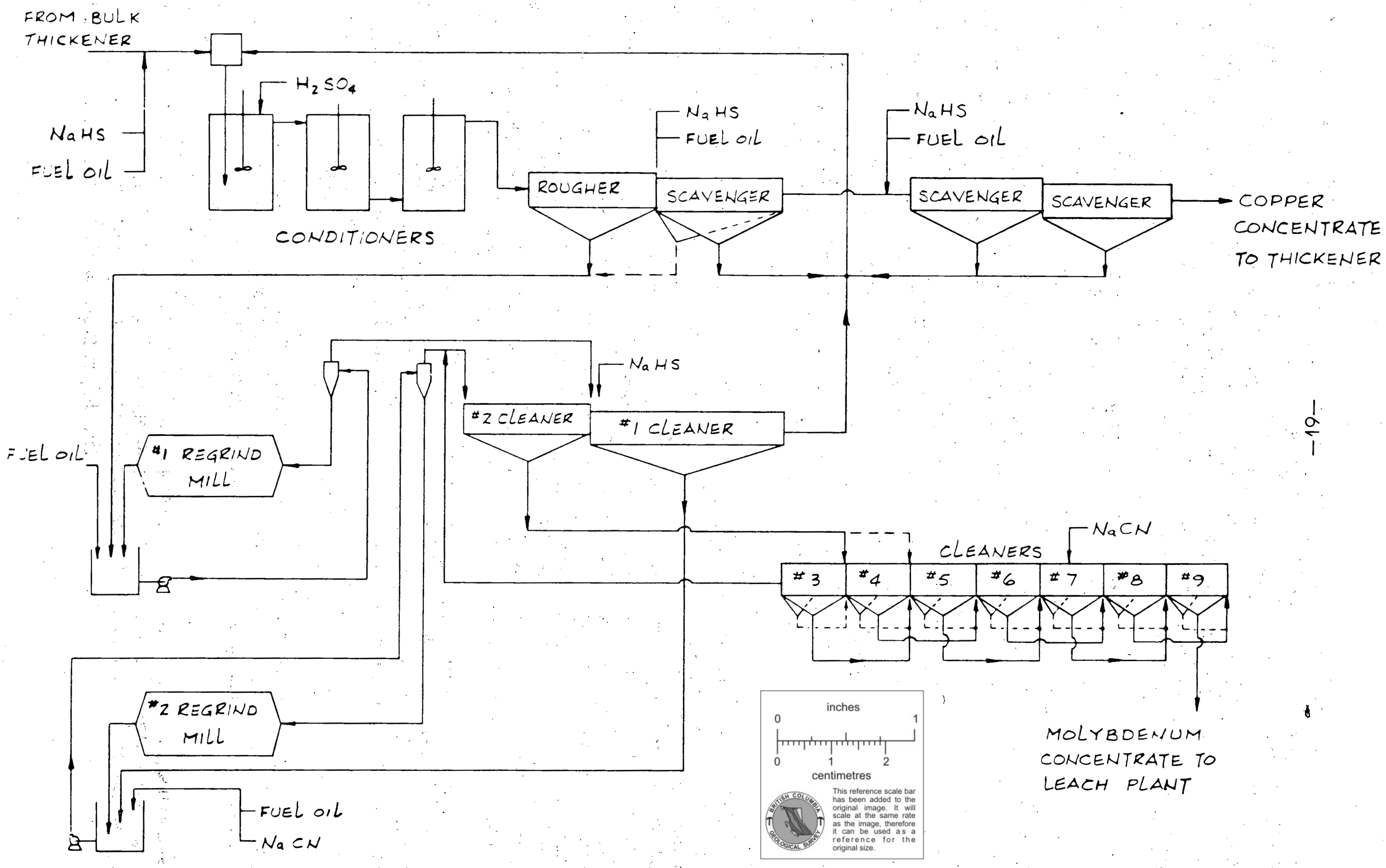
Copper/Molybdenum Separation

Dewatered bulk concentrates at 50 - 60% solids are conditioned with fuel oil and sodium hydrosulphide in a pump box prior to pumping to three separation plant conditioners, where sufficient sulphuric acid is added to reduce the flotation feed PH to 8.5. The rougher-scavenger section of the molybdenum flotation plant consists of 16 Denver No. 30 DR cells, arranged in four banks of four cells in series. Typically, four cells are used for roughing and eight for scavenging, although additional rougher and scavenger cells are sometimes used.

The molybdenite rougher concentrate reports to two 11 inch Krebs cyclones and the cyclone overflow cleaned in six No. 24 DR specials. The cyclone underflow passes through a 6 foot diameter by 10 foot long Denver ball mill back to the cyclone feed. The first cleaner tailings and scavenger concentrates are recycled to the pre-flotation conditioners, and the first cleaner concentrate sent to the discharge sump of a Denver 6 foot diameter by 6 foot long regrind mill in closed circuit with a 6 inch Krebs cyclone, and thence cleaned in a second cleaner consisting of four Denver No. 24 DR special cells. Six additional cleaning stages, each using two Denver No. 24 Sub-A cells, arranged to operate counter-currently, complete the circuit. The concentrate from the eighth cleaner is collected in a surge tank prior to pumping to the leach plant.

The tailings from the molybdenite flotation plant is the final copper concentrate. This material flows by gravity to a 100 foot diameter thickener for dewatering prior to filtration.

LORNEX COPPER/MOLYBDENUM SEPARATION CIRCUIT



Copper Concentrate Drying and Shipping

Underflow from the final copper thickener is pumped to two 8½ foot diameter by seven disc Dorr-Oliver-Long filters. The filtered product, normally at 12 - 14% moisture, is conveyed to an 8 foot diameter by 48 foot, natural gas-fired, parallel-flow rotary dryer. Dryer discharge, at 8% moisture, is conveyed to a 1,400 ton storage bin.

The concentrate is loaded directly from the bottom of this bin into trucks which take it to the railhead at Ashcroft. From Ashcroft, it is moved by rail to Vancouver to await transportation to offshore smelters. A 14,000 ton concentrate storage shed provides on-site surge capacity.

Molybdenite Processing

The molybdenite flotation product is pumped to the molybdenite leach plant where it is filtered, typically using two of six available discs on a 6 foot diameter Dorr-Oliver-Long disc filter. Copper impurities are leached from the concentrate by batch heating the filter cake in a 50 gram per liter ferric chloride solution in one of three Pfaudler steam-jacketed 2,000 gallon reactors at 110 degrees.

The leach process is operated under licence from Brenda Mines Ltd. Following leaching, the molybdenite/brine slurry is blown to a 4,000 gallon Pfaudler water-jacketed cooling vessel and thence to one of two 1,200 mm Perrin filter presses equipped with 42 plates. A dump hopper beneath each filter press provides surge capacity. Ferric chloride is regenerated from the copper-laden brine by replacement reaction in a 5 foot by 8 foot neophrene-lined cementation drum followed by chlorination in the reactors prior to concentrate addition. The cement copper recovered is pumped to the copper concentrates thickener. The filter press cake is metered via ribbon-type screw conveyors to a five hearth, 4 foot diameter Skinner dryer. Dried concentrates are transported via two ribbon screw conveyors and a bucket elevator to four 15 ton concentrate storage bins in the molybdenite packing section. The product is either drummed, using a Howe-Richardson auger-type packing machine, or bagged in a 30 cwt reinforced PVC bags before transportation to roasters.

Process Control

Analogue indication and control is performed by a Taylor Mod 3 shared display instrumentation system and a Taylor 1010 computer is used for supervisory control of critical loops. Motor stop/start stations and status indication, alarm communication and C.C. TV monitors enable most of the operation to be monitored and controlled from the central control room but where central control is felt to be impractical, field-mounted analogue controllers are used.

Tailings

The Lornex tailings pond is being developed in a valley between two tailings dams some 6.2 and 19 kilometers from the concentrator.

The location of the tailings pond was determined by the existence of additional ore bodies in the Highland Valley and by the control of certain surface rights in the area.

The elevation of the valley at the upper dam site is approximately 3,900 feet; the lower dam site 3,625 feet. The valley walls slope upward on either side of the U-shaped Highland Valley to the surrounding mountains which rise to a maximum elevation of approximately 6,000 feet. Two dams are required because of the relatively flat slope of the valley floor and the location near the natural surface divide of two watersheds. The Highland Valley is a classic example of a divide valley being drained to the northwest by one creek and to the southeast by another. The division between the two surface drainage systems occurs 3.2 kilometers upstream of the upper tailings dam at an elevation of 3,925 feet.

Agreements exist with other neighbouring mining companies to permit eventual joint use of the tailings pond. There is a potential impoundment capacity in excess of two billion tons between the upper and lower tailings dams, of which a third of the capacity is reserved for Lornex use.

Initial development of the pond included a third middle dam which was used to provide economical storage for the first 89 million tons deposited in the tailings pond.

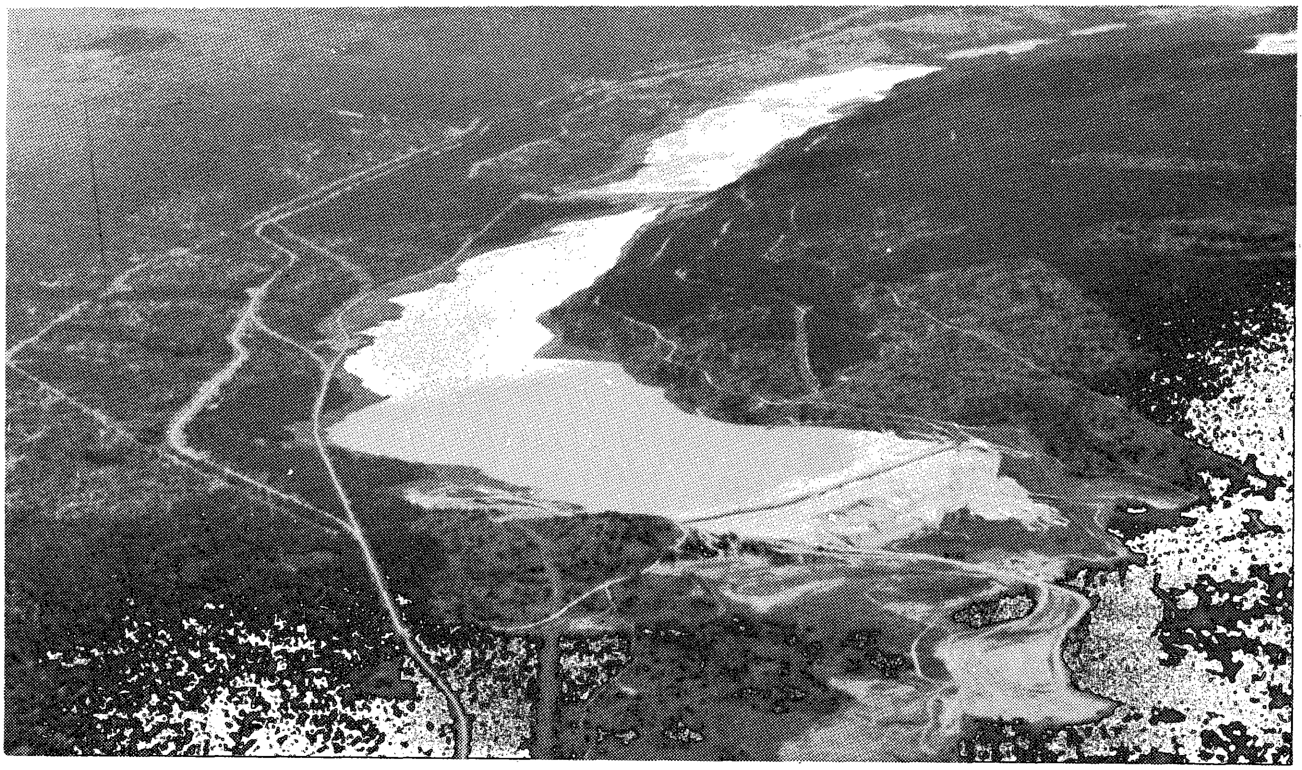
Rapidly escalating energy costs made the lower dam more economical than the middle dam by reason that two dams require less energy to build over the life of Lornex and neighbouring ore bodies than three dams, and by reason that the run-off area entrapped by the tailings dams increased from 40 square kilometers to 80 square kilometers, greatly reducing the energy costs required to pump make-up water from the Thompson River.

The tailings dams are zoned earthfill structures utilizing the centerline method of construction and an impervious glacial till core to reduce seepage through the structures. As the dams are raised, the zones upstream and downstream of the core are constructed using sand cycloned from tailings as pervious granular construction material. The zone upstream of the core does not require special compaction. The zones downstream of the inside edge of the core are compacted to provide required stability during seismic conditions.

Spillways are not provided to bypass flood water by reason of cost and prevention of contamination of local water courses. The dams are designed to hold the annual run-off, plus the 100 year flood, plus the maximum probable (statistically the 10,000 year) flood, and still have 5 feet of freeboard.

The tailings pond is designed to be closed to the environment. All seepage and contaminated ground water is pumped back into the tailings pond.

Tailings from the copper-scavenger flotation circuit flow by gravity through twin 36 inch diameter polyethylene tailings pipelines to the upper end of the tailings pond inside the upper tailings dam.



The tailings flow down the delta to a flood control structure in the middle dam where part of the tailings is diverted to a pumphouse, the rest dumped in the upper end of a delta stretching towards the lower dam. These tailings flow down into the pond above the lower dam. Part of the solids in the tailings is deposited in the rising delta, the rest of the solids falling from suspension in the slurry in the pond.

The process water clarified by this sedimentation process is recycled back to the mill in the reclaim water system.

The tailings diverted to the tailings pumphouse is pumped by one of two 700 H.P. 16 by 16 LSA39 slurry pumps - one working, one standby - to a headbox through 20 inch diameter steel pipelines where it is fed through a 24 inch diameter polyethylene pipeline and carried 12,000 feet to a primary cyclone station at the lower dam.

The primary cyclone house contains a bank of fifteen 20 inch cyclones and two 250 H.P. 12 by 10 slurry pumps feeding two 14 inch pipelines feeding secondary cyclones on the dam.

The cycloned sand produced by the secondary cyclones is placed hydraulically directly in place on the upstream side of the dam, spread and compacted at the lower downstream side of the dam using D8 bulldozers, or placed in stockpiles upstream and downstream of the dam. The material placed in stockpiles is subsequently hauled by scrapers, spread and compacted in the downstream shell.

Water Supply

Low annual precipitation and high evaporation rates encountered in the Highland Valley and the considerable distance of the mine from a reliable source of water made it difficult and expensive to assure an adequate and dependable supply of industrial water.

The Highland Valley occurs in the "Interior Dry Belt" in British Columbia's southwest interior and precipitation varies from 12 to 25 inches annually.

The only completely reliable source of water is the Thompson River, some 26 kilometers from the plant, at an elevation of 850 feet compared to the elevation of 4,200 feet at the floor level of the concentrator.

Provisions are included and have been expanded over the years to provide for maximum recycling of water, and to use all the natural run-off into the tailings area and other areas of mining operations to provide makeup water for the operations to reduce pumping requirements from the river.

Prior to the time Lornex expanded its operation from 48,000 T.P.D. to 83,000 T.P.D., the natural run-off into the tailings pond and other areas of the mining operation was sufficient in a year of average precipitation to provide all the makeup water required to run the operation.

The Thompson River pumping system which at startup had been designed to pump 4,000 - 5,000 U.S. gpm, was utilized only during dryer than average years or during emergencies.

After expansion, during years of normal precipitation, one of the four Thompson River pumps provides the additional makeup water, 2,000 U.S. gpm required for process; the other three pumps are in reserve for dry years and emergencies.

The reclaim water system delivers an average of 28,000 U.S. gpm back to the mill as reclaimed process water.

Raw Water System

Fresh water is drawn from the Thompson River by three vertical turbine pumps (two operating, one standby) mounted on the concrete intake structure in the river. The pumps are equipped with 125 H.P. motors and pump 3,800 gpm each against a total dynamic head of 100 feet. The intake structure is equipped with two travelling screens for trash removal. These are of an approved type to prevent the ingestion of fish. The entire intake system has been approved by the Department of Fisheries.

Normal requirements of fresh makeup water are expected to be 2,000 gpm. The pumping system from the Thompson River is designed for a capacity of 6,000 gpm.

A maximum intake capacity of 20,000 gpm allows for expansion of the Lornex system and for water supply to other possible future operations in the Highland Valley. The river intake pumps discharge into a clear water tank, 90 feet in diameter by 40 feet high.

From the clear tank, fresh water is pumped in a single stage through 18 kilometers of 20 inch line to a 266 million gallon reservoir at an elevation of 4,700 feet. Each of the three 6 inch by 8 inch 9-stage pumps (plus one standby) in the system, is driven by a 3,000 H.P. motor and delivers 2,000 U.S. gpm against a total dynamic head of 4,390 feet.

Reclaim Water System

The reclaim water system is designed to provide the total average mill water requirement of 28, 450 U.S. gpm, with a spare pump in reserve for maintenance backup and above average monthly production rates.

Water from the tailings pond is pumped from a barge containing six 1,000 H.P. 3-stage 20 inch vertical turbine pumps through two 24 inch diameter rubber hoses to shore, then through four 20 inch diameter pipelines to a head tank approximately 500 feet above the barge. Each pump delivers 6,042 U.S. gpm against a total dynamic head of 518 feet, providing a total capacity of 36,250 U.S. gpm. The feed tank feeds a 36 inch diameter gravity pipeline, 18,000 feet long feeding the reclaim water booster pump station.

The reclaim water booster pump station contains seven 16 inch 10-stage vertical turbine pumps each delivering 4,575 U.S. gpm against a total dynamic head of 808 feet, driven by 1,000 H.P. synchronous motors, providing total capacity of 32,000 U.S. gpm. The reclaim water is pumped 4,000 feet through four 20 inch steel pipelines and a 32 inch polyethylene pipeline, 6,000 feet to a reservoir containing 266 million gallons of live storage.

The reservoir feeds eight kilometers of 28 inch polyethelene 24 inch steel and 20 inch steel pipeline in three parallel pipelines to the mill.

At the concentrator, three steel tanks, with a total capacity of 3 million gallons, are provided for process water storage.

Two additional 300 foot diameter thickener tanks provide an additional 15 million gallon reserve water storage capacity.

Reclamation

The Reclamation Department is concerned with developing methods for the huge reclamation operation to begin when operational conditions permit. Plans and techniques are being tested on an on-going basis. Grasses, legumes and trees are planted on slopes and in varying soil types and environmental conditions. Growth performance is monitored and recorded for future reference and planning.

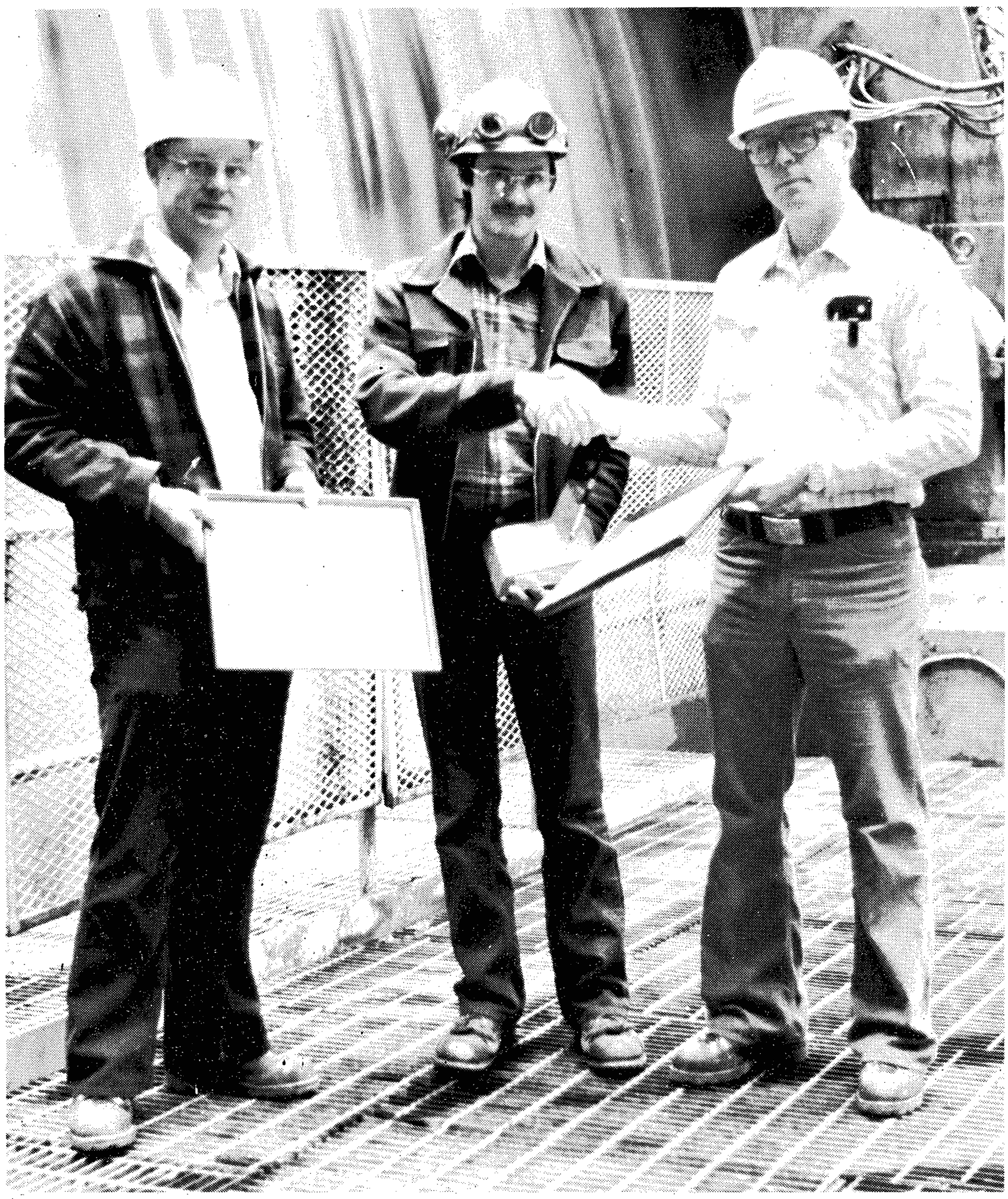
Guidelines for the direction of long term reclamation have been established by the mining industry and the Provincial Government Mines Department. As these rules apply to Lornex, for the mined out pit, the waste dumps and the tailings pond, a vegetation must be established which is:

1. Visually and practically complimentary with the surrounding vegetation of the Highland Valley;
2. Self sustaining after initial establishment fertilizer applications;
3. Hopefully, an improvement to the economic value or an enhancement to the natural value of the land.

Some of the ultimate land uses planned for different areas of the abandoned minesite are tree farming, in cooperation with the Provincial Forestry Service, enhanced grazing land for both cattle and wildlife, hay production on irrigated flat areas and recreation land open to the public as are most Crown forest lands in the Highland Valley today.

Manpower and Housing

Our manpower continues to grow with each expansion. As a result of the most recent, 300 additional employees were hired, bringing our total to 975. Of these, 539 are employed in the Mining Department; 228 in the Milling Operations; 102 in the supporting Services Department; 102 in Administration and Warehousing, and four in the Vancouver office. This contributes to an annual payroll in excess of $30,000,000.00 (1982).



Participating in government approved/assisted apprenticeship programs, Lornex is providing employees incentive to achieve Journeyman certification in the welding, mechanical and electrical trades. Educational assistance is also available to those employees desirous of upgrading knowledge and skills in order to prepare themselves for increased responsibility with the company.

A company newspaper is published by the Personnel Department on a quarterly basis, keeping employees advised of related activities.

Worker turnover rates at Lornex are the second lowest in British Columbia. Consistent with high wages and good working conditions are an excellent living environment in Logan Lake, where 75% of our employees live.

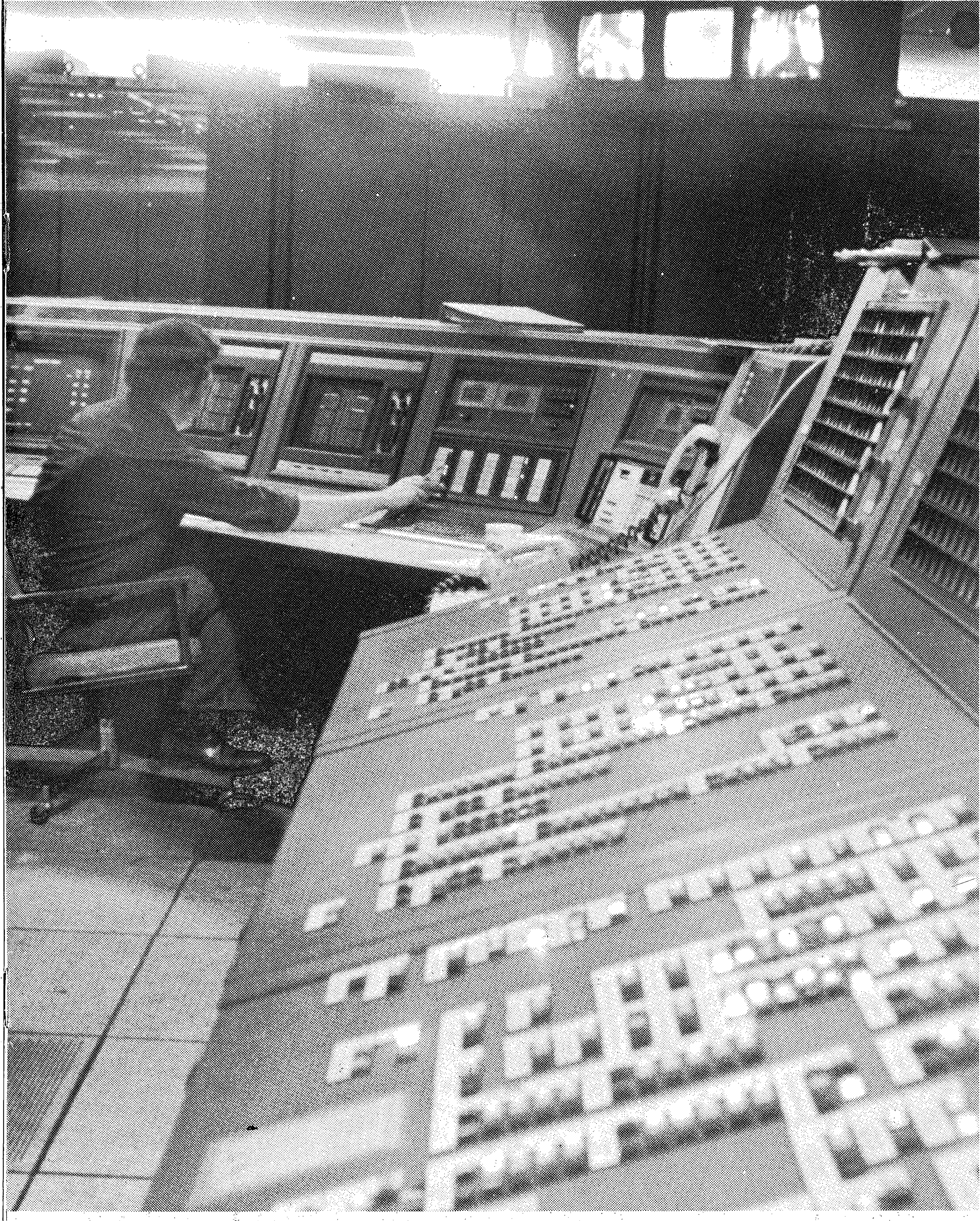
Located 17 kilometers east of the minesite, the village provides an urban living in an attractive rural setting. Shopping malls, an all-denominational church, library, garages, hotel, motel, and a year round recreation centre are augmented by a medical centre, a provincial ambulance service and a well equipped fire department. Educational facilities offer education to Grade 11 with Grade 12 being completed in Kamloops.

From the original townsite of 100 homes into which employees moved in July of 1971, this model town now boasts 760 single family homes and four large apartment complexes. Provincial aid and generous company home ownership assistance plans encourage further growth by employees.

Increased mining activities in the valley have accelerated growth in Logan Lake, with employees of Cominco and Highmont Mines selecting the favourable opportunities offered in this modern townsite over that of commuting to other nearby towns or cities.

ACKNOWLEDGEMENT

Articles contributed by
the staff at Lornex



Lornex

P.O. Box 10335
Suite 1650 - 609 Granville Street
Vancouver, B.C. - V7Y 1G5
Phone (604) 688-3646

Mine Office,
Lornex Mining Corporation Ltd.
P.O. Box 1500, Logan Lake, B.C.
V0K 1W0
Phone (604) 575-2443