Front Cover: Zinc-covered bubbles in flotation cells. Inset: A silhouette of Pine Point's 30-cubic-yard dragline.

Cominco

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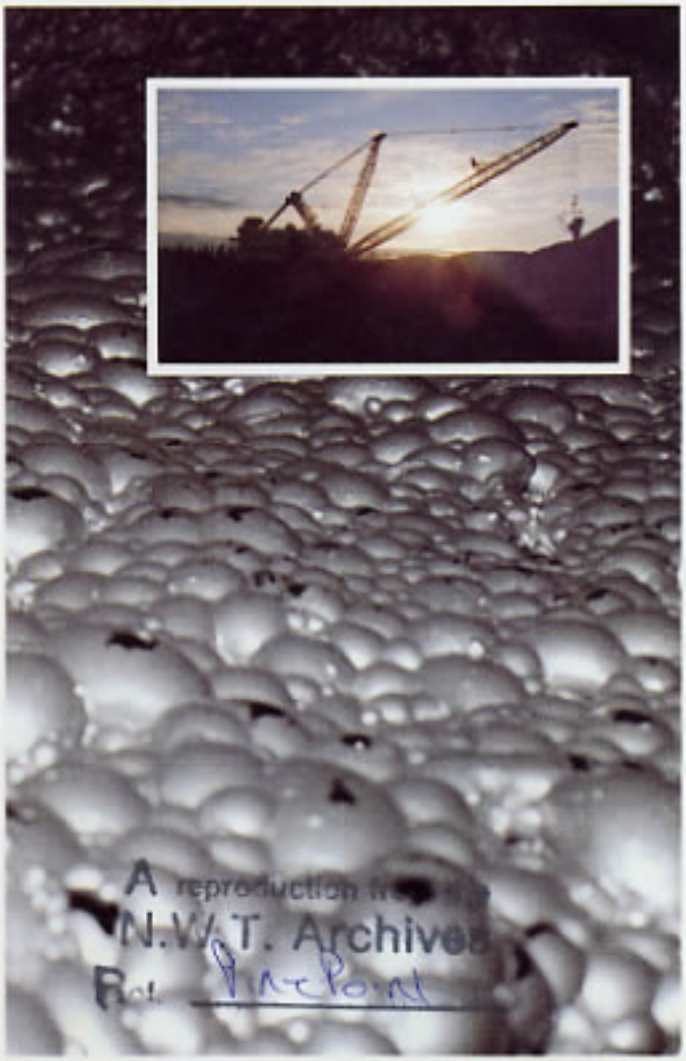
Zinc/Lead Mining at Pine Point, N.W.T.

Pine Point Mines Limited



Pine Point

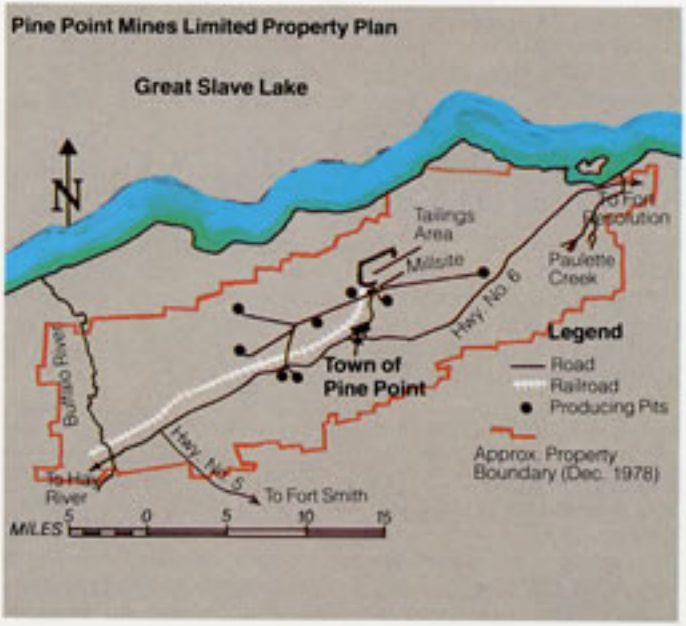
A commitment to the North

Pine Point Mines Limited owns zinc-lead mining and milling operations located at Pine Point, Northwest Territories, five miles south of the Great Slave Lake. The company is staffed and managed by Cominco Ltd., which has a 69% interest in Pine Point Mines.

Established at Trail, British Columbia in 1906, Cominco has been a major world miner and processor of zinc and lead for over 70 years. The company has been committed to exploration and development in the North since 1928 when it acquired some claims in the Pine Point area. The following year Cominco established the first exploration flying service and its engineer-pilots combed the North, focusing on the Great Slave Lake and Mackenzie Valley area.

Cominco's first northern mine, the Con, started producing gold at Yellowknife, N.W.T. in 1938. Today, the company employs over 275 people at the Con and over 550 at the Pine Point Operations. The company also owns 75 per cent of Arvik Mines Ltd., which owns the Polaris lead/zinc deposit located on Little Cornwallis Island, high above the Arctic Circle.

In 1975, Cominco established its Northern Group office in Yellowknife headed by a Group Vice-President. The office is responsible for all of Cominco's mining operations and subsidiary companies in the North.



From 1898 . . .

The first recorded mining activity in the Pine Point area happened back in 1898 when the Yukon gold rush was on. Gold fever was contagious in northern Canada then, but when the zinc/lead showings in the Pine Point area didn't yield much in the way of gold, interest in the area soon waned.

Serious prospecting began in the 1920's when Dr. C.B. Dawson staked claims for a Boston group. Cominco followed in 1928 and in 1929 amalgamated with the Atlas Exploration Company and Ventures Ltd. to form the Northern Lead Zinc Company to explore the Pine Point area more fully.

Poor surface showings curtailed interest in the area in 1930. However, Cominco maintained its interest there and continued assessment work from 1930 to 1948 to retain its 104 claims.

During the 1940's, Cominco geologists developed and expanded geological theories about the area and concluded that several orebodies might occur in the general vicinity of previous work. Extensive exploration drilling began on a 500 square mile concession area in 1948 and continued through to 1955, indicating rich pockets of zinc/lead ore near the surface. Pine Point Mines Limited was formed in 1951 with Cominco acquiring a majority interest in it. The new company obtained the claims staked in the concession area as well as the ones held by Northern Lead Zinc.

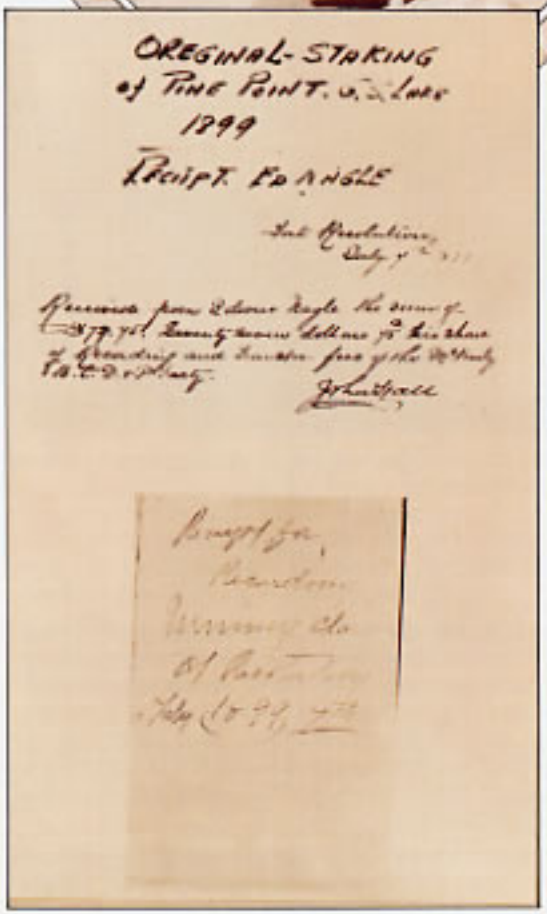
The early 1960's were expanding years for Pine Point. In 1962 construction began on the Great Slave Lake Railway between Roma Junction, Alberta and Pine Point. The $79 million rail line, part of the "Roads to Resources" program, was the result of an agreement reached the year before by the Canadian National Railway, the Federal Government and Pine Point Mines Limited.

While the 423-mile-long railway was being built in 1963, the townsite of Pine Point was laid out and services were installed. By the end of the year, 53 homes, a dining room/recreation hall and a number of new bunkhouses provided Pine Point with a permanent spot on the map.

Also in 1963, Cominco began mining operations and construction was started on the 5,000 ton-per-day concentrator.

The following year, 1964, the railway reached Pine Point well ahead of schedule and before the concentrator was completed. This early transportation, and the availability of high grade ore (averaging 50% combined zinc and lead) made it possible in 1965 to send ore shipments directly to Cominco's plants at Kimberley and Trail, B.C. for processing.

In late 1965, the mill began operation. It was also a year of major claim staking in the Pine Point area. This activity resulted in the discovery of a substantial orebody east of the Pine Point property by Pyramid Mining Co. Ltd. The following year Pine Point Mines Limited acquired Pyramid's mineral claims in the area. In 1968, the company increased its concentrating capacity from 5,000 tons to 10,000 tons-per-day. Various improvements since then have resulted in the capability to treat 11,000 tons of ore per day.



Ted Nagle (top) in 1929 arriving at Pine Point's original cabin. Pictured below, the receipt for original staking of Pine Point.

Mining at Pine Point

The Pine Point Operations differ from many other surface mines. Instead of mining one large orebody at a time, the company mines several small orebodies simultaneously. Each open pit has its own characteristics; the ore grade, ore density and orebody depth vary with each pit. Because of this, a great deal of imagination and innovation has been necessary to deal with the logistics and problems unique to mining at Pine Point.

Part of a year-round exploration program, this shrouded diamond drill rig works on a bed of frozen muskeg in the winter.

Finding the Ore

A continuing exploration program in and around the Pine Point property has kept ore reserves at a relatively steady level, continually extending the life of the mine. An active exploration program is essential to maintain ore reserves and to allow long-term planning and development. When exploration can no longer find orebodies, the mining operations will gradually be exhausted and will close. It goes without saying that exploration plays an important role at any mine.

Exploration programs leading to the discovery of orebodies are fairly complex. When a geologically "favourable" area has been outlined by geologists, an I.P. (induced polarization) survey is conducted. By sending electrical currents through the earth, the geophysicists and geologists can locate places where mineralization might occur.

Diamond drilling is then carried out in promising areas, and the cores from the drilling are closely examined and tested to determine basic geological information and to note the occurrence of any ore. If there are good results from an area, much more diamond drilling is necessary to define the size, shape and grade of the orebody.

(The geological formation in the Pine Point area is a reef-like body of rock deposited 350 million years ago in a warm, subtropical sea. The ore minerals are sphalerite [ZnS] and galena [PbS], known as zinc and lead sulphides.)

Ore reserves are compiled from each body of mineralization located and their outline, size and grades are then passed along to the planning department where the ore samples are evaluated in terms of mining economics. The planning department projects accessibility of the orebody on a cost basis and looks at it in relation to the orebody's grade, the current and projected market conditions of lead and zinc, transportation costs, government taxes and regulations and many other factors.

If, after all the planning department's tests and projections, it is found that an orebody can be developed and give the company a profit, it is put on a development schedule.

Galena — lead ore at Pine Point.

Developing an Open Pit Mine

In planning to mine a pit, the planning department must determine how the pit's production will fit in with the company's production forecast. Deciding when to develop the pit, how the ore grade fits in with current grades being mined, what the distance is from the orebody to the concentrator and how the pit will fit in to the Operations' dewatering program* are some major considerations that are made in this stage.

**(Land in the Pine Point area has a high water table. Water must be pumped out of the pit area to bring the water level down so that the pit can be dug without encountering thousands of gallons of water.)*

The first step in the physical development of the mine is building an access road to the pit site and doing a pump test. This involves drilling a hole to the level of the orebody to find out how much water is present and to discover at what rate water will flow into the well hole from the surrounding water table when pumping begins.

This test helps establish the number and size of pumps needed for dewatering the orebody and what pumping rate will be required to keep the mining operations, people and equipment dry.

With the pump test completed, the area covering the orebody is cleared and an access road is built around the perimeter of the area to be mined. The necessary number of pump holes are drilled and pumps are put in place. A power line is brought in to service the pumps and other electrical equipment used in mining (such as electrically-operated, 9-cubic-yard shovels). A dumping area is outlined for the overburden (earth covering the orebody).

Top: The dragline removing overburden dwarfs a bulldozer at work.
Inset: An electrically-operated shovel loads an 85-ton-capacity truck with lead/zinc ore.
Bottom: While blastholes are drilled, truck hauls blasted ore to the concentrator.

Digging the Open Pit

The actual digging begins with the removal of overburden by dragline or shovels and trucks. Overburden depth varies from 20 to 90 feet on Pine Point's property. Sometimes there is caprock (bedrock covering the orebody) under the overburden which must be blasted away.

When the orebody is uncovered, its density is evaluated and blastholes are drilled in specified grid patterns and loaded with predetermined amounts of explosive. Each blast breaks up ore to a depth of 25 feet or more. When all the broken ore is removed, another grid is drilled and blasted. The blast breaks the ore into manageable chunks that can be loaded into ore trucks by the 9-cubic-yard electric shovels and front-end loaders.

The variety of mining equipment and machinery at the Pine Point Operations includes electrically-operated and diesel-operated shovels for overburden and ore removal; a fleet of 85-ton-capacity ore trucks; a 150-ton-capacity ore truck named "Fat Albert"; 150-ton-capacity tractor-trailer ore haulers; blasthole drill rigs; front-end loaders; bulldozers and numerous service vehicles. A 30-cubic-yard walking dragline was brought into operation early in 1979 to increase Pine Point's overburden removal capacity.

The number of people and amount of equipment to be used at each pit is determined by the size of the orebody and the need for ore from that particular pit.

The pits are planned and dug so that there is a 45 degree slope to the walls. This provides for a spiralling road down into the pit and also for wall stability to protect the people and equipment working in the pit bottom.

Depending on the pit's location, the ore is transported five to ten miles by truck to the concentrator. At the concentrator the ores from various pits are blended by stockpiling them to standardize the grade of ore being fed to the mill (concentrator).

The time it takes to explore, plan and evaluate a potential open pit mine can take many months, even years. The time it takes to actually mine an orebody can take years and millions of dollars.

One of the company's larger open pit operations.

Top: Inside the concentrator, rod and ball mills rotate to grind the ore.
Centre: Zinc concentrate bubbles to the top of these flotation banks then moves on to further processing.
Bottom: A focal point in the concentrator: flotations cells (lower right), part of a thickener (left) and drum filters (upper centre).

Processing the Ore

Concentration of the Pine Point ore begins by reducing the chunks of mine ore to particles of less than ¾ inches in diameter using primary and secondary crushers. (See Flow Diagram - back page fold-out.)

The crushed ore is conveyed to large storage bins that feed three rod mills. These mills are large cylindrical machines (approx. 9 ft. diameter) containing steel rods 11½ feet long and up to 4 inches in diameter that are used to grind the ore to the size of sand as they rotate. Water is added in this process to make a "slurry". The slurry is piped to three ball mills (approx. 11 ft. diameter) which also rotate and use two-inch steel balls to further grind the ore to a flour-fine consistency.

This slurry is in turn fed to cyclones which send oversize material back to the grinding circuit and send acceptable slurry on to the flotation cells. In these cells, chemical agents are added to the slurry and the mixture is agitated with air. Bubbles rise to the surface with the lead and zinc minerals attached to them. The mineral-laden bubbles are skimmed off, leaving most of the waste material behind.

The water from the lead concentrate slurry is removed in two stages: first it is thickened in a settling tank and then more water is removed by a vacuum process on a drum filter. The concentrate, approximately 76 per cent lead at this stage, is then loaded directly into railcars.

The concentration of zinc is a little more complex than the lead process. Because the Pine Point zinc concentrate contains some impurities that cause problems in refining, these impurities must be "leached" out. After the flotation process, the zinc concentrate is passed on to the thickener for partial water removal. From this point it is pumped to large wooden tanks where it is mixed with 93 per cent sulphuric acid to dissolve (or "leach") some impurities and change the chemical composition of others. These reactions use up most of the sulphuric acid so there is little problem with corrosion of the process equipment, although "acid-proofing" precautions are taken.

After this, the zinc concentrate is thickened and filtered to remove most of the water. It is then put through a rotary dryer to remove much of the remaining moisture with hot air. The dried concentrate, consisting of 58 per cent zinc, is conveyed to railcars or to a stockpile to await later shipment.

Working through the night, an ore truck heads for another load.

Mine to Market

Zinc concentrate from Pine Point is transported by rail chiefly to Cominco's metallurgical operations at Trail, B.C., with the balance going to off-shore sales, to Flin Flon, Manitoba or to Idaho. Some of the lead concentrate goes to Trail for refining but most of it is sent by rail to Vancouver for overseas shipment to the Mitsubishi-Cominco lead smelter in Japan and to other export customers.

At Cominco's Trail operations, the concentrates are smelted under extreme heat and then are electrolytically refined. Zinc slabs weighing 56 pounds each, one-ton blocks (jumbos) and special continuous cast (C-Cast) bars weighing 100 pounds per linear inch, are sold to North American and overseas die casting and galvanizing companies. Much of the lead is sold in 100-pound bars and one-ton jumbos to vehicle battery manufacturers and to gasoline manufacturers.

Concentrate train on its way to concentrator.

Uses of Zinc and Lead

Zinc

The two major uses of zinc are galvanizing and die casting.

In galvanizing, steel products are dipped into baths of molten zinc until they are completely covered with a thin layer of it. This zinc coating is called galvanizing and is a very effective rust prevention agent. Examples of galvanized products include chain link fencing, metal light poles, heating ducts and steel siding.

In the die casting process, molten zinc is injected or poured into a metal mold called a "die" where it hardens to the form of the mold. There are die cast zinc products in every North American household: in electrical appliances, plumbing fixtures and power tools. Zinc die cast products are in cars and trucks also — the most notable example being carburetors.

Lead

Lead storage batteries constitute the biggest user of lead in North America. Trailing a distant second is the use of lead as an anti-knock additive to gasoline. Lead is also used for ammunition, solder, cable covering and many more products.

Pouring of molten metal — part of smelting process at Cominco's Trail operations.
Inset: Lead and zinc applications — lead acid storage battery (top) and highway median (bottom) made of zinc galvanized steel.

Working at Pine Point

Over 550 men and women contribute to making the Pine Point Operations run efficiently and smoothly. There are five major areas in which the employees work:

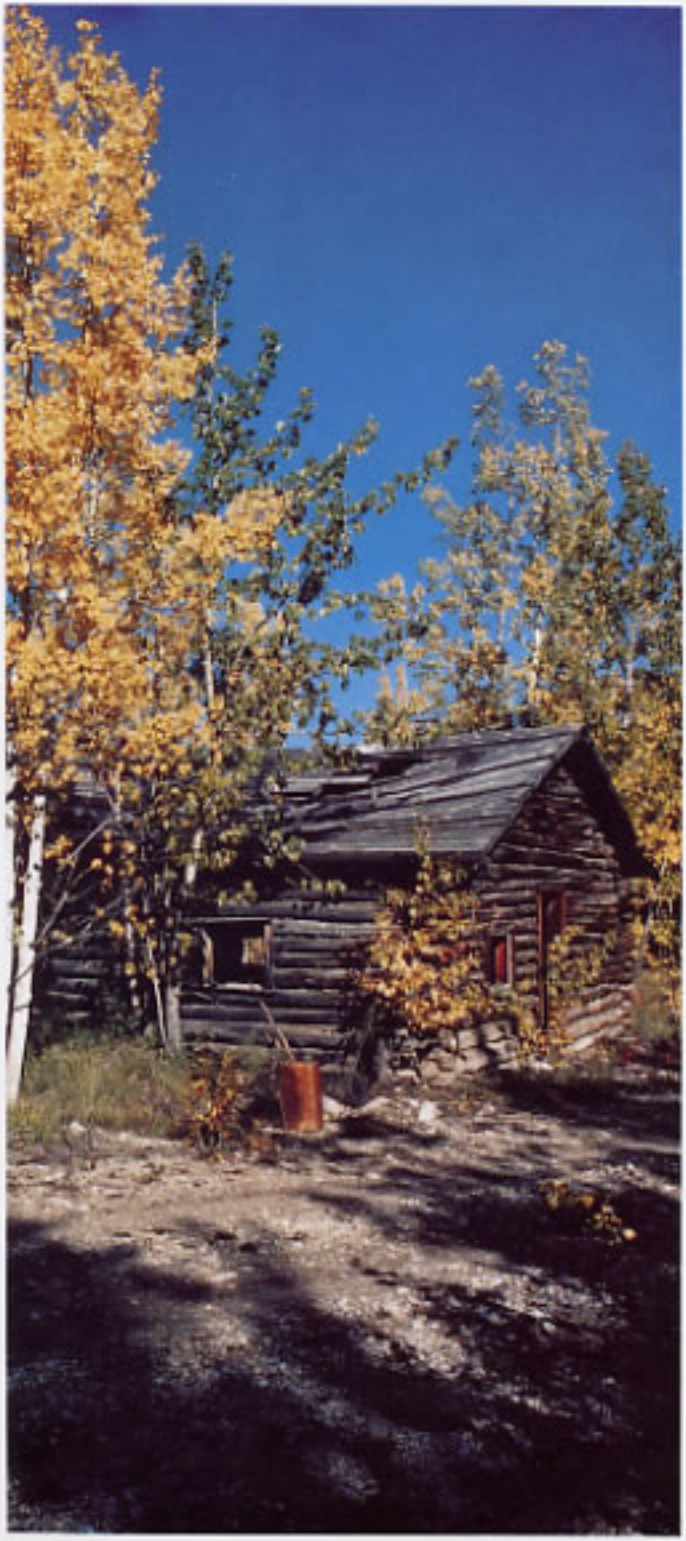
1) Pit Operations — Jobs include surveying, operating heavy equipment such as ore-hauling trucks, electric shovels and blasthole drill rigs; installing and maintaining dewatering wells; casual labourer jobs involve assisting in the above and other jobs at the pits.
2) Mill Operations — Technical, maintenance and professional skills are required to oversee the crushing and concentrating operations. Jobs range from doing chemical analyses and planning improvements to the concentration process, to keeping the plant clean and all machinery in top operating shape.
3) Shops and Services — This area involves a wide range of essential jobs including maintaining and repairing *all* equipment in the pit and mill operations; ensuring a ready supply of goods and equipment and improving repair systems. (Apprenticeship training programs are offered in each of the above areas, and many employees take advantage of them.)
4) Office Services — The management, personnel and accounting functions of the Pine Point Operations are handled by the office staff. Jobs include professional and clerical positions in all three functions.
5) Engineering and Geology Services — People in this area conduct and analyze Pine Point exploration programs as well as plan and develop mining production plans. Occupations in this area include mining and exploration geologists; metallurgical engineers and a number of mining, geological and survey technicians.

The company offers employees and their families such benefits as subsidized housing, fuel allowance and paid airfare programs to "southern" Canada as well as other benefits.

The total annual payroll of the Pine Point Operations is over $14 million.

A continuing job recruitment program is carried out in the surrounding communities and outside the Northwest Territories.

Employees at Pine Point have come from across Canada and overseas to work in the North. The majority of them are young, with the average age being 25 years. Most of the people live in the nearby town of Pine Point.



Caring for the Environment

All industries produce waste and many change the contour, shape and look of their surroundings. Cominco's policy is to eliminate problems which create a hazard or nuisance to their employees and the public. The company's management team at each local operation is responsible for pollution control and environmental rehabilitation. They are supported by an experienced professional staff of environmental control specialists including agronomists, soil scientists, laboratory and research technicians, biologists and a variety of engineers.

There are a number of revegetation projects being conducted by Cominco environmentalists at various pit operations to discover how best to return the mined-out areas to native vegetation. The reclamation of pit areas and the overburden dump sites is also being worked on so that eventually the mined-out areas will blend with the surrounding environment.

Tailings (waste water) from the concentrator are impounded in a tailings pond where solids settle out and necessary treatment is done to ensure that any water that leaves the pond will meet the conditions specified in the licences issued by the NWT Water Board. When water is discharged, it is monitored regularly to ensure that standards are met.

In the pit dewatering operation, natural water is pumped from the ground, collected in a series of ditches and discharged in the swampy areas to the north of the property. Precautions are taken to control this water and to minimize its effect on the natural environment.

In addition to the company's environmental specialists, Pine Point Operations have used the independent services of B.C. Research — a well-known company in the field of environmental research. B.C. Research has conducted major wildlife and vegetation studies in the Pine Point area and also has studied the surrounding watershed to determine the effects of the mining operations on the environment. All studies have been made available to the public.

Technician examines vegetation in one of company's test plots.
Left: Built in the late 1920's, one of the log buildings from the original exploration base camp.

Pine Point, N.W.T.

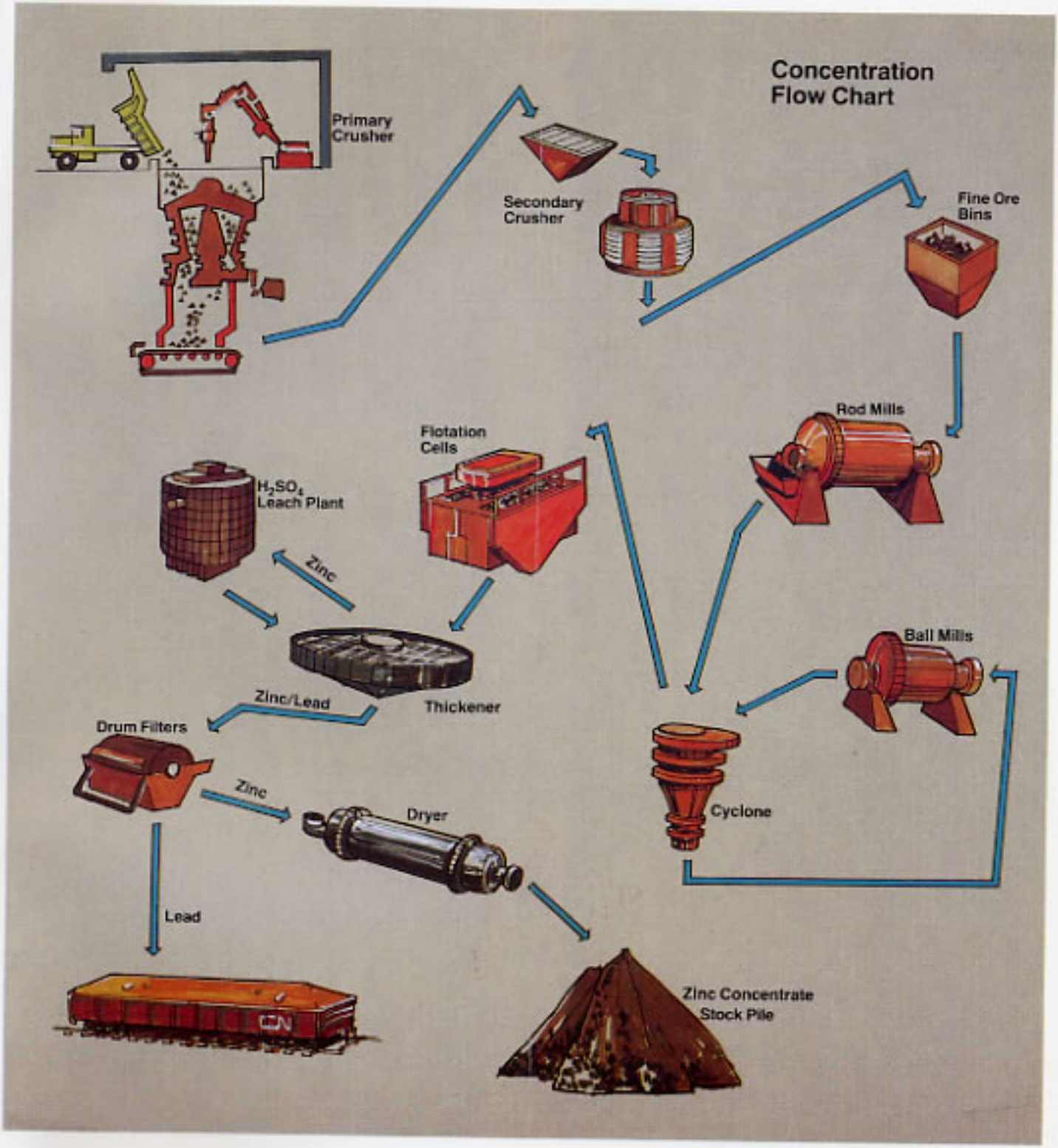
Today the Town of Pine Point has a population of over 1800 residents. Most of the mine employees live in houses, mobile homes, apartments and bunkhouses in Pine Point. The Town is run by a council elected by the residents.

Pine Point has a variety of stores, a bank, a number of churches and a full-time medical clinic. There are excellent recreational facilities, including a golf course, baseball park, indoor swimming pool, a curling/skating arena complex and indoor rifle range.

Grades one through twelve are offered by Pine Point schools. The Pine Point Hotel provides accommodation for out-of-town guests.

Curling is one of several winter sports at Pine Point.

The Town of Pine Point (golf course in foreground).


Concentration
Flow Chart
Primary
Crusher
Secondary
Crusher
Fine Ore
Bins
Rod Mills
Flotation
Cells
H_2SO_4
Leach Plant
Zinc
Ball Mills
Zinc/Lead
Thickener
Drum Filters
Cyclone
Zinc
Dryer
Lead
Zinc Concentrate
Stock Pile