MINESITE ENVIRONMENTAL REVIEW
HARBORSIDE, MAINE
JULY, 1986

for

Arrowhead Holdings Corporation
New York, New York

F. M. Beck, Inc.
198 Main Street
Yarmouth, Maine

TABLE OF CONTENTS

APPENDICES

Table of Figures and Plates

Minesite Environmental Review

Harborside, Maine

July, 1986

INTRODUCTION

In April, 1986, Mr. James Benenson requested that F. M. Beck, Inc. undertake an independent evaluation of Callahan Mining Corporation's former minesite in the Harborside community of Brooksville, Maine on Cape Rosier. The stated intent of this review was to identify any possible future costly cleanup by the owner--particularly in light of Federal environmental laws holding landowners financially responsible for pollution created by the owned land--whether created by the current landowner or not.

This report describes the areas of present and possible future pollution problems and discusses the nature and magnitude of the problems as well as current governmental policies toward the specific areas. The report is organized first to educate the reader about the history of the minesite and in particular the operational and reclamation history of the site during Callahan's tenure. Secondly, specific areas of the operation are discussed in more detail since they constitute isolated conditions and areas more or less independent of each other. An abundance of reference materials have been used for this report. Sources for this have included the Department of Marine Resources, the University of Maine, Department of Environmental Protection, personal files and Callahan Mining Corporation files which were made available for inspection in Phoenix, Arizona. Key references are included in the Appendix.

SUMMARY

The most obvious potential environmental problem at the Callahan minesite is the presence of buried oil tanks. Removal of these is required and some cleanup afterward may be necessary if they are found to have leaked.

The tailings pond does not appear to pose any significant environmental problems. Very small volume leaks of water from the base of the dam contain elevated levels of copper, zinc and cadmium. These leaks do not presently pose any recognizable environmental problems. If the leak water is porespace compaction water, the leaks will gradually diminish and stop. If they represent percolating rain water they will persist indefinitely but no increase in volume would be anticipated. The actual quantity of leak water is so low that it will not effect the large volume of tidal estuarine receiving water.

HISTORY OF OPERATIONS

Mining

The Harborside Mine was first operated in 1880 as an underground mine which produced high grade copper- and zinc-bearing rock which was shipped directly to smelters by sea for reduction to metal. Apparently, the mine enjoyed some prosperity until 1887 when a drop in metal prices closed this and most other mines in Maine. Sporadic attempts to explore and/or reopen the mine occurred during both World Wars but it was not until the mid

1950's that serious evaluation began (see Appendix A by for more detail). At this time (1955 I believe) a Canadian group acquired the property, capitalized it as Penobscot Mining Company on the Canadian stock exchanges, and conducted considerable drilling exploration. Apparently Penobscot Mining Company concluded that it could not economically justify putting the property into production and little activity occurred in the early 1960'S.

In 1964 Callahan Mining Corporation geologists became interested in the potential of the old mines along the Maine coast. Callahan acquired a lease from Penobscot Mining Company and began a period of exploration and evaluation which culminated in 1968 with the beginning of operations. The cost of exploration, evaluation and construction was $4.5 million which was financed internally. Callahan is a small mining company which has been listed on the New York Stock Exchange since 1914. It has owned and operated numerous mines over the years. Its principal source of income in 1968 was (and continues to be) a 50% net profits interest in the Galena Mine--a major silver producer in Idaho operated by Asarco, Inc.

Extensive engineering studies by Callahan confirmed that an underground mining operation was not economic, but that an open pit mine with its lower operating costs would yield a satisfactory return on investment. In order to conduct open pit operations, a variety of government permits needed to be obtained. These are listed below in no particular order or importance.

1. Mining lease from Maine Mining Bureau: The state owned

all the land and minerals underlying Goose Pond. The lease provided royalty payments to the State for all minerals extracted from State land.

2. The State acquired through legislative action the riparian rights to all lands bordering Goose Pond to allow draining the pond for mineral extraction.

3. Permit to construct a dam in a navigable waterway from the U.S. Army Corps of Engineers.

4. Permit from Maine Department of Transportation to construct a dam under the bridge--with the provision that it be removed following mining activities.

5. Permit from Maine's Water Control Board. This permit authorized Callahan to discharge water into Goose Cove.

6. A variety of operating permits such as explosives, trucking, etc. etc.

Callahan's overall concept was fairly simple. The seawater entrance to Goose Cove would be dammed at the north end of the pond and the fresh water entrance dammed at the south end. The fresh waters which normally flowed into Goose Cove would be diverted south through a drainage ditch into Wier Cove on the south side of Cape Rosier. Thus, with no new water flowing into Goose Pond it could be pumped dry and open pit mining undertaken in a normal fashion. The locations of the fresh water dam (now removed) and Wier Cove ditch are included in Appendix A. Probably the only other unusual feature of the mining operation was the planned use of seawater to use as process water in the concentrating mill. During operation this concept proved not to be entirely satisfactory and fresh water combined with recycled tailings effluent was substituted to the extent possible.

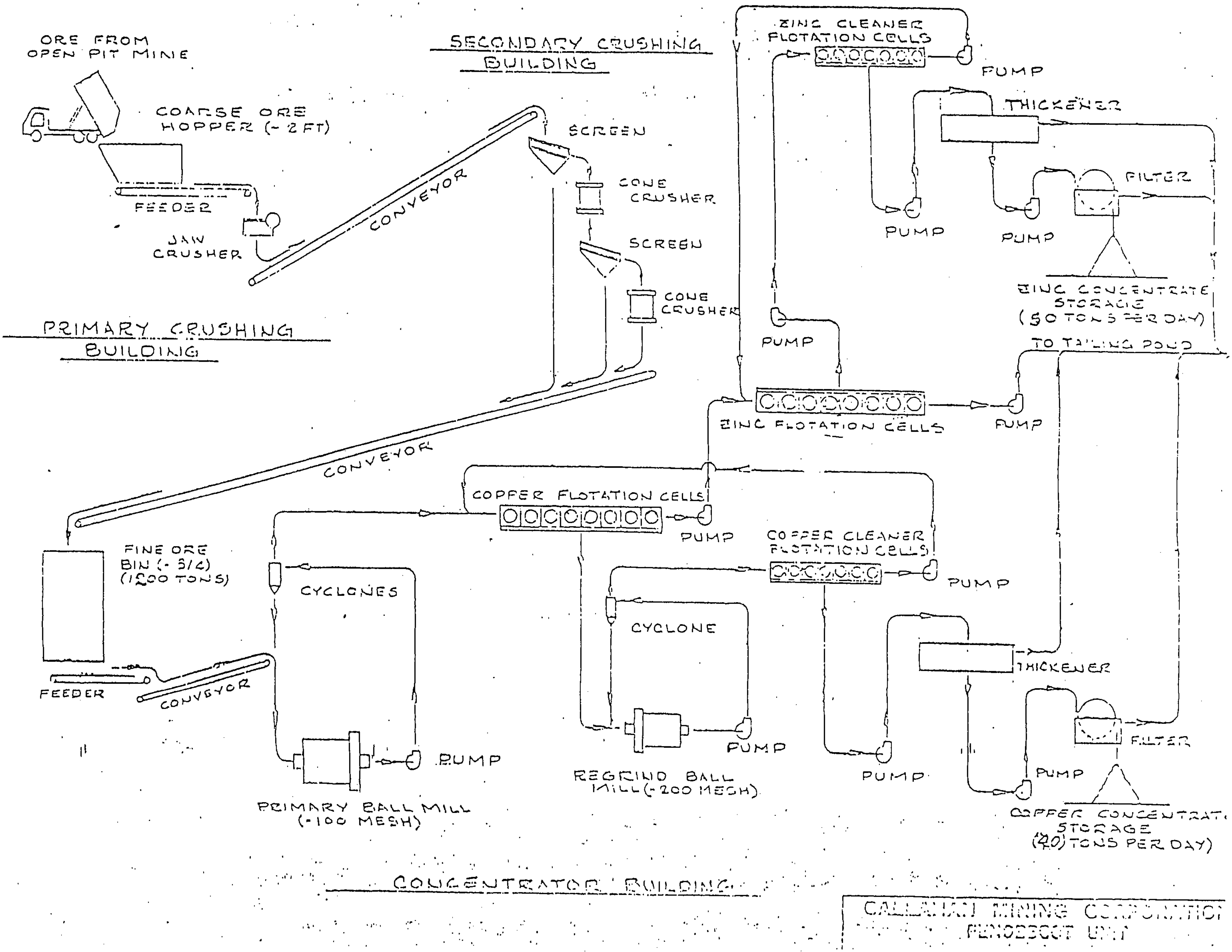
Callahan's production period extended from February, 1968 to June, 1972. During that period Callahan excavated a total of about 5 million tons of non-metal bearing waste rock and mined 798,000 tons of metal-bearing "ore" rock which was processed in a concentrating mill.

In the mining process, a roughly circular open pit was created about 600 feet in diameter and 320 feet deep. About two thirds of this occupied the original Goose Cove and one third occupied land originally owned by the Dyer family. For every ton of "ore" extracted, six tons of waste had to be removed and deposited in waste piles--now "Callahan Mountain" and the adjacent piles along the estuary. The "ore" was taken from the open pit to an ore storage area located above and behind the millsite on the south flank of Dyer Hill. From this storage area the ore was loaded into a series of crushers which reduced the rock size to under 1" in diameter. This crushed rock was stored in a large silo, from which it was fed into a ball mill which reduced the size to the consistency of fine sand and silt. This pulverizing was necessary to separate the ore minerals from the barren rock. Approximately 18% of the ore reaching the mill was actual ore mineral. The remaining 82% was barren. The function of the concentrating mill was to separate the ore minerals from the non-ore host rock. Following ball mill pulverizing a process called flotation was employed to separate the ore minerals. The separated ore minerals, called concentrates, were stored for shipment while the unwanted components were discharged in a slurry line to the "tailings pond".

The flotation process utilizes the concept of differing surface tensions experienced by different minerals to various fluids. Briefly, reagents added to water will create a froth (bubbles) which will cause ore minerals to rise to the top of a frothing container and waste products to sink to the bottom where they can be removed continuously. The frothing reagents do not chemically interact with the waste or ore minerals. To the extent possible, the frothing reagents are recycled within the mill. However, certain amounts of these reagents will accompany the tailings to the tailings storage pond. A flowsheet showing the milling process is shown as Figure 1.

During the life of the mine, 798,000 tons of ore were processed in the mill. The concentrates were shipped by truck to Bucksport where they were rail transported to appropriate smelters for reduction of the ore minerals to metal. The gross proceeds from sales to smelters totalled approximately $21,000,000. The total expenditure by Callahan from 1964 through 1972 was $22,000,000. The reasons for this obvious lack of profitability hinge on unrealistic pre-mining cost projections combined with poor management during the first two years of operation. Some financial risk was accepted in the belief that additional ore would be discovered to prolong the life of the mine--a hope not realized. Original pre-mining geologic estimates of ore tonnage and grade were within a few percent of actual tonnage mined.

Mining and milling operations ceased in June, 1972 and a reclamation program was begun which included the following



ORE FROM OPEN PIT MINE
COARSE ORE HOPPER (- 2 FT)
FEEDER
JAW CRUSHER
CONVEYOR
SECONDARY CRUSHING BUILDING
SCREEN
CONE CRUSHER
SCREEN
CONE CRUSHER
PRIMARY CRUSHING BUILDING
CONVEYOR
FINE ORE BIN (- 3/4) (1200 TONS)
FEEDER
CONVEYOR
CYCLONES
PUMP
PRIMARY BALL MILL (-100 MESH)
COPPER FLOTATION CELLS
PUMP
COPPER CLEANER FLOTATION CELLS
PUMP
CYCLONE
PUMP
REGRIND BALL MILL (-200 MESH)
PUMP
THICKENER
PUMP
FILTER
COPPER CONCENTRATE STORAGE (40) TONS PER DAY)
ZINC FLOTATION CELLS
PUMP
PUMP
ZINC CLEANER FLOTATION CELLS
PUMP
THICKENER
PUMP
PUMP
FILTER
ZINC CONCENTRATE STORAGE (50 TONS PER DAY)
TO TAILING POND
CONCENTRATOR BUILDING
CALLAHAN MINING CORPORATION
PENOBSCOT UNIT

components:

1. Grading, seeding and planting of waste dump piles.
2. Draining surface waters from Tailings Pond and seeding the surface.
3. Beginning "economic rehabilitation" of the site by introduction of aquaculture--specifically, suspended float oyster rearing and floating pen salmon production.
4. Creation of a joint town-state-company advisory committee to formulate reclamation policy and to make specific recommendations for appropriate action. This group was named Goose Pond Reclamation Society. Callahan and other interested individuals contributed funds for administrative costs of the Society.
5. Removal of the fresh water dam.
6. Flooding of the 320' deep open pit by opening of 18" sluice boards in the dam at Goose Falls.

The final reclamation plan was prepared by this writer in 1972 and is included with this report as Appendix B.

Aquaculture

Callahan hired a marine biologist, Robert Mant, to manage its aquaculture projects. Mant had been in the University of Maine graduate school prior to joining Callahan. The aquaculture project was designed to raise Coho salmon from egg to about 2/3 pound utilizing techniques then proving successful in Puget Sound. Eggs were purchased from the west coast, hatched in the large mine shop building, transferred as fingerlings to floating net pens in Goose Pond and fed pelletized feed till they reached "pan size". These were sold initially in local restaurants and eventually the market extended to Boston. An effort was made to raise oysters from seed size to market size. Plastic bread trays were loaded with seed, stacked together, and suspended from floats in Goose Pond. Numerous problems with the oysters combined with apparent success with the salmon caused the oyster pilot project to be abandoned after two years.

Callahan spent $135,000 with the pilot aquaculture project before deciding that it should divest itself of this activity. Consequently, the entire project including land, buildings and equipment was sold to Bob Mant and an interested investor for about $25,000. This occurred about 1975. It is my understanding that Mant filed for bankruptcy in 1979 or 1980. He had involved other investors but apparently he was unable to generate sufficient cash flow to meet his committments.

Goose Pond proved to be an unique location for raising salmon. The very deep water and limited tidal flow created an environment of adequate oxygen, thick ice cover and no winter water temperature below 30 degrees -- thus eliminating a problem experienced by all other salmon projects in Maine to date. Sub-30 degree temperatures are lethal to salmon.

Planting

Many areas were planted with Norway Pine and Spruce seedlings during mining operations--particularly along the Wier Cove ditch. A total of 15,000 trees were planted during the first two years of operation. Following mine closure, a hydroseeding firm was hired to hydroseed those areas where some chance of revegetation might occur following grading. In 1973, Mr. Chandler Mortimer , a landscape planner and reclamation specialist, was retained to work on the entire minesite revegetation. A copy of his original proposal is included as Appendix C. Mortimer's recommendations were followed for the initial work. Three or four subsequent years were spent reseeding, fertilizing and experimenting with different grass mixtures etc. A total of about $100,000 was spent under Mortimer's direction. Concurrently with Mortimer's work, the University of Maine Department of Agronomy under Dr. Cecil Brown's direction experimented with various mixtures of grasses and fertilizer on controlled plots on the tailings area. These 1972-1973 plots are still visible on the tailings area.

Government Agencies

A number of government agencies have had input into the reclamation process since 1972. The agency which has taken the lead role has been the Maine Department of Marine Resources (DMR). Their concern has been directed entirely at potential pollution of the marine environment--particularly beyond the limits of Goose Cove. That concern resulted in initial refusal to allow Callahan to remove the Goose Falls dam as planned. In addition to the DMR, the Federal EPA, Corps of Engineers, Department of Transportation and Town of Brooksville have all played a role in reclamation of the site.

Recent discussions with the Department of Environmental Protection in Augusta indicate that a complaint may have been filed to the DEP. Dianne Albert has been assigned the responsibility of enforcing the buried oil tank problem. Gordon Fuller has reportedly been assigned to look into a complaint about a "lagoon of hazardous materials". Fuller has been on vacation and could not be reached for comment.

AREAS OF ENVIRONMENTAL FOCUS

This section will discuss specific areas of environmental concern. The locations of each of the areas discussed are shown on Plate 1.

Tailings Storage Pond

As mentioned earlier, the tailings are fine sand and silt-sized pulverized rocks which constitute the unwanted waste from the milling process. The tailings storage area is located on the former Redman farm. The construction of the tailings "dam" is shown in Figure 2. The final dam height is 82 feet above the base. The stored tailings cover 11 acres. A 1972 analysis of the tailings shows:

Sulphur	5.19%	
Calcium	4.92%	
Magnesium	9.80%	
Arsenic	nil	(<0.005)
Cadmium	0.007	
Antimony	nil	(0.005)
Copper	0.15%	
Lead	0.06%	
Zinc	0.71%	
Iron	7.28%	
Barium	0.005%	
Bismuth	<0.002%	
Boron	<0.002%	
Chromium	<0.005%	
Cobalt	<0.005%	
Columbium	<0.005%	
Gallium	0.001%	
Gold	0.005 oz/ton	
Molybdenum	<0.002%	
Nickel	<0.002%	
Paladium	<0.005 oz/ton	

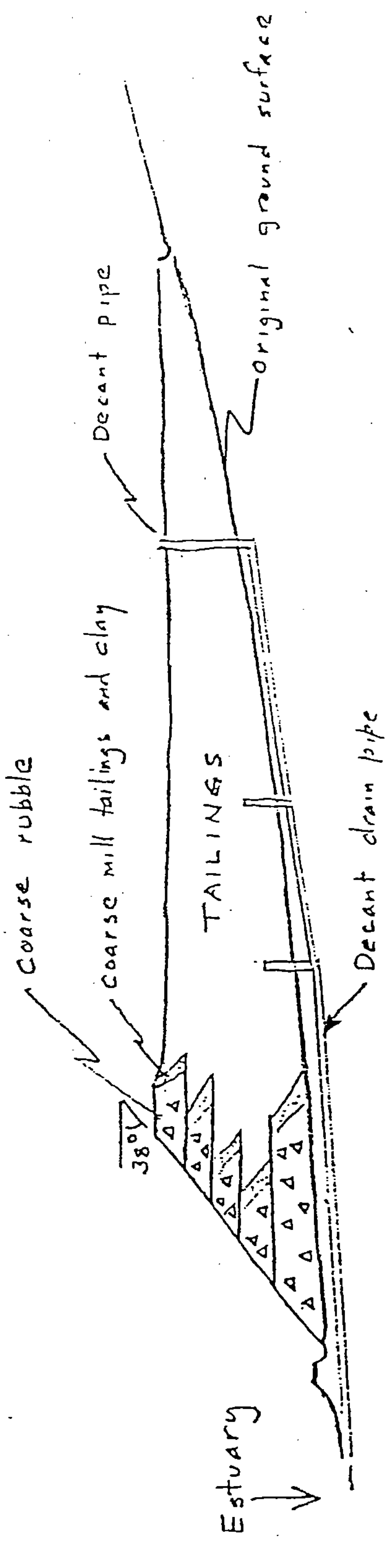


Figure 2 Tailings Dam Cross Section

Silver	0.1 oz/ton
Titanium	0.07%
Vanadium	0.005%
Yitritium	0.005%
Zirconium	0.01%
Sodium	0.3%
Potassium	0.5%
Aluminum and Silica	major

Although the list of analyzed elements is extensive, there are some compounds which have not been analyzed. These include many of the common major oxides such as MgO, CaO, SiO_2, FeO etc. Nor are there any analyses for organic compounds used in the flotation process. These compounds were American Cyanamid products No. 3501 collector, No. 242 promoter, sodium aerofloat, and F-71 amyl alcohol frother. According to Edward Bentzen, head of Colorado School of Mines Research Institute's flotation section, most of the organic compounds would have attached to the zinc or copper concentrate and been shipped to the smelter. The organics which would have accompanied the tailings would have biodegraded in a short interval. He was unaware of any environmental problems with these products. Ms. Pat Bond of American Cyanamid's mining group office in Utah said she was unaware of any environmental hazards with these products. She said that extensive testing had not been undertaken by Cyanamid other than that required by law. She said the products had been used for years and continue to be used extensively and there have been no toxicity problems reported. MSDS sheets for these products are included as Appendix D.

Prior to and during Callahan's operation, the State Environmental Improvement Commission, now the DEP, required a complete listing of all chemicals used in the milling process.

The state apparantly felt that the reagents used in the milling process posed no problem since they had the power to stop operations at any time they felt an environmental threat existed. A copy of one letter to the State is included as Appendix E for reference.

The structural stability of the tailings area seems sound. The rock dam is constructed of angular blocks of mixed sizes. There has been no indication of movement during the past 14 years since mine closure. The question of structural stability was raised by the Corps of Engineers in 1972 (Appendix F). The U.S. Bureau of Mines at the request of the Corps of Engineers inspected the site and said "The heavy, coarse rock face virtually assures its long term stability" (Appendix G).

In 1972, an effort was made to provide a permanent drainage of surface water from the tailings. A ditch was excavated from the center to the north end of the tailings (Photo, Fig 3). This worked for awhile, but as the tailings settled and compacted, the center of the tailings area became depressed below the level of the drainage ditch. In retrospect, this has worked out for the better. The water which remained ponded in the center became a fertile environment for cattails and other marsh organisms. An organic matte has been developing in the cattail pond and provides a much needed organic cap to at least part of the tailings (Photo, Fig.4).

In general, the results of earlier planting experiments in the tailings have been mixed. Some of the bristly locust still persist and even thrive along the edges. There has been

Figure 3 Tailings drain ditch

Figure 4 Cattails on tailings area

considerable volunteering of poplars and birchs (Photo, Fig. 5). There is about a 60% cover of small grasses and lichens between the cattail pond and the edge of the tailings (Photo, Fig.6). It is unlikely that these areas will show much improved growth without the addition of organic material.

There is a small amount of seepage from the base of the tailings. Specifically, there are two "leaks". The leaks were sampled and analyzed for metals in our lab in Yarmouth. The results are listed below:

Sample 1. Tailings surface water at spillway, north end.
Sample 2 Tailings seep water, SE end of tailings dam.
Sample 3. Tailings seep water, NE end of tailings dam.
Sample 4. Water from drainage ditch at foot of dam just prior to entering estuary.

	Cu	Zn	Pb	Cd	pH
Sample 1	.08	.73	.02	.004	7.5
Sample 2	.02	10.60	<.01	.025	7.5
Sample 3	.01	6.50	<.01	.018	7.3
Sample 4	.02	4.91	<.01	.020	7.5

all values in mg/l

The grasses within a few feet of the leaks are stressed by the leak water and are yellow in color (Photo, Fig.7). Grass color returns to normal within a few feet of the the leak indicating a loss of toxicity through either dilution or more likely oxidation. The toxicity is probably due to the high levels of zinc in the water. The volume of leak water from the two leaks is about 0.2 gal/min. It is not known whether these waters are percolating rain waters or residual pore space water from continued compacting of the tailings. The water is iron-rich as evidenced by the iron hydroxides deposited at the point of emergence from the base of the rock retaining wall (Photo, Fig.8). It is not known whether any of the tailings water is percolating directly downward into the surficial materials and

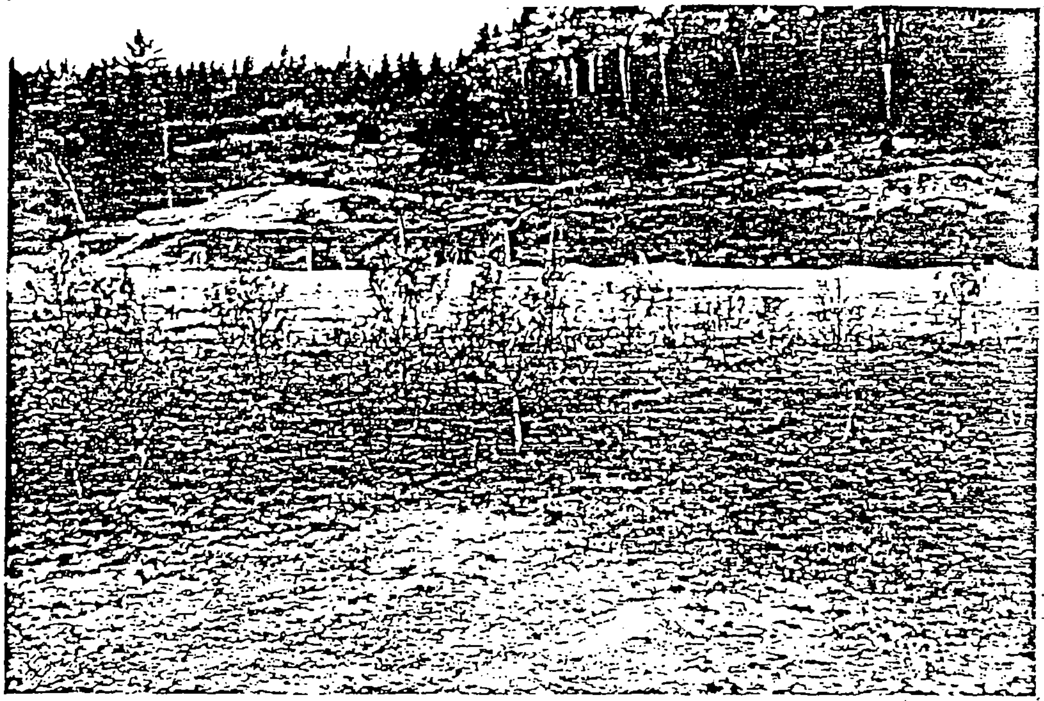


Figure 5 Volunteer trees on tailings area

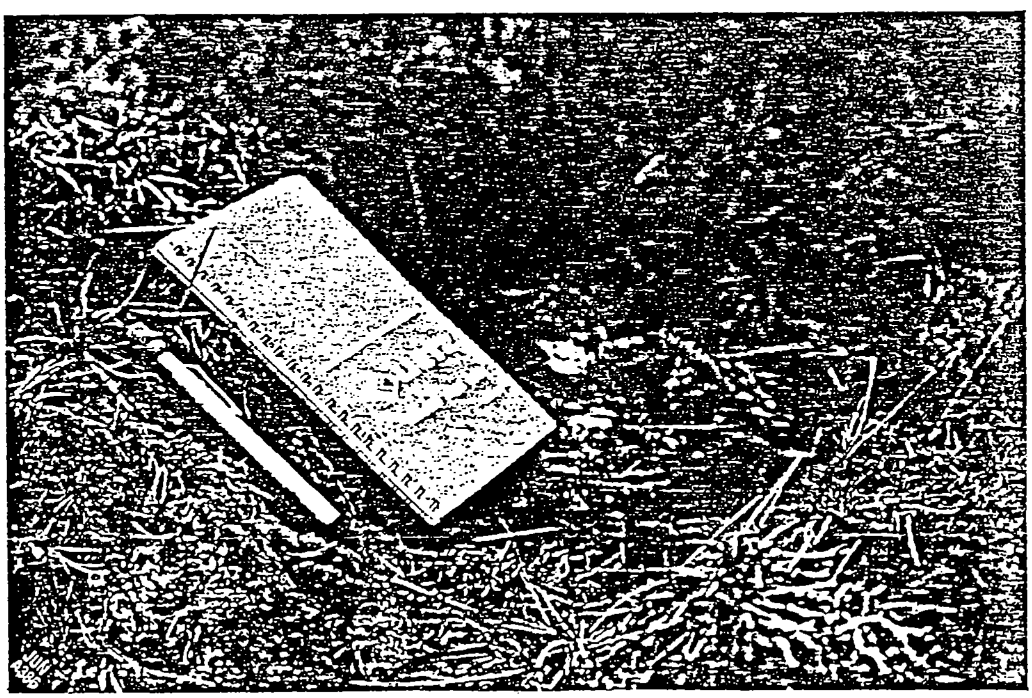


Figure 6 Stunted grass growth covering much of tailings area

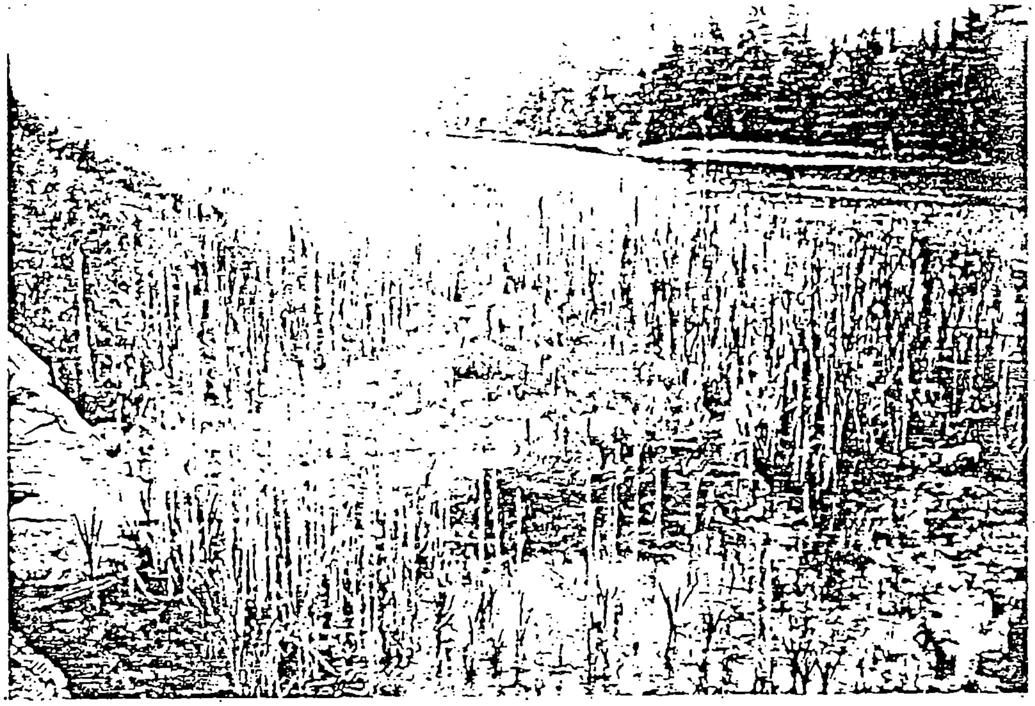


Figure 7   Stressed grasses adjacent to tailings leak

Figure 8   Iron hydroxides precipitating from tailings leak water

bedrock underlying the tailings. A fairly extensive set of test bore holes would be needed to make a thorough hydrographic study to determine any leakage into bedrock or underlying surficial deposits.

Rock Dumps

Large quantities of dump rock are piled on the property. This rock represents rock with no mineral value which had to be removed in order to mine the relatively narrow, steeply dipping ore deposit lenses. The rock consists largely of volcanic agglomerate and rhyolite with minor amounts of carbonate, talc and talc-chlorite rock with varying amounts of associated disseminated pyrite. An occasional piece of ore rock can be found consisting of chalcopyrite and sphalerite ($CuFeS_2$ and ZnS) within a chloritic or talcose matrix. With the exception of the rocks containing pyrite, the rocks in the dump appear to be in near chemical equilibrium with surface conditions and no dissolution was observed. The rocks containing pyrite are oxidizing as evidenced by rusty staining (Photo, Fig.9). These rocks are slowly disintegrating due to the oxidizing pyrite and eventually will become mostly clay, sand and micas.

The dumps do not appear to pose any structural threat and with the pyrite exceptions mentioned above, are chemically benign. Large amounts of marine clay were dumped on the lower portions of "Callahan Mountain" in 1968. This clay came from a 200,000-ton mud slide into the pit. The clay has provided a fertile host for volunteer vegetation on the slopes and first terrace of "Callahan Mountain".

Figure 9   Pyritic oxidation from dump rock

During the latter period of mine operation, the company's water well showed an increased chloride content. It is likely that this chloride was leached from the marine mud on "Callahan Mountain" and affected the water source which services the company well. New wells were drilled to the south above the tailings pond to provide potable water to some residents of Harborside and to the aquaculture project.

Dyer Cove

Dyer Cove Plate 1 is a shallow offshoot from Goose Pond. During the operation it was separated from the open pit with a causeway (since removed). It was utilized as a settling basin for water which was pumped from the open pit. The material which would settle out consisted of rock "flour" and silt. An effort was being made to reduce the amount of rock "flour" and silt reaching Goose Cove.

In May 1986, the author waded in Dyer Cove and found the bottom to consist of firm, dark mud. Samples of this mud were collected and analyzed for metals. The analyses listed below show elevated values for zinc and copper as would be expected. No borings were taken to determine the thickness of the material, but it is likely not more than a few feet thick. Marine worms and other organisms were abundant in this sediment.

Sample 1. Cu-3760ppm; Zn-8600ppm; Pb-740ppm; Cd-33ppm.
Sample 2. Cu-1590ppm; Zn-4800ppm; Pb-670ppm; Cd-19ppm.

Goose Cove

The 16" pipe from Dyer Cove and the "fresh water sump" discharged into Goose Cove approximately 450 feet from the Goose

Falls Dam. Rock "flour" and silt which had not settled out in Dyer Cove were discharged from this pipe. This material eventually covered the bottom of Goose Cove to an average thickness of about eight inches (Appendix H). The total quantity of settled material discharged is about 2500 cubic yards. The average values of heavy metals are 3200 ppm copper, 900 ppm lead, 9000 ppm zinc and 30 ppm cadmium. The cadmium values are approximately the same as in underlying "pre-mine" sediment; the other values are much higher than in underlying sediment.

The 16" pipeline is still in Goose Cove. Its removal was prevented in 1972 by the Department of Marine Resources which feared stirring up the metal-laden sediments. Their position at that time was and continues to be that the sediments pose a threat to marine organisms and that the longer they remain in place the less the impact to Goose Cove and nearby areas. A new veneer of sediment is slowly covering the discharged sediments and isolating them from the cove's aqueous environment.

The Goose Pond Reclamation Society sought a permit in 1980 to dredge the Cove. This approval was apparently denied. In 1979 Mr. Murray Gray, an abutter to Goose Cove, brought suit against Callahan to remove the wastes from Goose Cove and to remove the dam. That suit was apparently dismissed. The abutters to and users of Goose Cove have been consistent in their desire to deepen the cove and to have the dam removed to return the original tidal flow through the harbor. Recent discussions with John Hurst of the Department of Marine Resources indicate that he would continue to oppose any dredging of the cove.

Goose Falls Dam

This dam was constructed in 1966 by H. B. Fleming, Inc., general contractors from South Portland. The dam is 60'-10" long, 10' wide at the base, 2'-2" wide at the top, and approximately 14' tall from the bedrock in which it is anchored to the top. A plan and sections are included as Plate 2. Approximately 16 feet of the dam was removed in 1978 by Laite Construction Company at a cost of $12,000. Additional removal was not undertaken since Robert Mant, the owner, requested that the remainder of the dam was necessary to provide limited flow to the salmon pens. Too much tidal interchange could have lowered the winter temperatures in Goose Pond below those necessary for salmon survival.

Discussions with Mr. John Hurst of the Department of Marine Resources indicate that he would have no objection to dam removal. He did not feel there would be significant additional tidal scour of Goose Cove as some have indicated due to the increased tidal currents through the cove.

The dam was deeded to Robert Mant in January, 1978. In August of that year, this writer was asked by Callahan to inquire of any continuing obligation Callahan might have to the Department of Transportation (DOT) concerning the dam. The DOT said Callahan had no further obligations to the DOT. The DOT has no objection to dam removal so long as the bridge integrity is insured. A letter discussing these points is included as Appendix I. Although the dam is owned by Mant, I suspect that permission to remove the dam will have to be obtained from Murray

Gray, owner of the land on the east side of the dam, the Town of Brooksville, the Department of Transportation and the Corps of Engineers (who will rely on the advice of the DMR).

Removal of the dam would have the most environmental effect within Goose Pond and its upper reaches. With the increased tidal flow, Goose Pond would fill to a higher level than present. Vegetation, particularly alders, which has grown up since 1966 when the pond was drained will become drowned and die off. It is felt that returning Goose Pond to its original size through dam removal will have a positive long term effect as increased estuarine habitat, increased intertidal habitat and improve visual effect for those neighboring Goose Pond.

Open Pit Mine

The open pit is a circular quarry 320 feet deep and about 600 feet across. It is the deepest near-shore saltwater depth on the east coast. The potential environmental problems associated with the pit appear minimal. The pit walls are nearly vertical. There is some "ore" remaining in the walls which is presently exposed to saltwater. Experimental and empirical evidence on solubility in seawater of ores from the mine indicate that the ore minerals are essentially insoluble. Specific solubility tests were undertaken on the ore in 1971 by C. M. Trautwein--now with the U. S. Geological Survey. He found solubilities extremely low. These experimental data are confirmed by observations of numerous veinlets of the ore minerals in the Bagaduce estuary. These minerals show only a thin film of oxidation over fresh sulfide. The film represents the solubility of the mineral during post-glacial times--about 12,000 years. The DMR has recognized that high values of metals in shellfish and other organisms do not come from the water, but from the particulate matter ingested by the marine organisms.

Relict Facilities

There are a number of buildings and structures remaining on the property. These include from south to north the Old Redman farmhouse and shed above the tailings pond, the powder magazine on the high ground south of Callahan Mountain, the pump house and well next to the office foundation, the large metal shop-building, the assay lab foundation, the concrete walls which supported part of the mill, the concrete foundation to the primary jaw crusher, the compressor building next to the transformer bank and a small wooden building next to Goose Pond. A considerable amount of junk and trash is strewn about the office and lab foundations; most of the buildings have old aquaculture junk stored within. With the exception of possible injury due to playing around or within the old buildings or foundations, the only environmental problem is with several buried oil tanks near the shop building. State law requires that these be removed if they have been out of service for over one year. I was unable to determine if the tanks are presently leaking. Discussions with the DEP's Bangor office indicate they are aware of four tanks. One is a waste oil tank; two are probably diesel tanks and one a gasoline tank. Barbara Taylor of the Oil and Hazardous Materials Division said she was not aware of any leaks. A walk along the edge of Dyer Cove disclosed an area which is the most likely exit area for any leaks. While no oil slicks were apparent, I thought I could smell petroleum products. However, this smell may have come from buried trash in this vicinity.

In any event, the tanks will have to be removed. There are specific guidelines for tank removal cited on pages 63, 64 and 65 of Chapter 691 of the State's Regulations for Registration, Installation, Operation and Abandonment of Underground Oil Storage Facilities (Appendix J). Several Maine firms are experienced with tank removal. C.M. Brown and L.E. Winchester of Bangor have both been recommended. If, during removal, it is found that the tanks have leaked, the owner may be responsible for removal of the effected soil. Since there are no domestic wells or neighbors in the area the DEP may not require extensive cleanup.

There were two or three domestic trash piles utilized by the mine. These contained trash and junk of the type normally accepted by the town dump. These trash piles were covered over with rock during the post-mining grading activity. No evidence of pollution from these buried dumps has been observed. To this writers knowledge, no toxic materials were placed in these dumps with the possible exception of paint cans, thinners, etc which may not have been completely empty.

APPENDICES

THIS IS A PREPRINT --- SUBJECT TO CORRECTION

Marine Challenges Encountered by a Small Mine on the Maine Coast

By

Frederick M. Beck, Callahan Mining Corp.

ABSTRACT

Callahan Mining Corporation is currently mining copper and zinc ore from an open pit mine on the edge of Penobscot Bay in Maine. The open pit occupies an area once largely covered by a salt water pond. The mining operation utilizes conventional mining and milling techniques and in this respect perhaps could not be considered a true marine mining operation. However, many obstacles had to be overcome due to the proximity of the ocean before the mine could be brought into production. Problems with which inland mines do not have to contend are faced daily. These include effluent control, marine mud stability, salt water encroachment, reclamation, and exploration.

The ore deposit is a stratiform massive sulfide body in early Paleozoic volcanics. The principal ore minerals are sphalerite and chalcopyrite with minor galena. Associated minerals include chlorite, talc, and carbonate.

The deposit was discovered in 1880 at low tide by a clam digger. Surface ore outcrops were entirely below high tide. The mine was developed and mined from three shafts. Apparently the deposit became unprofitable in about 1887. A re-evaluation in 1964 by the Callahan staff prompted the present open pit operation. Production is currently at the rate of 700 tons per day.

Exploration for additional ore deposits is complicated by the presence of salt-saturated mud in estuaries and salt water covering geologically favorable prospecting ground. Many conventional inland exploration techniques are useless near these areas.

The ocean presence has added substantially to the mining costs, thus narrowing the profit margin. New techniques must be developed by the mining industry to cope with oceanographic problems. Some of these challenges are being met at Cape Rosier and can be applied to future mining ventures faced with similar marine problems.

Illustrations at end of paper.

INTRODUCTION

The Penobscot Mine on the Maine coast is not a "marine mining" operation in the strictest sense. For the most part, conventional techniques of mining and milling are in use and the ocean is a nuisance. However, by being located at the sea-land interface, there are a number of factors which influence the operation which would not be encountered inland. The engineering challenges of dealing with the shallow estuary were relatively easily mastered. The challenge to mineral exploration still exists and is a subject of continuing effort. The nation's sea-land interface is probably one of the most popular and valuable multiple use areas in the country. In Maine it has scenic beauty, is sought after for summer homes, provides food and shelter during parts of the life cycles of innumerable marine species, and is the basis for commercially important coastal fisheries. It is an area high on most lists for environmental protection. It is natural that the addition of another "user" to this area would be resisted, particularly when that user represents an industry which has a past record of environmental abuse. The greatest challenge to Callahan Mining Corporation has been to operate a mine in a way which does not pollute or otherwise adversely change the environment and yet returns a profit to the stockholders. This paper will describe some of the problems encountered and ways in which they were or are being solved.

HISTORY

Eastern coastal Maine (Figure 1) has had a long sporadic history of mineral exploration and minor metal production. During the 1880's there was a mining boom, complete with a stock exchange located in Blue Hill. Prospecting was intense during this period and the deeply incised coast provided a relatively high percentage of bedrock exposure in an area otherwise mostly covered with glacial till.

Production during this period was largely from the Douglas and Twin Lead Mines at Blue Hill (Figure 1). A smelter at Blue Hill reduced the copper ore and the product was shipped to the populated areas further south by coastal schooners.

About ten miles west of the Blue Hill mining camp an outcrop of massive zinc and copper ore was discovered at low tide by a clam digger. This outcrop occurred in a tidal estuary known as Goose Falls Pond (Figure 2). Subsequently a shaft was sunk on the nearby shore and production of high grade zinc-copper ore commenced. The ore was taken from Goose Cove to Castine (Figure 2) by barge and piled on a dock. Periodically, coastal schooners would load the ore and deliver it to smelters in the south.

The ore at the Penobscot Mine was eventually mined from three shafts and production from 1881 to 1883 was about 10,000 tons. Apparently, low metal prices in 1887 forced the mine to close. It remained closed until 1914, at which time an attempt to reopen the mine proved unsuccessful.

In 1940 the St. Joseph Lead Company conducted a drilling program on the property. This was supplemented in 1942 by drilling conducted by the U.S. Bureau of Mines. Although numerous intersections of copper and zinc sulfides were encountered, apparently the property was considered uneconomic. Additional diamond drilling was done by the Bureau of Mines in 1950. The property was eventually optioned by the Penobscot Mining Company, Ltd., of Toronto in 1956.

This company drilled a few holes from the surface, cleaned out the old workings, and drilled from underground. The property was brought to the attention of Callahan Mining Corporation in 1964. Re-evaluation of all past work indicated that sufficient values might exist to warrant an open pit mining operation. A lease was negotiated with the Penobscot Mining Company and the property is currently being mined under the terms of this lease.

GEOLOGIC SETTING

The base metal mineral occurrences in eastern coastal Maine occur in early Paleozoic volcanic and sedimentary rocks. The volcanic rocks range in composition from mafic pillow lavas to felsic fragmentals. Rhyolite domes and rhyolites of probable tuffaceous origin are common. The sedimentary rocks are present as schist, gneiss, and quartzite, and may represent, in part at least, sedimentary accumulations derived from and deposited during volcanism. The sediments and volcanics are intruded by igneous rocks, mostly of granitic composition.

The base metal deposits in eastern coastal Maine occur in volcanic rocks and associated sediments. Metamorphism due to subsequent igneous activity has in places affected both the metal deposits and the enclosing rocks.

PRESENT OPERATION

At present, the mine consists of an open pit, roughly circular in shape, which will have an ultimate depth of 340 feet below sea level (Figure 3). The present depth is 150 feet below sea level. The pit covers about 9.4 acres and when "mined out" will have produced over seven million tons of ore and waste. Mining and milling began early in 1968.

The ore occurs as lenticular pods of massive zinc and copper sulfide ore. It is a stratiform deposit in a sequence of fragmental volcanic rocks. Associated chlorite, talc, and carbonate rock is either barren or, particularly in the deeper levels, contains finely disseminated sulfides. The ore is trucked to a nearby mill. Approximately 700 tons of ore with an approximate grade of 6% zinc and 1% copper are processed daily. The mill is a conventional flotation mill with one exception; it was designed to operate with salt water rather than fresh water.

Consideration was given to the feasibility of loading the metallic concentrate onto barges, or other vessels, for cheap transport to a smelter. However, due to the relatively small size of the mine, trucking to the railhead 30 miles away in Bucksport and shipment to smelters in Quebec and Pennsylvania by rail proved to be the more economic.

LEGAL CONSIDERATIONS

In order to mine the deposit with an open pit, it was necessary to drain a salt water estuary. This estuary, named Goose Falls Pond, covered 90 acres. The name is derived from the falls created during ebb tide (Figure 3).

The normal tides for this portion of the Maine coast range from a 0.0 foot low to a +8.5 foot high, with extremes ranging from -1.9 foot low to +11.5 foot high. The restricted rocky entrance allowed water to flow into the pond only during the high portion of the tidal cycle. This resulted in an average water level fluctuation within the pond of approximately three feet.

Briefly, the plan was to build one dam at the mouth of the estuary to prevent the tide from entering the pond and to build another dam at the head of the estuary to divert the fresh water drainage from 1600 acres of adjacent forest land to another drainage area. The pond could then be pumped dry and inflow would be minimal (Figure 3).

Goose Falls Pond was bordered on the east by a privately owned wildlife sanctuary and on the west by land owned or leased by Callahan Mining Corporation. The pond waters, land below low tide, and the mineral rights below low tide are owned by the State of Maine. The intertidal land is owned by the adjacent landowners. In order to drain the pond, the riparian rights of the adjacent landowners would have to be temporarily taken and held by the State. The owners of the wildlife sanctuary objected to this seizure. The Maine Mining Bureau, administrator of the State's mining rights, questioned whether it had the authority to authorize draining of the pond under these circumstances; an act of the legislature was considered necessary.

Accordingly, a bill was introduced to a special session of the legislature in 1966 which would allow the State, through the Mining Bureau, to authorize drainage of the pond and temporary taking and holding of the adjacent landowners' riparian rights. It should be noted that before the Governor would support the bill and submit it to the legislature, four State agencies had to submit their recommendations to him. These were the Departments of Sea and Shore Fisheries, Forestry, Inland Fish & Game, and Water Improvement Commission. An ecologist was retained by the Company to make independent studies and to assist in operational planning. Understandably, there was considerable lobbying in opposition but the local residents generally supported the planned operation. The legislature referred the bill to the State Supreme Court for a decision on its constitutionality. The Supreme Court ruled in or of the bill and it was subsequently passed by the legislature and signed into law.

The Mining Bureau issued a mining lease to the Company shortly after the legislative action was taken. Concurrently, permission was sought from the U.S. Corps of Engineers to construct a dam at the tidal mouth of Goose Falls Pond, which was considered a navigable waterway. The U.S. Fish and Wildlife Service was consulted by the Corps of Engineers and conducted studies with the assistance of the State agencies mentioned earlier. The Fish and Wildlife Service eventually recommended that if a dam was built, the pond should be kept full of fresh water and a coffer dam be built around the perimeter of the pit. This plan was considered unsafe and impractical by the Company. The Corps of Engineers finally approved building the dam according to the plan recommended by the Company. The last authorization required for the project was a permit from the State Water Improvement Commission to pump the pond discharge the water into Penobscot Bay. is permit also provided for effluent quality standards and monitering of effluents discharged during mining and milling. The monitering is currently supervised by the State Department of Sea & Shore Fisheries. This agency has worked closely with the Company, with other interested agencies, and with concerned conservation groups to assure that the living resources of this portion of Penobscot Bay are not adversely affected.

CONTINUING PROBLEMS

Current mining problems which can be related to proximity to the ocean can be grouped into four catagories; pollution, salt water encroachment, marine sediments, and rehabilitation. These problems are especially "visible", principally because the ocean-land interface is a high multiple-use area where conflicts of use are bound to be at a maximum.

Pollution

Four types of pollution pose problems r the mining operation. These are noise, silting, heavy metal, and scenic.

The noise pollution is a factor due to the proximity of numerous residences. Heavy

much as possible by (1) only day shift drilling, (2) no graveyard mining shift, (3) carefully controlled pit blasting, (4) no secondary blasting of oversize boulders, and (5) careful maintenance of equipment to minimize muffler noise. Despite these efforts occasional complaints are received.

Silting is taking place in Goose Cove (Figure 3). Early in the operation this was partly due to the effluent from the mining operation. This has been largely cured with the use of several settling ponds. After heavy rain storms the effluent contains silt, just as do all natural fresh water runoffs into the ocean. In addition to the settling ponds, a 16" pipeline has been extended 400 feet from shore to the mouth of Goose Cove to help disperse any silt. The principal cause of silting in Goose Cove, however, is probably natural silting which would be expected in a cove which no longer has a tidal current to keep the cove scoured.

The continuously monitored effluent from the mining and milling operation contains trace amounts of heavy metals. These amounts are higher than found in raw sea water. Periodic testing of clams and other invertebrates in the vicinity has indicated a higher than normal heavy metal content, and this apparently has increased since startup of the mine. Unfortunately, there were insufficient studies conducted prior to mine startup to establish a normal background for the area. Although there are probably a number of factors contributing to the buildup of heavy metals in shellfish, it can only be assumed that the mine is one of the contributors. Other possibilities include continuing erosion of previously operated sulfide occurrences, disturbance of metalliferous bottom sediments due to storms, pollution from the Penobscot River, or pollution from toxic paints used on the 10,000 Ton maritime training ship "State of Maine" which is docked in nearby Castine (Figure 3). There are probably physical and chemical variations of the sea water such as temperature, organic content, etc., which also contribute to the concentration of heavy metals in shellfish. Insufficient sampling has been conducted to date to establish any valid relationships.

Recently, the Company performed tests in which the effluent was recycled and

Preliminary tests have been encouraging and although no benefits are derived metallurgically, the concept of a closed system is particularly attractive to a company management concerned with pollution as well as to governmental agencies. It is highly probable that systems developed by Callahan on Cape Rosier in cooperation with governmental agencies will become the basis for regulations under which future mining operations on the Maine coast and possibly other coasts will have to operate.

Scenic pollution simply means that it is impossible to operate an open pit mine and not affect the traditional Maine coast scenery. In order to minimize the problem, all buildings are placed inconspicuously behind a hill and barren areas and dumps are being planted with grass and trees. A local artist has helped by painting a corrugated iron pump house on Goose Cove to resemble a lobster shack. The mine is, incidently, also a tourist attraction and draws crowds during the summer months for regular scheduled tours.

Ground Water

The ground water table in the vicinity of the mine is being lowered due to continuous pumping to keep the mine dry. Consequently, some of the neighbors' wells in the cone of influence have gone dry. Although under Maine law the Company is not liable, deeper wells were drilled for those affected. However, as might be expected, salt water encroachment into the ground water has become a problem. This is being relieved by providing those affected with water from Company wells away from the influence of the salt water. Salt water encroachment occurs when the load of fresh water is relieved by pumping or other causes from a coastal area thus causing the underlying salt water-fresh water interface to rise. This interface eventually intersects the drilled water wells. Raising the pump intakes above this interface is a temporary solution but doesn't solve the problem.

Clay and Mud

Goose Falls Pond was a shallow pond with up to 90 feet of mud and clay in the bottom. Three test borings were made to determine the nature of the bottom sediments. A typical boring encountered 33 feet of organic silt at the top, followed by 45 feet of gray silty clay, followed by 5 feet of gray gravelly silty sand. Soil tests indicated that a maximum steepness of slope of 4:1 (14°) would be safe.

On June 29, 1968, the pit had reached a depth of 60 feet below sea level. There was a minor mud slide at the northeast side of the pit but this was not serious and the mud was quickly removed. On July 23, 1968, the mud again began moving at the northeast side of the pit. This time it did not stop as before, however, and within 8 hours it had filled the bottom of the pit to a depth of 25 feet. It is significant that when the mud came to rest the surface was essentially horizontal, indicating that once movement had started, the mud became fluid, much like molasses. It took approximately a month to remove the 225,000 tons of mud from the pit. One power shovel had been completely buried and required extensive repairs. A series of rock dikes with finger dikes were constructed to hold back the mud; so far these have been successful.

A subsequent boring and soil test into the mud indicated that only the organic silt was involved in the slide. There was little effect on the underlying clay. The shear strength of the organic silt was considerably reduced by the slide. The in-place water content of the organic silt did not change appreciably due to the slide (approximately 66% by weight).

The problem of where to put the mud from the pit was soon resolved when it became apparent that it could be used as topsoil on the dump rock and thus provide an ideal base for seeding and planting. The salt apparently leaches fairly quickly from this material.

Rehabilitation

Rehabilitation of the mine site is a continuing effort and involves recommendations from the Soil Conservation Service, the State Forestry Department, and local residents. The eventual decision of what to do with Goose Falls Pond when mining is completed will rest with the Town of Brooksville. Three options appear possible; it can be returned to its original state as a saltwater estuary with a tidal falls; it can become a fresh water lake (the deepest on the Maine coast); or a channel can be opened from the ocean and it can become a totally protected deep water harbor. In any case, the affected land portions will be landscaped and planted as much as possible and could eventually benefit future recreational or residential use of the area.

EXPLORATION

The targets for mineral exploration in eastern coastal Maine are massive base-metal sulfide deposits containing zinc, copper, lead, and silver. These deposits are typically fairly good electrical conductors, although metamorphism and structural deformation often reduce their conductivity considerably. In addition, the sulfides and their enclosing host rocks are usually relatively soft and consequently occupy the topographic lows in the region. Hence, the deposits are often deeply buried with glacial till or marine clay or both and physical exploration for outcrops is useless. Recognizable alteration "halos" around these deposits do not exist. Therefore, exploration must be of a geochemical or geophysical type localized within areas of favorable volcanic stratigraphy.

Geochemical sampling is used extensively in Maine to locate general areas of highly metalliferous soil. However, pinpointing of drill targets with geochemistry is impossible due to local migration of metal ions and "masking" of targets by impervious clay. The clay along the coast is the product of a once higher sea level. The clay deposits are saline, have a low conductivity, and act as a very effective geochemical <u>and</u> geophysical shield.

So far, no systematic geochemical sampling of the ocean bottom has been attempted even near favorable areas such as the Penobscot Mine on Cape Rosier. The present state of the art is such that until geochemistry becomes more definitive for the land areas, its application to underwater areas near shore is not warranted.

Geophysical prospecting techniques offer the best chance for locating massive sulfide deposits under salt water along the Maine coast. Yet, the problems are formidable. Not only is it probable that the ore deposits are buried under highly conductive marine clays, but conductive sea water is also a hindrance to most geophysical techniques.

It is likely that both the saltwater and [illegible] more conductive than possible ore bodies. These barriers would tend to negate any techniques which are designed to measure slight conductivity differences within the earth. It is possible that inductive techniques which could differentiate between horizontally and vertically oriented conductors would be useful. The ore deposits generally have a strong vertical component in an area of steeply dipping rock units.

The Penobscot Mine is not associated with any magnetic minerals — or lack of such minerals. Therefore, the use of a magnetometer would not be effective. Naturally, if deposits associated with magnetite or pyrrhotite were being sought the magnetometer would be very useful.

Since there is considerable mass associated with large massive sulfide deposits, gravity measurements may be useful. However, it would be difficult to justify the drilling of gravity "high" in the ocean without additional supporting geophysical data. There are many causes for gravity highs, very few of which are massive sulfide deposits.

The use of some of the more recently developed systems such as INPUT[R], AFMag, and VLF might have some application over salt water in highly favorable geologic environments. These have not yet been tried along the Maine coast but some testing is anticipated in the near future.

Exploration on land is costly. Exploration of the offshore would be prohibitively costly except perhaps in areas adjacent to known mineralization or along underwater strike extensions of favorable geologic units.

SUMMARY

The Penobscot Mine on the Maine coast has encountered many problems related to the proximity of the ocean. These problems are not insurmountable, but they add considerably to the cost of mining. As highly popular multiple-use areas, the coast will challenge the skills of mining companies to operate at a profit and yet co-exist with the environment. As exploration techniques improve and deposits are located further from shore, the challenges will become greater. Actual mining of the ore will be one of the lesser engineering problems. A major challenge will be to develop a system which does not adversely affect the environment.

An example of concern for the environment was shown by the Maine legislature last year in passage of a bill which prohibits all offshore commercial sand and gravel mining. It was feared that the harmful side effects would outweigh the benefits. It is entirely possible that all offshore mining in Maine could be outlawed if the Penobscot Mine, which is a highly visible example, cannot operate in a way which does not abuse the environment. The challenges and responsibilities of this small mine are great and the results will have far-reaching effect. So far, the results look promising.

ACKNOWLEDGEMENTS

The author would like to thank the management of Callahan Mining Corporation for permission to publish this paper. In particular, the assistance of John B. Malcolm, Penobscot Unit manager, is appreciated. Also, the author would like to acknowledge the cooperation and encouragement of the people of Brooksville, without which the mining operation would not have been possible.

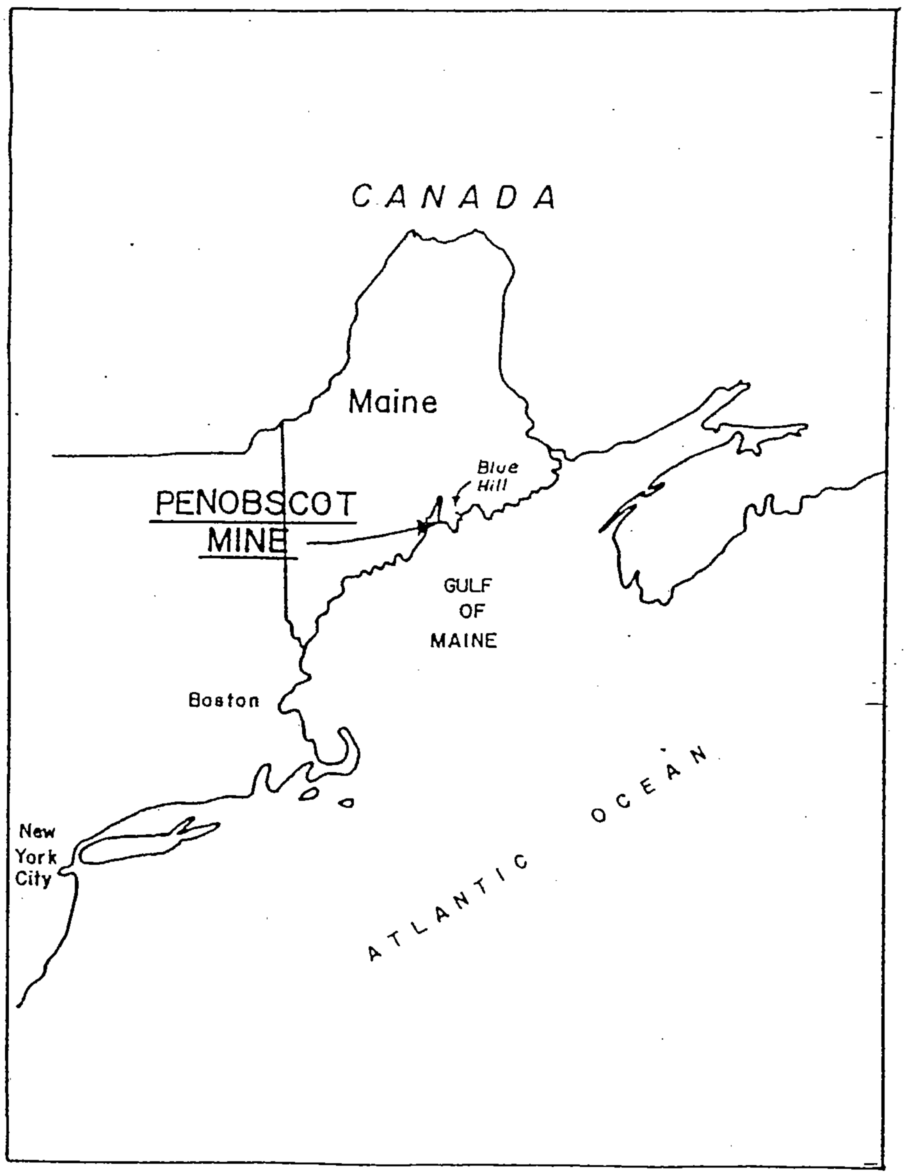


Fig. 1 - Index map, scale 1 in. = 75 miles.

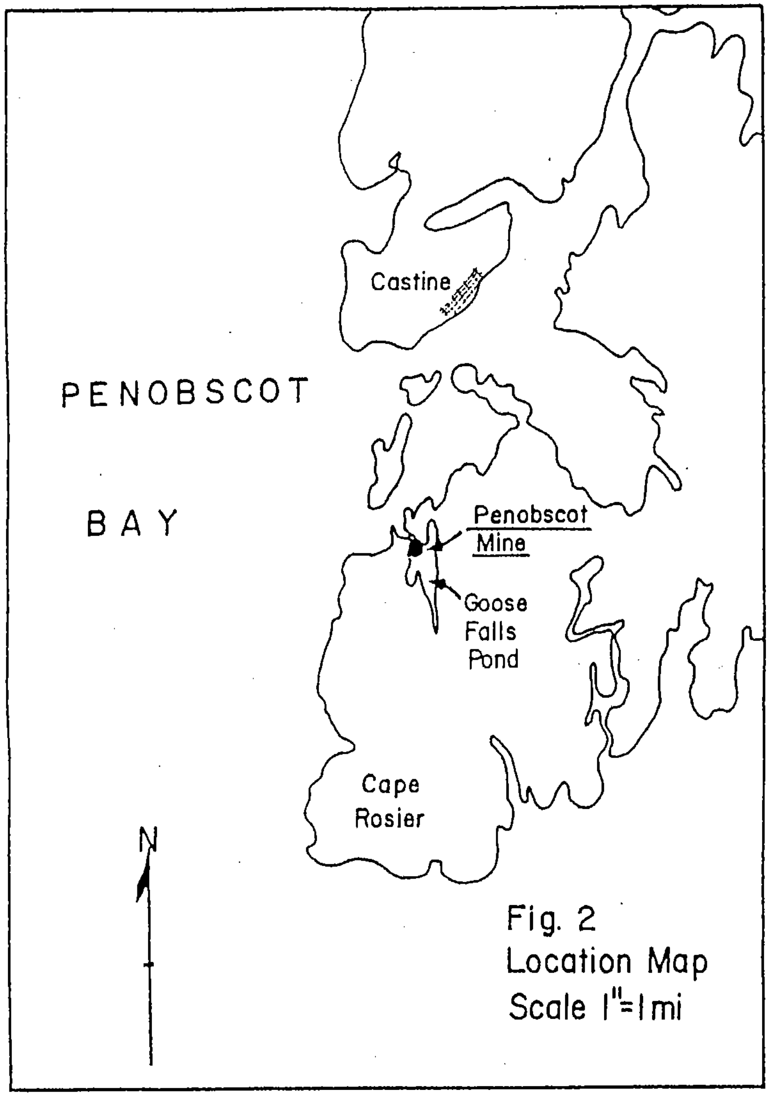


Fig. 2 - Location map, scale 1 in. = 1 mile.

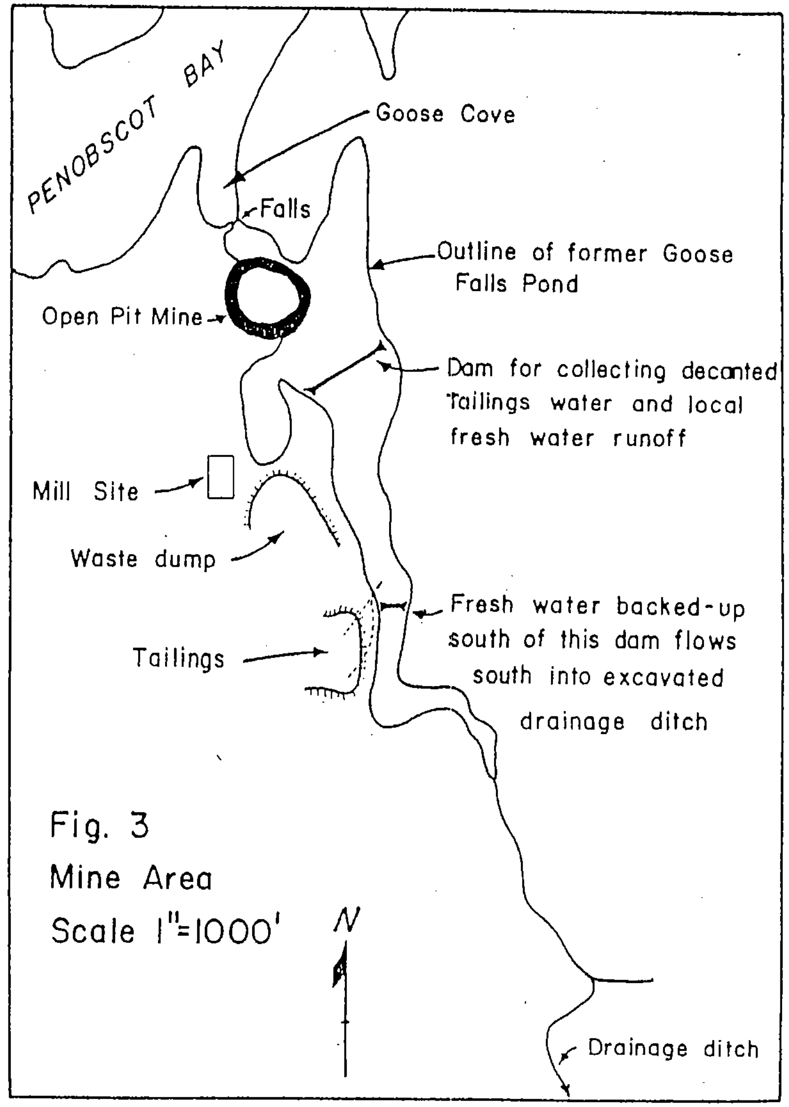


Fig. 3 - Mine area, scale 1 in. - 1,000 ft.

RECLAMATION PLAN, GOOSE POND
BROOKSVILLE, MAINE

Prepared by: Frederick M. Beck, Callahan Mining Corporation
Endorsed by: Goose Pond Reclamation Society
Date: August 15, 1972

RECLAMATION PLAN, GOOSE POND
BROOKSVILLE, MAINE

Prepared by: Frederick M. Beck, Callahan Mining Corporation
Endorsed by: Goose Pond Reclamation Society
Date: August 15, 1972

Introduction

Since February, 1968, Callahan Mining Corporation has been mining and milling zinc and copper minerals from an open pit mine which occupies a portion of the former Goose Pond, a state-owned tidal estuary, and adjacent privately-owned land on the west side of Goose Pond. Goose Pond is located on the northwest coast of Cape Rosier, a peninsula located in Brooksville, Maine on the eastern shore of Penobscot Bay.

Due to depletion of the mineral reserve, mining ceased on June 15, 1972, and milling ceased on July 14. A total of 800,000 tons of ore was processed in the concentrating mill. The average ore grade was 1.30% copper, 4.91% zinc, 0.35% lead, and 0.50 ounces per ton silver.

Callahan operated the mine under a number of permits, licenses, and leases. The only specific state reclamation requirement for the area underlying the former Goose Pond is contained in the state mining lease wherein "Lessee will cooperate with Lessor, its various agencies, and the Officials of the town of Brooksville . . . in the planning, funding, and implementation of a program for the rehabilitation of the said lands upon the completion of mining activities thereon. The details of such program, including the funding and administration of same and the source of funds to accomplish the program shall be the subject of further discussion and negotiation between the parties." To this end, the Goose Pond Reclamation Society was formed and provides the forum for discussion and recommendation for reclamation as envisioned by the state, town, and company, in 1967. Appendix "A" contains the articles of incorporation and by-laws of the society. The state, town, and company are not obligated to accept the recommendations of the Society, but each group has indicated a willingness to cooperate with the Society and provide assistance and support whenever possible.

A reclamation plan has been prepared as a result of numerous meetings of the Society. The plan has been prepared by Callahan Mining Corporation, but reflects the concensus of opinion of the Goose Pond Reclamation Society and is endorsed by that group. This plan if followed requires modification in existing federal permits, action by certain state agencies, and considerable work by the Company. The following plan provides the basis on which these decisions can be made; lack of approval would require modification to the plan.

Appendix B is a preprint which details the operation of the mine. Although two years old, it provides background which is sufficiently current. If time permits, it should be read prior to considering the plan. The plan is described in three parts; planting and grading of disturbed areas above sea level, economic rehabilitation of the area, Tailings Pond

Steps are being taken to assure that structural and chemical stability of the tailings pond will be maintained. Plates II and III indicate the area of the tailings pond and shows the location of a proposed drainage ditch which will keep the tailings drained. Vegetation will be planted on the area to provide a moisture barrier and to prevent erosion by wind and water. The U.S. Bureau of Mines is taking an active interest in the tailings and the Company and the Bureau are currently working jointly toward acceptable reclamation.

Economic Rehabilitation

In an effort to relieve the negative economic impact of the mine closure, Callahan is conducting a pilot project to determine the commercial feasibility of raising salmon and oysters under controlled conditions. The technology has been developed in other areas and it would appear that these technologies could be successfully applied to the Cape Rosier area. It is anticipated that a modest tax and employment base could be developed if the project proves feasible.

As part of the aquaculture project, analyses will be conducted periodically on water quality, both within and outside the pit area, and bioassays will be performend periodically to determine heavy metal accumulation in selected marine species. The company assay lab will be used for making most tests. Analytical assistance will be provided by the University of Maine's Darling Center and the Department of Sea and Shore Fisheries.

The following periodic tests will be conducted, both in the pit and from selected control points in Penobscot Bay:

- Temperature (surficial and with depth)
- Location of thermocline
- Salinity
- Turbidity
- Dissolved oxygen
- pH
- Heavy metals in shellfish, seaweed, and bottom sediments in locations agreed on by company and Department of Sea and Shore Fisheries

Below-Sea Level Reclamation

It is proposed that the end result of the Goose Pond reclamation should be a large salt water pond open to the tidal action of Penobscot Bay. Tidal exchange would be similar to the pre-1967 era.

In order to achieve this end result, the following steps are proposed:

1. Remove the fresh water dam.
2. Remove top three feet of concrete dam at Goose Falls to eliminate danger of ice damage to bridge deck, but provide a dam which would not allow tidal exchange.
3. Siphon salt water into pit to a level of 990'. Stop siphon and allow

4. Test water at this level after one month for heavy metal content. If significant quantities of heavy metal are present, retest one month later. When the Goose Pond Reclamation Society, after review, deems it advisable, siphon salt water into pit to a level of 1004'.
5. Periodic testing of Goose Pond waters will be undertaken during fall and winter months. If the Environmental Protection Agency, Department of Environmental Protection, Maine Department of Sea and Shore Fisheries, and the Corps of Engineers determine that there is not a significant pollution problem, the Goose Falls dam will be removed by Callahan Mining Corporation and replaced with a permanent spillway at an agreed upon elevation, which will be riprapped and constructed in such a way that it ressembles a natural ledge. A reversing tidal action will be returned to Goose Pond.

Summary

The plan described above in general terms reflects over a year of careful study by the Goose Pond Reclamation Society and Callahan Mining Corporation. It is felt that the objective of providing a continuing tax and employment base combined with environmentally and aesthetically acceptable reclamation will be achieved if the plan is followed. Specific details will be addressed to those agencies directly concerned or responsible for certain items outlines in the plan.

CALLAHAN MINING CORPORATION

TO: Fred Beck   DATE: June 22, 1973

FROM: Chan Mortimer   COPIES:

SUBJECT: Revegetation of the Harborside Site: Brief Description and Cost Estimates

---

There are approximately 40 acres of derelict land with no, or virtually no vegetation. In addition, there are 20 acres of land that were hydroseeded in August, 1972, and which have some grasses growing, ranging from barren to sparse to moderate cover. Also, there are other areas, totalling perhaps 10 acres which have been disturbed and which have some vegetative cover, mostly grasses or weedy shrubs.

The revegetation plan consists of attempting to establish tree seedlings, annual grasses, perennial grasses, and legumes. This strategy of planting a variety of plants and vegetative types is being pursued for three reasons: (1) a wide variety of surface material, exposures, and slopes; (2) inevitable uncertainly as to which vegetation will grow in a given area; (3) varying needs depending on location for erosion control, beautification, speed of covering surface material and long-term considerations from both esthetic and environmental standpoints.

Assuming success in revegetation, the area should make an excellent site for recreation, being located adjacent to Goose Cove, facing across to a nature sanctuary. Facilities for aquaculture remain on the site and reclamation should eliminate any potential erosion and environmental complications for this land use. Two office buildings also will remain on the site. Thus the potential for a variety of land uses will be made possible through revegetation.

Of the forty acres of virtually barren land, a 10-acre area comprising tailings from the milling process present distinct problems and circumstances. Following field tests in June and July, this area will be harrowed and planted much like a large field. Of the other 30 barren acres as much as possible will be planted either by hydroseeding or a similar method incorporating seed, ferlitizer, mulch, and chemicals to hold the materials down in order to minimize wind and water erosion. Areas most visible and areas near water will be given highest priority. Trees will be planted where feasible.

On the areas which were hydroseeded in 1972, 20 acres, fertilizer will be applied to improve growth of the grasses which have become established. In areas which do not show growth but which were hydroseeded, additional seed will be distributed. On all areas already hydroseeded tree seedlings will be planted.

To: Fred Beck
From: Chan Mortimer

June 22, 1973

Other areas which show some vegetative recovery will be planted with a variety of tree seedlings.

Cost Estimates

Method 1:
Hydroseeding by Gordon Company, Pittsfield, Miane. This method would apply to about 30 acres of barren land and would be only to establish grasses on these areas.

Cost per acre: $650--$700
All Materials including hay mulch, seed mix, terratac (to hold down materials), fertilizer, labor, machinery would be included.
Total cost for 30 acres: $19,500.00 -- $21,000.00
Additional costs:

monthly salary for 3½ months		$3850.00
labor, fertilizer, materials for this area and previously hydroseeded acreage	about	1500.00
seeding inaccessible areas	about	2000.00
TOTAL		$26,850.00
including tailings at same rate		6,500.00
		$33,350.00

Advantages:
1. Based on last year's experience, at least limited success is certain, and grasses would be established on many areas.

Disadvantages:
1. Cost
2. Trees would not become established in near future
3. Cost of revegetating the tailings pond is not included (although it could possibly be hydroseeded as well, adding $6500--7000 to the cost.

Method 2:
Hydroseeding by EROCON, Toronto
Method would apply to same areas as Method 1.

Cost per acre $368, not including seed, fertilizer, mulch
Cost per 30 acres

Cost per 30 acres		$11,040.00
seed @ 90/acre		2,700.00
fertilizer @60/acre		1,800.00
hay mulch @40/acre		1,200.00
	PER ACRE	THIRTY ACRES
TOTAL	558	16,740.00
Additional costs (as in Method 1)		7,350.00
		24,030.00
If the tailings were included at this rate		5,580.00
		$29,670.00

Advantages:
1. Use of hydroseeder method probably best for ...

To: Fred Beck
From: Chan Mortimer

June 22, 1973
page 3

ablishing grasses, although company has not experience in immediate area
2. lower cost thatn Method #1.

Disadvantages:

1. No tree establishment
2. Possibility that cost would be higher if hay mulch were used. (Eroc o suggests possibility of hydroseeding without mulch).

<u>Method 3</u>:
Buy a hydroseeder, hydroseed 30 acres; seed tailings area by plowing method. Seed areas near water which can't be hydroseeded by hand. Spread hay mulch by hand. Plant tree seedlings around tailings pond, on other areas which have vegetation and which lack vegetation.

Materials:

A. <u>Trees -- seedlings</u> ---------------------- 500.00

3000 White Pine	55
1000 European White Birch	85
1000 Bristly Locust	100
1000 Redosier Dogwood	75
500 Scotch Pine	20
400 Green ash	25
385 hybrid Poplars	105
shipping	35

B. <u>Grasses -- seed</u> ---------------------- 3191.00

2000 lb. Ky 31	1100
1000 lb. Red Fescue	800
1000 lb. Annual Rye	250
500 lb. Dutch White Clover	625
200 lb. Birdspot Trefoil	396
innoculant for Trefoil	20

4700 lb. : 100 lb./acre for 40 acres and remainder for reseeding 1972 hydroseeded areas

C. <u>Fertilizer</u> ---------------------------- 763.48

8000 lb. 16-16-16	408.80
8000 lb. ammonium nitrate	354.68

(≈2 tons/acre for 40 acres)

D. <u>Hay</u> ---------------------------------- 1600.00
80 tons @ $20/ton
(≈2 tons/acre for 40 acres)

E. <u>Terratack</u> ---------------------------- 1800.00
(or other material to hold down mulch)
800 lb. (≈20 lb./acre for 40 acres) + shipping

F. <u>Salaries and Labor</u>---------------------- 4578.00

A. monthly for 3½ months	3850.00
B. 2 @ $1.80/hr. for 12 wks.	1728.00

G. <u>Machinery</u> ---------------------------- 3750.00

A. Purchase of Bowie Victor 500 Hydroseeder	3100.00
B. Shipping	470.00
C. 200 ft. fire hose	180.000

To: Fred Beck
From: Chan Mortimer

June 22, 1973
page 4

H. Other ---------------------- about------1000.00

A.	Rental of bulldozer for 1 day	200.00
B.	Rental of field equipt. for tailings pond	200.00
C.	Soil tests, etc.	300.00
D.	Tools, etc.	300.00

TOTAL $17,982.48 TO $20,500.00 OR $21,000.00

Note that more materials may be needed and added expense might well add up to at least $2000-3000.

An essential part of this method (and the other methods) is supervision, evaluation, and possible maintenance of the site after planting is completed. It is not unlikely that this will have to be done periodically for several years, but it will be most important during the first year.

Advantages:

1. Lower cost -- covers 40 acres plus upgrading 20-30 other acres ($300-$475/acre)
2. Continual on the spot supervision, greater possibility of adequate hydroseeding
3. Hydroseeding the best method for establishing vegetation
4. Includes tree planting, diversified strategy.

Disadvantages:

1. Potential shortage of water?
2. Possibility of machinery breakdown (hydroseeder)
3. Small hydroseeder will take longer than methods 1,2.

Method 4:

All revegetation by hand. Trees and grasses planted manually as well as mulch and fertilizer. Same coverage as method three.

Materials:

A.	Trees (as in method 3)	500
B.	Grasses (")	3191
C.	Fertilizer (")	763
D.	Hay (")	1600
E.	Asphalt (Terratack probably impossible to use, although another substitute might possibly work)	2000

To: Fred Beck
From: Chan Mortimer

June 22, 1973
page 5

		1194	
	B. 2 @ $1.80 for 12 weeks	1728	
	C. 3 @ $1.80 for 8 weeks	1728	
Other:	same as in Method 3	1000	16,360
Rental of asphalt distributor @ $300 a day 3-8 days $900-2400		900-2400	17,260 to 18,760
Possibility of more materials (as in Method 3)		2000-3000	2,000 to 3,000
			$19,260 to 21,760

Advantages:

1. cheaper than contract hydroseeding
2. includes trees as well as grasses

Disadvantages:

1. will probably not as successful as hydroseeding
2. appears more expensive than buying hydroseeder unless a substitute can be found for asphalt. There is 1 possibility called "Coterex."
3. Even if Coiterex is used price will be almost the same as buying hydroseeder, especially if hydroseeder is capitalized.

Summary

Method 3 appears best from both economic and vegetative points of view. Hydroseeder could be reused or sold.

A potential problem is that it will take 3-4 weeks for delivery of a hydroseeder, so it should be ordered as soon as possible.

ACM:lja

CALLAHAN MINING CORPORATION

TO: C.D. Snead, Jr.

DATE: March 23, 1973

FROM: F.M. Beck

COPIES: Hall, J.T. Beattie, G.J. Lohden, W.P. Mettham, J.T.

SUBJECT: - Penobscot Reclamation -

An estimate of work to be done follows:

<u>Land & Buildings</u>

Donate to Town of Brooksville

Action: Formal request has been mailed to Town to accept property of Penobscot Mining Company and buildings owned by Callahan.

Cost: None

<u>Tailings Pond</u>

Provide permanent drainage and vegetative cover

Action: Hire experienced man for summer to supervise seeding, drainage, etc.

Cost: $6,000 (reimbursable possibly)

<u>Goose Falls Dam</u>

Apply for permit to remove dam in May when sufficient water quality data is available.

Action: Remove dam in August

Cost: $8,000

<u>Dredging of Upper End of Goose Cove</u>

Requested by Sea & Shore Fisheries; they may object to removal of dam if dredging is not done.

Cost: $12,000 (reimbursable possibly)

<u>Planting of Dumps and Shoreline Areas</u>

Provide permanent vegetative cover for more visible areas

Cost: $10,000 (reimbursable possibly)

<u>Mill</u>

1. Provide separate electric meters - immediate
2. Cover foundations - winter
   Cost: $3,000
3. Plant vegetative cover in mill and office area - Spring, 1974
   Cost: $1,000

Land Town of [illegible] $30,000 [illegible]

Dyer Houses

1. Victor Dyer house - sell in fall
   Revenue: $12,000

2. George Dyer house on market now
   Revenue: $9,000

3. Elwin Dyer house - sold to R. Mant now? Yes
   Revenue: $12,000?

Water Wells

1. Test owner's wells and return these to service if water is adequate -- May

   OR

2. Drill "churn drill" hole on Sandecki property to tap shallow water -- June

   Cost: $3,000 (if drilled)

Other

Clean up last vestiges of mining operation such as old fences, caved in #4 shaft, odds and ends of junk, etc.

Cost: $1,000

Total Costs Possible..................$40,000

Revenues (Dyer houses) 33,000

Possibly reimbursable (loan to town).. 20,000 (?)

Other revenues: Assay Furnace 1,000

Balance 1,000

Scoop tram 15,000

Compressors............ 7,000

$24,000