PR90-009

NOLAN, DAVIS & ASSOCIATES

ENVIRONMENTAL ASSESSMENT REPORT FOR A PROPOSED GOLD MINE PROJECT AT GOLDBORO GUYSBOROUGH COUNTY, NOVA SCOTIA

Submitted to:

Nova Scotia Department of the Environment

by:

Exploration Orex Inc.
Rouyn-Noranda
Quebec

May 1990

EXPLORATION OREX Inc

April 30, 1990

Mr. W.A. Coulter, P. Eng.
Assesement Administrator
Nova Scotia Department of
the Environnement
P.O. Box 2107
5151 Terminal Road, 5th Floor
Halifax, Nova Scotia
H3J 3B7

Dear Sir,

RE: Proposed Goldboro Project

We are pleased to submit ten (10) copies of our Environmental Assesement Report which has been prepared in accordance with the Terms of Reference approved by your Department. We will be pleased to meet with you and other regulatory officials to review the contents of the report at your earliest convenience.

Yours very truly,

Yves Morissette
President

Encls. (10)

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PREFACE

This report is submitted by the project proponent in accordance with the Terms of Reference developed and approved under the Nova Scotia Environmental Assessment Act.

Coordination and management of the Environmental Assessment has been the responsibility of Nolan, Davis & Associates (N.S.) Limited of Halifax. This company has been working in a subconsulting capacity to our principal project consultants, St. Michel Geoconseil of Rouyn-Noranda. Thus, the description of the project and much of the material in Part 1 of the report was prepared directly by St. Michel with Nolan, Davis providing the assessment of existing environment (Part 2) and impact assessment sections of the document.

EXECUTIVE SUMMARY

Exploration Orex Inc propose to develop a new gold mine and mill at a site approximately 2 km northeast of the community of Goldboro in Guysborough County, Nova Scotia.

The mine will be an underground operation with an initial capacity of 1000 tonnes per day and will be accessed by means of a ramp which has already been developed as a function of recent exploration activity. The ore will be fed into an on-site mill of similar capacity. Gravity, conventional flotation and cyanidation will be used to produce a concentrate which will be fed to an on-site refinery where metallic gold will be produced as the final product.

The initial operation is planned for a period of three years but extensive ore reserves have been identified and future long-term operations at expanded production rates appear feasible. Any significant upgrading of the project will be subject to new and separate regulatory approvals.

The proposed operation will provide significant employment and economic benefits to the local region. Approximately 75 persons will be employed once the project is operational, with somewhat more, possibly about 100, during the development phase. No significant negative impacts are anticipated for the following reasons:

- The development area appears to contain no unique or unduly sensitive environmental elements.

- The area has been impacted by previous mining activity around the turn of the century.

- Although the use of cyanide is always the subject of environmental concern, the project will apply cyanidation to only about 10 percent of the mill feed. Cyanide levels in this waste stream will be treated in the mill using the proven SO_2-Air process prior to mixing with the larger volume flotation circuit wastes and mine water. The levels of cyanide discharged to the environment (tailings disposal facility) will, therefore, be very low and will be reliably controlled.

- The tailings are non-acid generating and will, therefore, not have a major impact other than physically inundating the disposal area (54 hectares) if proper reclamation measures are applied on abandonment.

- Potentially contaminated surface water will be treated in already constructed settling ponds which also provide the means to control accidental spills of oil or fuel in the mill area.

- The old Boston Richardson shaft is currently dewatered. Thus the mine is unlikely to have any further significant effect on groundwater relative to influencing wells in the community of Goldboro.

- Other potential impacts such as increased levels of airborne dust and noise will likely be quite minor.

- The developer proposes to use local labour and does not anticipate the need for camp facilities at the site. This will maximize benefits to the community and reduce potential social problems.

Exploration Orex has initiated, and will maintain, a policy of close cooperation and information sharing with the community. The majority of local residents appear to favour the development if reasonable environmental controls are reliably applied.

INTRODUCTION

INTRODUCTION

Exploration Orex Inc. propose to develop a new gold mine and mill at a site approximately 2 km northeast of the community of Goldboro in Guysborough County.

In order to proceed with this development, the company must obtain the pertinent mining and environmental approvals. This Environmental Assessment Report has been prepared to address the requirements of the recently enacted Nova Scotia Environmental Assessment Act and has followed the sequence of stipulations defined in the Act. It is one of the first projects in the Province to do so.

The report is presented as five parts. The first two parts describe the project and the existing environment, and thus form the basis of the report. The description of the environment is based primarily on available data although some field investigations were undertaken relative to defining the fishery resources of the area. The subsequent parts of the report describe the potential impacts between the project and the environment, measures proposed to mitigate these impacts (Part 3) followed by a concise description of residual impacts (Part 4) and proposed effects monitoring (Part 5).

PART 1: PROJECT DESCRIPTION

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1.1 Location

The proposed mine site is located approximately 2 km northeast of the community of Goldboro in Guysborough County on the eastern shore of Nova Scotia, approximately 180 km northeast of Halifax (Figure 1-1). Its UTM coordinates are 5007200 m north, 606900 m east. The ground surface at the site is gently rolling with an elevation ranging from 65 to 80 m above sea level.

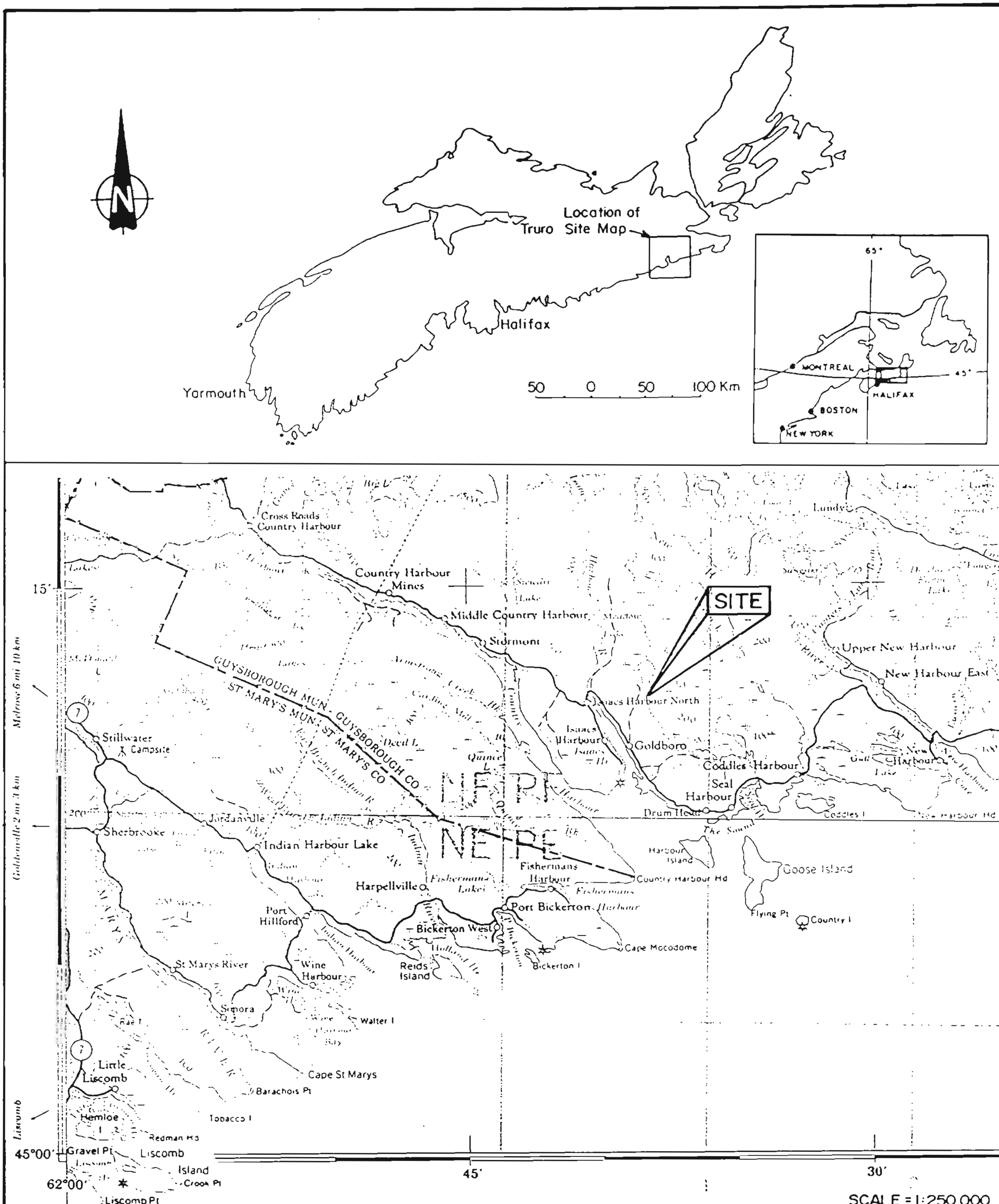
Access to the site is excellent. Good gravel roads from Highway 316 at Goldboro pass through the site. An existing portal and offices are located north of the gravel road. A mine shaft and headframe (Boston-Richardson Mine) and the proposed site for a mill are located on the south side of the road which also accesses the southern tip of Gold Brook Lake, immediately east of the mine shaft (Figure 1-2).

Residential dwellings are present along the gravel road to the site. A cemetery is located on the east side of the road, approximately 1.5 km south of the site. The area is moderately to heavily forested.

1.2 Past and Present Activity

1.2.1 Old Mine Workings

The Goldboro area was an active and productive mining area for many years around the turn of the century. Historical reviews of mining activity in the region have been described by Naert (1988), Roy (1989) and others.



NOLAN, DAVIS & ASSOCIATES

FIGURE 1-1

EXPLORATION OREX
GOLDBORO PROJECT
LOCATION MAP

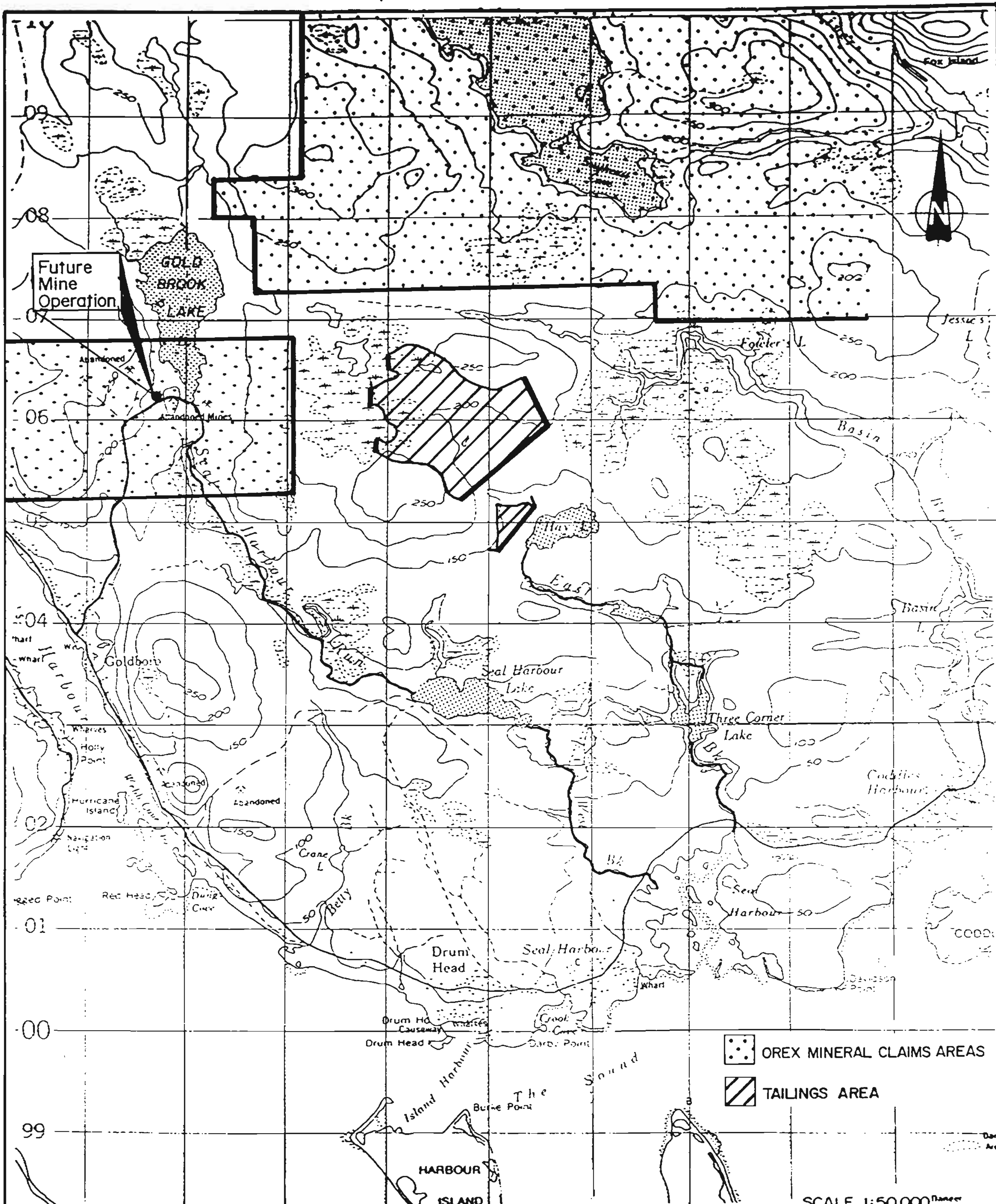


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FIGURE 1-2

EXPLORATION OREX
GOLDBORO PROJECT
SITE MAP

In 1892, Howard Richardson first discovered gold-bearing mineralization in the argillite belt which would later bear his name. Development work was undertaken later that same year by the Richardson Gold Mining Company. Mining began on a small scale in February 1893. First, a shaft was sunk on the southern limb (South Shaft), then another on the northern limb (North Shaft), near the apex of the ore body. In 1897, the apex was mined between the two shafts, and in 1898, a third shaft (East Shaft) was opened on the crest of the ore body. Several cave-ins occurred that year, including a very serious one that occurred at the third shaft. This shaft was subsequently developed as the main shaft and reached a depth of 122 metres in 1899. A fourth shaft was sunk on the northern limb of the ore belt, about 60 metres west of the North Shaft. All sites were cribbed and pillars were left in for support.

The mine became the property of the Boston-Richardson Mining Company in May 1903. In order to regain access to the ore body, the new company enlarged the existing shaft to its present dimensions (5.8 metres x 1.8 metres) and sank it down to the Richardson belt at 117.7 metres. It was further developed to 133 metres in 1905, and the 121.9 metre level was mined along both limbs of the belt using more modern shrinkage or room and pillar methods.

The new mining method was a success and the northern limb was mined to within 30 metres from the surface. Operations were suspended on August 15, 1908, because of financial difficulties.

A year later (in 1909), operations resumed again under the direction of a new company, the New England Mining Co., but all development work stopped in 1910. Mining continued although only on the established sites, which were mined out one after the other. On August 23, 1910, a cave-in on the upper part of the northern limb, on one of the older sites, resulted in a dangerous increase in water flow in the mine and work was suspended.

In 1926, the property was acquired by the Metals Mining and Smelting Corporation of Canada Ltd. They attempted to recover the auriferous arsenopyrite from the tailings during 1926-1927. Since then, the property has been dormant.

Other discoveries of gold on the Upper Seal Harbour Anticline led to the development of the Dolliver Mountain, East Gold Brook and West Bold Brook Mines.

The Dolliver Mountain Mine was discovered in the early 1890s and development proceeded in 1901 until a shaft of 149 metres cut several ore bodies. In 1905, a drillhole 152 metres below the shaft gave unsatisfactory results and the mine was allowed to flood. It has since remained idle. Figures of 6376 grams of gold from 7311 tonnes were reported for this mine.

The East Gold Brook Mine was discovered in 1906 and from 1907 to 1908 a shaft was sunk to 53 metres with some cross-cuts. Between 1931 and 1934, Renada Mines Ltd. dewatered and sampled the shaft. Their geological interpretation was that the mine was not near the axis or nose of the anticline.

In 1909, the New England Mining Company cleaned an old 26 metre shaft and did some lateral work on what is known as the West Gold Brook Mine.

In 1929, Locarno Copper Mines Ltd. sank a shaft to 30 metres on the Nugget Lead, west of the New England shaft. In 1956, the Canso Mining Corporation dewatered the shaft and did some cross-cutting to locate previously drilled leads. Work was stopped because of financial difficulties.

Patino Mines (Quebec) Ltd. performed some geophysical work at the site in the summer of 1981. Some of the mining claims were covered by EM-16 and magnetometer surveys over a grid with lines spaced at 75 m, and station intervals of 25 metres.

In 1984, an exploration hole (1984-01) of 530 metres was drilled downdip from the Boston-Richardson Mine, and in 1985 a five hole program of 390 metres was drilled on the West Gold Brook Mine.

From January to March 5, 1987, a program funded and managed by Petromet Resources Limited and Greenstrike Gold Corporation was executed. Five holes were drilled for a total of 1,925 metres.

Since May 1987, Onitap has completed an additional 33 holes for a total of 11,865 metres.

In 1987, an IP survey was conducted over the central area of the claims. Helicopter borne magnetic and EM 16 surveys were done by Aerodat Limited of Mississauga.

1.2.2 Old Tailings Facilities

Records indicate that a large portion of the material brought to surface from the four area underground workings was milled. In excess of 385,000 tonnes of ore are reported to have been crushed from 1893 to 1912 in a stamp mill capable of production rates of up to 1800 tonnes per month.

Gold concentrate was obtained by gravity methods using Wilfley tables until 1906, after which time a bromo-cyanide plant was built. The continued use of gravity methods thereafter is uncertain.

The mill produced more than 1700 kg of gold. Records also show that at least 775 tonnes of arsenical concentrate were produced for shipment to Belgium and Wales.

Four locations are known to have been used for tailings disposal during past mill operations. These are shown in Figure 1-3. None of the tailings disposal sites were contained and tailings were allowed to migrate down the streams into which they were deposited.

Old foundations suggest the principal mill building was located immediately west of Gold Brook Lake, north of the road (Figure 1-3). The presence of another mill is suggested based on the location of the tailings area "A" (Figure 1-3). The locations of past waste rock storage and ore storage areas are unknown.

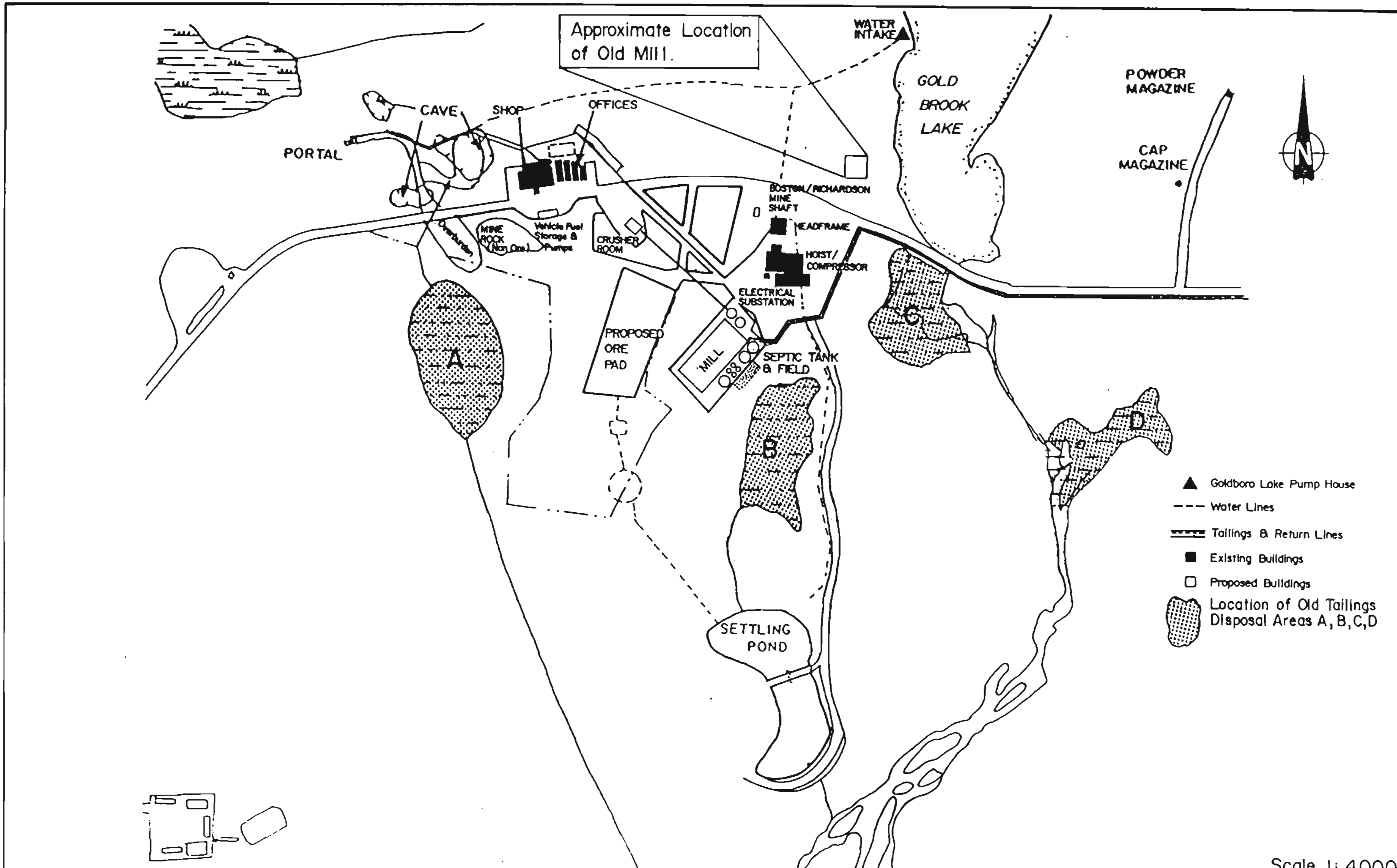

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FIGURE 1-3

EXPLORATION OREX
GOLDBORO PROJECT
LOCATION OF OLD TAILINGS DISPOSAL AREAS
AND OTHER FACILITIES

1.2.3 Environmentally Sensitive Remnants of Past Activities

The old tailings areas, which are not owned by Orex, are likely to present a continuing threat to the environment. Tailings were simply deposited into streams and wetland areas with no provisions for containment or control of leachates. Consequently, tailings migrated along Gold Brook. Stream water samples collected downstream of tailings Areas "A" and "B" (Figure 1-3) have shown elevated levels of arsenic and iron.

Other areas that may be subject to continued effects from past activities include the old mill sites and any unidentified waste rock and ore storage sites. These are areas where leachate and milling reagents may have infiltrated into bedrock although water analyses such as those taken in Gold Brook Lake show no evidence of such effects.

Most of the entrances to old underground workings and caved portions of the surface overlying these workings have been backfilled or otherwise sealed and should, therefore, not present a risk to animals and humans.

1.2.4 Recent Developments

Surface exploration programs conducted in 1988 and 1989 accounted for a total of 13,069 metres of drilling involving 61 holes in the western part of the Boston-Richardson Mine area and in the West Gold Brook Mine area. In addition, a total of 234 metres was drilled in four holes in a 1988 underground exploration program.

In 1988, a 5 m x 4 m decline with a slope of 15 percent, was driven 416 metres to the 76 metre level and 4 m x 3 m cross-cuts were driven at the 38 metre and 76 metre levels. A total of 3000 tonnes of potential ore and 20,000 tonnes of waste rock were brought to surface. A 27.4 metre headframe was erected and the Boston-Richardson shaft was rehabilitated down to the 122 metre level to allow future access to greater depths.

An ore storage pad capable of storing approximately 30,000 tonnes of ore and waste rock storage facilities was established. Two settling ponds were constructed in series south of the Boston-Richardson Mine to treat water pumped from the mine shaft and decline and to process leachate from the ore storage area.

The site around the mine shaft and the decline was cleared and levelled for surface facilities. An office trailer complex was installed and a shop/dry, including air lines and water line, were constructed.

An area about 0.5 km south of the mine site, immediately east of the site access road, was cleared for future mill, office and maintenance facilities and a sewage disposal system was installed (ref. Section 1.5).

1.3 Reasons and Alternatives to Proposed Undertaking

Exploration Orex Inc. was incorporated in July 1987 and was registered for trade at the Montreal Stock Exchange in March 1988. The head office of the company is located at 67 Perreault Street East in Rouyn-Noranda, Quebec. Exploration Orex Inc. is part of the Sociètè de Gestion Morisco, whose main activities are centered in the mining and real estate fields.

Exploration Orex Inc.'s activities consist of acquiring mining properties in order to explore and develop them and eventually bring them into production. The company has several properties in Quebec and Nova Scotia. Its most important project at present is the Goldboro project.

Drilling and underground exploration operations at Goldboro have revealed eight previously unknown mineralized belts (see Figure 1-4). New reserves are shown in Table 1-1. Reserve calculations assume excellent continuity along the horizontal and vertical axes of the mineralized belts.

Probable reserves are limited to drill-defined areas and possible reserves extend belts to a 260 metre depth except for 3A and 4A which are defined to 137 metre and 76 metre depths, respectively.

TABLE 1-1

New Reserves of Gold Ore at Goldboro, Nova Scotia

Belt	Apex Thickness (m)	Tons Probable	Tons Possible	Total	Grade (oz./Au)
New	5.00	389,497	426,832	816,329	0.169
3	5.15	480,769	360,049	840,818	0.189
3A	3.42	138,292	157,027	295,319	0.152
4	5.26	405,624	453,562	859,126	0.215
4A	7.00	104,727	231,408	336,135	0.312
5	5.90	204,639	758,629	963,268	0.240
6	3.00	10,745	479,052	489,797	0.110
7	6.00	29,445	950,149	979,594	0.090
Total		1,763,738	3,816,708	5,580,446	0.199

Ore reserves indicate that deep underground mining and open pit mining operations, at rates of 5000 to 10,000 tonnes per day, may be warranted. However, in order to keep initial capital investment to a minimum, a more conservative approach will be utilized for at least three years or until a viable cash flow has been established.

A section extending horizontally, approximately 450 metres to 670 metres west from Gold Brook Lake and extending in depth 38 metres to 122 metres from surface, estimated to contain more than 1 million tonnes of ore, will be targeted (see Figure 1-4). This volume of ore will allow operations to proceed at 1000 tonnes per day for approximately 3 years. Decisions on whether to proceed further and the size of future operations will be made at the end of the first 3 year period. Open pit mining may then be feasible but will be subject to new and separate regulatory approvals.

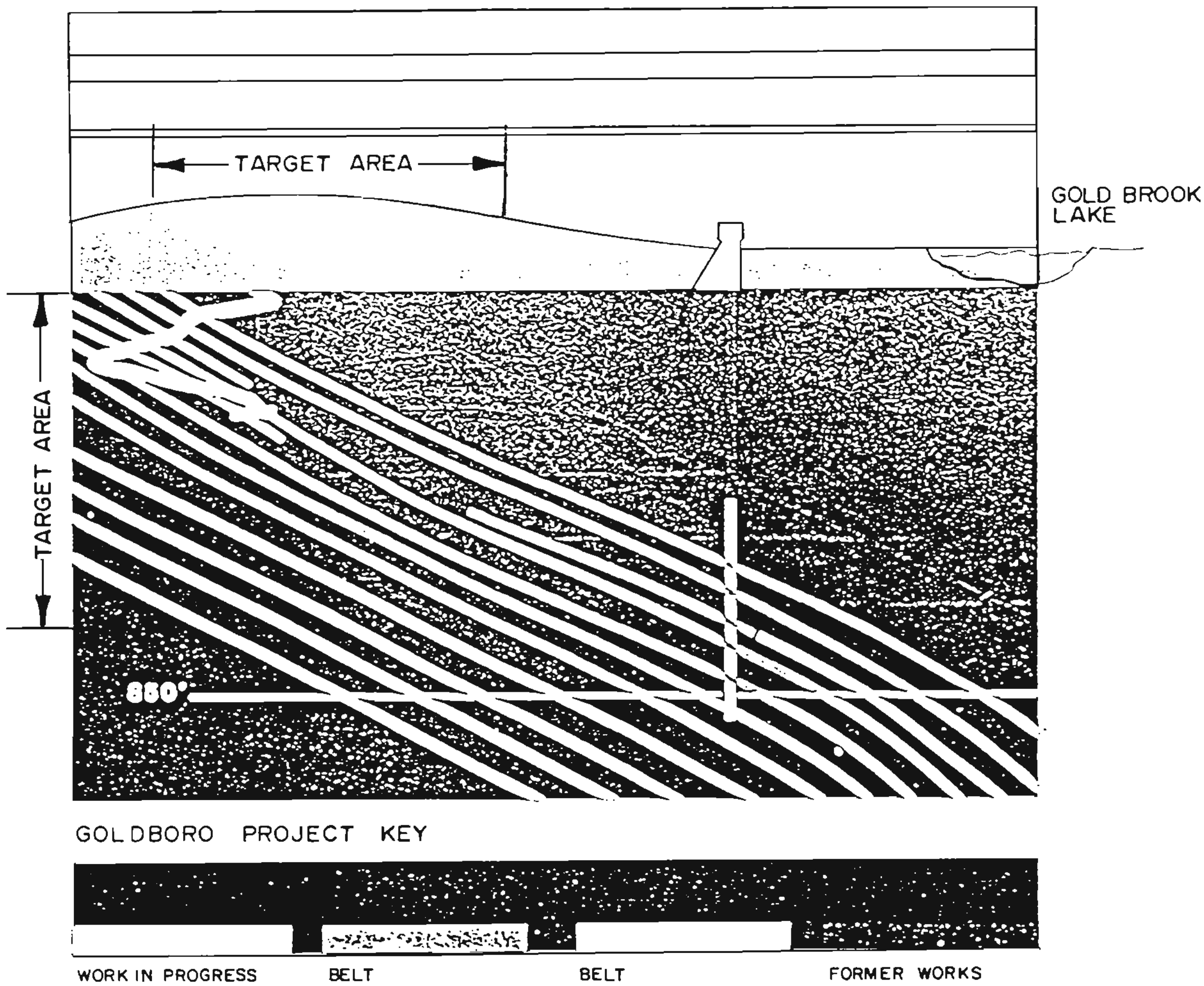

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FIGURE 1-4

EXPLORATION OREX
GOLDBORO PROJECT
SCHEMATIC CROSS-SECTION

Expected yearly gross income and profit for the first 3 years of operation are shown in Table 1-2. Local residents will be employed for underground and milling operations plus general administrative and maintenance activities.

Underground development and mining will at first be contracted, albeit specifying the use of locally based personnel. Orex will operate the mill.

A vertical retreat mining method is expected to be more beneficial than other methods such as shrinkage, cut and fill, etc., although conventional mining equipment will be used. This will result in some ore dilution.

Considering the dilution of the ore, transportation costs and the cost for custom treatment of the ore at other locations, an on-site 1000 tonne per day mill has been selected as the preferred option for initial development. Milling will involve a combination gravity/ flotation/cyanidation process with a conservative anticipated gold recovery of 92 to 94 percent. This recovery rate far exceeds that observed in any other gold mill in Nova Scotia to date.

Operations will proceed in such a way that the old tailings will not be disturbed.

1.4 Proposed Development Facilities

The facilities required for the exploration phase of the project already exist at the site. Other facilities will have to be installed and constructed as the project proceeds.

TABLE 1-2

Income Generated by the Goldboro Project

Variables	Year		
	1990-91	1991-92	1992-93
Tons milled	350,000	350,000	350,000
Grade (g/mt)	7.72	3.97	6.43
Price of Gold[1]	$450	$468	$487
Mill Recovery[2]	92%	93%	94%
Income	$36,000,000	$19,400,000	$33,100,000
Cost/mt[1]			
Mill	$8.33		
Mining	$22.50		
Administration	$5.17		
	$36.50	$38.00	$39.50
Cost/year	$12,775,000	$13,300,000	$13,825,000
Gross Profit	$23,225,000	$ 6,100,000	$19,275,000

[1] A 4% increase per year was taken into account to adjust to inflation.
[2] Mill performance should improve over the years.

1.4.1 Surface Facilities

In addition to the mine and mill, the following ancillary facilities will be required: office/administrative building, a guard house, septic system, parking area, a potable water supply and core storage space. Figure 1-5 shows the location of all present and proposed facilities at the site. As described in Section 1.4.5.1, the existing settling ponds will be used to collect and treat the surface runoff from potentially contaminated areas such as the ore storage pads, mill and maintenance areas.

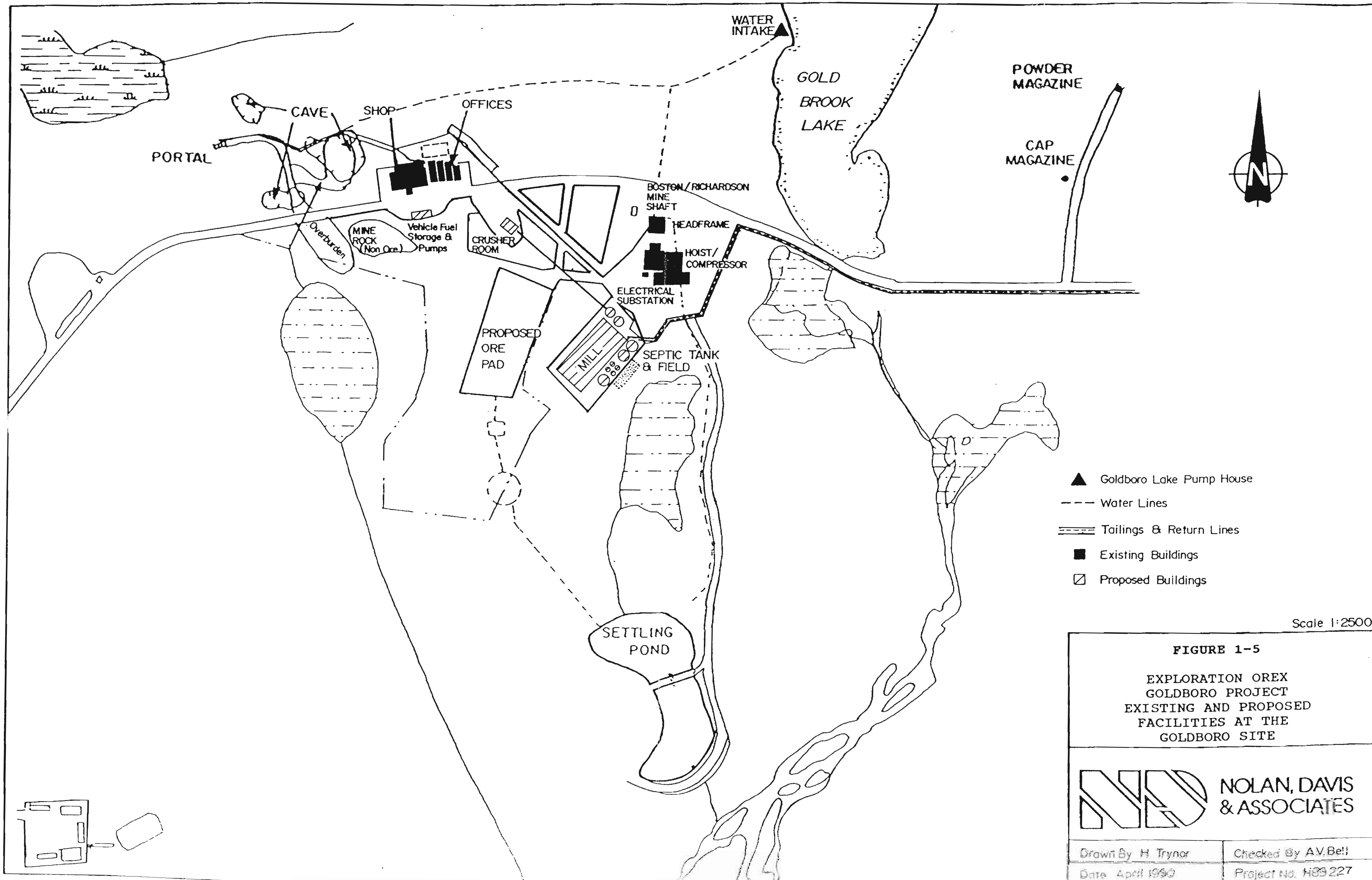


FIGURE 1-5

EXPLORATION OREX
GOLDBORO PROJECT
EXISTING AND PROPOSED
FACILITIES AT THE
GOLDBORO SITE

NOLAN, DAVIS & ASSOCIATES

Drawn By H. Trynor	Checked By A.V. Bell
Date April 1990	Project No. H89227

1.4.2 Mining Facilities

The decline into new underground workings and a new headframe for the Boston-Richardson Mine shaft are already in place. Other mining facilities in place include a shop, a dry, hoist room and compressor room, electrical services and generators, as well as the settling ponds described in the foregoing section which are currently used.

There is presently one ore storage pad with a capacity of approximately 30,000 tonnes (Figure 1-5). This pad will have to be extended to handle up to 60,000 tonnes during the mine development phase. Approximately 30,000 tonnes of waste rock will be produced as a function of mine development. This material is non-acid generating and will be used for infrastructure development. Any excess will be stored at the site in the location indicated in Figure 1-5. Waste rock management is further reviewed in Section 1.4.5.3.

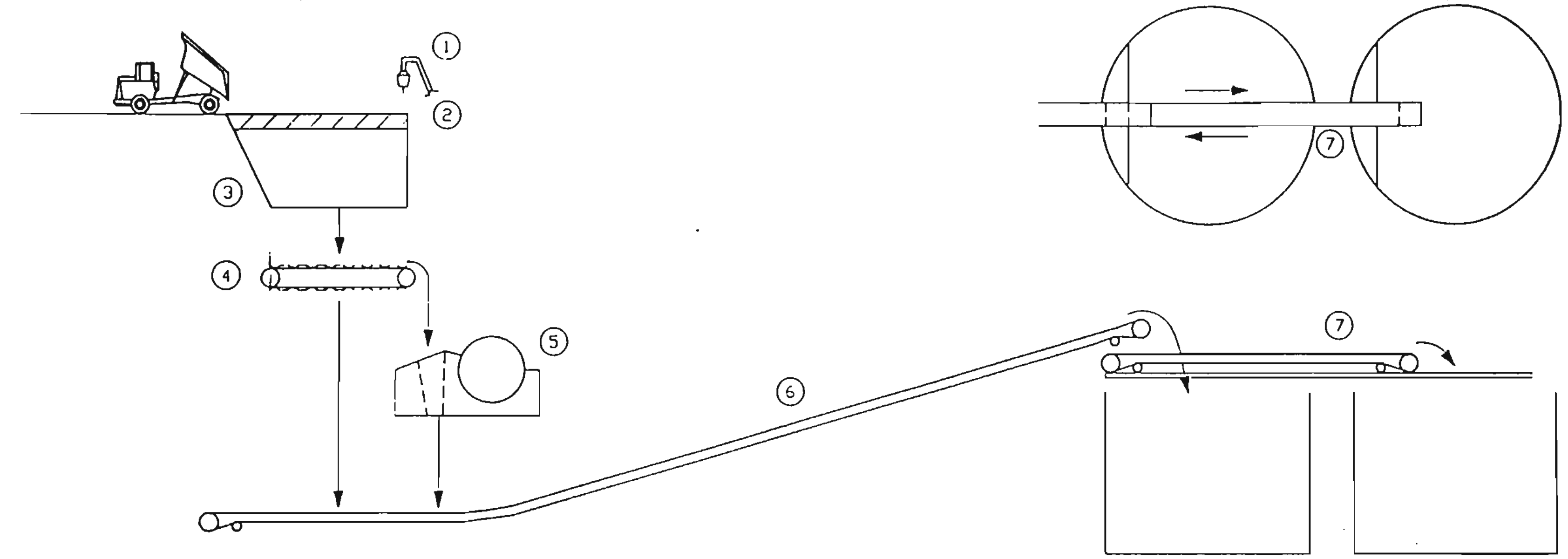
Fuel will be stored in above-ground, cribbed storage tanks at the location shown in Figure 1-5. This will eliminate the need for pumps to refuel vehicles and any spills or leaks from the tanks will be contained and readily detected.

Mining will proceed using standard equipment, such as jumbos, scooptrams, underground trucks, longhole drilling machines, etc. A remote control scooptram may be used.

1.4.3 Mill Facilities

A 1000 tonne per day mill will be used for the first three years of the project. The proposed location for the mill is shown in Figure 1-5.

Primary crushing will be done in a separate building located north of the mill. The proposed process diagram for primary crushing is shown in Figure 1-6.



1 ROCK BREAKER
2 GRIZZLY BARS (8" SPACING)
3 HOPPER (70 TONS CAPACITY)
4 APRON FEEDER (36")
5 JAW CRUSHER (36'X25')
6 CONVEYOR (TO FINE ORE BIN)
7 SHUTTLE BELT

REFERENCE: ST-Michel Geoconseil, Exploration Orex Inc. Goldboro Project, Mill Flow Sheet.

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FIGURE 1-6

EXPLORATION OREX
GOLDBORO PROJECT
CRUSHING PLANT FLOWSHEET

The milling process proposed is a combined gravity, flotation and cyanidation circuit as shown in Figure 1-7. After initial grinding and screening, the mill feed is passed through a cyclone where high density gold-bearing material is separated and directed to Knelson concentrators. The rejects from this process are returned to the mill feed while the metallic material is subjected to further gravity separation. This results in a feed to the refinery and an inert tailing stream. This circuit accounts for approximately 1 percent of the total mill feed.

Material not entering the gravity circuit (approximately 99 percent) enters the flotation circuit where the underflow of non-metal bearing material is discharged as inert tailings. The concentrate is then fed into the cyanidation circuit from which the products are a refinery concentrate and "cyanide tailings". These tailings are then processed for cyanide destruction (ref. Section 1.4.5.1) before being mixed with the inert tailings for ultimate disposal in the tailings pond. The on-site refinery will produce metallic gold from the cyanidation and gravity current feedstocks.

The layout for the proposed mill building is shown in Figure 1-8.

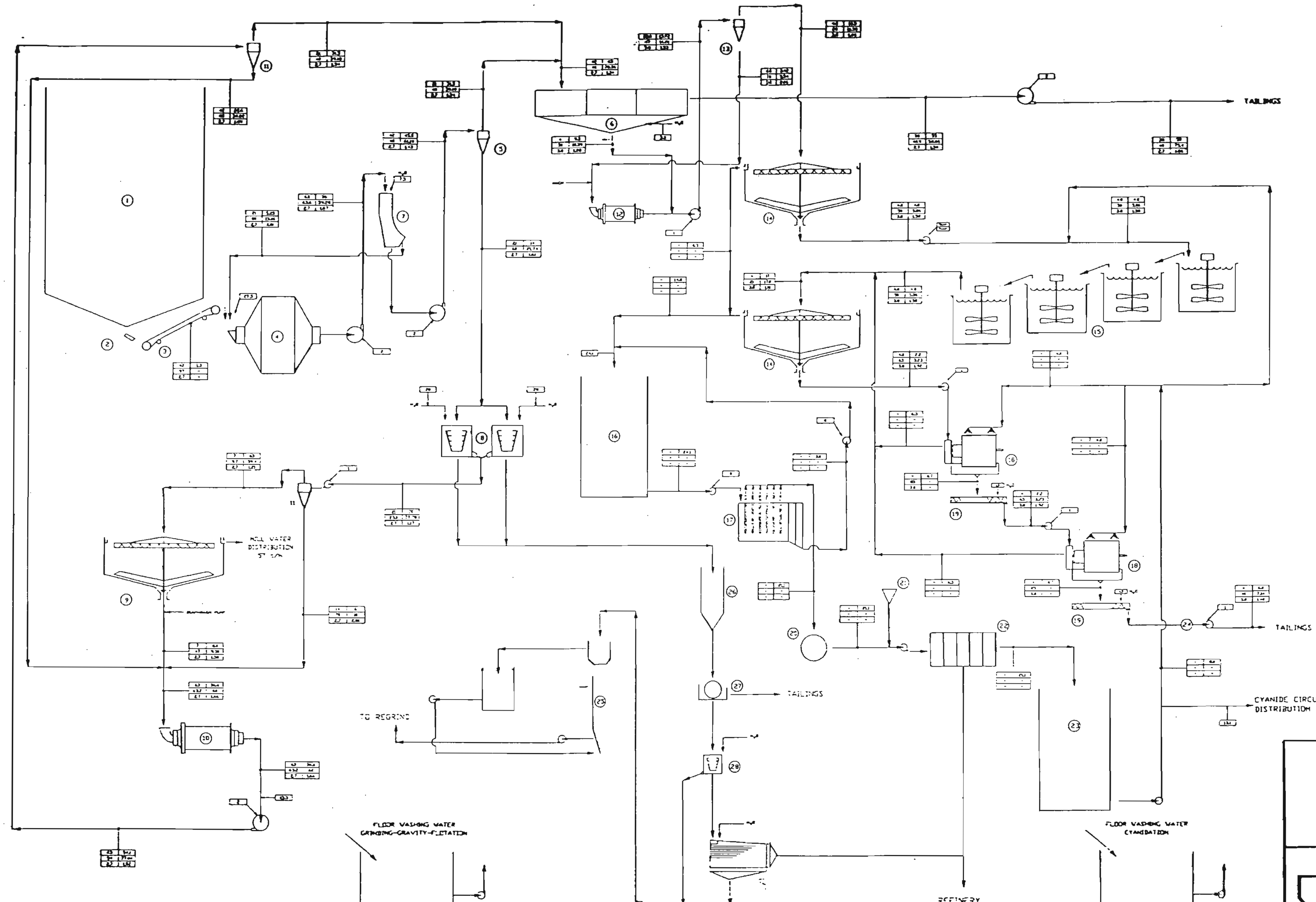
1.4.4 Water Supply

Exploration Orex Inc. presently holds a water rights permit for the withdrawal of 54,600 litres per day from Gold Brook Lake.

The mill will require 1.5 million litres per day during full operation. This water will be provided by recirculating water from the tailings pond by the use of mine water and from withdrawals from Gold Brook Lake and through precipitation at the pond.

An overall annual water balance is shown in Figure 1-9.

A source of potable water has yet to be defined or developed.



1 ORE BINS (2)
2 FEEDERS (2)
3 CONVEYORS (3)
4 SAG MILL
5 CYCLONES (2)
6 FLOTATION CELLS (1)
7 DSM SCREEN
8 KNELSON CONCENTRATORS (3)
9 THICKENER
10 BALL MILL
11 CYCLONES
12 REGRIND MILL
13 CYCLONES
14 THICKENERS (2)
15 AGITATORS (4)
16 PREGNANT TANK (1)
17 CLARIFIER (1)
18 DRUM FILTERS (2)
19 REPULPERS
20 CROWE TANK (1)
21 ZINC FEEDER (1)
22 GOLD PRESSES (2)
23 BARREN TANK (1)
24 CN. DESTRUCTION PLANT (if required)
25 CYANIDATION COLUMM (3)
26 BIN
27 MAGNETIC SEPARATOR (1)
28 KNELSON SEPARATOR (12po)
29 WIFLEY TABLE (1)

FLOW LEGEND

Solids t/h	Solution m³/h
% Solids	Slurry m³/h
S.G. Solids	S.G. Slurry

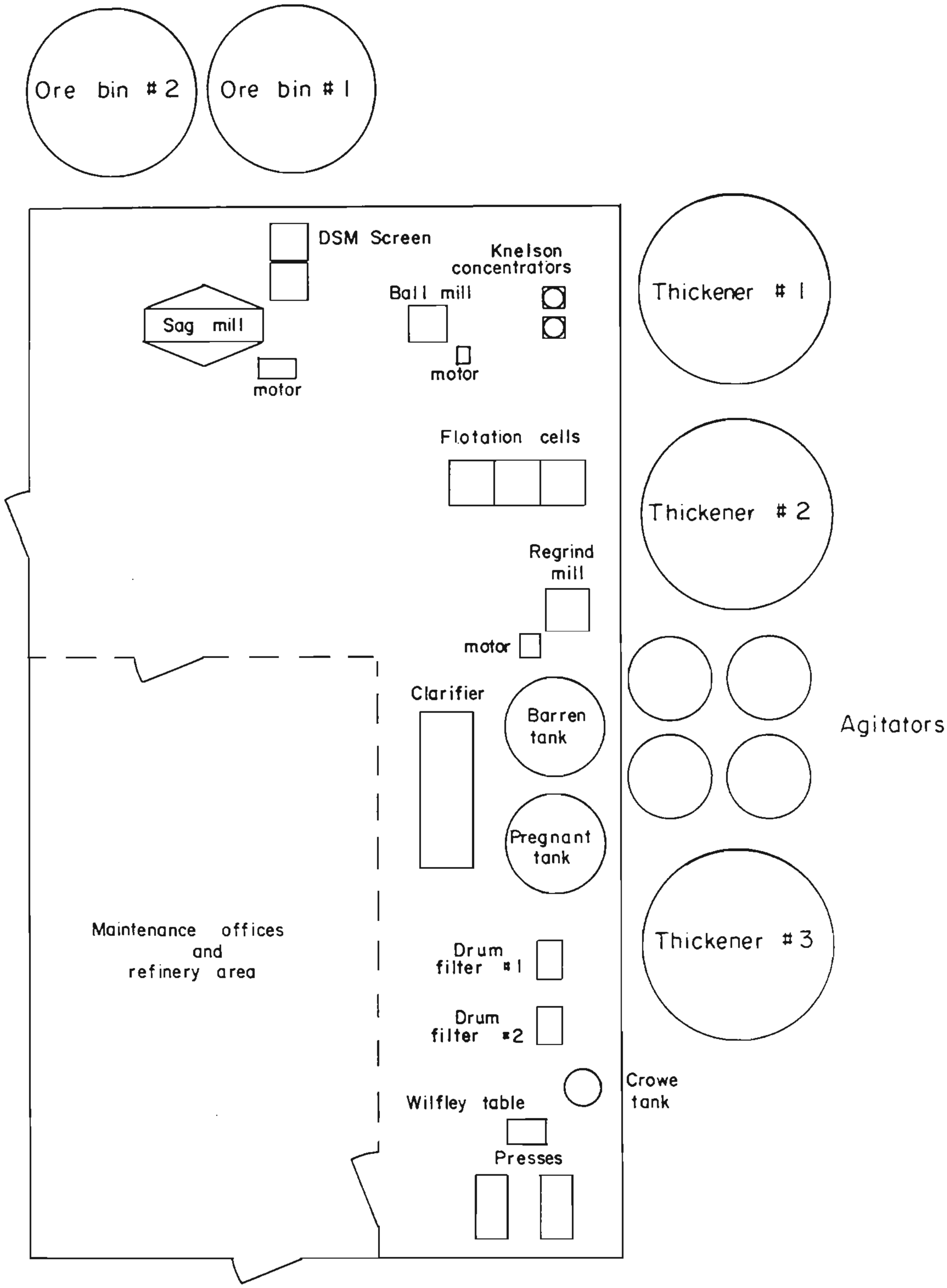
FIGURE 1-7

EXPLORATION OREX
GOLDBORO PROJECT
MILL FLOW SHEET

NOLAN, DAVIS & ASSOCIATES

Drawn By Others	Checked By A.V.B
Date, May 1990	Project No. H89 227

REFERENCE: ST-Michel Geoconseil, Exploration Orex Inc.
Goldboro Project, Mill Flow Sheet.

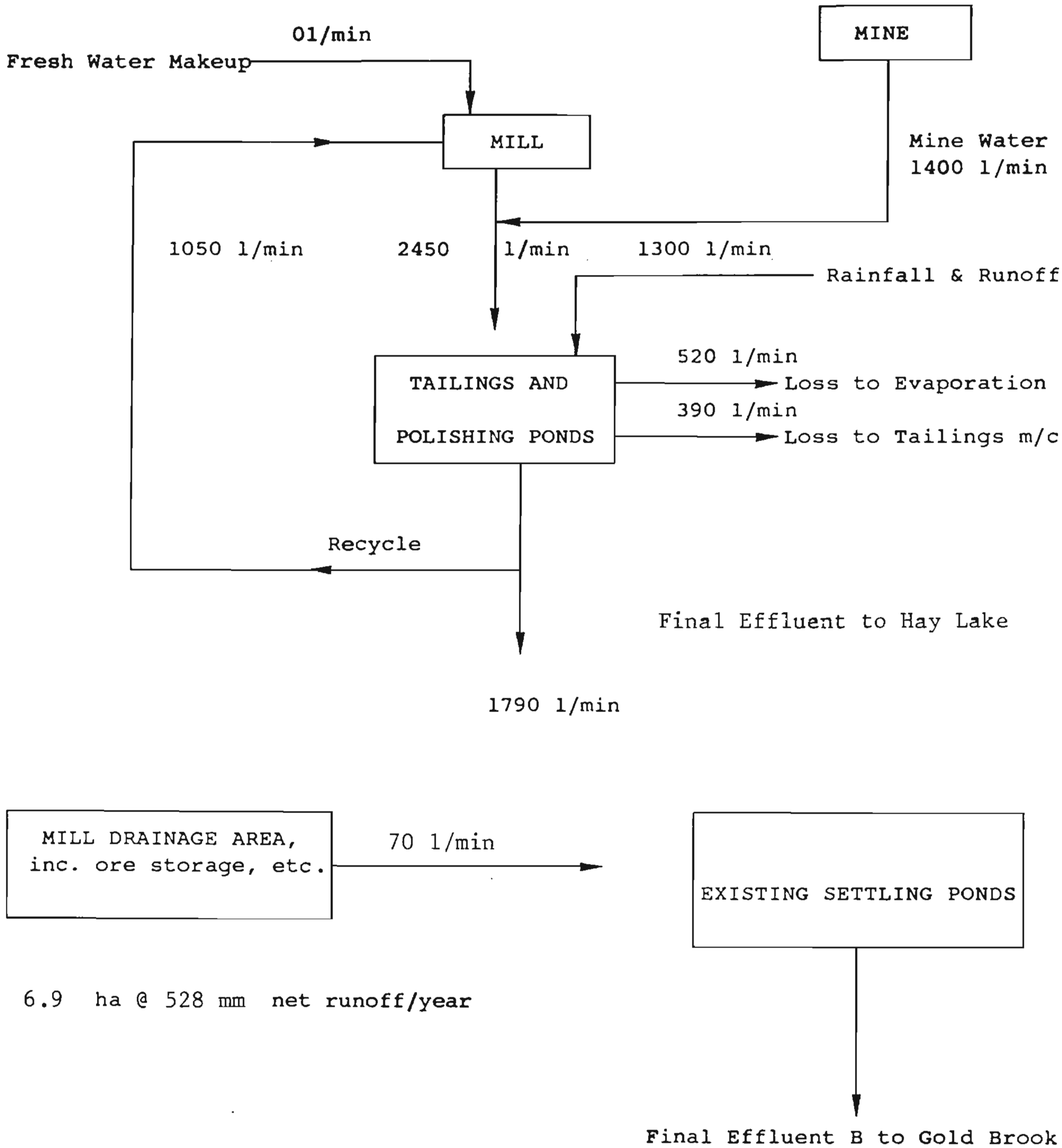


REFERENCE: ST-Michel Geoconseil, Exploration Orex Inc.
Goldboro Project, Mill Flow Sheet.

NOLAN, DAVIS & ASSOCIATES

FIGURE 1-8

EXPLORATION OREX
GOLDBORO PROJECT
PROPOSED MILL LAYOUT



Source: St. Michel, Geoconseil

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FIGURE 1-9

ANNUAL WATER BALANCE FOR THE GOLDBORO PROJECT

1.4.5 Waste Management

1.4.5.1 Liquid Effluents

Three sources of potentially contaminated liquid effluent have been considered: mill effluent, mine water and site drainage, including waste rock storage runoff and ore storage leachates. The overall annual average water balance for the operation is shown in Figure 1-9.

The mine water will be added to the tailings slurry in the mill and pumped to the tailings pond. The components of the tailings discharge will therefore be:

- flotation circuit tails 950 l/min
- cyanidation circuit tails 100 l/min
- mine water 1400 l/min

The cyanide circuit effluent, which will contain about 100 mg/l total cyanide, will be treated as a pulp to destroy cyanide to levels not exceeding 10 mg/l total cyanide using the INCO SO_2-Air process. This is an established method of cyanide destruction used extensively in the mineral industry in Canada. The treated effluent will then be added to the flotation circuit tailings and mine water for discharge to the tailings pond. Dilution will, therefore, decrease cyanide levels in the discharge pumped to the tailings pond to about 0.4 mg/l. Additional removal of cyanide as well as removal of the tailings solids will occur in the tailings disposal system. The pH of the tailings stream will be approximately 8.5 which should favour the precipitation of iron and other metals in the tailings pond to levels consistent with the Canadian Mining Liquid Effluent Regulations (Table 1-3).

Approximately 1050 l/min will be recirculated back to the mill from the tailings polishing pond leaving an average of 1790 l/min for final discharge to Hay Lake. This effluent should easily conform to the Canadian Metal Mining Liquid Effluent Requirements (ref. Table 1-3) and to an anticipated cyanide effluent requirement of 1.0 mg/l total cyanide.

Mine water and ore leachates are presently directed to two series settling ponds for treatment prior to release to Gold Brook (details on pond construction are presented in Appendix A). Their estimated combined volume is approximately 2300 m^3 and the disturbed area they control is 6.9 hectares, approximately half of which would be classified as "disturbed" under the NSDOE guidelines for pond sizing. The ponds are, therefore, of ample size to meet the guideline of 40 m^3 volume per 1000 m^2 disturbed area.

Once the mill is operational, the mine water will be used as tailings slurry water, thus leaving the settling ponds to provide only for the treatment of surface water from the general mill area.

The decant to the ponds will be fitted with skimming devices so that any floating materials such as oil or fuel will be trapped in the ponds.

TABLE 1-3

Canadian Metal Mining Liquid Effluent Requirements

Subsistence	Max. for Monthly Mean	Max. in Grab Sample
Arsenic	0.5 mg/l	1.0 mg/l
Copper	0.3 mg/l	0.6 mg/l
Lead	0.2 mg/l	0.4 mg/l
Nickel	0.5 mg/l	1.0 mg/l
Suspended Solids	25 mg/l	50 mg/l
Radium 226	10.0 pci/l	30.0 pci/l
pH	6.0 (minimum)	5.0 (minimum)

Final effluent from the settling ponds has been monitored regularly in recent months and has conformed to the requirements stipulated by NSDOE (Permit No. 88-054) which essentially reflects the Canadian Metal Mining Requirements defined in Table 1-3 with the addition of Total Ammonia (2.4 mg/l max.) and oils and grease (1.0 mg/l max.).

1.4.5.2 Tailings Disposal

The tailings disposal system will be built at the same time as the mill. The small percentage of acid generating, sulphide-rich tailings from the cyanidation circuit will be blended with acid consuming flotation tailings in order to produce a combined tailings stream that is acid consuming (ref. Table 1-4). The tailings slurry water will have a neutral to slightly alkaline pH.

An initial acid generation test conducted on ore samples form drill core by the Technical University of Nova Scotia showed the ore to be acid generating (see Table 1-4). A subsequent test by the Mineral Research Centre in Quebec showed the opposite. So, a third acid generation test was conducted on samples (totalling 110 lbs.) taken along the full length of the two crosscuts in the ore that will be mined. It shows that, globally, the ore from the outlined orebody is relatively neutral. This is supported by the fact that the leachate form the ore storage pad has shown no evidence of acid generation to date. Acid generation was, therefore, not considered as a potential problem in the design of the tailings disposal concept. Recent tests on the combined tailings made by Lakefield Research (Table 1-4) as a function of mill tests confirms the validity of this assumption.

The tailings ponds dykes are to be designed for an initial 1.4 million tonnes capacity, although the tailings for the first three years of operation will amount to only 1.0 million tons or approximately 62,600 cubic metres. Should the Goldboro project continue beyond the first three years, provisions must be made to dispose of tailings material if the mill continues

TABLE 1-4

Results of Acid Generation Tests

Date of Test or Sample No.	Material	Acid Producing Potential (lbs. of SO_4/ton)	Acid Consuming Ability (lbs. of SO_4/ton)	Net Acid Producer
	<u>Waste Rock</u>			
88/04/26	From core (pH=9.8; S=0.093%)	2.8	7.5	No
88/08/03	From core and ramp walls (pH-9.6; S=0.025%)	7.7	11.6	No
89/11/14	Ramp waste (pH=9.8; S=0.04%)	1.2	13.8	No
	<u>Ore</u>			
88/04/26	From core (pH=9.8; S=0.98%)	30.0	11.5	Yes
89/08/21	From metallurgical pilot plant rejects (pH=7.22; S=0.21%)	3.2	7.5	No
89/11/14	From 125xCut (West Wall) + 250xCut (East Wall): Average for the orebody (pH-8.21; S=0.45%)	13.8	13.8	No
	<u>Combined Tailings</u>			
AG-1	S = 0.32%	9.79	18.99	No
AG-2	S = 0.32%	9.79	21.07	No
AG-3	S - 0.28%	8.57	18.50	No

Note: All tests on the ore and waste rock were conducted at the Technical University of Nova Scotia except for that of the pilot plant rejects which were done at the Mineral Research Centre of the Quebec Department of Energy and Resources. Tests on the tailings were conducted by Lakefield Research. Refer to Appendix F for copies of data transmission.

to operate at a capacity of 1,000 tonnes/day. The expansion of the tailings system after the first three years of operation will allow adjustments to be made to the disposal concept, if required.

Site selection procedures for potential tailings disposal areas in the general area of the mill identified several sites. The process used to screen these options and to arrive at the selection of "Site C" for the disposal of tailings is described in Appendix B.

The selected site has the potential to hold approximately 11 million cubic metres of tailings, well in excess of the proposed Phase 1 development. The proposed scheme involves subaerial deposition of tailings, polishing of the decant in a separate pond, with recycle of 40 percent of the annual average discharge back to the mill. The final effluent will be discharged into a small brook that flows into Hay Lake and then into Seal Harbour (ref. Figure 1-2).

1.4.5.3 Waste Rock

Approximately 30,000 tonnes of waste rock is expected to be generated during the initial phases of driving the ramp, haulage drifts and drawpoints. Since the waste rock is not acid generating, an area south of the proposed mill location should be adequate for disposal of any waste above that used for site infrastructure development. Runoff from the pile will be directed to the settling pond.

Approximately 1220 m^3 of overburden is expected to be removed at the ventilation raise, 2300 m^3 at the mill site and 270 m^3 at the crusher site. All the removed overburden will be stored immediately west of the initial waste rock pad and preserved for future reclamation purposes.

1.4.5.4 Solid and Domestic Waste

The disposal of tailings and waste rock has been described in the foregoing sections. Other solid waste will consist primarily of office and kitchen waste plus waste oils and sludges from equipment maintenance facilities. These will be disposed of in a manner conforming with current municipal and provincial regulations.

Domestic and office related solid wastes will be bagged and hauled to the local landfill. Oils and sludges will be placed in metal drums for collection and disposal/recycling by a contractor.

A septic system is in place for the existing office, dry and shops. However, a new system will be required to serve up to 25 people at the mill and to accommodate additional loadings from the other site facilities once they are at operational capacity.

1.5 Employment and Camp Facilities

Camp facilities will not be required due to the use of locally-based personnel for construction and operation of the mine and mill. Supervisory staff from outside the area will be housed in one or the two homes purchased in the community.

The approximate number of people required for each area of activity during the operational phase is as follows:

Office	-	15
Mill	-	25
Underground	-	25
Surface	-	10
Total:		75

The number of people required during the construction phase may be somewhat more than this, perhaps in the order of 100 persons.

1.6 Management of Hazardous Materials

Hazardous materials which may be kept on site are listed in Table 1-5.

Fuels will be stored in cribbed, above-ground tanks so leaks can be detected immediately. Product transfers to and from the tanks will be in accordance to the Petroleum Storage Regulations of the Dangerous Goods and Hazardous Wastes Management Act of Nova Scotia (February 16, 1988).

TABLE 1-5

Hazardous Materials Which May Be Kept at the Goldboro Site for Gold Mining and Milling Operations

Type	Substance	Typical Quantity Stored
Fuel	Gasoline	500 l
	Diesel	2000 l
Flotation Agents	Xanthates	100 tonnes +
	MIBC	100 tonnes *
	Aero 208	100 tonnes +
	Copper Sulphate	60 tonnes +
Cyanides		
Others	Lime	100 tonnes
	Oils	12,000 tonnes ?
	Grease	Several Drums

+ Above 3 year use.
* Above 10 year use at 1,000 t.p.d

The delivery of cyanide to the mill is expected to be in the form of crated, one-tonne bags of briquette-shaped sodium cyanide. A dry storage place with a concrete floor, possibly in the mill itself, is planned for this purpose. Other materials, such as acids, etc., will be kept away from this storage area. Any spill of dry sodium cyanide will be picked up immediately.

The sodium cyanide bags will be opened in the mixing tank where dissolution in water will occur. The bags and crates will be rinsed of cyanide and disposed of as per Section 1.4.5.4. Cyanide-laden rinse water will be directed into the cyanide circuit or treatment plant.

Accidental spills of cyanide solution in the mill will be directed to drainless sumps where the material can be pumped back into the cyanide circuit or treatment plant.

Shipments of all materials to the mill site will be along Highway 316 through Goldboro. In order to deal with any accidental spills of hazardous goods in transit, an emergency response kit (including handling and storage equipment, plastic liners, and cover sheets, protective clothing, instructions) will be kept at the mill and appropriate personnel will be trained and made available for contingencies. Local authorities (fire department, police) will be supplied with data sheets of all hazardous materials to be transported to the mill.

1.7 Alternative Mining and Beneficiation Techniques

The background events leading to the current interest in the property are described in Sections 1.2 and 1.3. The options for mining and beneficiation of the orebody as defined to date favour the approach described. Underground mining of the orebody provides far more favourable initial economics for the project as compared to open pit mining, although it is felt that open pit mining of a larger capacity facility (possibly up to 5000 tpd) may be feasible in the future. Should this decision be made, an entirely new application and assessment will be prepared.

The mill circuit described provides for more favourable gold recoveries than alternatives such as gravity separation or heap leaching.

Disposal of the acid-generating cyanide tailings waste stream in the old workings of the Boston Richardson Mine was initially considered but was abandoned in favour of the currently proposed scheme due to the cost of trying to address long-term groundwater contamination concerns as well as issues such as the release of hydrogen cyanide in an acid underground environment.

PART 2: EXISTING ENVIRONMENT

PART 2: EXISTING ENVIRONMENT

This section of the report describes the existing environment in the vicinity of the proposed mine development. It has been prepared solely on the basis of existing available data with the exception of water, noise, and biological sampling undertaken during field visits.

2.1 Study Area

The study area for this section of the report encompasses the immediate and neighbouring vicinity of the proposed mine in which biophysical elements may be affected by mining, milling or mill waste disposal activity. Although areal coverage of physical parameters is concentrated on the Gold Brook watershed, neighbouring lakes and wetlands and nearby communities and fisheries are also included.

2.2 Geology

2.2.1 Surficial Geology

The area around the mine site is covered with a cobbly, silty sand till of the Quartzite Till Sheet (Stea and Fowler, 1979). It is described as a bluish to greenish-grey ablation till, formed primarily by weathering and erosion of the underlying quartzite bedrock. The till is typically very sandy and contains up to 95 percent locally derived pebble to cobble sized clasts of bedrock. It grades into a slightly siltier phase near the coastline as compared to the typically sandier phase inland.

The composition of the Quartzite Till matrix in the Eastern Shore region averages 80 percent sand, 15 percent silt and 5 percent clay (ibid.). The thickness of the till sheet on a regional basis averages 3 metres, but locally may attain depths of up to 20 metres.

From the Nova Scotia Land System map for the area (11F4 - Scale 1:50,000), the landform is of glacial origin and consists of basal moraine to the west of the mine site and of fluvial and outwash plain to the east of the site. Regionally, there is little expression of the structure of the underlying bedrock, with the exception of fault-induced lineations. The topography of the area appears to be the result of glacial erosion and the deposition of glacial landforms.

There are a number of different soil types in the area of the mine site which have developed from the glacial till as a result of the variable drainage conditions that exist in the area. Drainage can be limited by such factors as low topography and the silt content and degree of compactness of the underlying glacial till.

In the immediate area of the mine site, the soils are typically imperfectly drained. Regionally, significant peat deposits have developed in poorly drained topographic depressions located on the northwest shore of Gold Brook Lake, to the west and east of the mine site, and within the flood plain of Gold Brook.

The on-site surficial material consists of relatively uniform silty sand and gravel till with frequent cobbles and boulders. The silt and clay content of the till typically increases with depth, as the contact with the bedrock surface is approached. The depths to bedrock over the site are in the range of 1 to 7 metres. Outcrops of bedrock are rare.

2.2.2 Bedrock Geology

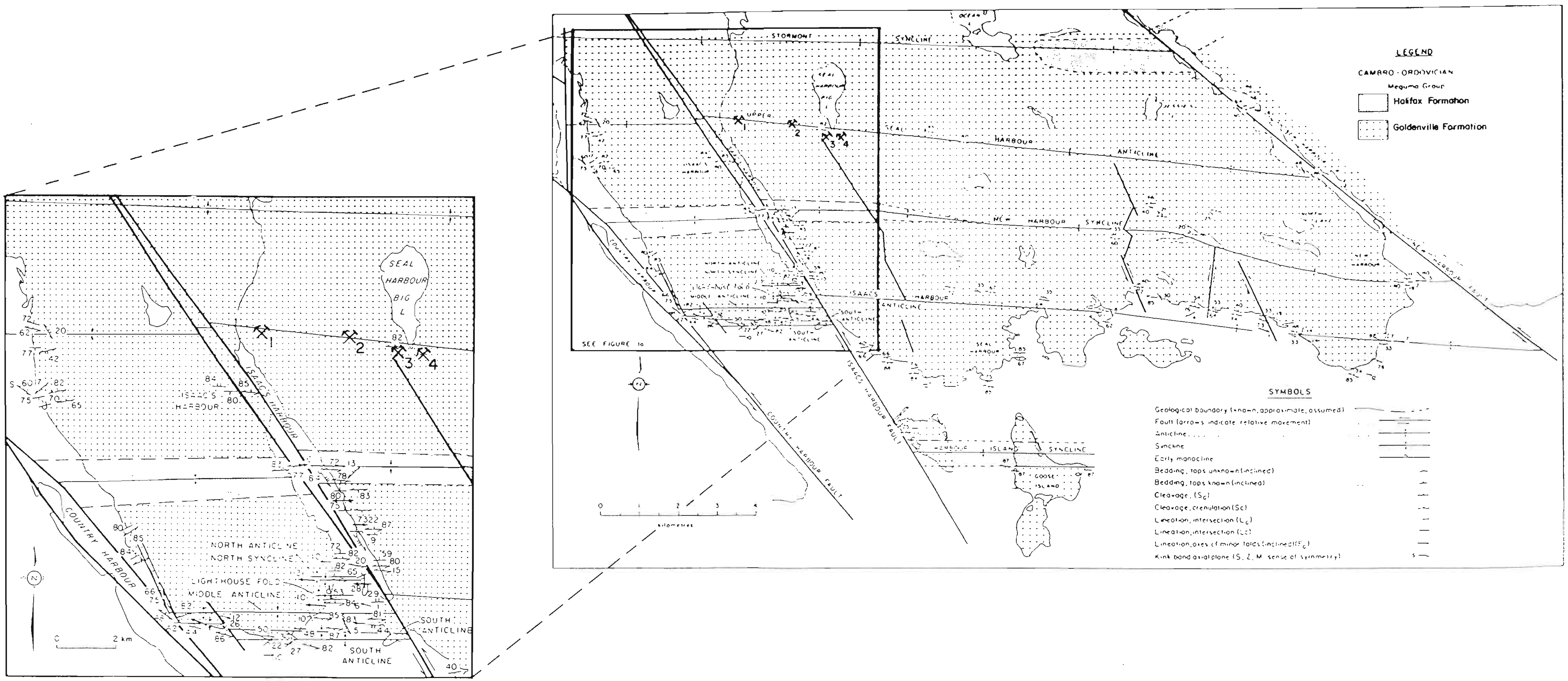
The bedrock along the Eastern Shore of Nova Scotia belongs predominantly to the Cambro-Ordovician aged Meguma Group. The Meguma Group rock units consist of the older, lower-most Goldenville Formation (comprised mostly of quartzite, greywackes, siltstones and minor slates) and the younger, conformable Halifax Formation (mostly slates, siltstones and minor schists). Metamorphic grades range from the greenschist facies in east-central Nova Scotia to the amphibolite facies at the northern and southern extremities of the Meguma Group.

Rocks of the Meguma Group are folded into a series of parallel arc-shaped regional folds (synclines and anticlines), the axial traces of which curve along the shore from the southeastern coast of the province up to the Canso area. The axial traces of these folds along the Eastern Shore consist of 2 to 16 km long segments which are commonly offset enechelon due to large northwest-striking regional faults.

The Meguma Group was subjected to several phases of deformation which controlled gold mineralization; gold typically occurs in quartz veins at the crests of anticlines within the Goldenville Formation.

Locally, the Goldenville Formation is known through outcrop, diamond drilling and underground exploration information. However, the Halifax Formation is poorly exposed and is seen in outcrop at only three localities on either side of Isaac's Harbour and on Goose Island (ref. Figure 2-1).

The Goldenville Formation in the study area is sedimentologically monotone, consisting of greywacke, mudstone and slate/shale. The greywacke is siliceous, light green to medium grey, massive and well inducted with good sorting, to moderately bedded and moderately sorted, to thinly bedded with sequences of argillaceous material. Bedding is generally obscured by very strong



LEGEND

- 1 - DOLLIVER MOUNTAIN
- 2 - WEST GOLD BROOK
- 3 - BOSTON - RICHARDSON
- 4 - EAST GOLD BROOK

REF. KEPPIE 1983

FIGURE 2-1

BEDROCK GEOLOGY OF THE GOLDBORO AREA

NOLAN, DAVIS & ASSOCIATES

Drawn By DSP	Checked By RW
Date SEPT 1989	Project No. H89.227

foliation. Biotite content ranges from 5 to 10 percent. The mudstone is black, fissile and exhibits a well-developed slaty cleavage. The slate/shale is black and generally contains 50 percent or more biotite with common quartz-carbonate porphyroblasts. Graphitic slate is also present. Sulphide mineralization consists mainly of arsenopyrite with lesser amounts of pyrite and pyrrhotite and occasional chalcopyrite.

The area lies on the Seal Harbour Anticline which strikes approximately east-west and can be traced for more than 13 kilometres. The anticline plunges gently to the east and passes beneath the southern-most tip of the Gold Brook Lake.

Locally, structural geology is relatively complex. The bedrock is highly to intensely fractured. Fractures (as measured in drill core) typically strike at 270 to 300 degrees and dip at 70 to 80 degrees towards the apex of the anticlinal fold. The bedding of the bedrock typically strikes at 90 to 100 degrees and dips at 70 to 80 degrees to the apex of the fold. Several joint sets were noted in bedrock outcrop (mine portal). The two predominant sets, however, strike at about 200 and 340 degrees, respectively, and dip at about 60 to 70 degrees. The bedrock is also highly faulted, with quartz vein intrusions along fault shear zones which cross cut the greywacke and slate strata. Some faults are highly brecciated.

The gold is typically associated with stratiform, stratabound and step quartz-carbonate veins and as rare dissemination in the host rock slates interbedded within the greywackes. Although true "saddle reefs" are present, many vein systems are located on the limbs of folds adjacent to monoclinal flexures. The mineralogy and form of the veins, and their attendant wall rock alteration effects suggest that the gold was deposited initially from hydrothermal solutions that passed upward through fault systems (Haynes, 1983).

Drilling results from the Orex project have confirmed at least four additional mineralized horizons beneath the old mine workings.

2.3 Climatology

The climate of the eastern shore of Nova Scotia is considered "humid continental" (Strahler classification, 1969).

Temperature and precipitation data shown in Table 2-1 are from the Stillwater and Stillwater Sherbrooke Atmospheric Environment Service (AES) station located about 50 km to the west. The nearest station for which wind data are available is Beaver Island located about 145 km west of Goldboro near Sheet Harbour. This weather station has only recently been put into operation and little data is available from it. Wind data for a six year period from 1955 to 1961 are available from a station at Ecum Secum, situated west of the site along the Eastern Shore. The next nearest station with a comparable, relatively long and comprehensive record of data is Shearwater, 330 km away.

2.3.1 Precipitation

The average mean annual precipitation for the Stillwater and Stillwater Sherbrooke stations is 1319.3 millimetres. The 10 percent variability in average monthly precipitation that exists between these stations may be explained by the relatively short recording period for Stillwater Sherbrooke and by the variations between years for the same station.

Rainfall is seasonally well distributed. Minimum precipitation occurs from April through September. The months of May, August and October are periods with a slightly higher incidence of intense storm events. However, most precipitation events are prolonged and of low intensity.

Maximum monthly precipitation occurs during the fall and early winter period from October through to January. Precipitation during this period is usually of long duration and low intensity and is generally created by frontal

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE
STILLWATER 45° 11'N 62° 0'W 17 m													
Daily Maximum Temperature	-0.5	-0.9	2.8	8.3	14.6	20.1	23.7	23.7	19.8	14.3	7.8	1.7	11.3
Daily Minimum Temperature	-10.8	-11.5	-6.6	-2.1	1.5	6.9	11.1	11.2	6.8	1.8	-0.9	-7.2	0.0
Daily Temperature	-5.7	-6.1	-1.9	3.0	8.1	13.7	17.8	17.4	13.2	8.0	3.5	-2.8	5.7
Standard Deviation, Daily Temperature	3.0	2.8	2.1	1.6	1.3	1.0	1.4	1.1	1.4	1.0	1.6	2.7	0.7
Extreme Maximum Temperature	14.4	12.2	20.0	26.7	31.7	34.4	34.4	35.6	32.2	29.4	21.7	16.7	35.6
Years of Record	52	53	51	51	53	53	52	53	52	53	46	48	
Extreme Minimum Temperature	-35.6	-40.0	-32.8	-24.4	-9.4	-7.2	-3.9	-5.0	-7.2	-13.9	-22.2	-31.1	-40.0
Years of Record	52	53	52	51	53	53	51	53	51	53	46	48	
Rainfall	101.3	81.8	73.4	78.7	91.0	78.1	86.0	108.9	95.4	128.9	134.9	100.9	1133.1
Snowfall	30.0	46.6	33.9	7.2	0.1	0.0	0.0	0.0	0.0	0.4	5.4	33.4	157.0
Total Precipitation	130.4	110.1	107.9	85.8	93.1	78.1	86.0	108.9	95.4	128.8	141.8	132.7	1298.9
Standard Deviation, Total Precipitation	60.8	42.9	43.1	23.3	63.9	42.7	46.5	51.9	44.3	61.9	66.6	38.0	136.1
Greatest Rainfall in 24 hours	81.3	52.8	57.7	54.1	100.6	95.3	69.1	101.6	86.4	127.0	81.8	91.9	127.0
Years of Record	46	46	45	44	43	48	45	49	47	46	36	45	
Greatest Snowfall in 24 hours	27.9	61.0	30.5	36.6	14.5	0.0	0.0	0.0	0.0	3.8	35.6	45.7	61.0
Years of Record	44	44	44	46	52	53	53	54	52	50	46	46	
Greatest Precipitation in 24 hours	81.3	61.0	57.7	54.1	100.6	95.3	69.1	101.6	86.4	127.0	81.6	91.9	127.0
Years of Record	46	44	42	43	43	48	45	49	47	46	36	43	
Days with Rain	6	4	6	7	9	8	9	8	8	9	10	7	91
Days with Snow	6	5	5	2	0	0	0	0	0	0	1	5	24
Days with Precipitation	10	9	9	9	9	8	9	8	8	9	10	11	109

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
STILLWATER SHERBROOKE 45° 9'N 61° 59'W 14 m													
Daily Maximum Temperature	-0.2	-0.4	3.4	8.1	14.4	20.1	23.8	23.8	19.5	14.0	8.4	2.7	11.4
Daily Minimum Temperature	-9.2	-11.0	-5.9	-1.8	2.0	7.0	12.0	11.9	7.7	2.7	-0.3	-6.2	0.7
Daily Temperature	-4.6	-5.6	-0.9	3.4	8.5	13.9	17.9	18.0	13.8	8.7	4.1	-1.7	8.3
Standard Deviation, Daily Temperature	2.1	2.7	1.3	1.2	0.9	1.3	1.0	1.2	1.1	1.1	1.5	2.3	0.7
Extreme Maximum Temperature	12.8	12.2	13.9	23.3	27.2	35.0	33.3	31.1	32.2	28.7	17.5	13.3	35.0
Years of Record	9	9	8	10	9	11	11	10	12	10	11	10	
Extreme Minimum Temperature	-27.2	-31.7	-22.2	-11.7	-6.1	-2.2	4.4	1.7	-2.8	-6.7	-13.0	-25.5	-31.7
Years of Record	8	9	8	9	10	11	10	10	12	9	11	7	
Rainfall	85.8	61.5	57.6	81.5	122.1	96.9	90.8	102.5	80.0	125.7	133.3	89.2	1136.9
Snowfall	41.5	54.8	28.0	13.5	0.0	0.0	0.0	0.0	0.0	1.9	3.7	26.5	169.9
Total Precipitation	126.9	126.7	102.5	102.0	108.0	105.7	89.9	107.4	80.1	121.1	157.2	128.1	1341.5
Standard Deviation, Total Precipitation	46.7	38.7	35.9	47.1	56.6	50.4	43.1	69.6	45.2	52.4	101.2	43.1	1.3
Greatest Rainfall in 24 hours	44.2	49.0	80.0	73.4	105.9	78.7	49.8	112.0	65.2	81.3	80.5	114.3	114.3
Years of Record	9	8	8	7	8	9	8	9	9	7	9	9	
Greatest Snowfall in 24 hours	25.4	38.1	30.5	20.3	T	T	0.0	0.0	0.0	17.8	12.7	25.4	38.1
Years of Record	8	7	7	10	10	11	11	10	11	9	11	8	
Greatest Precipitation in 24 hours	44.2	49.0	80.0	73.4	105.9	78.7	49.8	112.0	65.2	81.3	80.5	114.3	114.3
Years of Record	9	7	8	7	8	9	8	9	9	7	9	9	
Days with Rain	5	5	5	9	9	7	8	8	8	8	10	7	89
Days with Snow	5	4	2	1	0	0	0	0	0	0	1	3	18
Days with Precipitation	11	9	8	10	10	7	8	9	8	9	12	9	110

Source: AES Canadian Climate Normals, 1951 - 80, Atlantic Province

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TABLE 2-1
PRECIPITATION & TEMPERATURE DATA
OREX EXPLORATION INC.
GOLDBORO PROJECT

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convergences of tropical and arctic air masses. The majority of cyclonic storms leave the North American continent over the Maritime Region.

Approximately 15 percent of the annual precipitation between October and May is recorded as snow at the Stillwater station. The reliability of the snow cover is low because of the moderating effect on temperatures of the Atlantic Ocean.

2.3.2 Air Temperature

Temperature data from the Stillwater station is assumed to be representative of conditions at Goldboro. The mean annual air temperature is 5.7°C, with a standard deviation of 0.7 degrees. Air temperature is strongly dominated by the seasonal cycles, with daily fluctuations in the order of 10°C.

Mean monthly temperatures below freezing occur from December through March. The mean minimum of -6.1°C occurs in February. Average daily temperatures peak in July (17.6°C). The mean annual winter/summer temperature fluctuation of 35.5°C is relatively small and is typical of coastline stations where the oceanic influences tend to suppress wide variations.

2.3.3 Wind

Large-scale wind patterns are generally consistent throughout most parts of the province. Wind speed and direction can, however, be significantly modified by local topographic effects and surface cover (vegetation, water, etc.). Coastal locations such as Goldboro are often affected by sea breezes (diurnal onshore/offshore air flow caused by differential heating of the land mass and the ocean). An open water fetch will also tend to slightly increase the wind speed from the offshore direction in coastal locations.

A comparison of the various available wind data sets (Figure 2-2) shows generally similar directional distributions. Goldboro is located approximately 8 km from open ocean, mid-way up Isaac's Harbour Inlet and, as a result, is partially shielded from offshore winds. The Shearwater station is located about 1 km from the Halifax Inlet and as such is intermediate between a coastal and inland station. Because it is the only station with a reliable and lengthy period of wind record, and because of similarities in proximity to the ocean, Shearwater is the station best used to represent conditions at Goldboro.

The Shearwater record is summarized in Table 2-2.

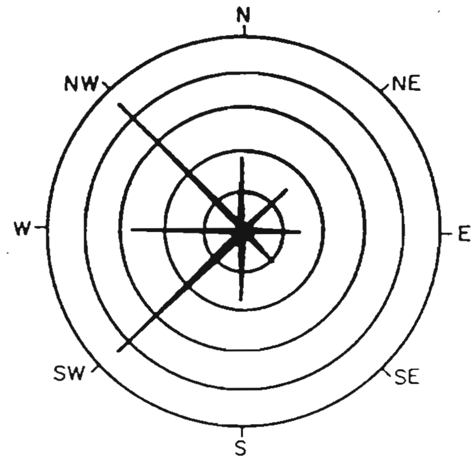
Annual mean wind speeds range from 17.1 kilometres per hour (km/hr) to 21.0 km/hr, with larger differences recorded for individual directions or times of the year. Wind intensity shows more of a seasonal pattern in the winter (November to March) than in summer. The maximum average wind speed peaks at 20.9 km/hr in January. A maximum hourly speed of 97 km/hr in February and gusts of up to 146 km/hr have been recorded in February. The predominant direction is from the western quadrant, typically southwest or northwest.

2.4 Surface Water Hydrology

2.4.1 Regional Hydrology

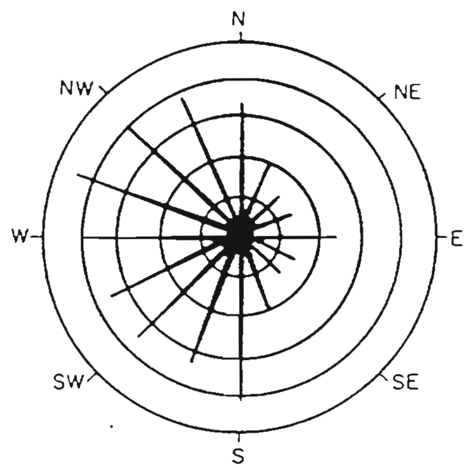
The mine development area is located in the Gold Brook Watershed (1EQ-SD31) close to the divide of the Isaac's Harbour Watershed (1EP-SD1) and Isaac's Harbour River Watershed (1EP-1).

Within the Gold Brook drainage area the key components relative to the mine site are Gold Brook Lake (formerly Seal Harbour Big Lake), which drains southward to Seal Harbour via Gold Brook, Seal Harbour Lake, and West Brook (Figure 2-3).



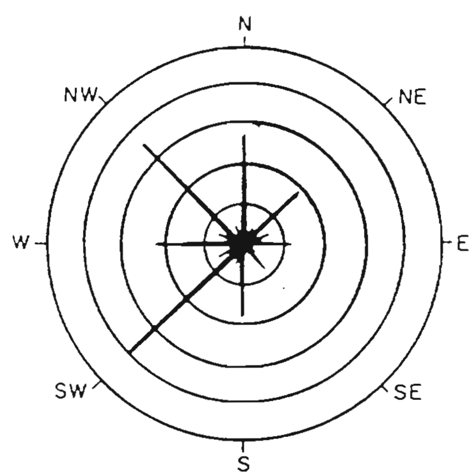
ECUM SECUM- 1955-61 DATA (6 yr.s)

CONTOUR FREQUENCY = 5%



SHEARWATER - 1955-80 DATA (25 yr.s)

CONTOUR FREQUENCY = 2%



BEAVER ISLAND - 1987 DATA (1 yr. only)

CONTOUR FREQUENCY = 5%

SOURCE: ENVIRONMENT CANADA

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FIGURE 2-2

ROSE DIAGRAMS OF

WIND DIRECTION – PERCENTAGE FREQUENCY

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SHEARWATER A N.S.

PERIOD 1955-80 PERIODE

Lat. 44°38'N Long. 063°30'W

Elevation 51 m Altitude

	JAN JANV	FEB FEV	MAR MARS	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEPT	OCT OCT	NOV NOV	DEC DEC	YEAR ANNUEL	
PERCENTAGE FREQUENCY														**FREQUENCE EN %**
N	8.1	8.1	10.1	9.9	7.4	5.2	3.0	3.8	6.5	7.5	7.4	7.7	7.1	N
NNE	4.2	4.2	5.9	4.6	3.6	3.2	1.9	2.4	4.3	4.2	4.6	4.4	4.0	NNE
NE	3.5	3.2	3.5	3.2	2.3	1.8	1.3	1.9	3.0	3.0	4.2	4.1	2.9	NE
ENE	4.0	3.3	4.2	3.6	3.1	2.1	1.6	2.3	2.7	2.8	3.6	3.2	3.0	ENE
E	4.4	4.6	5.5	6.6	8.5	8.6	4.4	3.4	3.3	3.6	4.1	3.7	4.9	E
ESE	2.2	2.9	3.3	3.8	5.0	5.0	3.2	2.8	2.9	2.5	2.6	2.4	3.2	ESE
SE	1.6	1.6	2.2	2.9	3.2	3.2	2.8	2.4	2.2	2.0	2.6	2.0	2.4	SE
SSE	2.3	2.4	2.8	4.3	5.8	6.4	7.1	4.8	3.7	3.6	3.5	2.8	4.1	SSE
S	3.4	4.4	6.0	7.1	11.0	13.3	16.6	12.9	6.4	7.1	5.8	4.8	8.4	S
SSW	4.1	4.1	4.1	5.2	7.4	10.1	11.3	9.8	8.4	6.7	5.4	4.1	6.7	SSW
SW	4.8	4.5	4.7	6.2	7.8	10.3	11.3	11.7	9.4	7.5	5.3	4.5	7.3	SW
WSW	5.7	7.0	6.1	5.9	6.7	8.4	8.7	9.3	8.3	9.9	7.4	6.5	7.5	WSW
W	10.6	10.1	8.6	7.0	5.2	4.6	5.0	6.5	6.9	9.9	10.4	11.1	8.0	W
WNW	14.0	13.4	10.5	8.7	6.0	4.3	4.8	6.7	8.1	9.4	10.9	12.6	9.1	WNW
NW	12.4	11.3	9.1	7.7	4.9	4.2	4.1	6.2	8.1	7.9	9.2	12.4	8.1	NW
NNW	11.2	10.6	9.8	9.0	6.6	4.4	4.3	5.0	7.6	7.5	8.4	9.6	7.9	NNW
Calm	3.5	4.3	3.6	4.1	5.5	6.5	8.6	8.3	6.0	5.4	4.6	4.1	5.4	Calme
MEAN WIND SPEED IN KILOMETRES PER HOUR / VITESSE MOYENNE DES VENTS EN KILOMETRES PAR HEURE														
N	20.0	20.9	24.0	21.8	22.1	19.5	14.6	14.8	16.9	18.1	19.4	16.5	19.7	N
NNE	20.6	21.6	23.9	22.4	20.5	19.3	15.1	16.2	17.7	19.1	20.8	20.2	19.6	NNE
NE	17.4	18.9	19.6	19.6	14.6	14.4	12.7	14.2	15.0	16.3	18.4	17.9	16.6	NE
ENE	74.5	23.1	24.2	24.0	19.4	17.7	13.6	15.7	18.7	16.5	21.8	18.8	19.8	ENE
E	77.2	28.8	24.5	23.1	19.0	17.4	15.7	15.4	15.2	18.7	22.4	25.4	71.0	E
ESE	26.9	24.7	24.3	19.4	16.0	14.7	12.7	13.1	17.8	20.8	21.8	27.7	20.0	ESE
SE	73.1	21.1	18.0	17.4	12.4	12.0	11.3	11.4	16.0	20.3	20.8	25.5	17.4	SE
SSE	24.1	21.3	17.7	17.2	15.4	13.8	13.5	13.2	16.4	20.0	22.3	25.3	16.4	SSE
S	71.8	20.2	19.6	17.3	16.4	15.1	14.0	14.3	16.3	18.0	21.0	21.3	17.9	S
SSW	23.9	21.2	21.2	20.1	18.0	18.6	15.3	15.4	17.8	19.0	21.9	21.9	19.4	SSW
SW	22.2	21.6	19.3	19.1	18.3	16.8	14.7	14.4	17.5	17.3	19.5	20.4	16.4	SW
WSW	19.2	18.5	20.2	16.7	16.8	15.1	13.1	13.3	15.0	16.3	18.3	20.9	17.0	WSW
W	21.0	19.8	19.5	16.9	15.3	12.8	11.8	12.5	13.9	16.8	18.7	21.6	16.7	W
WNW	22.8	21.6	22.9	20.3	18.7	16.1	13.2	13.6	15.6	17.9	20.6	27.9	16.9	WNW
NW	19.9	18.6	19.0	17.7	17.8	15.2	12.7	13.4	14.4	15.9	17.5	19.5	16.8	NW
NNW	70.7	19.1	22.9	19.9	19.8	16.9	14.7	13.9	14.9	16.7	17.4	17.7	17.8	NNW
All Directions	20.9	19.9	20.8	18.8	16.8	14.8	12.7	12.9	15.0	16.7	18.6	20.1	17.4	Toutes directions
Maximum Hourly Speed	77 SVL	97 E	77 SVL	85 ENE	72 E	77 N	87 SSE	60 ENE	97 SVL	60 ENE	89 SSE	89 SVL	97 SVL	Vitesse horaire maximale
Maximum Gust Speed	127 SSW	146 SSW	148 SW	122 ENE	106 W	111 NNW	114 SSW	64 SW	126 NNE	132 SSW	121 ENE	130 SE	146 SW	Vitesse maximale des rafales

Height of anemometer 10.1 m hauteur de l'anémomètre

SOURCE: CANADIAN CLIMATE NORMALS, 1951-80 BY ENVIRONMENT CANADA.

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TABLE 2-2

WIND DATA - SHEARWATER

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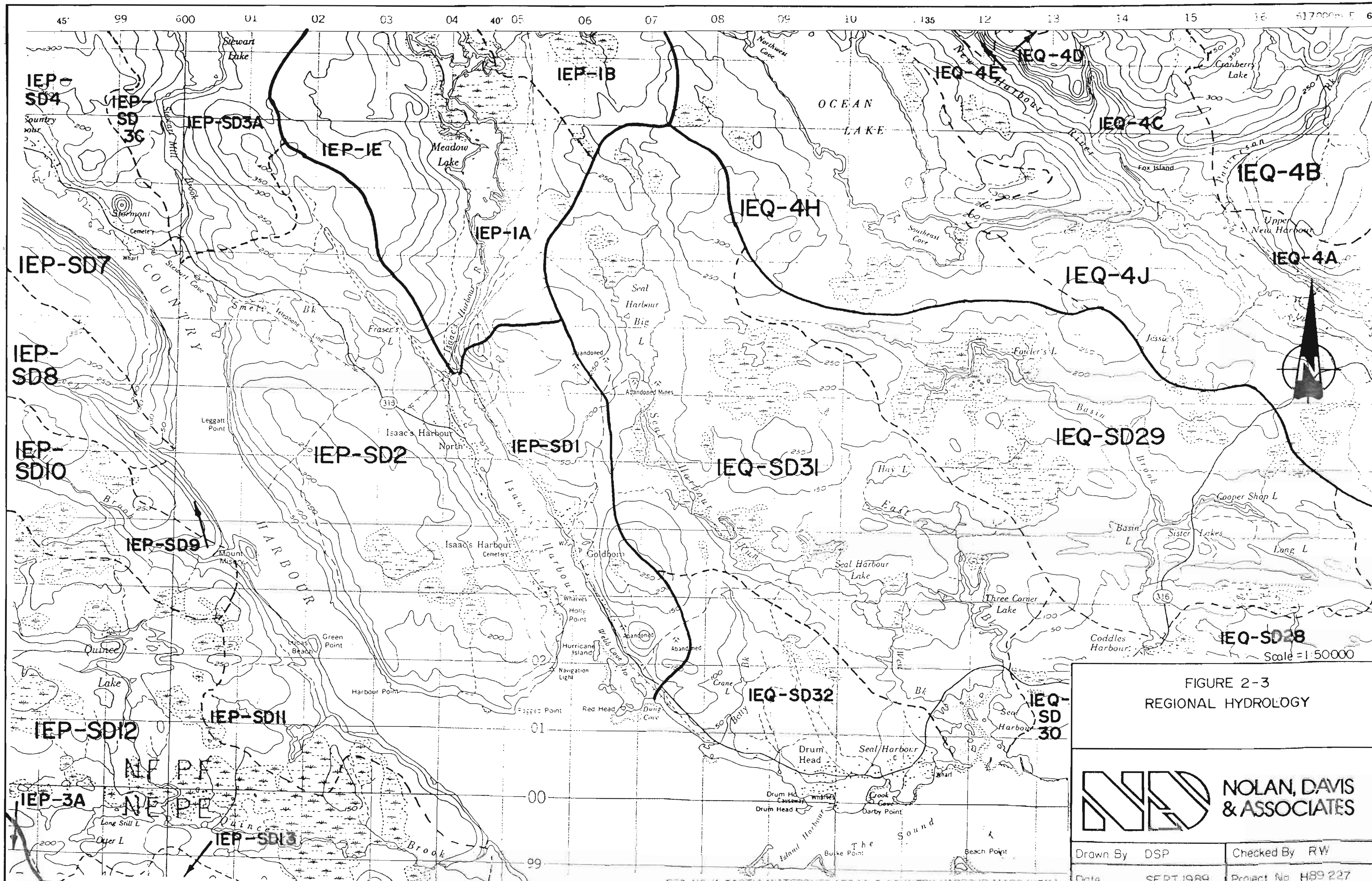


FIGURE 2-3
REGIONAL HYDROLOGY

The drainage area of Gold Brook Lake has been highly impacted by previous mining activities, particularly to the south of the lake. The original gold mill was located on the southwest shore of Gold Brook Lake. The area has been largely cut over and is now covered by a secondary growth of tag alders, maple, birch, spruce, balsam and tamarack. Some additional clearing of trees has occurred as a result of the current exploration activities. Mill tailings were dumped directly into the lake and to the south, adjacent to Gold Brook. Over time, the tailings have been transported downstream, and as a result of flood waters have spread over the flood plain of Gold Brook. The tailings are currently predominantly covered by moss and so are relatively stabilized. Two tailings ponds, used for the disposal of arsenic and cyanide wastes, are also located to the south of the lake. These areas are somewhat re-vegetated except in areas where contamination appears to have inhibited regrowth.

2.4.2 Surface Water Resource Utilization

Within the Gold Brook Watershed, Exploration Orex Inc. presently holds a water rights permit for the withdrawal of 54,600 litres/day (12,000 gallons/day) from Gold Brook Lake. The water intake is located at the southwestern side of the lake.

There are no other surface water withdrawal rights permits within the watershed (NSDOE, personal communication).

2.4.3 Drainage Basin Morphology

The Gold Brook drainage basin is roughly rectangular in shape and encompasses and area of 2,976 hectares based upon 1:50,000 scale mapping (NSDOE, 1980). It is oriented generally northwest-southeast, positioning it roughly perpendicular to bedrock strike and generally parallel to known regional fault trends. Gold Brook essentially follows the lineation created by a major northwest-southeast oriented fault system (Keppie, 1983). The basin drains into the head of Seal Harbour.

The low, gently undulating to rolling topographic relief within the basin rises from 0 m geodetic at the mouth to a maximum height of 76 m geodetic in the headwaters to the north of Gold Brook Lake. This gives an overall longitudinal topographic slope of 1 percent down the axis of the basin. The relief has created 5 main lakes within the system; namely, Gold Brook Lake, Rocky Lake, Seal Harbour Lake, Hay Lake and Three Corner Lake. Approximately ten much smaller, unnamed lakes are also located within the basin.

Recent bathymetric mapping undertaken by the Nova Scotia Department of Fisheries (1986) indicates that Gold Brook Lake attains a maximum depth of 3 metres in places, but in general averages about 2 metres in depth. Depths of the other lakes in the drainage basin are unknown, but are likely of a similar shallow depth.

The lakes in total encompass about 187 hectares or 6 percent of the watershed. The drainage density is relatively low at 0.53 km/km^2 (based upon 1:50,000 maps). This results in a Shreve Order channel number of 2 for the channel at the mouth.

2.4.4 Channel Morphology

The watershed has somewhat irregular single channel systems everywhere except where Gold Brook splits into two channels immediately to the south of Gold Brook Lake. These two channels reunite into one about one kilometre downstream of the lake.

There is no direct bedrock outcrop control of channel morphology. However, Gold Brook does follow a pronounced fault system lineation.

Field inspection revealed an abundance of boulders within the flood plain of the brook. Stony till has caused some lateral migration of the main channel. Gold Brook was subjected to excessive sediment loading due to tailings disposal in the past. The result is an increase in the degree of meandering of the brook. The brook now occupies a broad, flat, boulder-filled and swampy flood plain. It is apparent that during spring runoff and other high flow periods, the brook would occupy a much wider channel than that observed during September flow conditions.

2.4.5 Water Discharge

Given the humid climate, geology and vegetation growth of the area, it is expected that precipitation infiltration and interflow in the soil horizon above the till would predominate. For this reason, the "variable source" model of forest zone hydrology applies rather than the Horton Overland flow model, although the latter would be applicable over the mine site itself.

Stream baseflows would be provided by the glacial till/bedrock hydrostratigraphic units. Given the relatively low permeability of these units, low summer flows would be expected to be low unless significant surface storage is available.

Stream discharge data is only available for Liscomb River at Liscomb Falls and for the St. Mary's River at Stillwater. Although topographic relief, geology and climate are similar to the study area, these streams have much larger drainage basins of 389 and 1350 km^2, respectively. Pertinent data for the Liscomb and St. Mary's Rivers are given in Table 2-3. To date, no discharge monitoring has been undertaken on Gold Brook. Correlations of the Gold Brook basin to the Liscomb Rivers and St. Mary's River are difficult to make. Although accuracy is questionable, Table 2-4 shows the calculated mean annual flow (MASF) and minimum daily flow for Gold Brook Watershed.

TABLE 2-3

Runoff Coefficients for Liscomb & St. Mary's Rivers

	Runoff Coefficients	
	Liscomb River	St. Mary's River
Mean annual (long term)	3.75 cfs/mi^2 (16.0 m^3/s)	2.89 cfs/mi^2 (42.7 mi^3/s)
Mean annual (1968-77)	3.87 cfs/mi^2 (16.5 m^3/s)	3.19 cfs/mi^2 (47.1 mi^3/s)
Minimum daily/year	0.27 cfs/mi^2 (1.15 m^3/s)	0.15 cfs/mi^2 (2.21 mi^3/s)

TABLE 2-4

Calculated Data for Streams in Gold Brook Watershed

	Theoretical Mean Annual Flow (m^3/s)	Theoretical Minimum Daily Flow (m^3/s)
Gold Brook Lake Watershed (at outlet of Gold Brook Lake)	0.28 - 0.36	0.014 - 0.026
Entire Watershed		
- West Brook at Mouth	0.78 - 1.01	0.040 - 0.073
- East Brook at Mouth	0.22 - 0.29	0.011 - 0.021

2.4.6 Water Chemistry

No water chemistry was available for the streams on site prior to the commencement of Exploration Orex's activities in 1988. One sample was collected from Gold Brook Lake by the Nova Scotia Department of Lands and Forests in August 1985 as part of a regional lake water survey. Results are included in Appendix D.

Orex initiated a stream sampling program in January 1988, which included five stations in the vicinity of the mine site (Figure 2-4). Samples collected on a daily basis were analyzed for arsenic, suspended solids and pH; those collected on a weekly basis were analyzed for the same components, plus metals, ammonia, organic carbon, oil and grease. Groundwater samples from the old Boston-Richardson Mine were collected starting in June 1988. The results of these analyses are also included in Appendix D.

To augment the water sampling program, three stations (Figure 2-4) on pertinent streams around the site were sampled on August 29, 1989. Stations 1 and 2 were selected to provide background surface water conditions for water flowing into Gold Brook Lake, upstream of the mine site. Station 3 was located downstream of the mine site to determine the mine's influence on surface water chemistry at the time of sampling (low flow conditions). These samples should represent baseflow stream conditions as only minor precipitation was received the week prior to sampling. Water samples were sent to the Environmental Chemistry Laboratory of the Victoria General Hospital for analysis. The results are summarized in Table 2-5 and Figure 2-5.

From the water samples collected at Stations 1 and 2 on August 29, 1989, water flowing into Gold Brook Lake may be characterized as fresh, very soft, medium to highly coloured, non-turbid, predominantly sodium chloride type

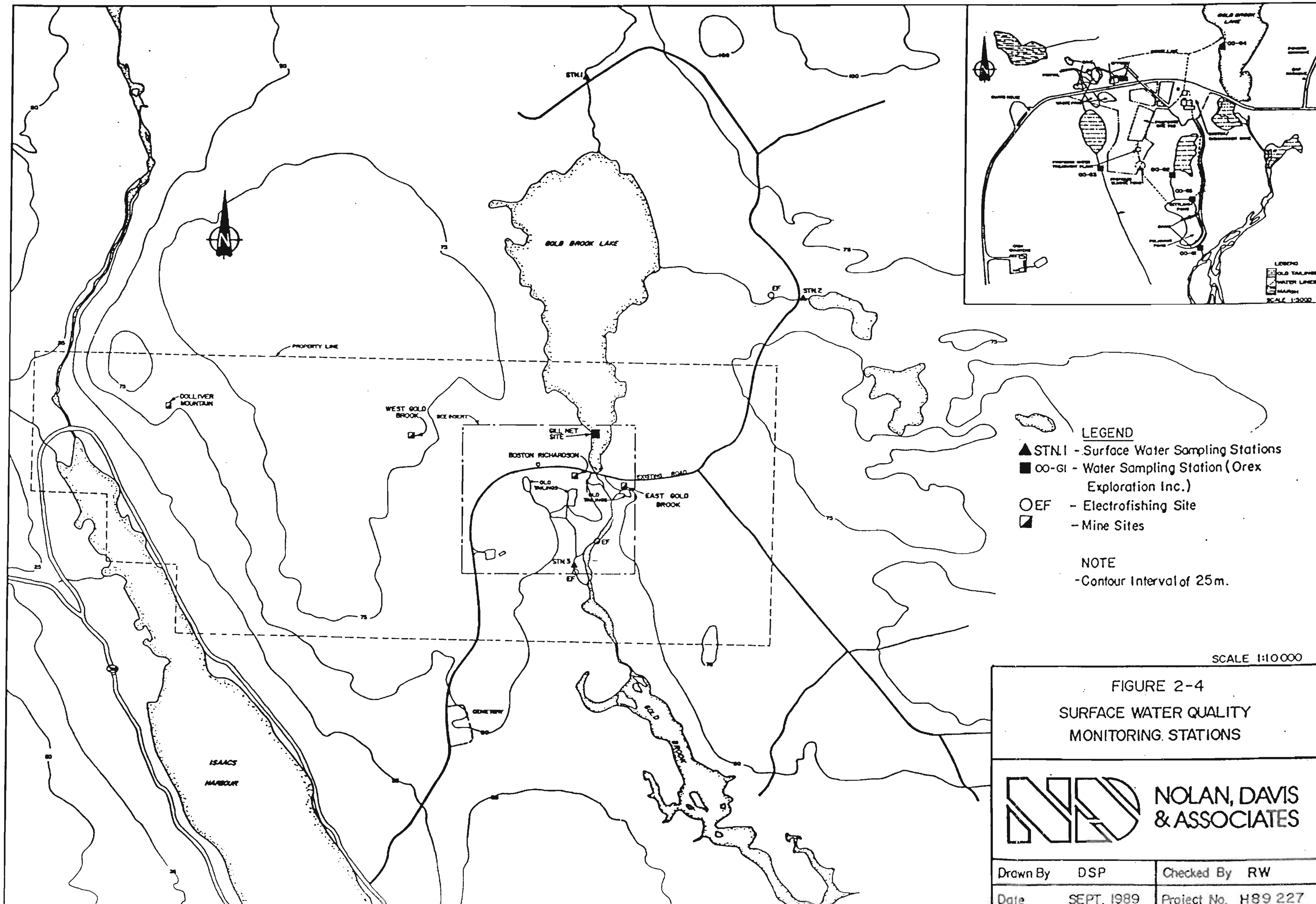
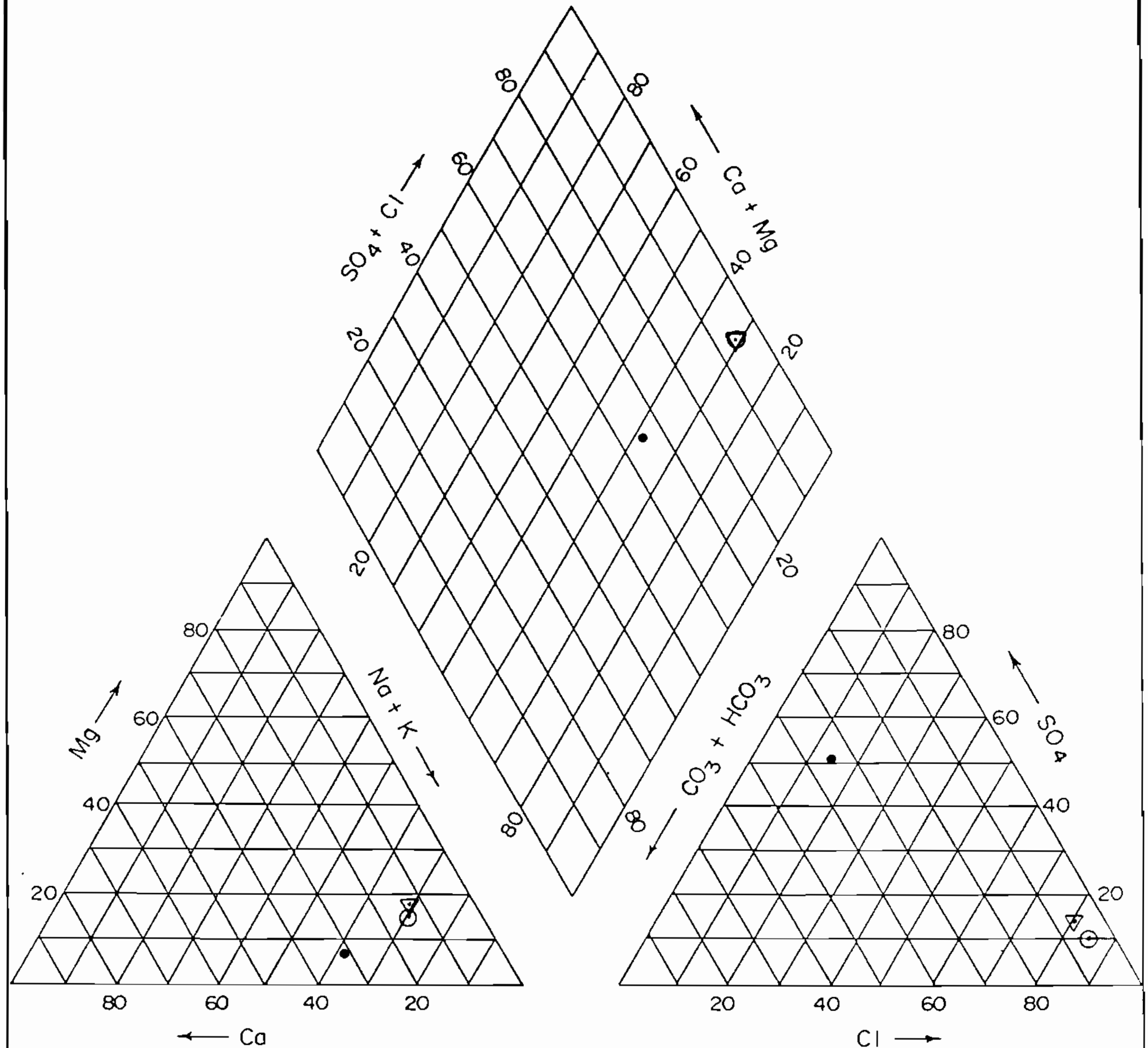


FIGURE 2-4
SURFACE WATER QUALITY MONITORING STATIONS

TABLE 2-5

Surface Water Chemistry
Gold Brook Lake Area

LOCATION		Gold Brook Lake Inlet Station 1	Rocky Lake Brook Station 2	Gold Brook Below Mine Station 3
PARAMETER	**UNIT**			
Sodium	mg/l	3.30	2.30	33.00
Potassium	mg/l	<0.10	<0.10	1.30
Calcium	mg/l	0.53	0.45	15.00
Magnesium	mg/l	0.40	0.31	2.00
Hardness	mg/l	3.00	2.40	45.70
Alkalinity	mg/l	<1.00	<1.00	41.00
Sulphate	mg/l	<2.00	<2.00	60.00
Chloride	mg/l	5.90	4.60	13.00
Silica	mg/l	5.30	0.74	3.60
Ortho-Phosphorus	mg/l	0.01	<0.01	0.29
Nitrate + Nitrite	mg/l	<0.05	<0.05	<0.05
Ammonia	mg/l	<0.05	<0.05	<0.05
Iron	mg/l	0.44	0.40	0.75
Manganese	mg/l	<0.01	0.02	0.03
Copper	mg/l	<0.01	<0.01	<0.01
Zinc	mg/l	<0.01	<0.01	<0.01
Colour	TCU	110.00	29.00	41.00
Turbidity	JTU	1.20	1.40	2.60
Conductivity	microho/cm	30.00	20.00	244.00
pH		4.80	5.50	7.70
Total Organic Carbon	mg/l	18.00	6.90	8.10
Ion Sum		15.40	8.40	152.50
Conductivity (Theoretical)		28.00	18.20	275.40
Arsenic	mg/l	<0.005	<0.005	0.42
Lead - HGA	mg/l	<0.002	<0.002	<0.002
Aluminum	mg/l	0.24	0.06	0.09
Nickel	mg/l	<0.002	<0.002	<0.02
Mercury	mg/l	<0.005	<0.005	<0.05
Suspended Solids	mg/l	6.00	5.00	8.00



PER CENT OF TOTAL EQUIVALENTS PER MILLION

● Sa. 3 GOLD BROOK WEST BRANCH
▽ Sa. 2 ROCKY LAKE BROOK
⊙ Sa. 1 GOLD LAKE INLET

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FIGURE 2-5

TRILINEAR DIAGRAM
SURFACE WATER CHEMISTRY

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water, with low suspended solids, low pH, and very low alkalinity. Organic carbon concentrations were moderate to low and nutrient concentrations (nitrogen and phosphorous) were very low to undetectable. Of the nine metals monitored, only three were detectable; namely, iron, aluminum and manganese.

Of the 27 parameters monitored, all were at acceptable concentrations according to the Guidelines for Canadian Drinking Water Quality (1987) with the exception of iron and pH. Elevated levels of iron, total organic carbon, low pH, and high colour are typical of water in areas of boggy terrain such as is found around the perimeter of Gold Brook Lake.

From the water sample collected at Station 3 on August 29, 1989, water flowing into Bold Brook, downstream of the mine site, may be characterized as fresh, soft, non-corrosive, highly coloured, non-turbid, predominantly sodium sulphate type water with low suspended solids, neutral to slightly basic pH and low alkalinity. Organic carbon concentration was moderate to low and nutrient concentrations (nitrogen and phosphorous) were undetectable to low. Of the nine metals monitored, four were detectable; namely, iron, arsenic, aluminum and manganese.

Of the 27 parameters monitored, all meet the maximum acceptable concentrations according to the Canadian Water Quality Guidelines (1987) with the exception of iron and arsenic.

Water analysis results on final effluent from sampling performed by Orex and the relative increase in arsenic, sulphate, iron, sodium and calcium downstream of the mine site from the August 29, 1989, sampling program suggest that present or past mining activity has affected the water quality of Gold Brook. However, levels do not surpass maximum recommended levels according to the Metal Mines Liquid Effluent Guidelines.

2.5 Hydrogeology

2.5.1 Hydrostratigraphic Units

A hydrostratigraphic unit is a group of earth materials having similar water storage and transmission capacity properties. There are three hydrostratigraphic units in the vicinity of the mine site: the glacial till, the bedrock and the old mine workings.

The till unit is expected to range in thickness from 1 to 7 m and permeability can be expected to range from 10^{-4} to 10^{-1} centimetres per second (Freeze and Cherry, 1979). Recharge is dependent upon recent precipitation events.

Because of its non-porous nature, groundwater flow within the bedrock unit is based mostly on secondary permeability (i.e. fractures, faults, joint and cleavage planes in the bedrock). Underground observations made during a site visit on November 7, 1989, in the new mine workings have shown that some large faults have been made impervious by breccia fines. Therefore, not all faults in the area will conduct groundwater. Typical yields of drilled domestic wells within the bedrock unit in the area range from 0.08 to 1.5 litres/second (l/s). Higher well yields are expected from wells drilled into highly fractured bedrock zones.

The old mine workings which are flooded must be considered a distinct hydrostratigraphic unit because their storage and transmitting capacity is distinct from those of the bedrock unit. The old mine workings have the potential to provide significant, instantaneous inflow to new mine workings if proper precautionary measures are not taken.

Typical rates of inflow to the old mine workings, as measured while they were being dewatered, ranged from 18.5 to 21.1 l/s. Higher rates of inflow are generally associated with fracture or fault zones and slate bands which typically have more closely spaced cleavage planes. These rates of inflow to the mine result from the generally fractured nature of the bedrock and the large surface area of exposed rock within the mine which is contributing to the total inflow of water to the mine.

2.5.2 Flow Systems

The following analysis is constrained by the limitations imposed upon this study. The analysis is based entirely on existing information and experience in the hydrogeology of the region. No detailed hydrogeological field investigations were undertaken. Given these limitations, a conceptual model of the groundwater flow field has been developed.

Groundwater flows in response to differences in total hydraulic head between any two points. The hydraulic head is governed by changes in the elevation and pressure head. Groundwater flow can be broken into three separate yet interdependent systems. Local flow systems will recharge at topographic highs and discharge at topographic lows. The water table surface will generally follow topography. Intermediate flow systems will be influenced by local flow systems, by the location of lakes and by local topography as well as by regional flow systems. In the vicinity of the mine site, intermediate groundwater flow is expected to be eastward (more specifically northwest to southeast) downgradient towards Gold Brook Lake and Gold Brook. The regional flow system will ultimately direct groundwater southeastward to the sea. Groundwater residence time is typically less for local flow systems and greater for regional flow systems.

As noted previously, the bedrock in the project area is highly faulted and fractured, particularly in the vicinity of the apex of the anticlinal fold, where the old mine workings are located.

The direction and rate of groundwater flow within bedrock will be largely controlled by the orientation and frequency of fractures, faults and bedding planes. The hydraulic characteristics of the bedrock are not well known at this time. It is very difficult, therefore, to predict the rate and direction of groundwater flow within the bedrock.

The near vertical nature of the fractures and bedding planes of the bedrock in the study area, and to a lesser extent the numerous boreholes drilled during the exploration programs, should result in a vertical permeability which is greater than the horizontal permeability. This will affect recharge/discharge schemes and will tend to promote the development of deep-seated local flow systems. Thus, deep groundwater/rock contact time is expected to be relatively short, resulting in a lower amount of total dissolved solids and a calcium bicarbonate type water.

Dewatering of the Boston-Richardson Mine and the new mine workings is likely affecting local and possibly intermediate flow systems. Dewatering will cause the groundwater table to be depressed, inducing groundwater flow towards the mines. Normal groundwater flow patterns should resume upon termination of dewatering and subsequent flooding of the mine workings on completion of the project.

The apparent fault producing the northwest-southeast lineation in which Gold Brook is located may act as a pathway through which groundwater will preferentially flow. This pathway is expected to affect the intermediate and regional flow systems.

Because of the difficulty in predicting the direction of groundwater flow at the mine site, it is difficult at this time to predict the behaviour of any mobile contaminants which may be introduced into the groundwater flow system during mining operations. The effective radius of drawdown due to underground mine dewatering is not known. Consequently, pumping effects on neighbouring wells cannot be predicted; however, effects on domestic wells are likely minimal due to their distance from the mine.

2.5.3 Groundwater Chemistry

The only groundwater samples from the Boston-Richardson mine shaft were available for analysis obtained during initial dewatering. Samples collected on June 17, 1988, were sent to the Victoria General Hospital Environmental Chemistry Laboratory for analysis. Results are shown in Table 2-6 and in Figure 2-6. Results for additional groundwater samples collected from the mine shaft as dewatering was maintained are shown in Appendix F.

Groundwater from the mine shaft (representing the bedrock hydrostratigraphic unit) can be characterized as fresh, soft, low to highly coloured, somewhat turbid, predominantly calcium bicarbonate type water, with somewhat elevated suspended solids and moderate alkalinity. Total organic concentrations nutrient concentrations were low. Of the 19 metals monitored in all samples, only aluminum (0.05-0.44 mg/L), arsenic (0.05-2.6 mg/L), barium (0.025 mg/L), boron (0.02 mg/L), copper (0.02 m,g/L), iron (3.7-8.4 mg/L), lead (0.003-0.022 mg/L), manganese (0.08-0.12 mg/L) and zinc (0.01-0.05 mg/L) were above detectable limits.

Oil and grease (1.0 to 1.1 mg/l) detected in groundwater samples collected on September 19, 26 and October 13, 17, 1988, while mine shaft dewatering was maintained, may have originated from shaft clearing and exploration drilling activities. The maximum allowable oil and grease in an effluent grab sample is 1.0 mg/litre.

Of the 38 other groundwater parameters monitored from mine shaft water samples, ammonia, arsenic, iron, manganese, phosphate, colour, turbidity and suspended solids surpassed levels for freshwater aquatic life according to the Canadian Water Quality Guidelines (1987). However, all mine water removed was adequately treated prior to release.

Only pH varied drastically in groundwater from the mine shaft during initial dewatering. Water samples taken at surface prior to dewatering was

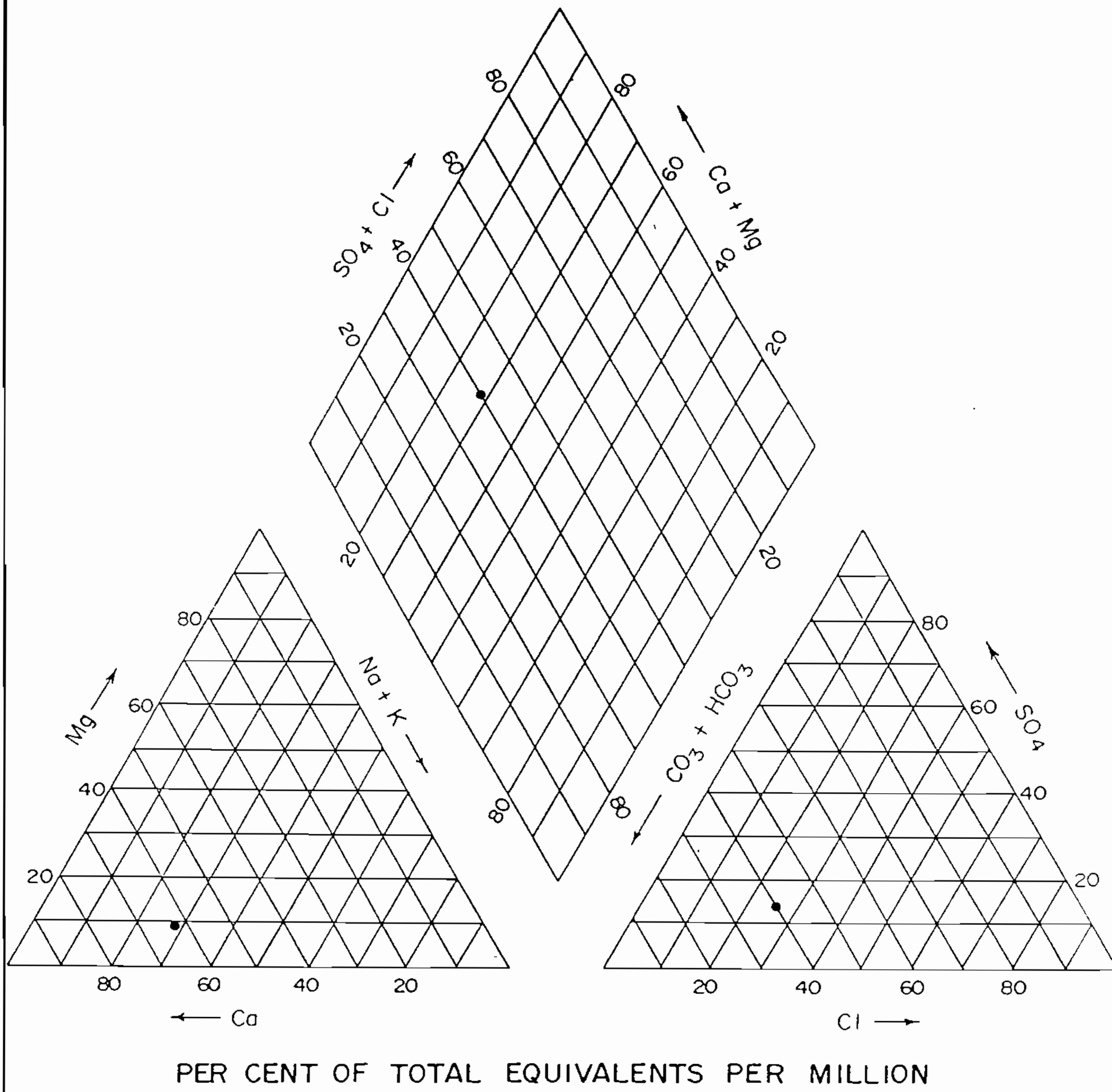
TABLE 2-6

Results of Analysis, Water from the Boston-Richardson Shaft
June 17, 1988

	Shaft Water Surface	Shaft Water 60 foot	Tailings Creek	Gold Brook River	Recommendations for the Protection of Aquatic Life (a)
Chemical Parameters					
Aluminium (mg/L)	<0.05	<0.05	0.2	0.16	0.005
Ammonia (mg/L)	<0.05	<0.05	0.05	0.05	2.20
Antimony (mg/L)	<0.05	<0.05	0.05	0.05	
Arsenic (mg/L)	0.17	0.2	0.02	0.009	0.05
Baryum (mg/L)	0.025	0.025	0.005	0.005	
Beryllium (mg/L)	<0.005	<0.005	0.005	0.005	0.011 (b)
Boron (mg/L)	0.02	<0.02	0.02	0.02	
Cadmium ICP (mg/L)	<0.01	<0.01	0.01	0.01	0.0002
Calcium (mg/L)	11	12	1.4	0.36	
Chloride (mg/L)	8.2	8.4	4	3.4	0.002
Chromium (mg/L)	<0.01	<0.01	0.01	0.01	0.02
Cobalt (mg/L)	<0.01	<0.01	0.01	0.01	
Copper (mg/L)	0.02	<0.01	0.01	0.01	0.002
Fluoride (mg/L)	<0.1	<0.1	<0.1	<0.1	
Iron (mg/L)	3.7	4.2	0.35	0.2	0.3
Lead HGA (mg/L)	<0.002	0.003	0.002	0.002	0.001
Lead ICP (mg/L)	<0.05	<0.05	0.05	0.05	0.001
Magnesium (mg/L)	1.1	1.1	0.36	0.27	
Manganese (mg/L)	0.12	0.08	0.03	0.01	
Nickel (mg/L)	<0.02	<0.02	0.02	0.02	0.025
Nitrate + Nitrite (mg/L)	<0.05	<0.05	0.05	0.05	0.06
Ortho-phosphorus (mg/L)	0.17	0.2			
Potassium (mg/L)	1.9	1.9	0.1	0.1	
Selenium (mg/L)	<0.1	<0.1	0.1	0.1	0.001
Silica (mg/L)	8.6	8.6	2	1.7	
Sodium (mg/L)	5	5.2	1.7	1.5	
Sulfate (mg/L)	9.4	6.8	3.3	2.3	
Tin (mg/L)	<0.03	<0.03	0.03	0.03	
Vanadium (mg/L)	<0.01	<0.01	0.01	0.01	
Zinc (mg/L)	0.01	0.01	0.01	0.01	0.03
Physical Parameters					
Alkalinity (mg CaCO3/L)	28	29	2.1	1	
Color (T.C.U.)	11	53	57	54	
Conductivity (µmhu/cm)	108	111	22.6	24.4	
Hardness (mg CaCO3/L)	32	34.5	5.1	2	
pH	6.4	6.7	6	4.8	6.5-9.0
Suspended Solids (mg/L)	17	16	1.5	2	25 (b)
Total Solids	78	88	42	52	
Turbidity (N.T.U.)	13	15	0.8	0.6	

Analyses were done at the Environmental Chemistry Laboratory, Victoria General Hospital, in Halifax, June 27, 1988.

a. Taken from Environment Canada, 1986.
b. Taken from Environment Canada, 1980.



• BOSTON - RICHARDSON MINE
(water depth 18.3 metres)

NOLAN, DAVIS & ASSOCIATES

FIGURE 2-6

TRILINEAR DIAGRAM
GROUNDWATER CHEMISTRY

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slightly acidic and became slightly basic as illustrated from a sample obtained when dewatering had advanced to the 18 metre depth. There were fluctuations in water pH from September 7 to October 17, 1988, during which period mine shaft dewatering was maintained. This fluctuation is likely a function of shaft clearing operations. Normal, undisturbed groundwater is expected to remain neutral to slightly basic.

2.5.4 Groundwater Utilization and Resource Potential

The till unit offers no potential for economic development of large, commercial or industrial water supplies. However, domestic dug wells are often located within this unit. Domestic wells in this unit rely upon shallow local groundwater flow systems and water supplies are usually somewhat unreliable because recharge is dependent upon recent precipitation events. Wells are susceptible to being pumped dry, particularly in the dry summer months. The quality of groundwater in the till is generally good, although iron and manganese are often above normal limits.

The bedrock aquifer may offer potential for adequate supplies for individual residences and modest sized institutional or commercial establishments. Yields rarely exceed 1.5 L/s except where highly fractured zones are intersected.

Groundwater quality from bedrock, as indicated by water pumped from the mine, is acceptable with the exception of elevated iron, manganese and arsenic. This is often typical of wells drilled in the Meguma Group and where arsenic exceeds the maximum acceptable concentration, it is often treated prior to use as drinking water.

There are no dug or drilled domestic wells in the immediate area of the mine site. The nearest dwelling along the road leading to the site is more than 1.8 kilometres southwest of the site. This road and the Village of Goldboro are located in a watershed adjacent to that of the mine site (1EP-SD1). Other dwellings in the area, located along Route 316 and at the Villages of Drumhead (6 km south) and Seal Harbour (6.8 km southeast), are located downgradient within the Gold Brook watershed. Except for the above-mentioned dwellings and for the mine site, there is no known need for other wells in the area.

2.6 Biological Resources

2.6.1 Fisheries

Fish and wildlife habitat was evaluated during field visits on August 29 and November 29, 1989 (Figure 2-7). Commercial fishery statistics for the area were also obtained from Fisheries & Oceans Canada and aquaculture information was obtained from the Nova Scotia Department of Fisheries.

Spot electrofishing was conducted between Gold Brook Lake and Rocky Lakes and in Gold Brook below Gold Brook Lake during the August 29 field visit. A gillnet was also set between 4 p.m. and 9 p.m. off the mine water supply inlet near the southern end of Gold Brook Lake.

On November 29, 1989, spot electrofishing was conducted in the brook below Gold Brook Lake to obtain samples of brook trout. Three juveniles were caught and taken to the Environmental Chemistry Laboratory of the Victoria General Hospital for arsenic analysis. The brook that flows southeast into Hay Lake was also spot electrofished just above where the old logging road crosses it.

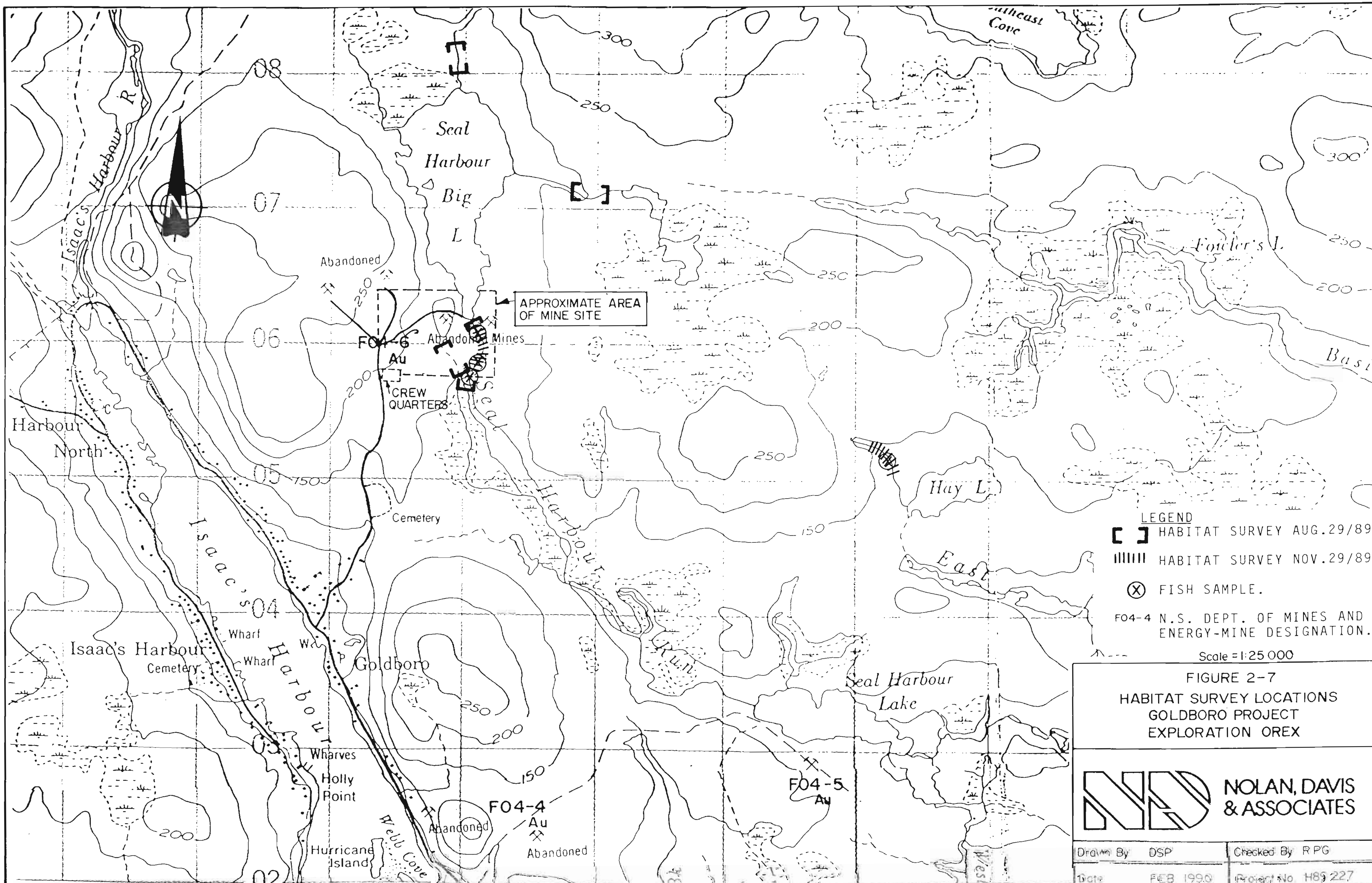

FIGURE 2-7
HABITAT SURVEY LOCATIONS
GOLDBORO PROJECT
EXPLORATION OREX

2.6.1.1 Freshwater

Fisheries and Oceans Canada (DFO) has no reports of angling catch from Gold Brook or its tributaries. The closest historical report of angling catch is for brook trout (Salvelinus fontinalis) from Coddles Harbour (O'Neil, personal communication). While there are no reported angling catches for Gold Brook or its tributaries, brook trout are likely fished wherever they are present.

Isaac's Harbour River, located 2 kilometres from the mine site, does support an early run of Atlantic salmon (Salmo salar). The salmon fishing season extends from June 1 to August 15 and annual catches generally range between 0 and 100 fish. Grilse, smaller, one-sea winter fish, comprise most of the angling catch. The mine area, however, drains into Gold Brook which is not a tributary of Isaac's Harbour River.

There are three lakes of significant size within the study area. Gold Brook Lake, immediately north of the mine site, is the largest lake (70 ha). Gold Brook drains from the southern end of this lake. Two additional small lakes, Rocky Lakes, drain into the eastern side of Gold Brook Lake.

Gold Brook Lake (formerly known as Seal Harbour Big Lake) was surveyed in 1985 as part of the lake survey program conducted by the Nova Scotia Department of Lands and Forests. The lake was found to be moderately coloured (87.5 TCU) and relatively acidic (pH 5.2) with low buffering capacity (alkalinity less than 0.1 mg/L). Most of the lake area is between 2 and 3 m deep with a relatively narrow littoral zone. This survey also found that the fish community in the lake was dominated by yellow perch and eel. Only one 150 gram brook trout was caught in two nights of gillnetting.

Results of gillnetting in August of 1989 are reported in Table 2-7.

TABLE 2-7

Gillnet Catch from Gold Brook Lake
August 29, 1989

Species	Length Range (cm)	No. of Fish
Yellow Perch	9 - 9.9	2
Yellow Perch	10 - 10.9	4
Yellow Perch	11 - 11.9	2
Yellow Perch	14 - 14.9	2
Yellow Perch	15 - 15.9	2

These results support findings that Gold Brook Lake is dominated by yellow perch. Discussion with a local resident indicated that a few, if any, local residents angle in this lake because of the scarcity of the trout.

Rocky Lakes are two 2 hectare lakes located 0.9 km east of the Gold Brook Lake. Most of the drainage area of the western-most Rocky Lake is covered by mixed softwood and hardwood forest, while most of the drainage area of the eastern Rocky Lake is composed of marshland (Seal Harbour Marshes). Both lakes are likely shallow with maximum depths similar or slightly shallower than Gold Brook Lake (2 m). The outlet of the lake draining to Gold Brook Lake was shallow with abundant arrowheads and other aquatic macrophytes. Periphyton was also abundant in littoral areas and in the outlet stream.

The water quality of these lakes, as indicated by a sample of their outflow, is more suitable for the production of game fish than is that water of Gold Brook Lake. These lakes are much less coloured (29 TCU) and less acidic (pH 5.5). While the fish populations were not sampled, a local resident reported that these lakes do support brook trout angling. A small trail leading to the lakes appeared well-travelled, and this suggests that these lakes do provide a recreational opportunity for some local residents. A brook trout was caught during spot electrofishing in the stream draining from Rocky Lakes to Gold Brook Lake.

Four streams in the area were assessed to evaluate fish habitat characteristics. The streams included the northern inlet to Gold Brook Lake, the Rocky Lakes inflow to Gold Brook Lake, and Gold Brook, the stream draining Gold Brook Lake, and the brook that flows southeast into Hay Lake.

Both brooks flowing into Gold Brook Lake were similar in substrate and periphyton abundance. The streams are rocky with a large proportion of boulders. Periphyton and aquatic grasses are abundant. Organic sediment and fine wood debris are abundant between the boulder and cobble substrate. These streams provide excellent cover for brook trout but spawning habitat appears to be limited. On August 29, water temperature in the northern inlet to Gold Brook Lake was 13°C and 15°C in the eastern inlet.

Gold Brook below Gold Brook Lake differs substantially from the inlet streams. While substrate is similar (90 percent boulder, 10 percent cobble), there is no stream-side vegetation for cover. Periphyton and a fungal mat cover almost all substrate in the areas of moderate velocity. Fine sediments (silt and clay) are present wherever currents are lower. Softwood forest predominates approximately 10 m from the stream. Hard crusted moss with sparse grasses are the only vegetation between the forest and the stream. While boulders provide cover for trout rearing, spawning habitat does not appear to exist in the main stem of this stream.

Spot electrofishing was conducted in the stream below Gold Brook Lake, including a small fork of the stream to the west that drains from recently constructed tailings and settling ponds. Six eels (Anquilla rostrata) and three brook trout (ranging in size from 13 to 30 cm) were caught in the main branch. Two eels and two trout (ranging in size from 4.5 to 6 cm) were caught in the smaller west fork. Eels appeared to be very abundant and juvenile trout moderately abundant.

A water sample from Gold Brook below the mine indicated the water was lightly coloured (41 TCU) and alkaline (pH 7.7). Total dissolved solids, notably sodium, sulphate and arsenic, were high (conductivity 244 micro-ohm/cm). This water quality, along with the general appearance of the stream, support that Gold Brook has been substantially affected by past mining activity, primarily tailings disposal.

There is evidence that surface water and stream sediment below Gold Brook Lake have been contaminated with heavy metals from mine tailings disposal.

Three small brook trout (8, 6.5 and 3.5 cm in length) were analyzed for total body arsenic levels. Total body arsenic concentrations averaged 7.2 ug/g (wet weight) in these fish. Background levels of arsenic in freshwater fish from the Great Lakes averaged 0.07 ug/g (Traversy et al., 1975). While a recent study found that heavy metals in fish tissues were not necessarily correlated with those in the sediment (Johnson, 1989), fish in Gold Brook do appear to be accumulating arsenic in body tissues from the widespread contamination.

One juvenile brook trout about 6 cm long was caught in the brook that flows southeast into Hay Lake, which confirms trout are found in this brook as well. The brook was observed to evaluate fish habitat characteristics for about 120 metres upstream of the road and as far downstream as could be seen from the road. It had rained heavily the previous night so the brook was in flood condition.

Above the road, the brook was spread out into various channels covering about 20 m, but the main channel was approximately 2 m in width. The braided channel narrowed to a single main channel (3 m wide) before passing through the culvert under the road. Stream substrata were primarily moss-covered boulders with a few cobbles. Some debris from the surrounding alders and balsam fir littered the brook. Cover was good for rearing trout, but there were no gravel beds for spawning. The velocity of the water was moderate above the road but increased in a single 4 m wide channel below the road where there were rapids. The substrate remained boulder with some cobble, but there was less moss cover because of the faster flow.

2.6.1.2 Marine

The most detailed commercial fishery statistics are available by fisheries statistical districts. District 16 extends from Isaac's Harbour to New Harbour and includes the communities of Isaac's Harbour, Goldboro, Drumhead, Seal Harbour and Coddles Harbour (Figure 2-8). Landings and value within this district by species from 1979 to 1988 are provided in Appendix E.

The landings and value between 1979 and 1988 for District 16 show a substantial decline in landings but a general increase in value over the last decade (Figure 2-9). Cod, herring and mackerel comprised 97 percent of the catch in 1979 (Figure 2-10). After 1979, landings of herring and mackerel decline markedly, and after 1983, landings of cod and other groundfish declined. The increase in value following 1984 is a result of increased landings and value of lobster. In 1988, lobster accounted for 86 percent of the total landed value within the district.

The commercial fishery in District 16 extends from April to October (Figure 2-11). Lobster dominates the fishery from April to June. The lobster fishing season runs from April 19 to June 20. Herring and mackerel are caught primarily in May and used as bait in the lobster fishery. After June, groundfish, primarily cod and haddock, dominate the catches.

In 1987 and 1988, most of the fish catch in District 16 was landed by longline, although a large proportion of the catch also came from set gillnets. Handlining accounts for a small amount of the catch. Scallop dragging and fishing for swordfish by harpoon occurs sporadically. Lobster are caught using set traps.

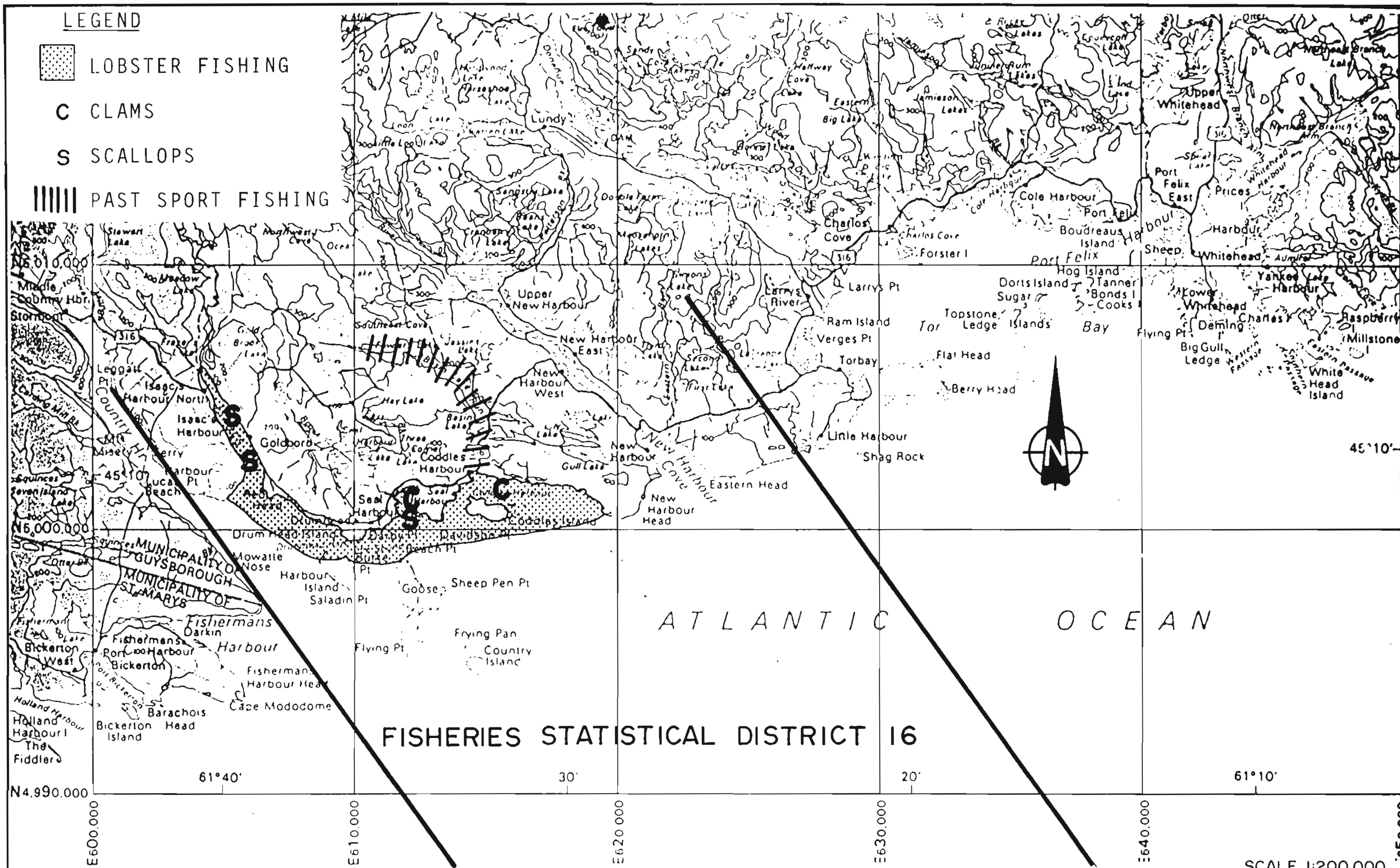

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FIGURE 2-8
FISHERIES STATISTICS
GOLDBORO PROJECT
EXPLORATION OREX

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Total Landings and Value for District 16, 1979 to 1988

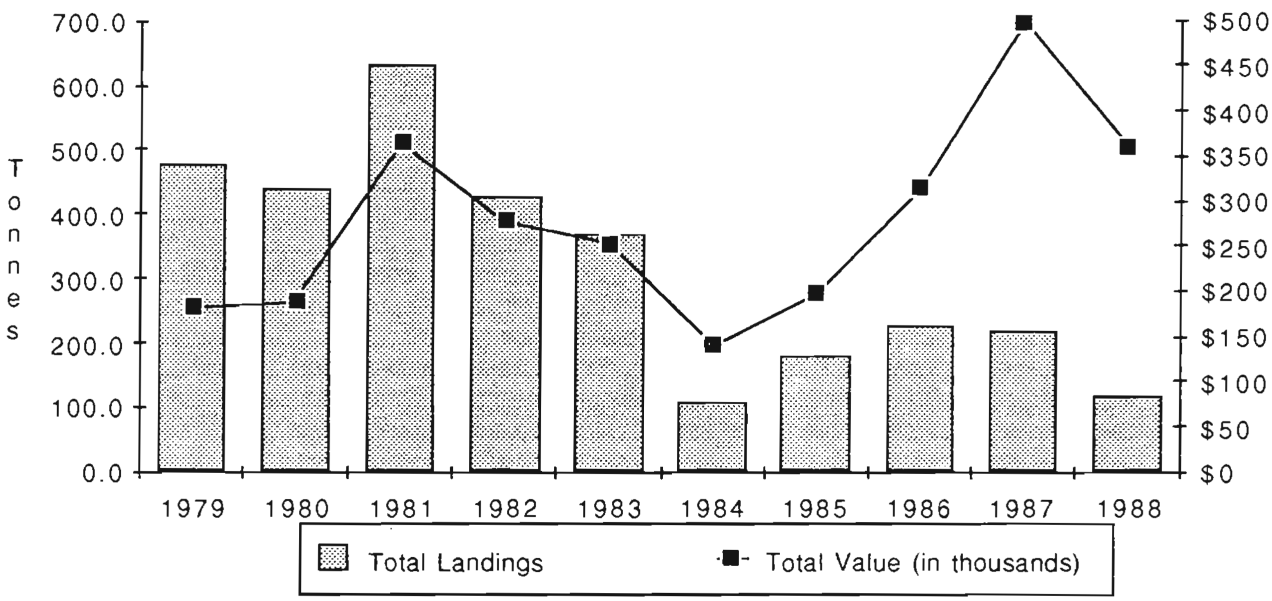

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FIGURE 2-9
LANDINGS & VALUE 79-88
GOLDBORO PROJECT
EXPLORATION OREX

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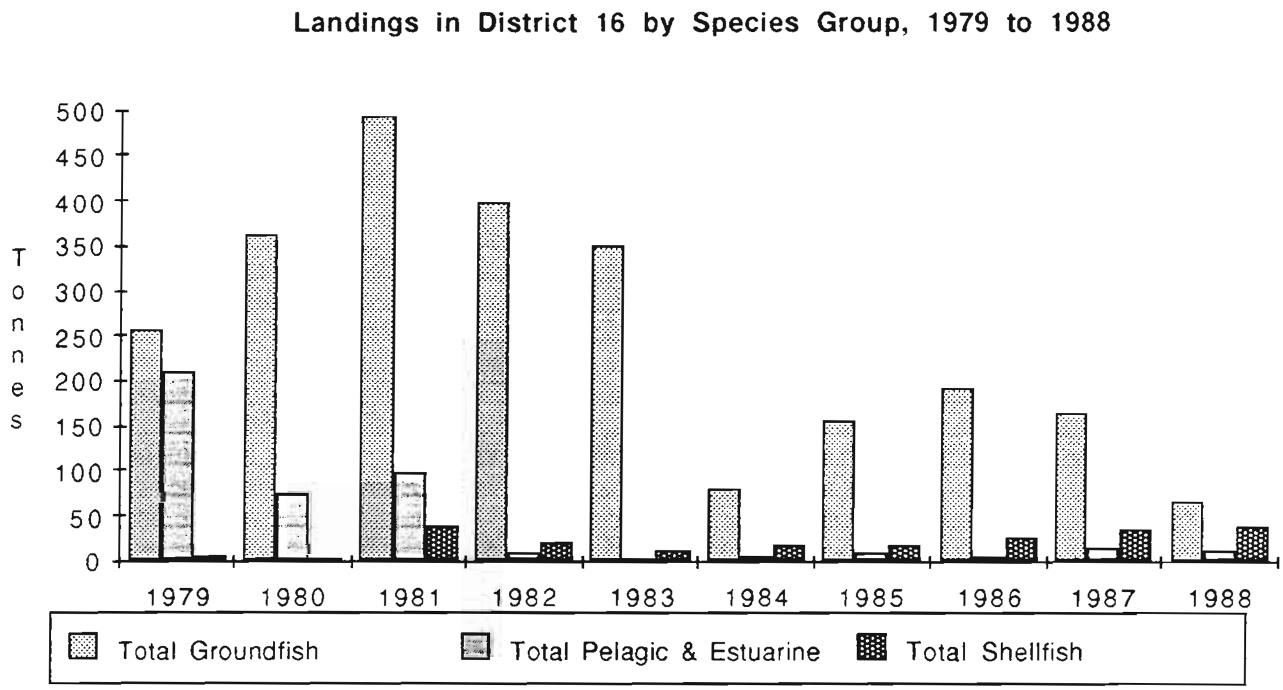

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FIGURE 2-10
LANDINGS 79-88
GOLDBORO PROJECT
EXPLORATION OREX

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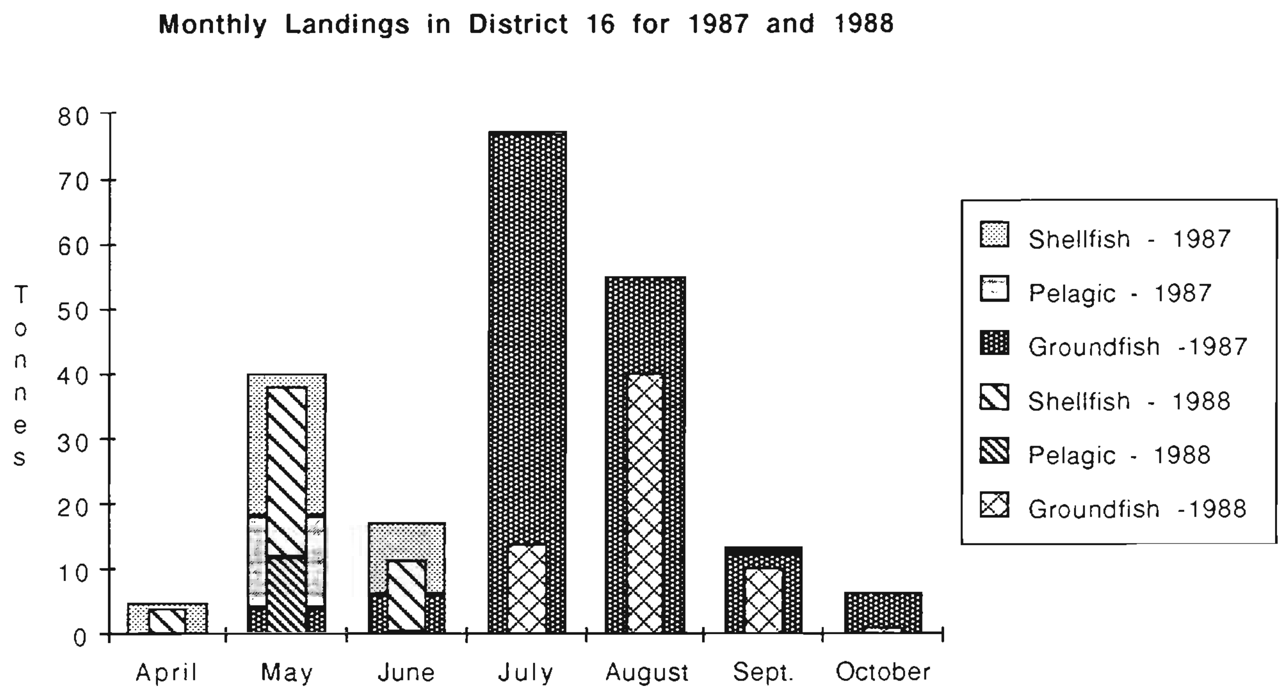

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FIGURE 2-11
MONTHLY LANDINGS
GOLDBORO PROJECT
EXPLORATION OREX

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Goldboro was grouped with the communities of Drumhead, Coddles Harbour, and Seal Harbour when a profile of fishing communities was tabulated (Raymond, 1985). There were eight full-time fishermen and eight part-time fishermen, generally crew members, in these four communities in 1983.

Discussions with the local fisheries officer indicated that currently two people hold groundfish, herring and mackerel fishing licenses in Isaac's Harbour and one of them also has a lobster license (Barrie, personal communication). In Drumhead, there are four fishermen who have licenses for lobster, herring and mackerel. There are three fishermen from Coddles Harbour and they hold licenses for lobster, herring and mackerel. No fishermen are registered in Seal Harbour, although lobster are fished for there by the fishermen from Isaac's Harbour, Drumhead, Coddles Harbour, and possibly elsewhere.

Seal Harbour and Coddles Harbour both have clam flats used by locals, and scuba divers collect scallops in Seal Harbour (Figure 2-8). The local fisheries officer was not familiar with any sport fishing near the proposed mine or tailings areas. Fowler's Lake and the Basin Lake system, east of Gold Brook, used to provided good trout fishing, but numbers of trout are now thought to be low.

2.6.1.3 Aquaculture

All aquaculture sites must be registered with and approved by the Nova Scotia Department of Fisheries. There are no approved aquaculture leases between Country Harbour and New Harbour, an area extending from 5 kilometres west of the mine site to 9 kilometres east of the mine site. An application has been made for an experimental mussel lease (1 ha in area) 800 m north of Holly Point in Isaac's Harbour, but this lease has not been approved (Lipsett, personal communication).

2.6.2 Wetlands and Waterfowl

Ratings of the capability of wetlands to produce waterfowl are available for Guysborough County from the Canada Land Inventory and the Nova Scotia Department of Lands and Forests. Most of the county provides little in the way of wetland-waterfowl habitat. Waterfowl production is limited by the low fertility and topography.

According to the Soil Survey of Guysborough County, Nova Scotia (Hilchey and MacDougall, 1964), the wetlands in the Goldboro area are all classified as peat. The upper and lower B horizons of peat consist of brown, poorly decomposed organic material that is 30 cm or more deep and mainly sphagnum moss. The parent material consists of brown to black, poorly decomposed organic material. The topography is level to gently undulating and the drainage is poor.

The Department of Lands and Forests rates individual wetlands. The ratings of the three main wetlands in the Goldboro area are listed in Table 2-8. A rating of 75 or greater is necessary before a wetland is considered good. A wetland rated below 60 is not considered to provide significant waterfowl habitat. The three wetlands in the Goldboro area provide relatively poor waterfowl habitat but, because of their large size, received moderate ratings. Within such large areas, there may be the odd patch of suitable vegetation that could support one or two nests. The Fowler's Lake Bog rates the highest, but it is also the largest. None of these wetlands rate above 75. They are all bog-based, which is not considered to make good waterfowl habitat (Payne, personal communication).

TABLE 2-8

Size and Rating Capability of Wetlands

Wetland	Capability Score	Area (Ha)
Seal Harbour Run	65.5	71.8
Seal Harbour Marshes	60.0	79.7
Fowler's Lake Bog	70.0	280.0

The Canada Land Inventory rates the Seal Harbour Marshes and surrounding wetlands as moderately severe for waterfowl production. There is a small area near the mouth of Isaac's Harbour that provides slightly better habitat.

2.6.3 Mammals and Birds

Bobcat, coyote, snowshoe hare and other species are trapped in the region but the mine area is not considered to be of particular importance (Bancroft, personal communication). The catch of furbearers for Guysborough County in 1988-89 is shown in Table 2-9. Neither Bald Eagle nor osprey nests have been identified in the mine area, although reference was made to the presence of a pair of Bald Eagles in the Isaac's Harbour area during a public meeting held on March 27, 1989.

Ungulates, deer and moose, are the most important wildlife in the area. The Gold Brook Lake vicinity provides relatively good deer habitat and may provide some habitat for moose. The Canada Land Inventory rated this area as having only moderate limitations to productivity for ungulates. The limitations to ungulate production are associated with exposure and poor soil moisture. This area is of similar habitat quality to much of Guysborough County.

Better habitat (based on CLI ratings) exists in many areas of the county including the area surrounding Isaac's Harbour. Deer yards (areas where deer congregate when snow is deep) have not been identified in the area (Bancroft, personal communication).

TABLE 2-9

Catch of Furbearers in Guysborough County and Nova Scotia, 1988-89

Species	Guysborough County	Nova Scotia	Percent of Province
Beavers	139	3,510	4.0
Muskrats	841	34,042	2.5
Otter	25	317	7.9
Mink	146	2,096	7.0
Bobcat	46	697	6.6
Fox	28	1,519	1.8
Raccoons	32	3,065	1.0
Skunks	0	19	0.0
Red Squirrel	199	4,188	4.8
Weasels	165	688	24.0
Coyotes	79	581	13.6

2.6.4 Rare and Endangered Species

The Nova Scotia Museum has advised that they have no knowledge of any ecological features that would be threatened by mining activities in the area. No rare or endangered species have been identified in the area during site visits.

2.7 Air Quality

2.7.1 Noise

Noise level measurements were made on August 29, 1989, using a Realistic Model 33-2050 sound level meter with an accuracy of ± 2 dB at 114 dB. Except as noted, the "A Slow" response setting was used.

Six points in the community were selected for measurements (Figure 2-12). Measurements were made at approximately 12:00 hours and 20:00 hours. Observations were made on the nature and direction of the various sound sources, which included dogs barking, vehicles and natural noises such as wind. Heavy machinery was not in operation and no blasting activities were ongoing at the time of the survey.

Temperature was 21°C at 12:00 hours. It cooled in the evening to 16°C. The wind was measured at 5 to 13 km/hour, with some wind gusts from the southwest. It was calm during the evening.

The noise monitoring results are summarized in Table 2-10. Because of inactivity at the site, all readings during the survey of the Goldboro area showed a natural noise background typically below 50 dB. Wind gusts increased the noise by 10 to 20 dB's. Passing vehicular traffic along Route 316 through Goldboro and along the Gold Brook Lake Road generated transitory noise levels of 70 dB at 5 metres.

It can be concluded that the community is typical of a quiet coastal/rural location in that the noise background is mainly natural sounds. However, there is moderate, intermittent noise in Goldboro from traffic, particularly along Route 316. Traffic levels along Route 316 are estimated at an average of 400 vehicles per day (1988), with some seasonal fluctuations (Class B). The road to the mine site, Goldboro Brook Branch Road, is estimated at an average of 170 vehicles per day (1988). Traffic levels along both highways are very low.

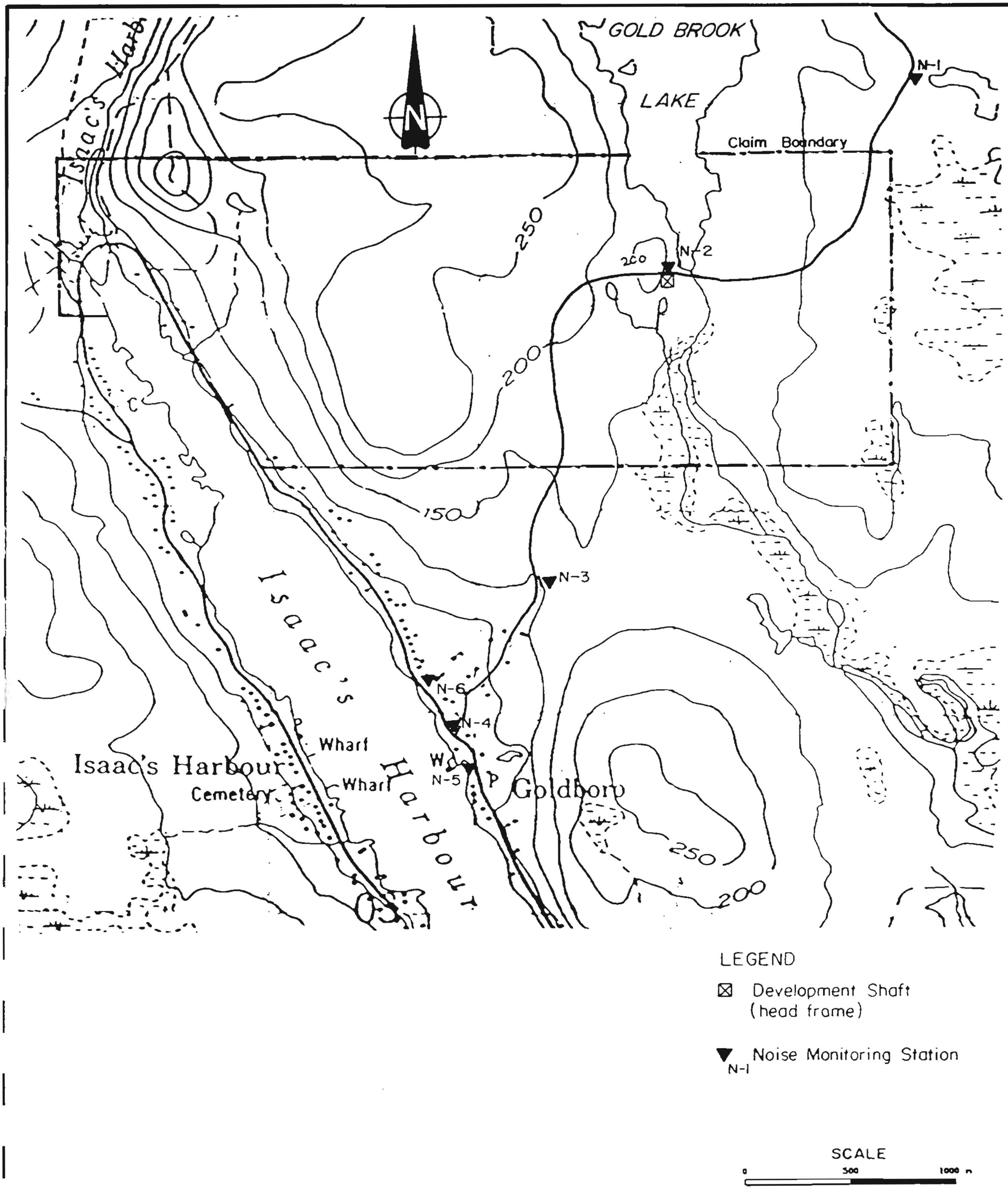

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FIGURE 2-12
NOISE MONITORING STATION
GOLDBORO PROJECT
EXPLORATION OREX

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TABLE 2-10

Summary of Noise Survey
Orex Goldboro Development Site
August 29, 1989

Station	Time	Reading (dB)	Comments
N-1	12:25	56	Wind and natural sounds.
Rocky Lake Stream	16:00	54	Wind and natural sounds.
N-2	12:10	54	Wind and natural sounds.
Mine Office	18:10	52	Wind and natural sounds.
N-3 Goldbrook Cemetery	18:40	<50	Wind, with wind gusts generating up to 70 dB.
N-4 Corner of Goldbrook Road	12:05	52	Wind and seashore sounds. Occasional passing traffic increasing noise to 70 dB.
	21:40	<50	Wind, sea, dog barking, with wind gusts generating up to 70 dB.
N-5 Cairn (Goldboro)	21:50	<50	Wind and other natural sounds.
N-6 Post Office	12:00	58	Wind and sea sounds, with occasional traffic increasing noise to 70 dB.
Goldboro)	22:00	<50	Wind and other natural sounds.

NOTE: Sound level setting "A Slow"
Southwestern winds at 5-13 km/hr, becoming calm with evening.

2.7.2 Dustfall

No dust collection has been collected at the Goldboro site.

The wind direction, as described in Section 2.2, is predominantly from the western quadrant. The mine site is, therefore, generally downwind from the residences at Goldboro.

A rural coastal community such as Goldboro typically has low dust levels. Major dust sources are aerosol salts and airborne shoreline materials, roadway generated dusts, and pollen. Values will vary seasonally; however, they are expected to be less than the limitations of 70 micrograms/m^3 annual mean and 20 micrograms/m^3 average over a 24 hour period, established by NSDOE.

2.8 Land Use and Sociology

2.8.1 Land Use in the Area

2.8.1.1 Forestry

The project area is 90 percent Crown land. Stora Forest Industries Limited of Port Hawkesbury holds a lease for this Crown land and the fibre rights to it. They are allowed to put in roads wherever they need them and presently have 60 percent of the area accessed, with possible plans for more roads next year. The forested land is generally low in productivity (Canada Land Inventory Class 5 to 6), similar to most forest land in Nova Scotia. Only a small amount of productive Class 4 land exists.

Over the last ten years, softwood and pulpwood have been harvested using a block management system with replanting. The average amount of wood obtained is 15 to 30 cords per acre from wild stands and double that from silvacultured stands.

2.8.1.2 Recreation

According to a local fisheries officer and the Goldboro area residents interviewed, not much recreational activity occurs within the project area. Hunting and sport fishing are restricted by the bogginess and dense underbrush (such as alders) common in the area. Some hunting does occur in the more open areas. Sport fishing formerly occurred in Fowler's Lake and the Basin Lake system. A small trail leading to Rocky Lakes appeared well-travelled, and this suggests that these lakes do provide a recreational opportunity for some local residents.

The logging roads are used by skidooers in the winter. Seal Harbour and Coddles Harbour both have clam flats used by locals, and scuba divers collect scallops in Seal Harbour.

2.8.1.3 Demography

The mine site falls within the Goldboro Enumeration Area (Figure 2-13). The total population for this Enumeration Area (EA) is 321, compared to 12,721 for all of Guysborough County. There are more older people and fewer younger people in the Goldboro area than in the county as a whole (Figure 2-14).

The county has approximately 4,085 households, about 120 of which are in the Goldboro EA. The homes are all single, detached dwellings, with no mobile homes or apartment buildings in the area. The average annual income of $9,227 for the Goldboro EA is lower than the county average of $12,641 or the provincial average of $16,688. The unemployment rate of about 15 percent is typical for the county and rural areas in Nova Scotia.

Table 2-11 and Figure 2-15 show the percentage of the labour force in the different sectors for the Goldboro EA and Guysborough County. In both, most of the labour force is involved in the manufacturing and primary sectors. Employment in the trade sector is higher in the Goldboro EA than in the county whereas employment in the service sector is higher in the county.

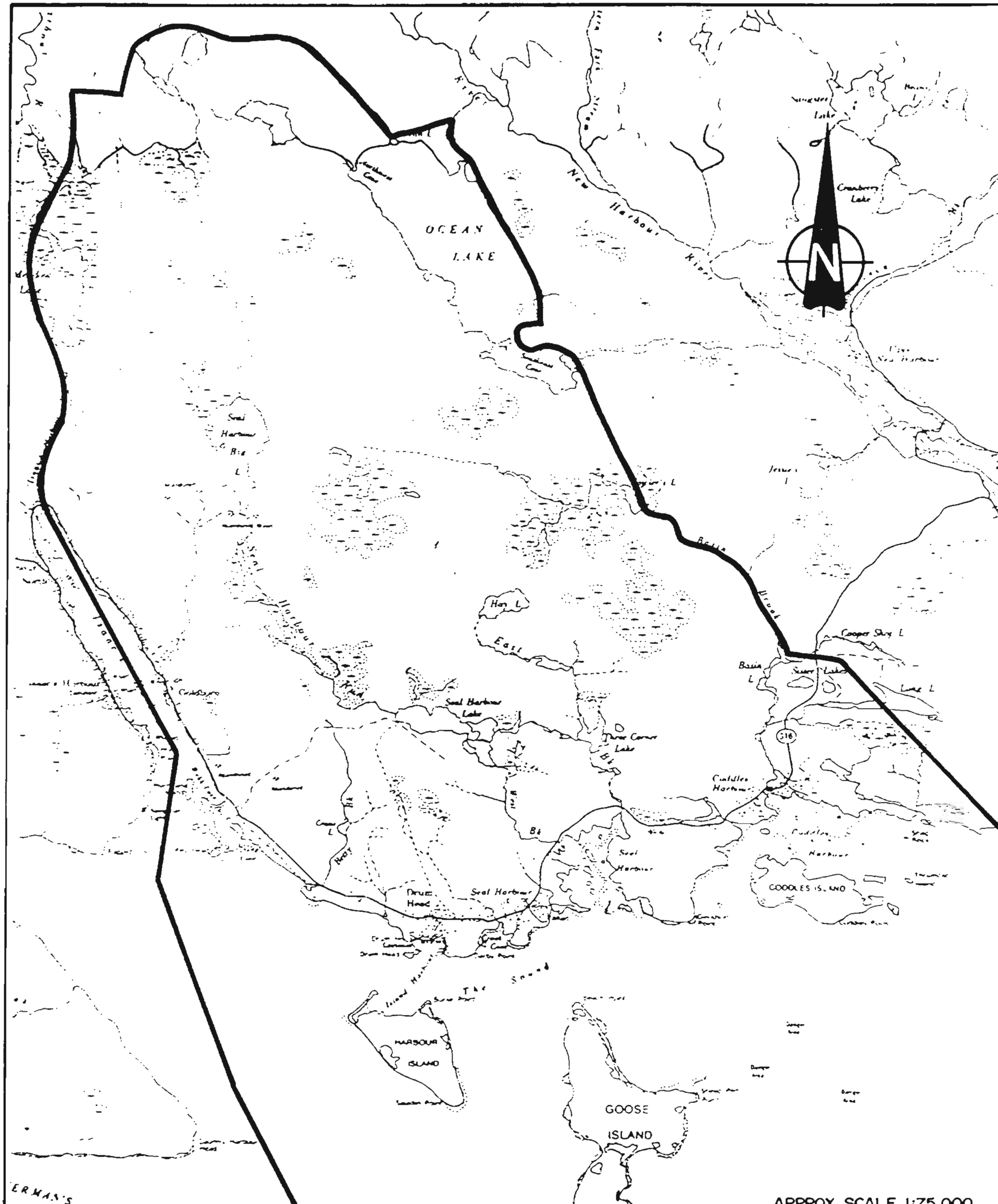

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FIGURE 2-13
GOLDBORO ENUMERATION AREA (005001)
GOLDBORO PROJECT
EXPLORATION OREX

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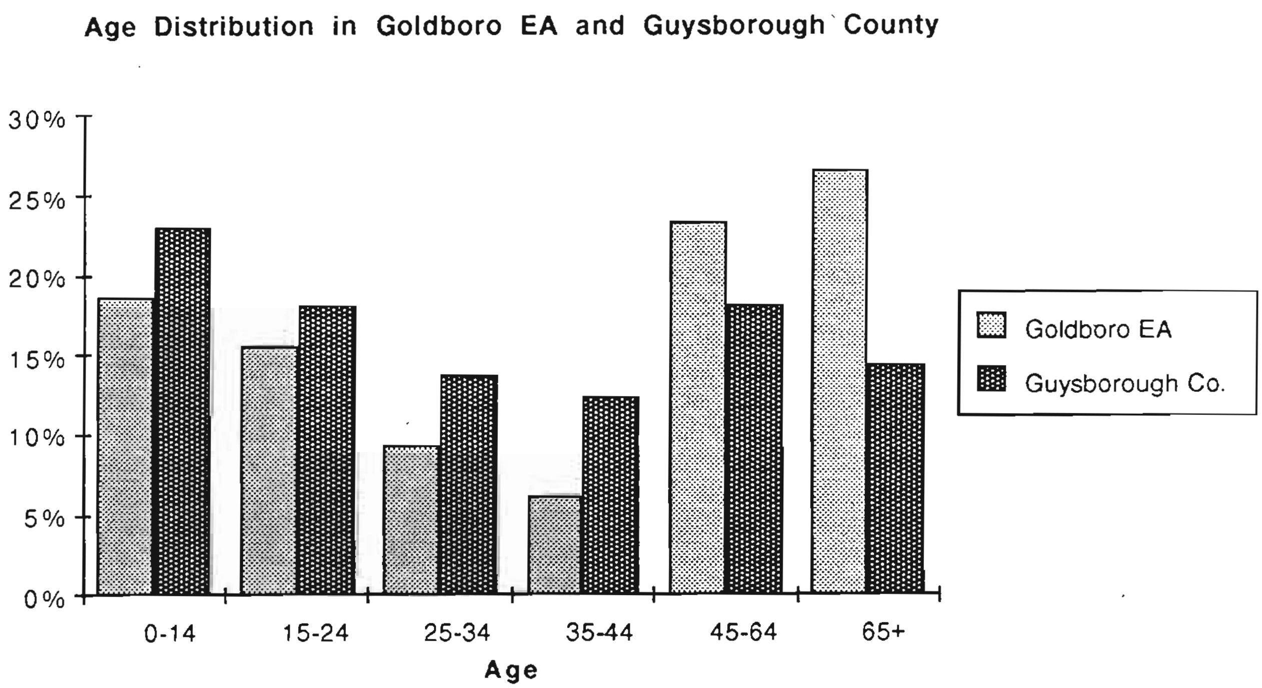

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FIGURE 2-14

AGE DISTRIBUTION
GOLDBORO PROJECT
EXPLORATION OREX

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TABLE 2-11

Labour Force Employment in Goldboro EA and Guysborough County

Industry Sector	Goldboro EA	Guysborough Co.
Primary	25 (25.0%)	1,125 (21.7%)
Manufacturing	25 (25.0%)	1,445 (27.8%)
Construction	5 (5.0%)	205 (3.9%)
Utilities (e.g. communications)	0	325 (6.3%)
Trade	20 (20.0%)	505 (9.7%)
Finance, Insurance and Real Estate	5 (5.0%)	55 (1.1%)
Service (e.g. Community or Business)	10 (10.0%)	1,095 (21.1%)
Public Administration and Defence	5 (5.0%)	270 (5.2%)
Other		155 (3.0%)
Employed	80	4,355
Total Labour Force (15+ years)	100	5,190

Source: 1986 Canada Census

The communities and their 1986 populations in the vicinity of the mine are provided in Table 2-12.

TABLE 2-12

Population Statistics*

Community	Number of Residents
Goldboro	99
Isaac's Harbour	48
Isaac's Harbour North	141
Drumhead	95
Seal Harbour	74
Coddles Harbour	52

*Based on Statistics Canada 1986 Census.

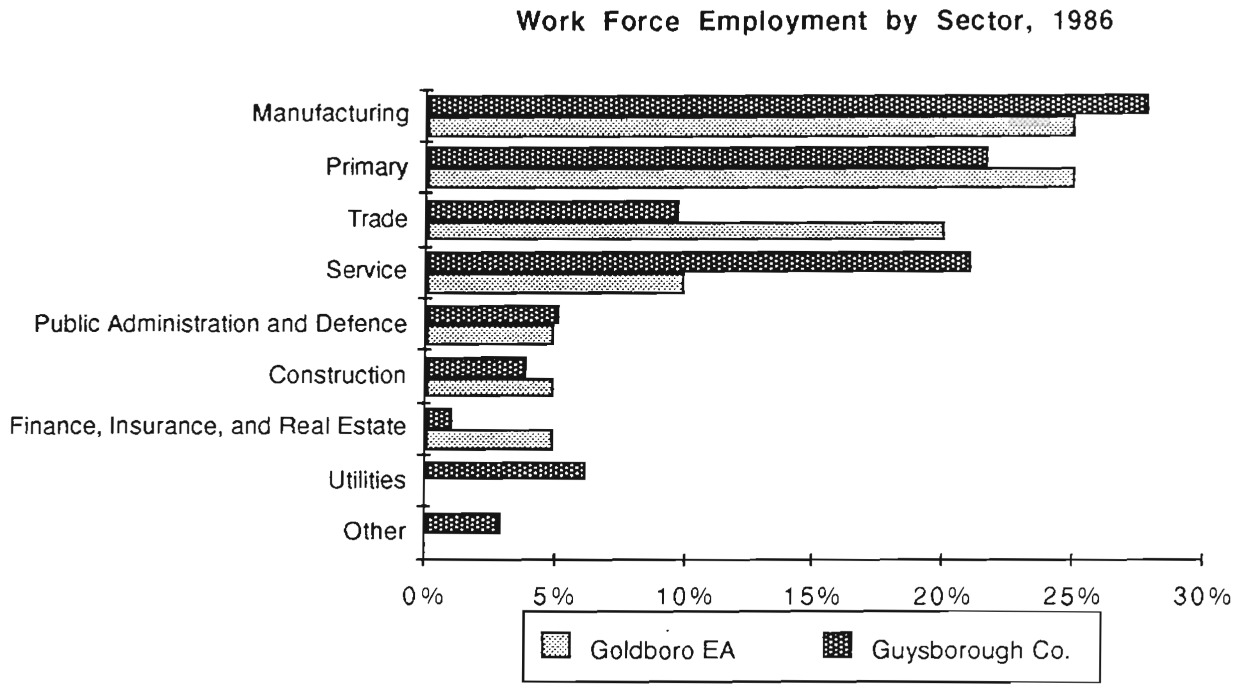

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FIGURE 2-15

LABOUR SECTOR
GOLDBORO PROJECT
EXPLORATION OREX

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2.8.1.4 Community Services

Only limited education facilities are available in the Goldboro area. An elementary school is located in New Harbour but the closest high school is in Guysborough.

Goldboro is policed from the RCMP detachment in Sherbrooke. This detachment has four or five officers and serves a relatively large area.

Fire protection in Goldboro is provided by the Harbourview Fire Department. This volunteer fire department has fire stations in four communities and is equipped with a total of three pump trucks and one tank truck with a portable pump. The fire department also has a one ton emergency van. The closest fire station to the mine is located in Drumhead, about 3 kilometres away. The station in Isaac's Harbour is only about 5 kilometres from the mine. Other stations further from the mine are located in New Harbour and Stormont.

2.8.2 Local Attitudes to Project

Public meetings were held on March 27, 1989 and January 24, 1990, in the Village of Goldboro. The intent of the meeting was to present information to the public on the nature of the mining project and environmental control measures and to obtain comments from the local residents about the project.

Some of the concerns included environmental control legislation and regulation by the Nova Scotia Department of the Environment; the potential for contamination of surface water streams; and requirements for reclamation after completion of the project.

Frank Buxton is the owner of the Dane Anchorage Bed and Breakfast in Goldboro. His well became contaminated soon after some drilling was done nearby. Iron has stained his shower stall, basins, bathtub, and the interior of his dishwasher. He feels the drilling has stirred up the contaminants from the old tailings in the region. His fear is that any new mining operation will further stir up these contaminants and they will then enter the groundwaters that eventually end up in the wells of Goldboro.

The prime concern of lobster fishermen in the area is that the mine will stir up contaminants that will end up in Seal Harbour where many of them set their traps. They feel this would cause damage to the lobster fishery and other shellfish populations.

Other concerns include reported sitings of a pair of Bald Eagles in the Isaac's Harbour area, reports of increased rowdiness among the locals who have had jobs at the mine; and that drug related events in the area have increased. There is also a fear that an open pit mine may be developed causing more disturbance of the existing environment than an underground mine.

There were no other major concerns. The majority of those present at the meetings were in favour of the mine and viewed it as having a potentially positive impact on the local economy.

2.8.3 Archaeology

A study of the Goldboro area was completed to evaluate the archaeological potential of an area representing the 37 mining titles belonging to Exploration Orex Inc. (Lavoie, 1989). The study involved research at the Public Archives of Nova Scotia, conversations with Dr. Stephen A. Davis at Saint Mary's University, and Brian Preston of the Nova Scotia Museum, along with field work in the Goldboro area.

Very little is known about the aboriginals in the Isaac's Harbour area. A prehistoric site on the west bank of the harbour was reported by an amateur archaeologist but was never studied by professionals.

The early history of Goldboro is poorly documented. Aboriginals lived at Isaac's Harbour where they led a nomadic life and participated in a complex trade system with other aboriginals. Later (as early as the 16th century), they were influenced by European fishermen who sheltered in the islands at the entrance to Country and Isaac's Harbours. It was only in the 19th century that settlers moved into the area following a small gold rush in 1862, and even then, the area remained relatively isolated. Mining in the area was most active in the periods 1870-1891 and during the 1920s and 1930s.

A preliminary field survey of the area revealed three archaeological sites - two domestic dwellings and an old refinery. The current remains of one house consist of an L-shaped depression with walls of flat stones without mortar or cement and remains of a chimney of cast bricks with mortar. The remains of the other house are not as well preserved and consist primarily of an L-shaped depression. Artifact analysis indicated the two houses dated from the period 1890-1942.

Very little evidence of the old refinery remains. The building was probably demolished and machinery removed. Archival information indicated the old refinery was operated between 1893-1934.

The majority of the artifacts found along the banks of Gold Brook Lake represented objects that would have been discarded by individuals passing through the area, and were not related to the old refinery or mining activities. Surface artifact concentrations retrieved from the area are indicative of other human activity, although useful information from them is basically lost as they were out of their context.

2.9 Overview of Existing Environment

The land around the mine site and its immediate vicinity is not in an undisturbed condition. The area has a relatively long history of mining activity, dating back to 1893. Numerous old shafts, adits and tunnels are located within mineralized areas and tailings have been disposed of into local streams through several phases of past mining and milling operations.

Structural geology at the site is relatively complex. Consequently, groundwater flow systems are not fully understood and may be difficult to monitor. Because of the verticality of bedrock features, permeability is expected to be greater in that direction and local groundwater flow systems may tend to be deep seated. The effect of dewatering underground mine workings on neighbouring wells has not been monitored and is, therefore, not defined. However, the distance of the mine site from local domestic wells suggests that effects may be minimal.

Despite previous mining activities, local streams appear to support populations of yellow perch, eels and limited trout. Fish in Gold Brook appear to be accumulating arsenic in body tissues from past tailings disposal sites. Although cover was good for rearing trout, local streams are not amenable to spawning. Wetlands in the area provide little in the way of waterfowl habitat. The area provides relatively good deer habitat. Except for reported sitings of Bald Eagle in the Isaac's Harbour area, rare or endangered species have not been identified around the mine site.

Softwood and pulpwood harvesting has been ongoing for the last ten years and much of the mine site area is destined for future harvesting. Local people make limited use of the area for recreational purposes.

Goldboro is a quiet coastal community with limited community services. The majority of the local population appears to be in favour of the mining project.

PART 3: IMPACT AND MITIGATIVE MEASURES

PART 3: IMPACT & MITIGATIVE MEASURES

3.1 Potential Impacts

Potential impacts associated with each phase of the project are summarized in Table 3-1 and discussed in the following sections of the report.

3.1.1 Construction Phase

The construction phase of a mining project is a critical one for several reasons; firstly, at the start-up of the project there are normally no systems in place for the control of sediments resulting from initial construction activities. Secondly, the inevitable changes to a small community as intensive construction activities commence will often impact the local population and community support systems. Both of these factors can be minimized through the identification of potential issues, followed by proper planning with involvement of the community in addressing ways to minimize impacts of concern. This section of the report attempts to identify potential impacts requiring consideration in this manner.

3.1.1.1 Sediment Control

The control of elevated sediment loadings due to initial construction activities will be required in the mill area and in the tailings disposal area. In the mill area all surface drainage will be controlled by the existing mine water treatment ponds. Their estimated volume is 2300 m3 and the disturbed area controlled by them is approximately 3.5 hectares. They would, therefore, appear to conform to the NSDOE guideline of 40 m3 pond volume per 1000m2 of disturbed area. Mine water will continue to be routed through the ponds until such time as the mill and tailings disposal system are operational.

TABLE 3-1

Potential Impacts

Phase	Potential Impacts
Construction	- Increased sediment loadings - Stress on community infrastructure - Increased noise levels - Leachates from ore and storage - Changes to groundwater regime - Economic and employment benefits
Operations	- Inundation of tailings area - Tailings discharge effects on surface waters - Tailings leachate effects on groundwater - Effects of mill area surface drainage - Changes to groundwater regime - Leachates from ore storage - Dusting from site - Increased noise levels - Disturbance of aquatic and terrestrial habitats - Contingency situations - Changes to community infrastructure - Economic and employment benefits
Abandonment	- Changes to groundwater regime - Loss of employment and economic benefits - Ongoing impacts from leachates, surface water and wind erosion

Construction of the tailings and polishing pond dams will involve stripping of the foundation areas and placement of the dam fill material. These operations will generate significant sediment loadings which will require mitigation through the construction of temporary downstream sediment control ponds in accordance with the recently published NSDOE Guidelines. Similar controls will also be required in the borrow area.

Thus, sediment control should be regarded as a mitigatable potential impact at the Goldboro Site, although there will likely be some increase in the levels of turbidity and suspended solids during periods of high runoff.

3.1.1.2 Community Impacts

The construction phase of the project will require an estimated labour force of approximately 100. This will provide economic and employment benefits but will also result in some changes to the community that might not be regarded as entirely positive by all residents. Orex intends to use locally recruited labour and will not be establishing camp facilities at the site. This should minimize the impact of the construction phase on the community while providing maximum benefits to the local economy. Supervisory staff will be accommodated in one or two homes to be purchased within the community.

3.1.1.3 Development Waste Rock and Ore Storage

The construction phase will include the development of the mine and will involve the generation of approximately 30,000 tonnes of waste rock. As outlined in Section 1.4.5, this material is non-acid generating and will be used as construction fill and subgrade material in the general mill area.

Any mineralized material produced during the construction phase will be stored on the existing ore storage area until the mill is operational. Any leachate from this material will therefore be controlled by the existing settlement ponds. To date acid generation in the ore has not been a problem, and based on the results presented in Table 1-4, any leachate from the storage are amy continue to be innocuous. However, the quality of the leachate will continue to be monitored and lime treatment facilities will be installed if the need arises.

3.1.1.4 Mine Dewatering

Since the workings are currently dewatered, there should be no significant change to the groundwater regime or in the characteristics of the mine water discharge during the construction phase. Mine water will continue to be pumped to the existing sedimentation ponds prior to discharge into Gold Brook.

3.1.1.5 Noise

Noise levels on the site will increase as a result of construction activities but these will be sufficiently far removed from the community to pose little or no problem. Impacts on wildlife will be highly localized. Increased levels of truck traffic through the community will inevitably raise noise levels but this should occur primarily during normal working hours.

3.1.2 Operation Phase

Once the development enters the operational phase, potential negative impacts will be associated primarily with the control of the various waste streams inherent to the operation and to contingency situations. The over-riding benefit of the project during this phase will be the ongoing employment opportunities and improved economic base that the project will bring to the area (ref Table 3-1). Community impacts such as increased traffic will probably not differ significantly from the construction phase and will likely have become an accepted characteristic of the area by that time.

As outlined in Section 1.4.5.1, three waste streams must be considered in a mining operation of type proposed: contaminated surface drainage, mill effluent including tailings, and mine water. Potential impacts associated with each of these waste streams are discussed in Section 3.2. Impacts to specific environmental components are discussed in the subsequent sections, with contingency situations reviewed in Section 3.8.

3.1.3 Abandonment Phase

The degree to which the project impacts the environment in the post-operational phase will depend to a large degree on the manner in which reclamation measures are planned and implemented.

The conceptual reclamation plan is described in Section 3.7. It presumes that all buildings are removed and mine accesses sealed with the mine allowed to flood. This will result in significant changes to the groundwater regime from that currently in existence, although the effects of this are not expected to impact significantly on other users (ref Section 3.3). The major area of potential concern will be the tailings disposal area as this can result in ongoing impacts to both air and water quality unless specific reclamation measures are applied. The proposed reclamation concept is described in Section 3.2.

The social impact of the abandonment phase also needs to be considered. After several years of operation the community will have become accustomed to the economic and employment benefits associated with the mine. Its eventual closure will therefore have a marked negative impact for which it is difficult to pre-prepare, particularly if the other alternate employment opportunities are scarce.

3.2 Waste Disposal Facilities

3.2.1 Surface Drainage

The surface drainage control system described in Section 1.4.5.1 will allow all potentially contaminated surface runoff from the mill and service area to report to the existing sedimentation ponds. The decants to these ponds will be fitted with surface skimmers to retain any floating material such as oils and grease which might be flushed into the system as a result of a spill or other contingency situation. The ponds will allow for settlement of suspended solids to within regulatory limits. This system should thus provide very reliable control relative to surface drainage from the mill/service area and impacts from this waste stream should have little or no impact on the environment except in periods of peak runoff when the decant could be somewhat turbid. Even then its impact on the receiving stream will be negligible due to dilution and high natural levels of suspended solids.

Addition of flocculants to the pond influent is not currently envisaged but can be provided in the future if the need arises.

3.2.2 Mine Water

As described in Section 1.4.5.1, the mine water will be pumped to the mill and used as slurry water for the tailings once the mill is in operation. It will, therefore, cease to be a discrete waste stream at that time. No impact specific to mine water discharge is therefore anticipated.

3.2.3 Mill Tailings Waste Stream

This waste stream presents the greatest potential concern and requires that adequate means be developed to both store the tailings solids in perpetuity and treat the supernatant to acceptable standards. The systems proposed to achieve these objectives are described in Section 1.4.5.

3.2.3.1 Cyanide ~~Treatment~~

The cyanide treatment system proposed should prove extremely reliable. The SO_2-Air system of treatment is proven technology applied at ten gold operations in Canada. The process should easily reduce total cyanide levels in the treatable waste stream to 10 mg/L. As described in Section 1.4.5.1, this stream will then be diluted as it is mixed with the flotation circuit tails and mine water such that the combined waste stream pumped to the tailings pond will contain only 0.4 mg/l total cyanide. This is less than half the anticipated final effluent requirement not allowing for further dilution from runoff into the tailings pond or any biochemical stabilization achieved in the pond. Thus, the use of cyanide in the mill should have no significant impact on the receiving environment and is not dependent on seasonally variable degradation within the tailings pond, although this factor will probably reduce the final effluent cyanide levels to virtually zero in summer.

3.2.3.2 Tailings Disposal

The impact of mine tailings disposal systems is very much dependant on whether or not the tailings are acid generating. Tests undertaken on the ore to be processed indicate that the Orex tailings will be non-reactive (ref. Table

1-4) and it is on this basis that a subaerial system of tailings disposal has been selected (ref Appendix B). This method of disposal results in efficient and cost-effective storage of the tailings. The tailings will, of necessity, inundate an area of approximately 54 hectares. In addition to this inherent impact, this method of disposal results in exposed tailings beaches which are subject to wind and water erosion until such time as the surface is stabilized. During the operational phase this can be achieved through the use of surface binders and on abandonment, permanent reclamation can be attained by establishing a vegetative cover. Trial plots will be established during the operational phase to determine the preferred surface treatment on abandonment.

In view of the non-reactive nature of the tailings, it is anticipated that leachates from the tailings area will be relatively innocuous. Their impact on the groundwater system is expected to be minimal both because of the non-reactive nature of the tailings and because the disposal area is underlain by impermeable till which is thought to be continuous over the entire area.

Thus, the disposal of tailings for this project is predicted as having minimal environmental impact other than the inherent inundation of the disposal area and the need to control surface erosion during the operational and abandonment phases.

3.2.4 Other Mining Wastes

The only other source of mining wastes envisaged at this time will be minor amounts of waste rock associated with ongoing mine development. This is expected to be chemically stable material and will be stockpiled or made available for local construction.

3.3 Hydrogeology

3.3.1 Blasting

Underground blasting will be frequent during drivage of the stopes and mining operations. However, the nearest dwelling is more than 1.8 kilometres from the mine site and the majority of the wells in the area are dug wells which are less susceptible to blasting effects.

Potential impacts on groundwater supplies which can be attributed to blasting include loss of supply and alteration of water quality. Loss of supply is related to disturbance of water bearing horizons in surficial materials or closure of water-bearing fractures in bedrock by compressional forces and shear waves generated by blasting operations. Groundwater quality is sometimes altered through suspended sediment and nitrate increases caused by blasting.

Any potential effects on existing wells would be expected to be more significant in bedrock wells than surficial ones. This is because bedrock wells in the region would rely on fracture flow and the probable degree of hydraulic connectivity between higher-yielding fracture zones. However, as the majority of residence in the area rely on surficial wells and because of the distance of the mine site from these wells, blasting is expected to have no impact on wells in the area. Structural damage to homes as a result of blasting is also highly unlikely due to their distance from the mine.

3.3.2 Dewatering

Potential exists for both shallow-dug and deep-drilled wells to be affected by dewatering during mine development. The extent of dewatering in wells could, in some situations, vary from slight reductions in the pumping or static water levels to complete loss of water.

The old Boston-Richardson shaft is currently dewatered, meaning that any impact of the mine on local groundwater resources is already in effect. The zone of influence is thought to be very localized due to the typically low transmissivity values for the Goldenville Formation which result in steep and narrow drawdown cones.

The mine is located topographically higher than area wells and is in a recharge zone. Heavy dewatering activities in recharge zones typically have less effect on water levels than do similar activities within discharge zones. Because of its distance from residential wells, mine dewatering is not expected to impact area wells and there have been no reports of problems to date from existing dewatering activities. Although mine dewatering is not expected to have any impact, regular monitoring of domestic wells in the vicinity is recommended.

3.3.3 Underground Waste Disposal

It was originally intended to dispose of the cyanidation circuit tailings in the Boston-Richardson mine shaft. Such a disposal scheme was found to have the potential to impact groundwater quality in the area and the concept has since been dropped. Underground waste disposal is, therefore, not an issue.

3.3.4 Proposed Groundwater Monitoring Program

Due to the non-reactive nature of the tailings, there will likely not be any adverse impacts to groundwater quality in the tailings pond area. Significant leaching of metal values over the long term would require an acid environment.

Recent work on abandoned cyanide tailings indicates that relatively high levels of cyanide may persist within the tailings solids on abandonment (Mehling & Broughton, 1989). In such situations cyanide can report in the groundwater and toe seepage during and after the operational life of the system.

The potential impact and degradation of cyanide in such circumstances is not well understood, although a number of modification processes will occur including natural degradation, volatilization, dissociation, oxidation, biodegradation, attenuation, complexation and adsorption.

The systems reviewed by Mehling & Broughton involved tailings with high cyanide concentrations. Cyanide residuals in the Goldboro system will be low and surficial materials in the pond area are expected to form a barrier to cyanide migration into the groundwater regime. It is highly unlikely that serious impacts will occur. However, long-term water quality monitoring is proposed as a safeguard (ref. Part 5).

The proposed tailings pond groundwater monitoring network is designed to meet the following objectives:

- to depict physical and chemical characteristics of the groundwater regime in the tailings pond area,
- to monitor subsurface seepage from the tailings and polishing ponds during their operation.

The tailings pond overlies a local recharge/discharge system; Hay Lake appears to be fed by groundwater at the discharge portion of this system. As Hay Lake is likely to tap more bedrock fractures than any of the piezometers installed in the tailings pond, the collection of surface and bottom water samples from Hay Lake will be included as an integral part of the groundwater monitoring program.

Piezometer placement in the network will be as follows:

- A bedrock piezometer located upgradient and northeast of the tailings pond area to monitor regional background groundwater quality conditions. Should the overburden at this location be thick enough a second piezometer will be installed in order to assess vertical gradients by allowing groundwater level measurements to be made from the overburden and the bedrock.

- A bedrock piezometer located downgradient and southeast of the polishing pond to monitor subsurface releases from the pond. Should subsurface conditions permit, a second piezometer will be installed so that vertical groundwater gradient measurements can be obtained there as well.

- Two bedrock piezometers, each located downgradient of the tailings pond, one northeast and the other southwest of the polishing pond, to monitor subsurface releases from the tailings pond.

- Two optional future bedrock piezometers, both located west of the tailings pond to monitor subsurface releases in that direction should the project continue beyond the first three years.

Water samples will be collected prior to the use of the tailings pond for baseline data on groundwater quality. Monitoring will be maintained throughout the operation of the tailings pond in order to reveal long term trends in groundwater quality. Any water wells which may be drilled to supply the mine site with potable water will also be monitored to provide useful data relative to long-term trends in groundwater quality in the vicinity of the mill.

3.4 Biological Impacts

3.4.1 Impacts on Surface Water and Associated Habitat

All operations are within one watershed, which includes Gold Brook Lake and Gold Brook at the mill site, and Hay Lake and East Brook at the tailings pond area. This watershed has been severely impacted by previous mining activities at the turn of the century as described in Sections 1.2.3 and 2.4.6.

As outlined in Section 1.4.5, direct discharges to the aquatic environment will be limited to two sources:

- discharge from surface drainage ponds near the mill averaging 70 l/m on an annual average basis

- discharge of non-recycled water from the tailings system averaging 1790 l/m on an average annual basis

The potential impact of the treated effluents on the aquatic environment is unlikely to be significant, either on the immediate receiving streams or on the marine environment into which the streams ultimately discharge. The distance of the mine to the point of discharge into the sea is approximately 7.5 km and during this distance the contributory drainage area more than triples. Thus, even under unforseen contingency situations there is significant dilution between the mine and the potentially valuable marine resources at Seal Harbour.

3.4.1.1 Gold Brook Lake

A withdrawal permit for 54,600 litres/day from Gold Brook Lake is currently in affect. Water from Gold Brook Lake will be used, when required, as make up water for milling operations. Water withdrawals up to the maximum allowable in this permit are not expected to affect water levels or fish in the lake. On an annual average basis, the volume of water withdrawn will be very small (ref. Figure 1-9) due to the high level of recycle from the tailings pond system.

The mill, mine tailings pipeline and all other facilities are located downstream of Gold Brook Lake. Thus, potential new impacts on Gold Brook Lake, other than the current withdrawals, will be limited to road wash and any contingency situations occurring outside the controlled drainage area around the mill.

3.4.1.2 Gold Brook

Gold Brook has been severely impacted by past mining activity. Fish populations that have re-established themselves in the stream (ref. Section 2.6.1.1) appear to have elevated arsenic levels and could therefore be potentially harmful if consumed in any quantity.

All mine site drainage entering Gold Brook will be controlled by the existing sedimentation ponds. Effluent quality from the settling ponds to date has been well below the regulatory levels given in Table 1-3. Effluent quality criteria should remain below these levels with the possible exception of suspended solids which will likely be closer to regulated levels during storm runoff events.

As long as the discharge from these ponds is within, or close to, the stipulated criteria, there should be no impact to the biological resources of Gold Brook; unless unforseen contingency situations arise that are not controlled by the ponds. Lime treatment will be installed in the unlikely event that the ore storage area produces acid leachate.

3.4.1.3 Hay Lake

Hay Lake is situated immediately downstream of the proposed tailings disposal area. Although the brook flowing south into Hay Lake was found to contain brook trout, there is no significant trout habitat in the brook above where the tailings dam will be located.

The impact on surface waters from the tailings and polishing ponds is expected to be minimal, both because of the non-reactive nature of the tailings and because the cyanide will be treated to effluent standards prior to discharge into the tailings pond. Thus, even in the event of increased discharge volumes due to storm throughput or lack of recycle due to difficulties in the mill, the tailings decant will not exceed the stipulated criteria.

The most likely impact to Hay Lake will be the result of suspended solids loadings during construction of the tailings and polishing pond dams. Every effort will be made to control this through the use of temporary sediment ponds and surface stabilization techniques in accordance with the construction guidelines published by the Nova Scotia Department of the Environment.

Any unforseen impacts on the environment from the operation of the tailings disposal system will be detected through regular monitoring of groundwater and surface water from Hay Lake.

3.4.2 Wetlands

Every effort has been made to avoid the inundation of wetlands in the siting of the tailings area and virtually no impact on regional wetlands is anticipated at any phase of the mine.

3.4.3 Mammals and Birds

Although bobcat, coyote, snowshoe hare and other species are trapped in the Goldboro region, the mine area is not considered to be of particular importance for trapping. The Gold Brook Lake vicinity provides relatively good deer habitat and may provide habitat for moose. However, evidence of deer populations has not been identified during visits to the area. Except for areas in the immediate vicinity of the mine and the tailings pond, mammals and birds are not expected to be affected by mining activities at Goldboro.

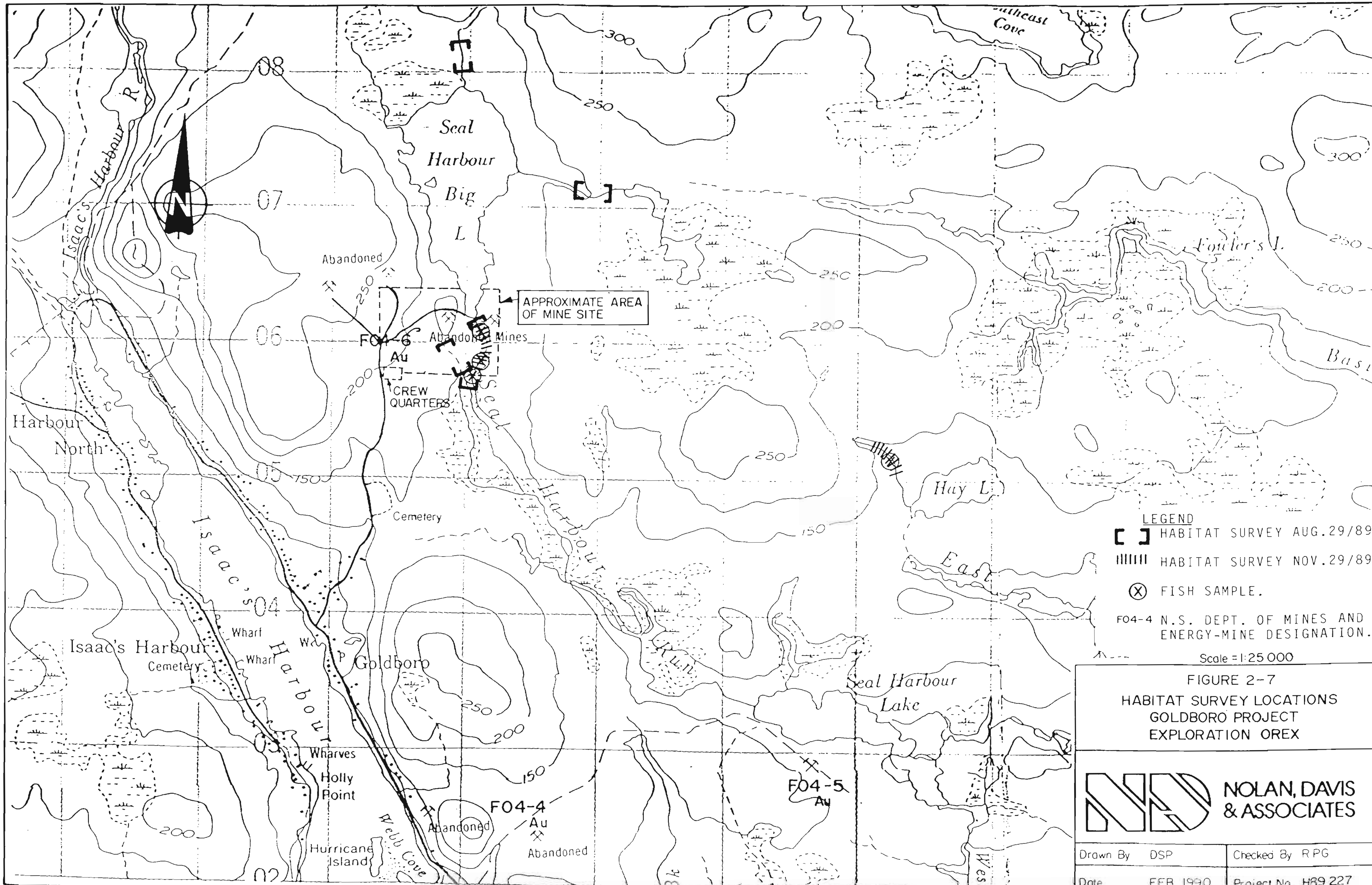


FIGURE 2-7
HABITAT SURVEY LOCATIONS
GOLDBORO PROJECT
EXPLORATION OREX

NOLAN, DAVIS & ASSOCIATES

Drawn By DSP	Checked By RPG
Date FEB 1990	Project No. H89 227

3.4.4 Rare and Endangered Species

The Nova Scotia Museum has advised that they have no knowledge of any ecological features that would be threatened by mining activities in the area, and no rare of endangered species have been identified in the area during site visits. Therefore, rare and endangered species do not appear to be an issue.

3.5 Air Quality Impacts

3.5.1 Noise

The existing sources of noise in the community of Goldboro are primarily natural sounds, such as the sea (waves breaking on the shore), wind through trees and the occasional animal. The roadway through the community is travelled moderately, with seasonal variations. As a result, vehicular traffic occasionally generates louder noises than the background. The ambient conditions, as measured on August 29, 1989, are presented in Table 2-10. No heavy machinery or blasting activities were ongoing at the mine during the time of the survey.

The proposed mine site is located above and generally down wind of the community of Goldboro. The existing sound background reflects the undeveloped, remote nature of the area at 50-60 dB.

The proposed development facilities will have little effect on the location and types of noise heard in, or close to, the residences of Goldboro, although the mine will require the operation of various noise generating equipment. Sound levels generated by typical mining equipment are presented in Table 3-2.

TABLE 3-2

Typical Mining Related Sound Levels

Activity	Sound Level (dBA)
Fan at top of adit	95 at 10 m front
	88 at 10 m side
Articulated ore haulage vehicle	85 at 10 m side travelling uphill
	90 at 10 m side travelling downhill
Truck ore carrier	94 at 10 m side
Front end loader	95 at 10 m
Tracked Excavator	95 at 10 m

The proposed facilities are well situated for noise attenuation. The sound energy or loudness is reduced as it spreads out from the source. Each doubling of the distance from the source lowers the level by 6 dB. Absorption similarly causes energy to be lost as sound is transmitted through the air. A complex function of the humidity, temperature and the sound frequency, absorbtion can be as low as 0.2 dB per km at 125 Hz to more than 30 dB per km at 2 KHz.

The intervening forested ground between the mine and the community will further absorb sound. The attenuation typically is 2 to 6 dB per 100 metres.

The unusual wind conditions and temperature inversions can also affect sound transmission, but often with complex and unpredictable results.

The aforementioned factors combine to maintain predicted noise levels at Goldboro at ambient levels and within the NSDOE guidelines for noise:

Night	55 dB
Day	50 dB
Evening	65 dB

The nearest home is approximately 1.8 kilometres from the development. The combined effects of sound attenuation are estimated at 77 dB. This will lessen even the loudest equipment at the mine site to a level indistinguishable from ambient background.

3.5.2 Dust

Dust levels have not been measured at the mine site. Based on the location and the surrounding development, the ambient suspended particle levels at the mine site and the community of Goldboro are assumed to be low. Values should be less than the NSDOE air quality objectives; namely, 70 ug/m^3 annual geometric mean, with a maximum of 120 ug/m^3 over a 24 hour period. Typical primary sources of particles are ocean aerosols, beach and road dust, and the wind borne plant pollens and spores.

It is unlikely that operational activities will result in any higher levels of dust in the community which lies upwind of the mine site. At this underground mine, the primary sources of dust generation are from the tailings delta during drying conditions or from on-site roads and ore/waste handling facilities. During construction, working and lay down areas are additional potential sources of dust.

Dust generation can be controlled and limited to the affected area. Good construction practices and the limited number of facilities which require development should restrict any dust to the immediate area. The vegetation of slopes and other exposed areas will further minimize the potential for dust. Use of coarse stable materials in road construction will help reduce dust generation. During extreme conditions however, spraying will be used as a means of dust suppression.

3.6 Community and Land Use Impacts

3.6.1 Social Impacts

As outlined in Section 1.5, the project will employ approximately 75 people, with labour supplied predominantly by local people. Therefore, the project will provide significant employment opportunities to communities in the area and will provide economic benefits in terms of direct expenditures to local suppliers as well as the indirect effect of worker's salaries.

The area will experience increased levels of traffic during the construction phase and operation of the mine. The impact of increased traffic, which may initially appear more severe, will likely not differ significantly during the latter phases of the project and will likely become an accepted characteristic of the area.

The relative level of economic benefit to the community will likely remain constant during both construction and operation phases of the project. Because of the increased economic activity at Goldboro, the area may be viewed as a beneficial one in which to establish new residences. However, population increases in the area, if any, are not expected to be large. The eventual closure of the mine will likely be accompanied by a relative decrease in economic conditions which may be difficult to adjust to. This issue will have to be addressed once the anticipated life of the mine is defined.

The majority of the local residents appear to be in favour of the mine and view it as having a potentially positive impact on the local economy. However, there may be some locals who will view the mine as being intrusive to an established life style and any resulting disparity in public opinion will have to be addressed at the local level.

Increased levels of rowdiness associated with workers at the mine site and an increase in drug related events were reported during the public meeting, held on March 27, 1989. It is probable that these are temporary phenomena but such occurrences, if they continue, may have to be addressed appropriately by the local legal and social authorities.

3.6.1.1 Impacts of Construction Camps

Orex intends to use locally recruited labour and will not be establishing camp facilities at the site. Supervisory staff will be accommodated in one or two homes to be purchased within the community. Thus, construction activity in this regard will have negligible impacts on the community.

3.6.1.2 Impacts on Community Resources and Systems

The community of Goldboro will inevitably experience some changes in lifestyle due to the increased levels of economic activity. There is presently little in the way of structured community resources at Goldboro. The use of local labour at the mine site will mean that the number of residents in the community should not change significantly and if this is the case, no significant impact will be felt. However, the increase in economic prosperity in the area may result in a demand for additional community facilities. Facilities directly associated with the mine such as trained emergency personnel and equipment will benefit the community as a whole in the event of future need.

3.6.2 Land and Water Use Impacts

Logging has been practised over the last ten years in the area. Hunting and sport fishing activities are limited, and logging roads are used by skidooers in the winter. These activities are not expected to be affected by the proposed mining activities.

Orex presently holds a water rights permit for withdrawal of 54,600 litres of water per day from Gold Brook Lake. No other water rights permits have been issued in the immediate vicinity of the mine. The existing water rights permit is unlikely to limit other water uses in the region with the possible exception of any future watershed designation. This is in any case unlikely to occur due to the impact of previous mining activities in the watershed.

3.6.3 Program of Public Information

Local community and area residents have been kept informed of planned activities at Goldboro through public meetings. This practice is expected to continue and local residents will be able to provide input to the planning of the operation and ultimately to the reclamation aspects of the project.

3.7 Site Reclamation

At this time, it is appropriate to develop a site reclamation plan only to the broad conceptual level. A detailed plan can best be developed once the mine is in operation and the characteristics of the mine facilities and properties of the materials involved are fully defined.

The objective of the conceptual plan is to return the entire site to a safe and environmentally stable condition such that the area can support wildlife, forestry and recreational activities similar to the present. To achieve this, all mine shafts and accesses will be permanently sealed; all buildings will be removed with foundations either demolished or buried; waste piles and other man-made slopes will be graded to approximately 3:1, topsoiled and seeded; while the tailings disposal area will be covered and seeded to provide a self-sustaining vegetative cover. Due to the fact that the tailings are non-acid generating, no difficulty is envisaged in achieving this last objective. At this time, it is envisaged that the tailings and polishing pond dams would be left in place, but alternative approaches could be reviewed with the regulatory agencies and the local community as a function of developing the detailed reclamation plan.

3.8 Contingency Planning

3.8.1 Construction Phase

Potential contingency situations relating to the environment during the construction phase could include the following:

- hydrocarbon contamination resulting from spillage during delivery or leakage from storage facilities
- fire resulting from mine and mill construction activity

Other than fuel and oils, there are no hazardous chemicals to be used during the construction phase of the project.

As stated in Section 1.6, fuel will be stored in cribbed, above-ground tanks. Spills or leaks will, therefore, be contained and detected immediately. The most likely cause of a significant contingency situation would be associated with an accident involving a delivery truck on site in which serious spillage of fuel would occur. Spills on site would be directed to the settling ponds, which will be equipped with skimming devices to remove floating materials. Spills elsewhere would be immediately dealt with and any contaminated soils removed to an approved disposal area. In view of the fact that access to the site is along a good gravel road, the chances of a fuel delivery truck being involved in an accident on site are felt to be very remote and to not exceed normal highway risks associated with fuel transport. No particularly sensitive ecosystem components would be threatened in the event of a contingency situation.

The risk of fire associated with the project results only from the fact that the general level of activity in the area is increased. Other than fuel and welding supplies, no high-risk materials will be in use during construction. Fire-fighting equipment stations will be maintained at key points at the site. Community services will be used in the event of a major fire.

3.8.2 Operation Phase

Potential contingency situations relating to the environment during the operation could include the following:

- hydrocarbon contamination resulting from spillage during delivery or leakage from storage facilities
- fire resulting from mining activity
- release of tailings/recycle pond water due to dam or decant failure
- release of water from the settling ponds
- release of cyanide from the mill or spills during transport to the mill

The risks associated with hydrocarbon spills and with fire during operation of the mine will be equal to, or less than, those associated with the construction phase of the project already described.

The tailings and recycle ponds and associated decant systems will be engineered structures. Their construction will be undertaken with qualified supervision. The risk of these systems failing even under extreme runoff or storm conditions is therefore extremely low. Since the tailings are non-reactive and cyanide concentrations at the tailings disposal system will have been reduced to within safe levels prior to disposal, the impact of even such a catastrophic event would likely be limited to Hay Lake and the upper reaches of East Brook. It is unlikely that the impact would be felt on the coastal marine environment.

3.8.2.1 Cyanide Spills in the Mill

Accidental spills of cyanide solution in the mill will be directed to drainless sumps where the material can be pumped back into the cyanide circuit or treatment plant. The sumps will be capable of retaining 110 percent of all cyanide solution kept within the mill and its circuits. Therefore, there is little risk that cyanide solutions would find their way into the environment from spills in the mill.

3.8.2.2 Spills on Transit to the Mill

A contingency plan for dealing with spills of cyanide and all other hazardous materials on transit to the mill is discussed in Section 1.6. Emergency response equipment will be kept at the mill and appropriate personnel will be trained and made available for contingencies. Local authorities will be supplied with data sheets of all hazardous materials to be transported to the mill. Cyanide will be transported in dry form. Should there be a spill of cyanide on transit to the mill, plastic sheets and tarps included with the emergency response equipment will be used to keep it dry and, therefore, non-reactive.

3.8.2.3 Cyanide Movement in the Groundwater System

The fate of cyanide in groundwater is not fully understood and reliable methods to assess the attenuation potential in the subsurface have not been defined. It is for this reason that the disposal of cyanide bearing tailings into the Boston-Richardson mine shaft has been abandoned.

The use of a cyanide destruction plant and the contingency plans that will be in place concerning the handling of cyanide will greatly reduce the risk of cyanide entering the groundwater system.

3.8.2.4 Release of HCN Gas in Active Workings

Cyanide will not be allowed to enter into the subsurface workings. Therefore, the release of HCN gas in the mine due to migration of cyanide in the groundwater system is not an issue.

3.8.3 Abandonment Phase

Assuming that the site is cleared of all potentially hazardous materials as part of the reclamation procedure, potential contingency situations relating to the environment during the abandonment phase centre almost entirely on the long term integrity of the dams and decant structures associated with the tailings disposal area, polishing pond, and sedimentation ponds. These will be constructed to conservative engineering criteria but over the coarse of several decades will likely require some maintenance if they are left in an operational condition.

PART 4: RESIDUAL IMPACTS

PART 4: RESIDUAL IMPACTS

The most significant residual impact associated with the project will likely be the positive affect it has on employment and economic activity in the region. Adverse environmental impacts will be relatively few and minor due to the following characteristics of the project:

- non-reactive nature of the tailings
- treatment and dilution of cyanide residuals prior to discharge to the tailings system
- location in previously impacted area
- the lack of sensitive ecosystem components in the area
- some control systems already in place, thus reducing potential construction phase impacts
- relative isolation of the site from populated areas resulting in minimal effects due to noise, dust, blasting and mine dewatering
- the use of locally obtained labour force and thus reduced negative impacts on local community systems
- good access roads for the safe transport of equipment and materials

Barring unforeseen circumstances, the only potentially negative residual impacts will be:

- intermittent noise nuisance associated with increased traffic in the area
- increased turbidity in some freshwater courses during the construction phase
- inundation of approximately 54 hectares due to tailings disposal
- increased risk of contingency situations associated with fuel and reagent transport, storage, etc.
- some social/behavioural pressures due to increased disposable incomes in the region

PART 5: PROPOSED EFFECTS MONITORING

PART 5: PROPOSED EFFECTS MONITORING

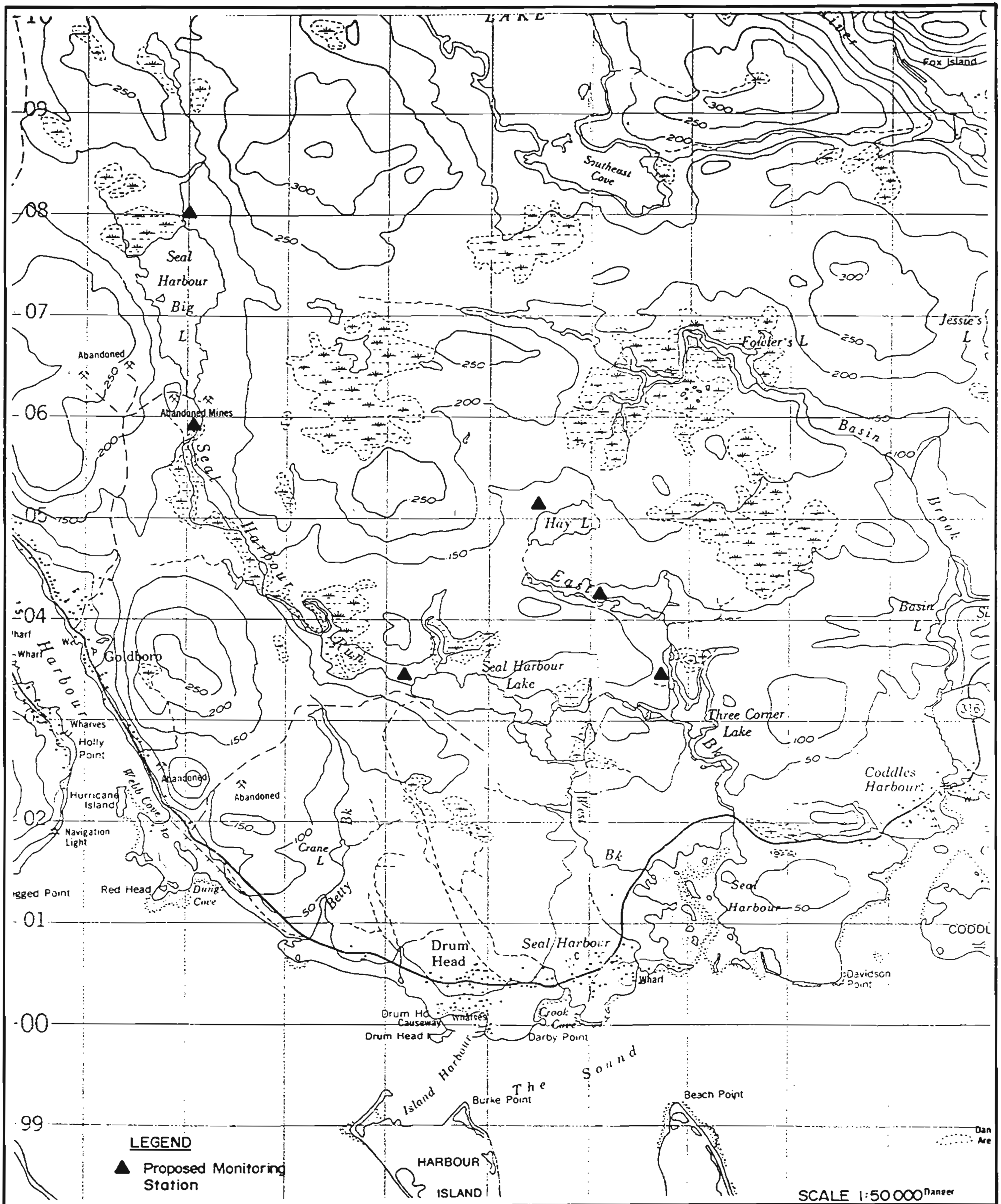
This report was prepared on the basis of available data and limited geological and biological data obtained during site visits. It is felt, however, that it provides adequate information to assess the impact of the project and no additional preconstruction monitoring is proposed other than the maintenance of required water quality sampling.

During the operational phase, the following effects monitoring is proposed:

- monitoring at stations 00-G-1 to 00-G-4, as per present Industrial Waste Discharge Permit requirements
- monthly monitoring of stream flow and surface water quality at all stations described for the pre-construction environmental study
- regular monitoring of noise and dustfall, as per regulatory requirements
- bi-annual survey of local residential wells for water levels and water quality
- regular monitoring of piezometers in tailings area and drilled wells near the mill as proposed in Section 3.3.4

Abandonment phase effects monitoring:

- none proposed



NOLAN, DAVIS & ASSOCIATES

FIGURE 5-1

PROPOSED LOCATION OF EFFECTS MONITORING STATION GOLDBORO PROJECT, EXPLORATION QREX

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APPENDICES

APPENDIX A

Report on the Settling Pond System
Goldboro Project

REPORT ON THE SETTLING POND SYSTEM
GOLDBORO PROJECT

presented by

OREX EXPLORATION INC.
ONITAP RESOURCES INC.

Martin Dubé
St-Michel Géoconseil inc.
july 15, 1988

INTRODUCTION

The present report explain the settling pond system. It includes the following points :

- Water flow coming into the settling pond
- Design of the dam
- Ditch required
- Decant tower design

A modification to the utilisation of the settling pond and polishing pond was bring. We have estimated the drainage water coming into the settling pond and we have found an important quantity of water. The area covered by the ditch was very large and the drainage water flow was about 4000 gallons per minute. This number was calculated with the value obtained by Environment Canada (25 years storm, 24 hours duration).

Therefore, we have decided to separate the water coming from the shaft and the ramp and waste pad. The settling pond located to the south of the old tailings will be used for the shaft water only. The water generated by the ramp and the waste pad will be send into an another settling pond. This settling pond will be required in one month. We have to check for to find a good location. We want to obtain the autorisation for beginning the shaft dewatering (with the settling pond presented thereafter) and in the next week (before july 22) we will present to you the design and the location for the other settling pond.required.

1. WATER FLOW COMING INTO THE SETTLING POND

The water will come from the drainage and the mine shaft.

1.1 Drainage water

Design storm : 25 years storm
24 hours duration

The following formula was used :

$$Q = C\ A\ i$$

where Q is the water flow (gallons per minute)
C is the water percentage flow (%)
A is the drainage area (square meters)
i is the intensity (mm per 24 hours)

The values obtained from the Environment Canada or the i factors are the following (Sherbrooke-Stillwater area):

Maximal value or 25 years	: 119 mm/24 hours
Mean value	: 76 mm/24 hours
Mean of extreme values	: 114.3 mm/24 hours

Therefore,

$$Q = 0.70 * 4500 m2 * 119\ mm/24\ hours$$
$$Q = 58\ gallons\ per\ minute$$

The area used in this calculation is the settling pond area. The drainage water around the settling area will not enter into the settling pond because we will put a ditch around it.

1.2 Shaft water

The dewatering water flow will be the following:

53,000 gallons per foot in the shaft
10 feet per day
530,000 gallons per day
368 gallons per minute

1.3 Retention time

The retention time will be:

Water flow = 426 gpm*60*24 = 614,000 gal per day
Settling pond volume = 600,000 gallons
Retention time = about 24 hours (1 day)

2. DAM DESIGN

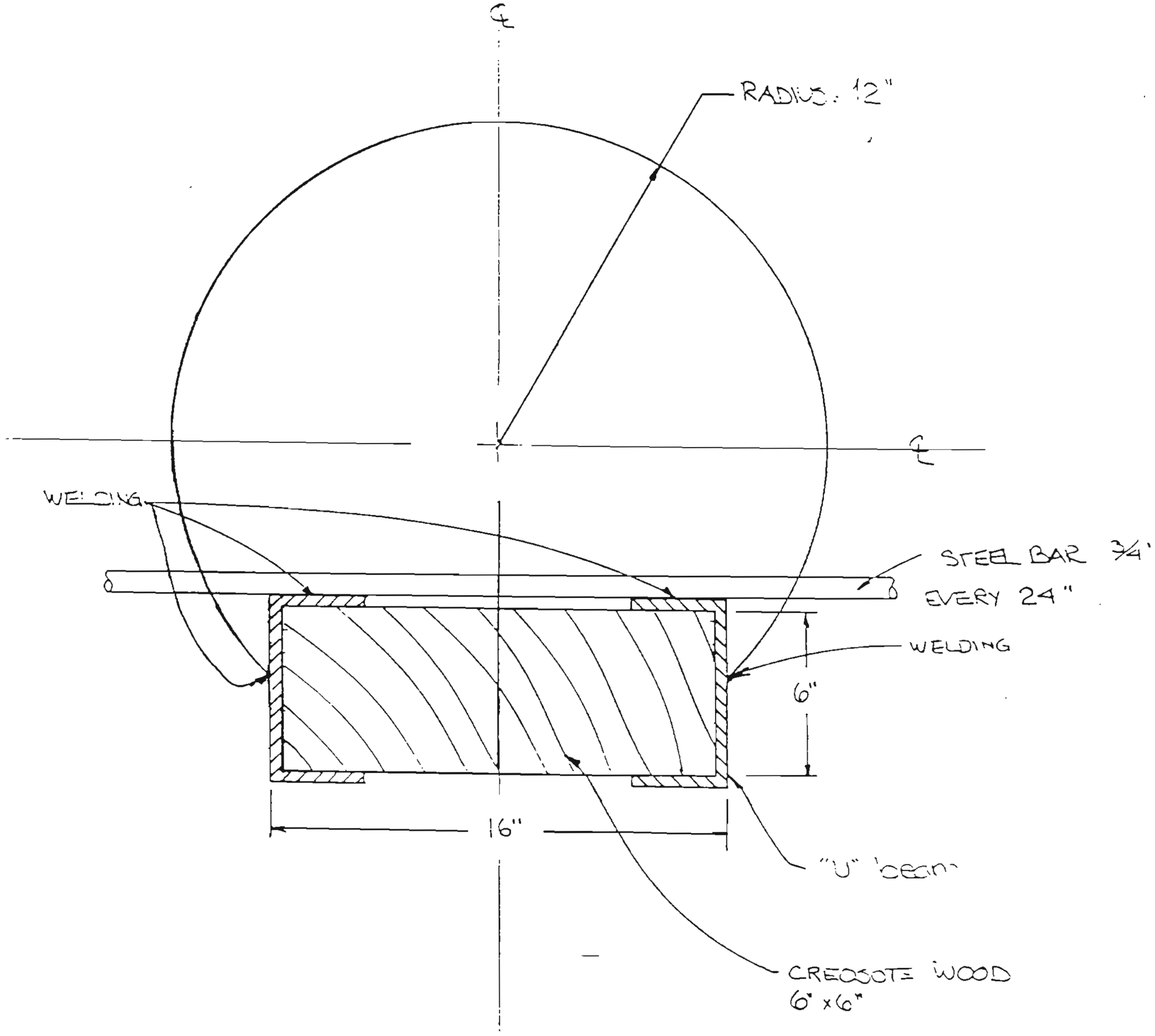
The dam design is shown on the plan no.88-25. The dam of the polishing pond will have the decant tower and an emergency spill way. The dam of the settling pond will have a calvert install to 2/3 of the dam height. A correction of the name of the dam must be bring on the plan no 88-20. The polishing pond is the settling pond and the settling pond is the polishing pond.

3. DITCH REQUIRED

The ditch is shown on the plan no 88-26. This ditch will drain all the drainage water.coming around the settling pond area.

4. DECANT TOWER DESIGN

The decant tower design is shown on the plan no 88-22, 88-23, 88-24. The diameter of the calvert has been calculated and with a flow of 426 gallons per minute(.032 meter3 per second) a 24 inches diameter calvert is all right.



EXPLORATION OREX inc.
ONITAP RESOURCES inc.

VIEW PLAN OF THE DECANT TOWER

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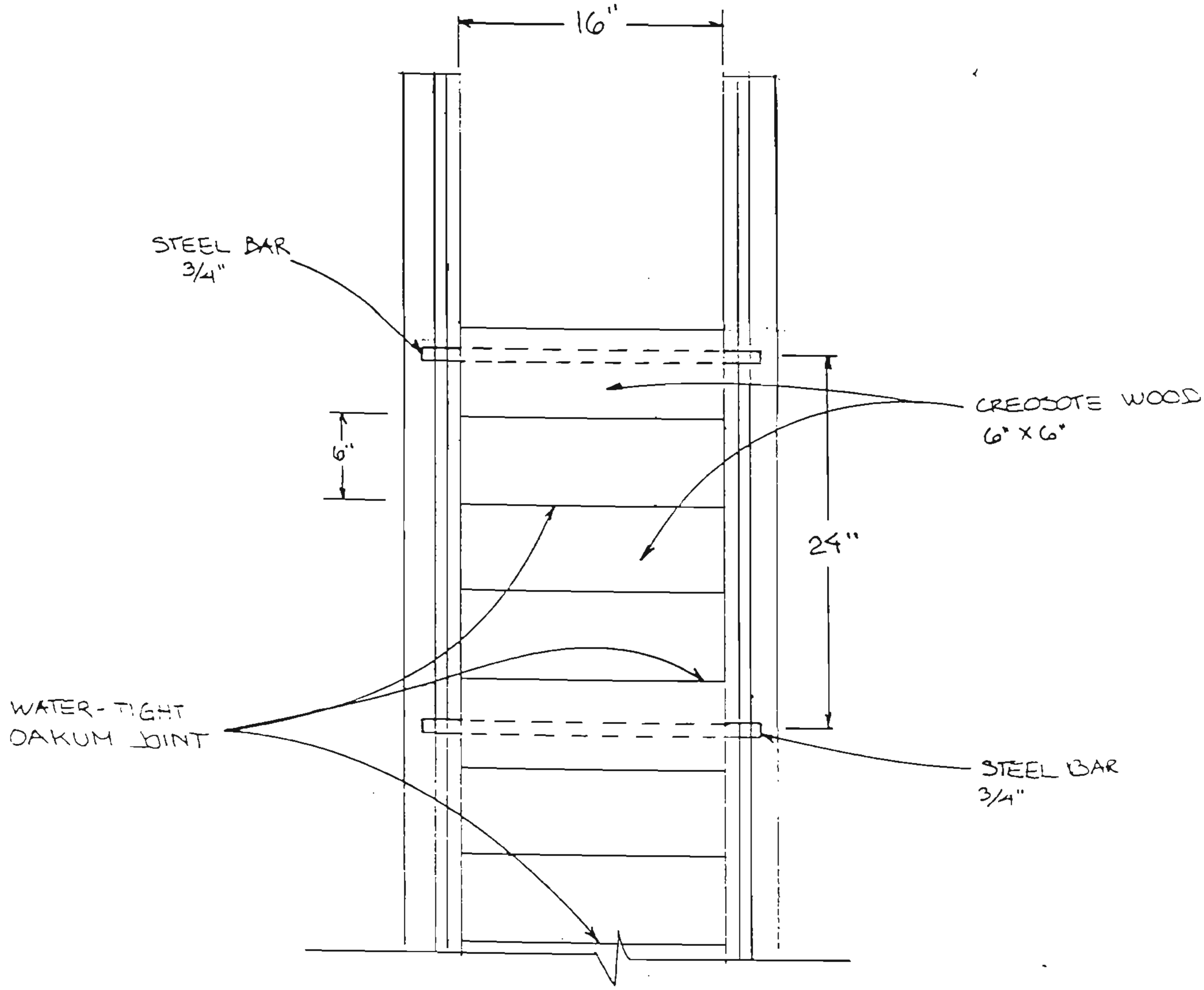
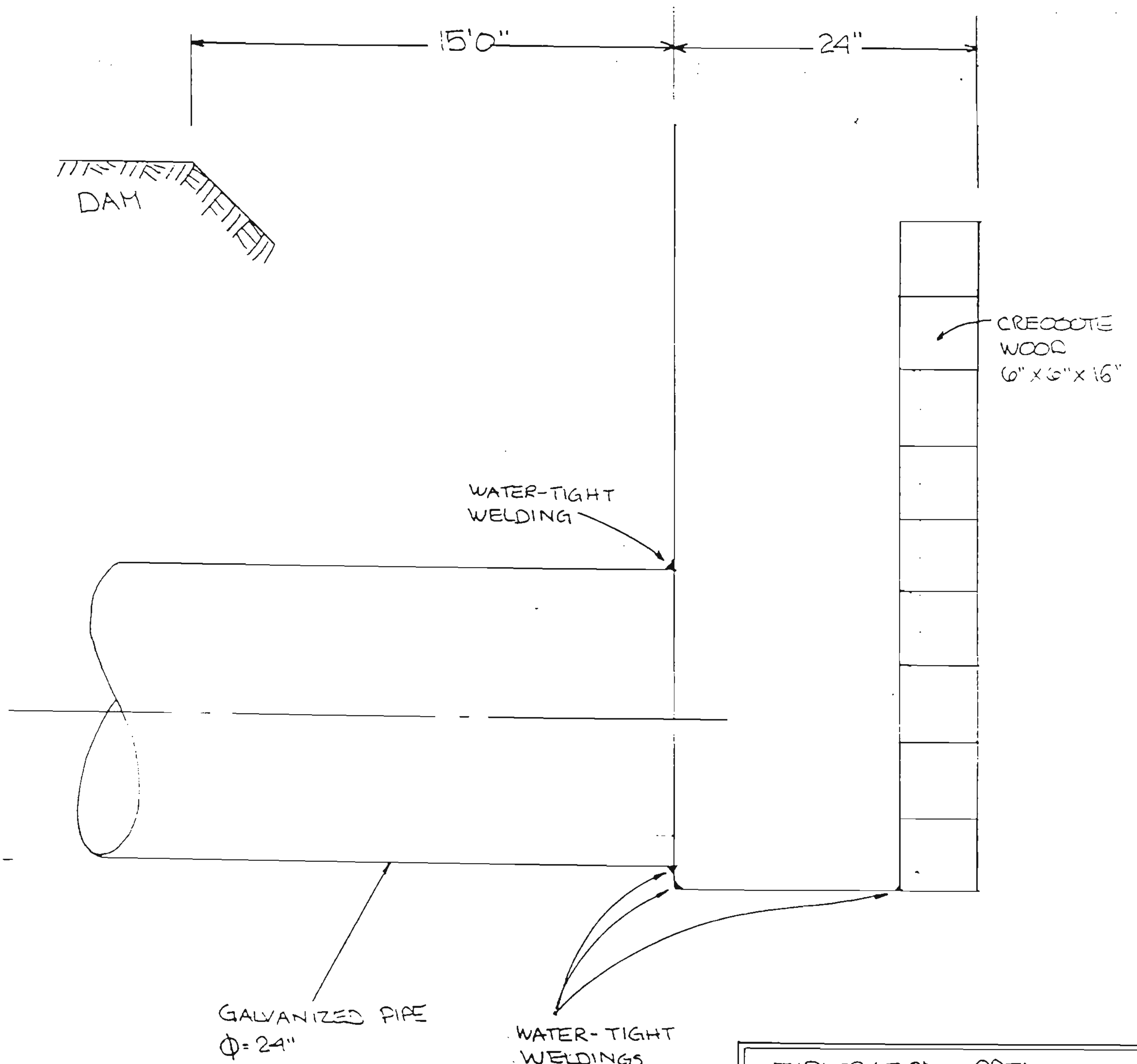
VERIFIED BY: M.C.	DATE: 15-JUL-88
	NO: 88-22



OUT OF SCALE

EXPLORATION OREX inc. ONITAP RESOURCES inc.	
TRANVERSAL SECTION OF THE DECANT TOWER	
DRAWN BY: S.L.	SCALE: —
VERIFIED BY: M.D	DATE: 15-JUL-88
	NO: 88-23



OUT OF SCALE

EXPLORATION OREX inc.
ONITAP RESOURCES inc.

LONGITUDINAL SECTION
OF THE DECANT TOWER

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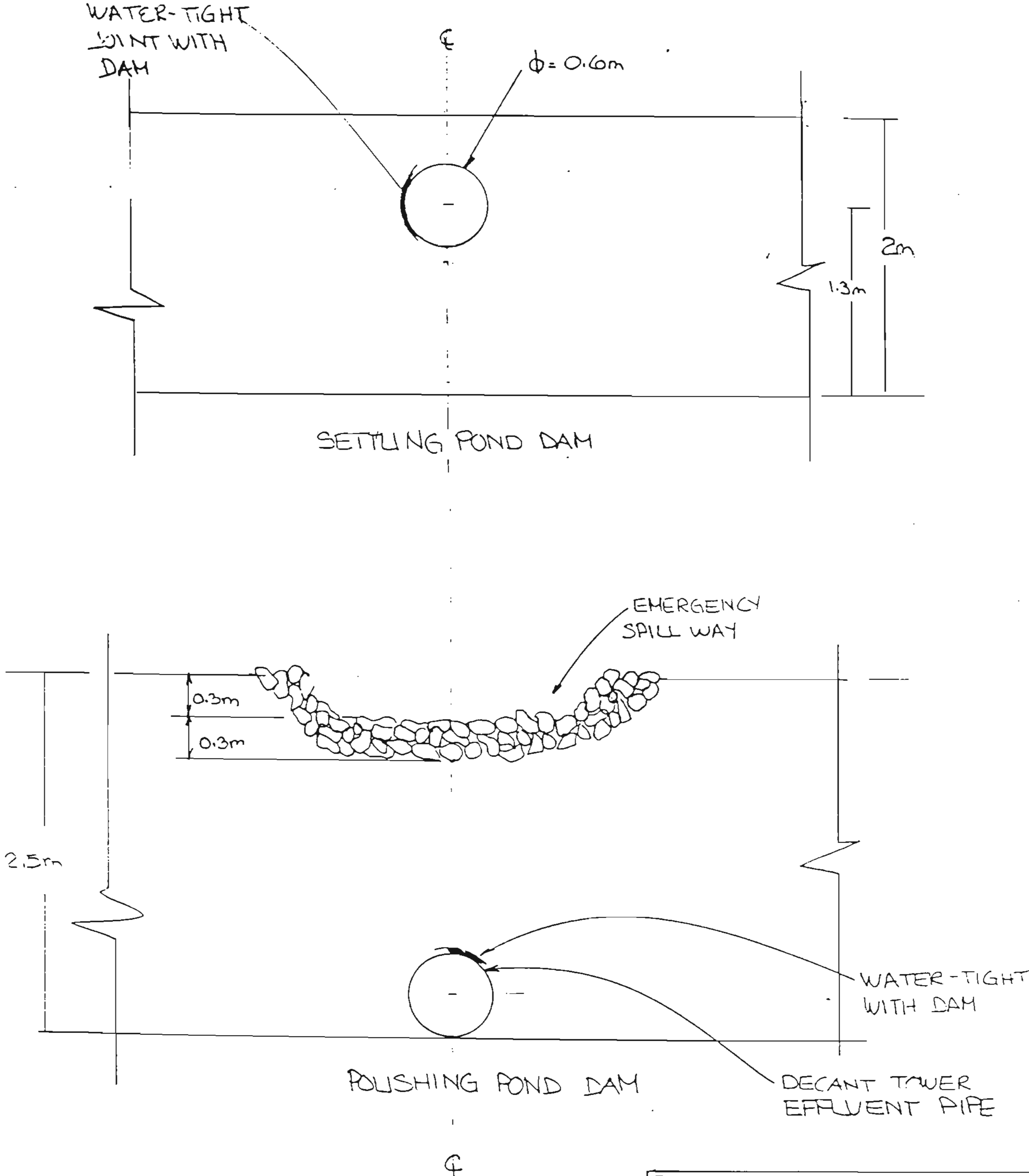
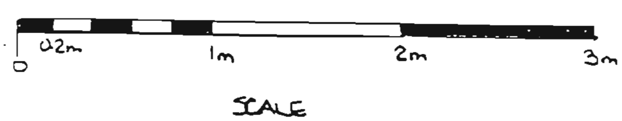
VERIFIED BY: M.D.	DATE: 15-JUL-88
	NO: 88-24





EXPLORATION OREX inc.
ONITAP RESOURCES inc

DAM DESING FOR THE SETTLING & POLISHING PONDS

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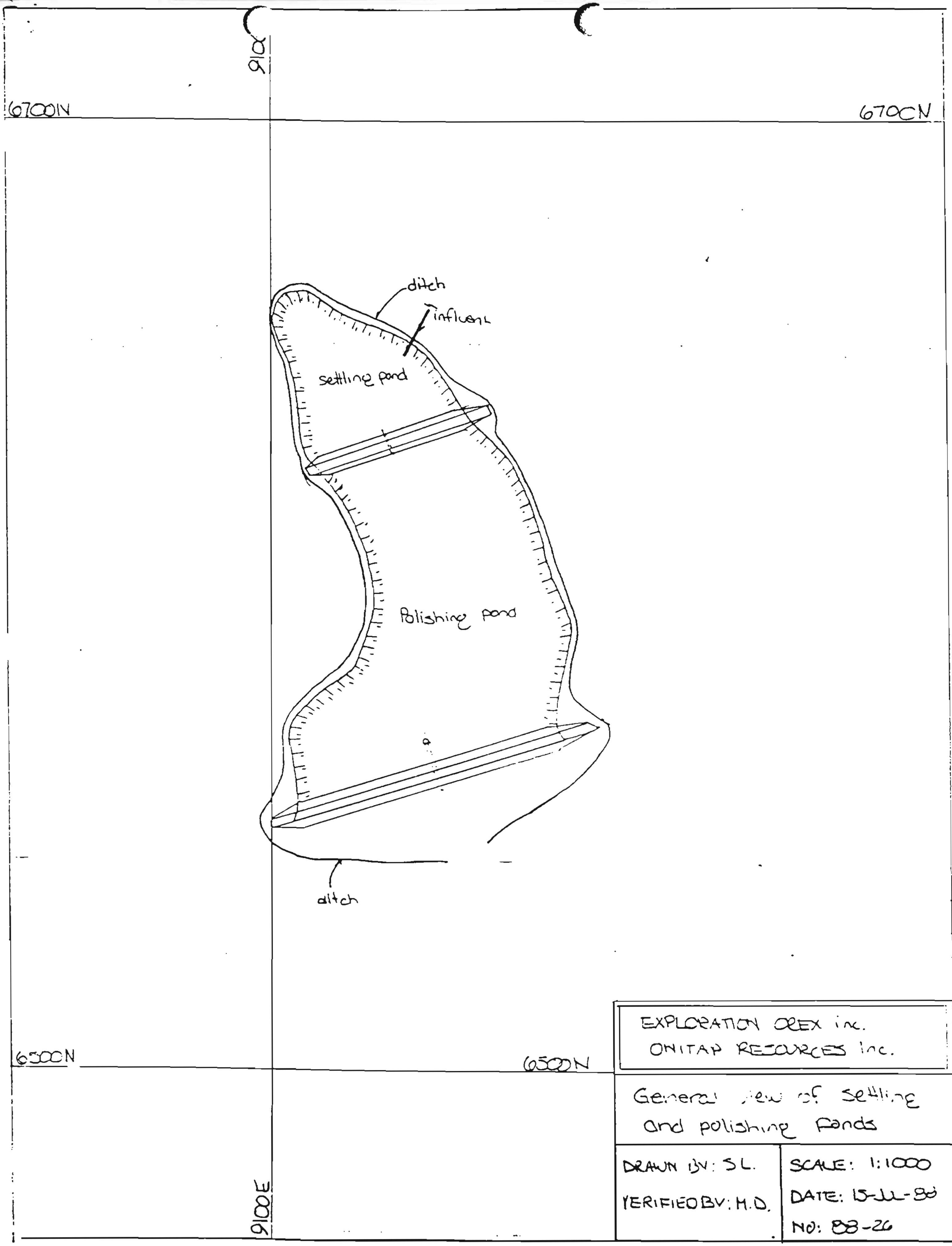
VERIFIED BY: M.D.	DATE: 15-JUL-88
	NO: 88-25



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ONITAP RESOURCES inc.

General view of settling and polishing ponds

DRAWN BY: S.L.	SCALE: 1:1000
VERIFIED BY: M.D.	DATE: 15-JUL-88
	NO: 88-26

APPENDIX B

Tailings Disposal Site Selection

Note: This material was developed with the assumption that the cyanide-rich acid producing tailings stream would be placed underground.

As described in Section 3.8.2.3 of the report, this approach was later abandoned in favour of cyanide destruction in the mill and combination of the tailings streams prior to discharge into the tailings disposal area.

The general selection approach and criteria are, however, still valid.

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November 17, 1989
File No. H89227

Mr. Guy Duchesne, P.Eng.
St-Michel, Geoconseil Inc.
209, 9E Rue
Rouyn-Noranda, Quebec
J9X 2C1

Dear Guy:

RE: Exploration Orex - Goldboro Property

We are enclosing our report on the tailings disposal site selection for your review. We have formatted this on the assumption that it will be an appendix of the environmental assessment report and/or the industrial discharge permit application.

Based on our last meeting, it will come as no surprise to you that we are recommending that Area C be given serious consideration as the area of choice. If you and your client are in agreement with this, we should move ahead quickly with the field program recommended in Section 5.0. Please advise us in this regard as soon as possible.

We are currently checking whether or not we can have one metre contour mapping prepared from existing air photos which would save the need to survey the area on the ground. We will advise you as soon as we have this information.

Kindest regards.

Yours very truly,

NOLAN, DAVIS & ASSOCIATES (N.S.) LIMITED

Alan V. Bell, P.Eng.
Principal and General Manager

AVB/mad
Encl.
cc: M. Thwaites

EXPLORATION OREX - GOLDBORO PROJECT

TAILINGS DISPOSAL SITE SELECTION

1.0 INTRODUCTION

This document reviews the approach and findings of the tailings site selection process adopted for the Goldboro Project.

2.0 TAILINGS AND MILL CHARACTERISTICS

The following tailings characteristics have been assumed for design purposes:

Mill feed:	1,000 tonnes per day
Tailings impoundment design quantity	1.4 million tonnes for first 3 years 10 million tonnes min. for 30 years
Tailings (solids) specific density	
- Inert Tailings	2.7 tonnes/m^3
- Sulphide Tailings	3.8 tonnes/m^3
Solids in pulp at discharge (by weight)	40%
Discharge slurry density	1.3 tonnes/m^3
Tailings grain size	20% - 65 to 150 mesh 30% - 150 to 200 mesh 50% - minus 200 mesh
Deposit void ratio	0.67

The mill will employ two parallel circuits. After running through the ball mill circuit, approximately 1 percent of the ore will be diverted to a gravity circuit for the removal of coarse gold. Its tailings plus the remainder of the ore stream will be processed by flotation. Sulphide minerals (up to 5 percent of mill feed) will be separated and treated by cyanidation and the Merrill-Crowe process. As such, approximately 10 percent of the overall waste volume will be discharged as sulphide-rich cyanide contaminated tailings and 90 percent will be discharged as flotation circuit tailings.

Tests were performed by Orex Inc. in April and August, 1988, at the request of the Nova Scotia Department of the Environment, to determine the acid generation characteristics of ore and waste. The acid generating and consuming capability was found to be 60.0 and 23.10 lbs. H_2SO_4/t, respectively, for the ore and 15.5 and 23.3 lbs. H_2SO_4/t, respectively, for the waste rock. Thus, the waste rock, which is generally devoid of sulphides, is an overall acid consumer while the ore has a net acid generation potential. After milling, the sulphides should be concentrated in the cyanidation circuit tailings which will, therefore, be acid generating. Tailings from the non-cyanidation circuit are expected to be acid consuming and relatively inert.

2.1 Required Tailings Storage Volume

Based on the 1.4 million tonnes tailings impoundment design life specified by Orex for the first three years of operation, the storage volume required will be $0.87 \times 10^6 m^3$ based on the following calculation:

$$\text{Volume of Solids} = \frac{1.4 \times 10^6}{2.7} = 0.52 \times 10^6 m^3$$

$$\text{Volume Including Voids} = 0.52 \times 10^6 \times (1 + 0.67) = 0.87 \times 10^6 m^3$$

This is a conservative design figure as total volume based on production of 900 tonnes/day of inert tailings would be only $0.58 \times 10^6 m^3$ over three years assuming 350 days/year operation.

3.0 TAILINGS DISPOSAL SCHEMATICS

3.1 First Three Years

During the first three years of operation, Orex propose to dispose of the cyanidation circuit tailings in the Boston-Richardson Mine. Studies will be undertaken to verify the technical and environmental acceptability of this approach but, if acceptable, the disposal of tailings on surface during this initial period will involve only the inert tailings stream (ref. Figure 1). Cyanide treatment will be provided when required to prevent any contaminated mine overflow.

3.2 Years 4 to 30

After year 3, the mine will likely switch to an open pit operation, possibly at a higher rate of production. Details of the mine and mill process are impossible to define at this time, as are the characteristics of the waste streams. It can, however, be anticipated that acid generating sulphide tailings with high cyanide residuals will require appropriate treatment according to the process diagram shown in Figure 2. This operation will be subject to separate regulatory approvals. At this stage, allowance should be made in tailings system selection to accommodate the concept of longer-term tailings disposal.

4.0 IDENTIFICATION OF TAILINGS DISPOSAL AREAS

4.1 Initial Screening

An examination was made of the 1:10,000 scale orthophotos of the area (5 m contour intervals) to identify potential sites for tailings disposal during the first three years of operation. Key criteria used for this initial screening were:

1. Sites within 6 km radius of the mill
2. Topographic features favouring impoundment with minimum capital cost for dam construction

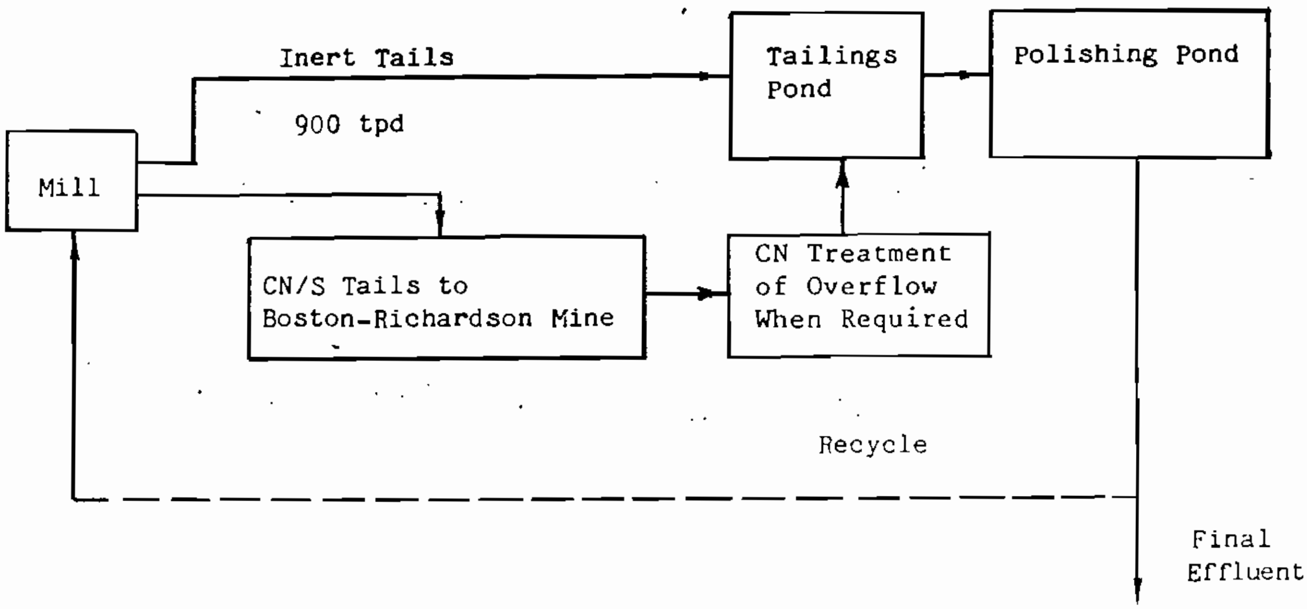


FIGURE 1: WASTE PROCESS DIAGRAM FOR FIRST 3 YEARS

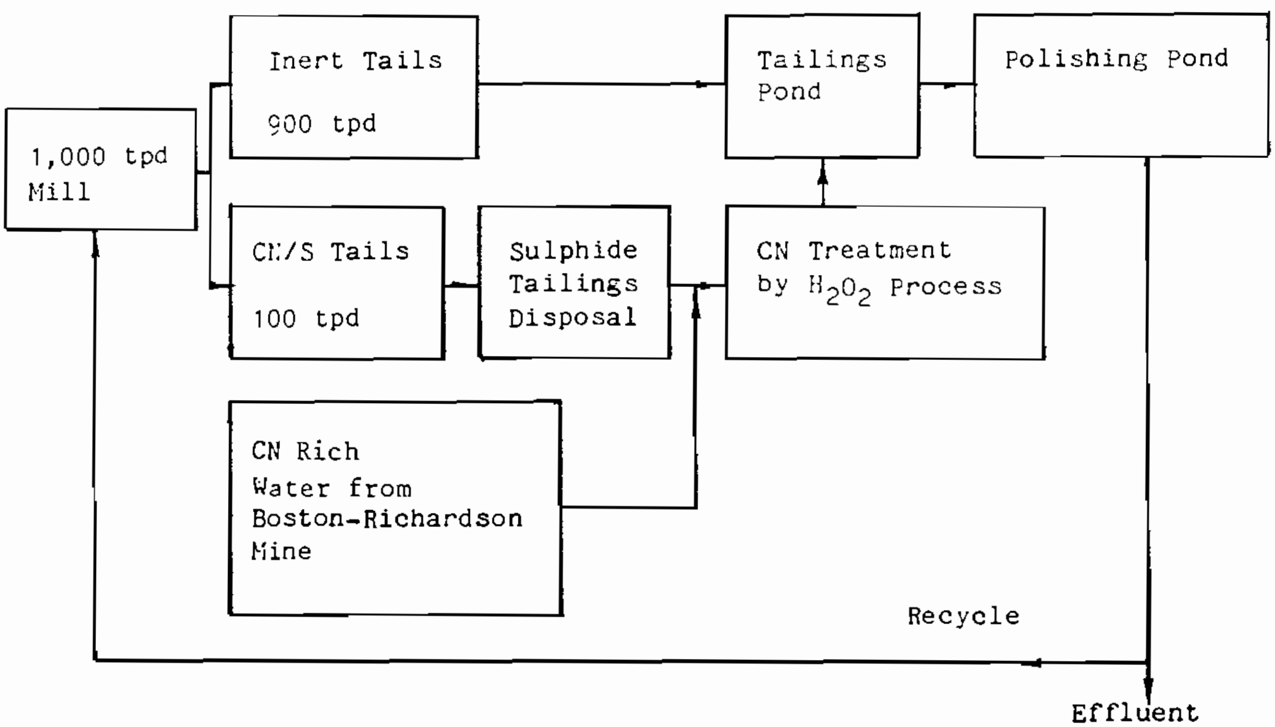


FIGURE 2: WASTE PROCESS DIAGRAM FOR YEARS 4 TO 30

3. Sites (or combinations of sites) meeting minimum required storage volumes

4. Sites with manageable drainage throughput

Potential environmental sensitivity and geotechnical considerations were not included in the initial identification of sites. No field testing has been undertaken at this stage.

Six sites meeting the above criteria were identified as shown on Figure 3. Characteristics of these sites are summarized in Table 1.

Based on this initial assessment, there appear to be technically feasible options that might prove environmentally and economically acceptable in Areas A, B, C and E. Area D was eliminated at this stage due to its distance from the mill, lack of topography favouring a cost-effective initial development, and the fact that the ultimate development would involve a second watershed. Area F was eliminated due to distance form the mill, the fact that productive wetlands would be inundated, and its location in a currently non-impacted watershed.

The remaining options were reviewed with interested regulatory agencies at a meeting on November 6, 1989. The following observations were made at that meeting:

- There is strong regulatory preference for disposal sites in the presently impacted Gold Brook River watershed.

- DFO would permit development of Area B only if there were no available alternatives not impacting salmonid habitat and would then require habitat enhancement in accordance with their "no-net-loss" policy.

Conceptual layouts were developed for Areas A, B, C and E. These are shown diagrammatically in Figures 4, 5, 6 and 7, respectively, and their characteristics summarized in Table 2. Factors influencing the selection of a tailings disposal area are addressed in the following sections. It should be

TABLE 1

Characteristics of Potential Tailings Disposal Sites

Site	Operating Elevation (m)	Surface Area (m^2)	Storage Volume (m^3)	Retaining Dams Length (m)	Retaining Dams Height (m)	Retaining Dams Volume (m^3)	Storage to Dam Volume Ratio	Limitations	Advantages
A	55	19,000	47,500	180	2.5	563	84	- will not contain tailings for entire life of mine - low storage to dam volume ratio - requires high dams	- in same watershed as mill - close to mill
	60	72,000	275,000	430	7.5	11,438	24		
	65	231,000	1,032,500	600	12.5	32,188	32		
	70	449,000	2,732,500	1,180	17.5	68,478	40		
	75	1,040,000	6,455,000	2,310	22.5	184,793	35		
B	65	122,000	305,000	100	2.5	313	974	- will not contain tailings for entire life of mine - includes lakes, regulatory approval may be difficult	- in same watershed as mill - high storage to dam volume ratio - presence of lakes easily allows perpetual submersion of sulphide tailings - close to mill
	70	378,000	1,505,000	465	7.5	10,035	150		
	75	1,114,000	5,195,000	1,160	12.5	44,713	116		
C	55	22,000	55,000	215	2.5	673	82	- not in same watershed as mill - low storage to dam volume ratio - requires high dams	- will contain tailings for life of mine - close to mill
	60	173,000	625,000	515	7.5	13,695	46		
	65	541,000	2,347,500	990	12.5	47,038	52		
	70	840,000	5,890,000	1,155	17.5	93,853	63		
	75	1,528,000	11,800,000	1,560	22.5	146,543	81		
D	55	149,500	373,750	385	2.5	1,205	310	- low storage to dam volume - requires high dams	- will contain tailings for entire life of mine - in same watershed as mill - close to mill
	60	776,000	2,687,500	1,400	7.5	33,473	80		
	65	1,128,000	7,412,500	2,120	12.5	105,625	70		
	70	1,257,000	13,245,000	2,480	17.5	191,415	69		
	75	1,399,000	19,805,000	2,700	22.5	291,375	68		
E	65	344,000	860,000	165	2.5	515	1,670	- not in same watershed as mill	- will contain tailings for entire life of mine - high storage to dam volume ratio - close to mill
	70	594,000	3,160,000	565	7.5	9,803	322		
	75	902,000	6,900,000	970	12.5	52,675	131		
F	50	1,370,000	3,424,500	1,480	2.5	4,625	740	- not in same watershed as mill - includes lakes, and rated as 70 wetland capability - distant from mill	- will contain tailings for entire life of mine - very high storage to dam volume ratio - presence of lakes easily allows perpetual submersion of sulphide tailings - low dams required
	55	3,692,000	16,080,000	3,550	7.5	45,698	352		

TABLE 2

Summary of Site Evaluation Data - First 3 Years of Operation

Disposal Alternative	Dam Vol. for 1st 3 yrs (m)	Tailings Storage Volume ($m^3 \times 10^6$)	Tailing Pond Volume @ 3 yrs (m^3)	Av. Pond Retention @ 3 yrs (days)	Polishing Pond: Dam Volume (m^3)	Polishing Pond: Storage Volume (m^3)	Polishing Pond: Average Retention (days)	Environmental Constraints	Environmental Advantages	Expansion Potential	Comments
Site A	98,400	1.13	69,800	5.1	28,100	65,500	31.7	None	Same watershed	Would require supplementary area	Option eliminated due to high initial cost and limited expansion potential
Site B	35,700	1.52	144,600	19.5	3,000	73,100	29.9	Inundates trout habitat	Same watershed	Would require supplementary area	Lowest cost option but eliminated due to environmental contrraints
Site C	65,600	0.86	131,700	6.4	12,100	114,400	26.6	None	Same watershed (different sub-basin)	Expandable to storage capacity of 9.6 x $10^6 m^3$ tailings	Preferred option
Site E	47,176	1.13	63,300	4.3	2,300	110,300	39.1	Different watershed but discharge could be pumped into Gold Brook Watershed	After 3 years dams would be raised resulting in gravity flow into Gold Brook Watershed	Feasible but expensive	Cost effective for initial option but eliminated due to reliance on pumping effluent and high expansion costs

noted that for each of these potential areas, the mineral rights are held by companies other than Orex (see Figure 8).

4.2 Site A

The conceptual layout for Site A is shown in Figure 4. This arrangement addresses the requirements of the operation for the first three years and then has the potential to be integrated into a larger tailings disposal system involving Area C for the balance of the project. In this case, the dams for Area A would be raised to the 75 m elevation to provide subaqueous disposal for sulphide tailings, while Area C would be used for disposal of inert tailings.

Both Areas A and C are totally within the currently impacted Gold Brook River drainage area. Based on the present level of investigation, there do not appear to be any sensitive components of the environment impacted by this concept. This disposal option does, however, require construction of a relatively high dam and has the highest initial development costs of any potential site.

4.3 Site B

An alternative for the initial three years of operation is development of Area B. A conceptual layout for this area is shown in Figure 5. This site provides the least cost development alternative in that it involves relatively minor dam construction to achieve capacities for the first three years of operation, and even beyond if the area is converted to subaqueous sulphide tailings disposal similar in principle to that described for Site A. In such circumstances, the inert tailings for years 4 to 30 would be discharged into a separate system in Area C or E.

A serious constraint to this option is the inundation of Rocky Lakes which drain into Gold Brook Lake. These are shallow marshland waterbodies within a currently disturbed watershed. However, it appears that they support a trout population and that development of the area will, therefore, be opposed by the Department of Fisheries and Oceans. For this reason, the option was dropped despite its low initial cost and attractive layout features.

4.4 Site C

This area provides a large potential storage volume that can be developed in a staged manner to address the needs of both the first three years of operation and future tailings disposal. Conceptual designs for each are shown in Figures 6A and 6B.

The post-3 year development of the site has not been examined in detail but in principle can be achieved by adding staged increments to the downstream face of the dam while maintaining the location of the polishing pond. The supernatant retention time in the tailings pond can be increased by raising the dam ahead of the demand for tailings storage.

4.5 Site E

This area provides an economically attractive alternative in that the volume of the retaining dams is relatively low for the first three years of operation (Figure 7A). The principal disadvantage of the scheme is that it is situated in a currently non-impacted watershed and the decant would have to be pumped back into the Gold Brook watershed if potential impacts to the watershed are to be avoided during the first three years of operation. Once the dam is raised to the 75 m elevation, the decant would drain naturally to the west into Gold Brook Lake but the required dam volume would be high (Figure 7B). For these reasons, this option has been eliminated.

5.0 RECOMMENDATIONS

It is recommended that serious consideration be given to the use of Site C for both the initial and long-term disposal of tailings.

If this approach is conceptually acceptable, we recommend that the following site-specific investigations be carried out with a view to confirming the suitability of the area:

1. 1 m contour mapping of the area.

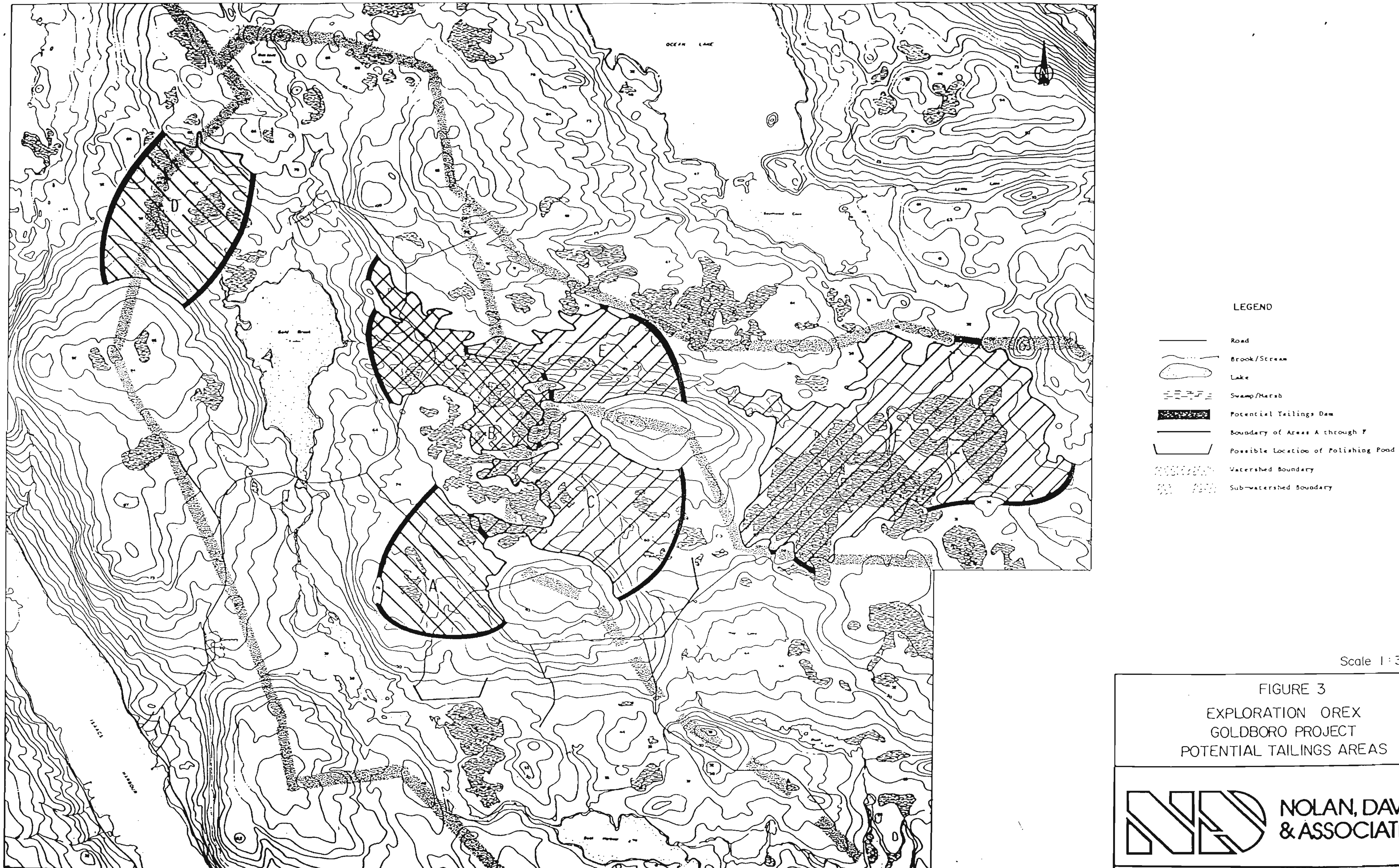
2. Phased site evaluation consisting of:

   a) geological site investigation and mapping;

   b) test pitting of dam centre lines, borrow areas and disposal site bottom; and

   c) boreholes on dam centre lines, if required.

3. Biological assessment of disposal area and downstream conditions.

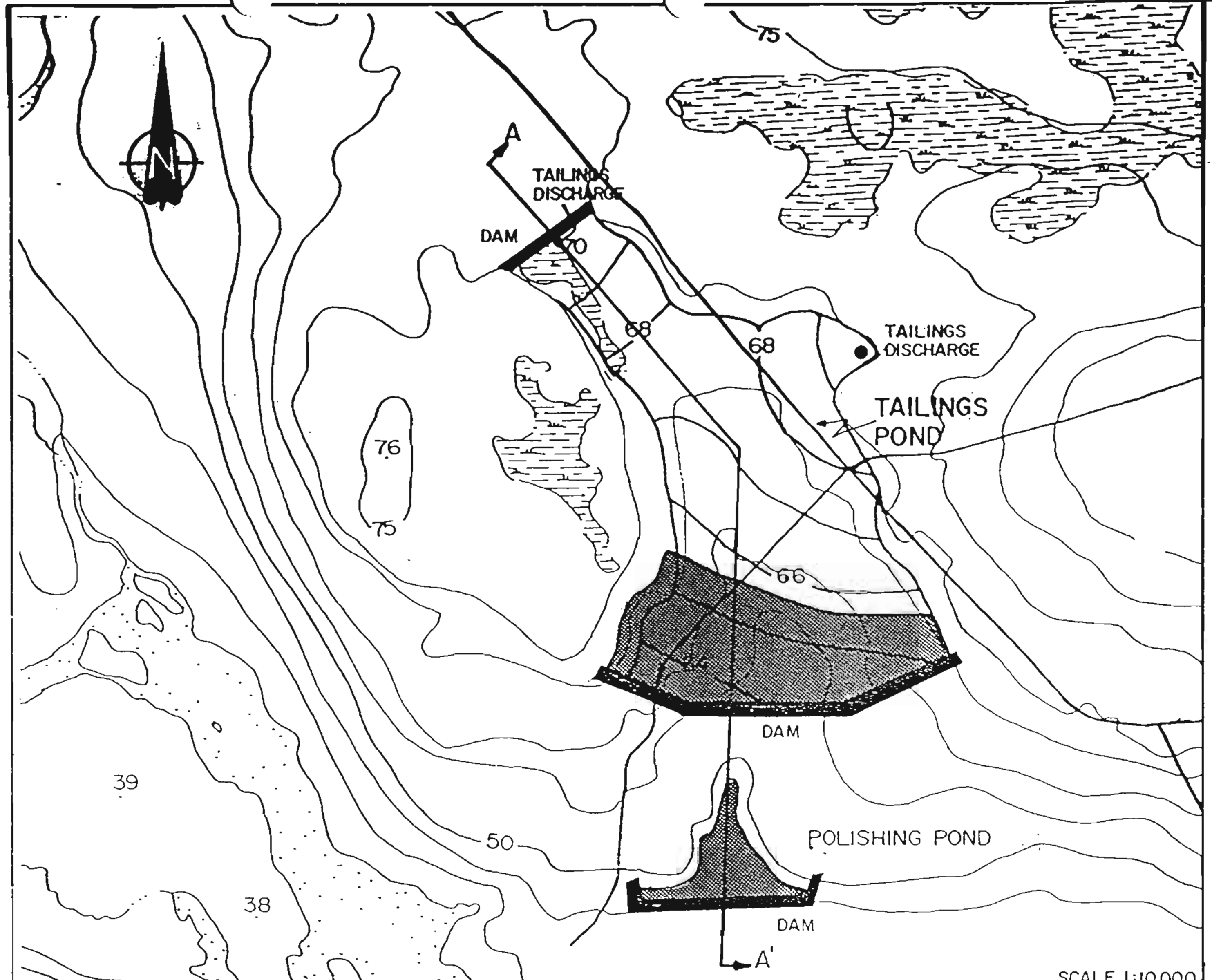


Scale 1:30000

FIGURE 3
EXPLORATION OREX
GOLDBORO PROJECT
POTENTIAL TAILINGS AREAS

NOLAN, DAVIS & ASSOCIATES

Drawn By H. Trynor	Checked By A.V. Bell
Date Oct. 1989	Drawing No. H89227-01



NOTES: **AREA A**

TAILINGS POND:

Available Tailings:	
Storage Volume (m^3)	1,129,650
Pond Volume (m^3)	
- Total	69,800
- Depth $\geq$ 2 m	12,900
Retention Time (days)	5.1
Dam (s) Characteristics:	
- Length (m)	810
- Maximum Height (m)	13.5
- Volume (m^3)	98,400

POLISHING POND:

Volume (m^3)	65,500
Retention Time (days)	31.7
Dam Characteristics:	
- Length (m^3)	410
- Maximum Height (m)	6
- Volume (m^3)	38,250

Spillway Details Not Shown.

Refer to Drawing No. H89227-01 for Location.

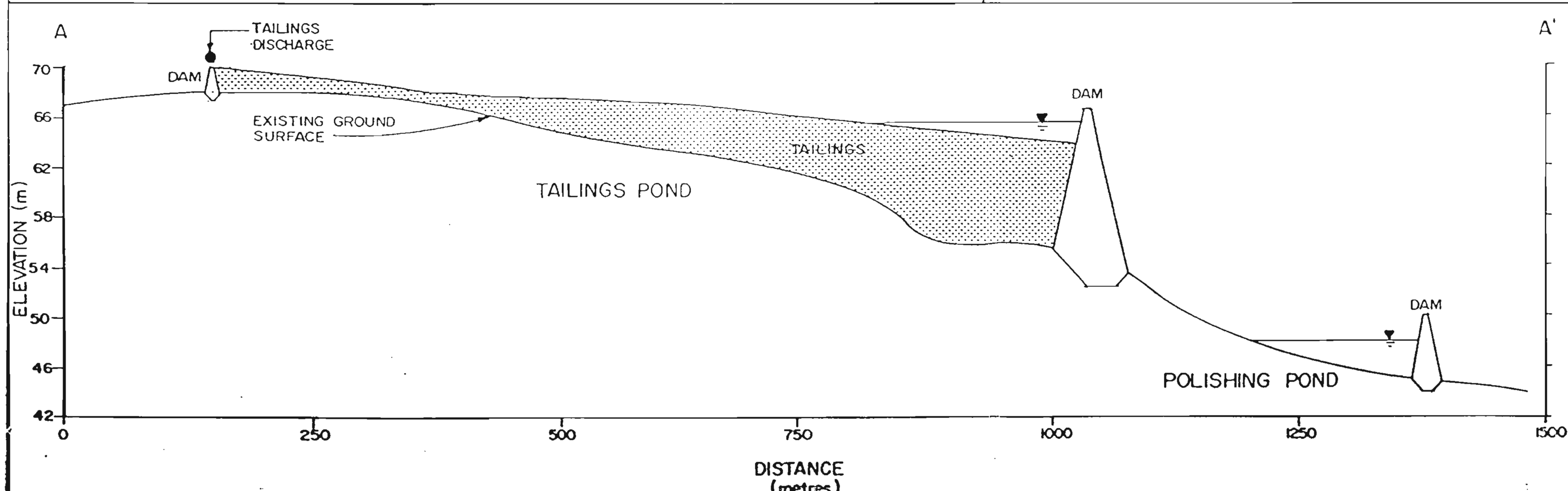
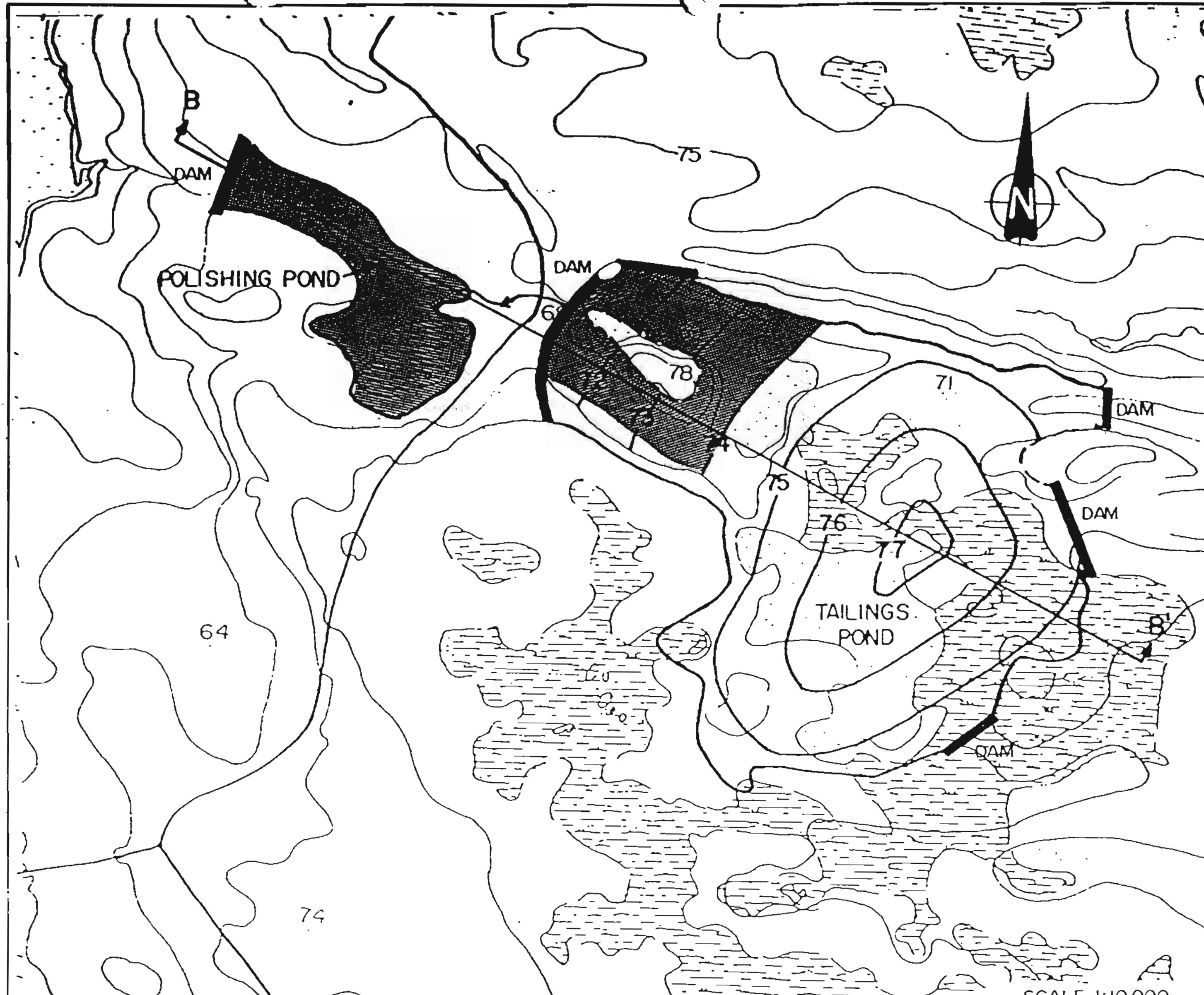


FIGURE 4

EXPLORATION OREX
GOLDBORO PROJECT
TAILINGS DISPOSAL SITE
AREA 'A', INITIAL DEVELOPMENT

NOLAN, DAVIS & ASSOCIATES

Drawn By H.T.	Checked By G.G.
Date: NOV. 1989	Project No. H89227



AREA B

NOTES:

TAILINGS POND:

Available Tailings:	
Storage Volume (m^3)	1,523,750
Pond Volume (m^3)	
- Total	144,600
- Depth ≥ 2 m	44,800
Retention Time (days)	19.5
Dam (s) Characteristics:	
- Length (m)	650
- Maximum Height (m)	7
- Volume (m^3)	35,700

POLISHING POND:

Volume (m^3)	73,100
Retention Time (days)	29.9
Dam Characteristics:	
- Length (m^3)	160
- Maximum Height (m)	4
- Volume (m^3)	3,000

Spillway Details Not Shown.

Refer to Drawing No. H89227-01 for Location.

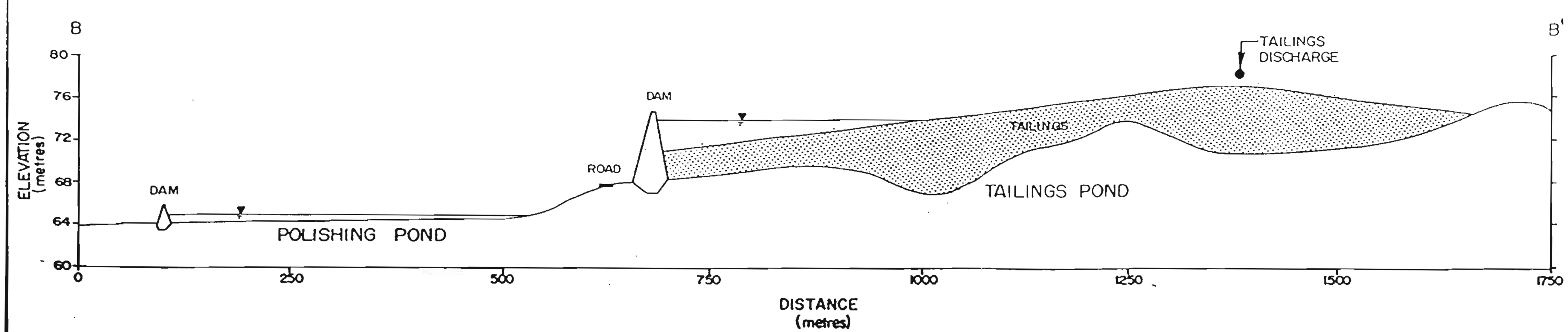


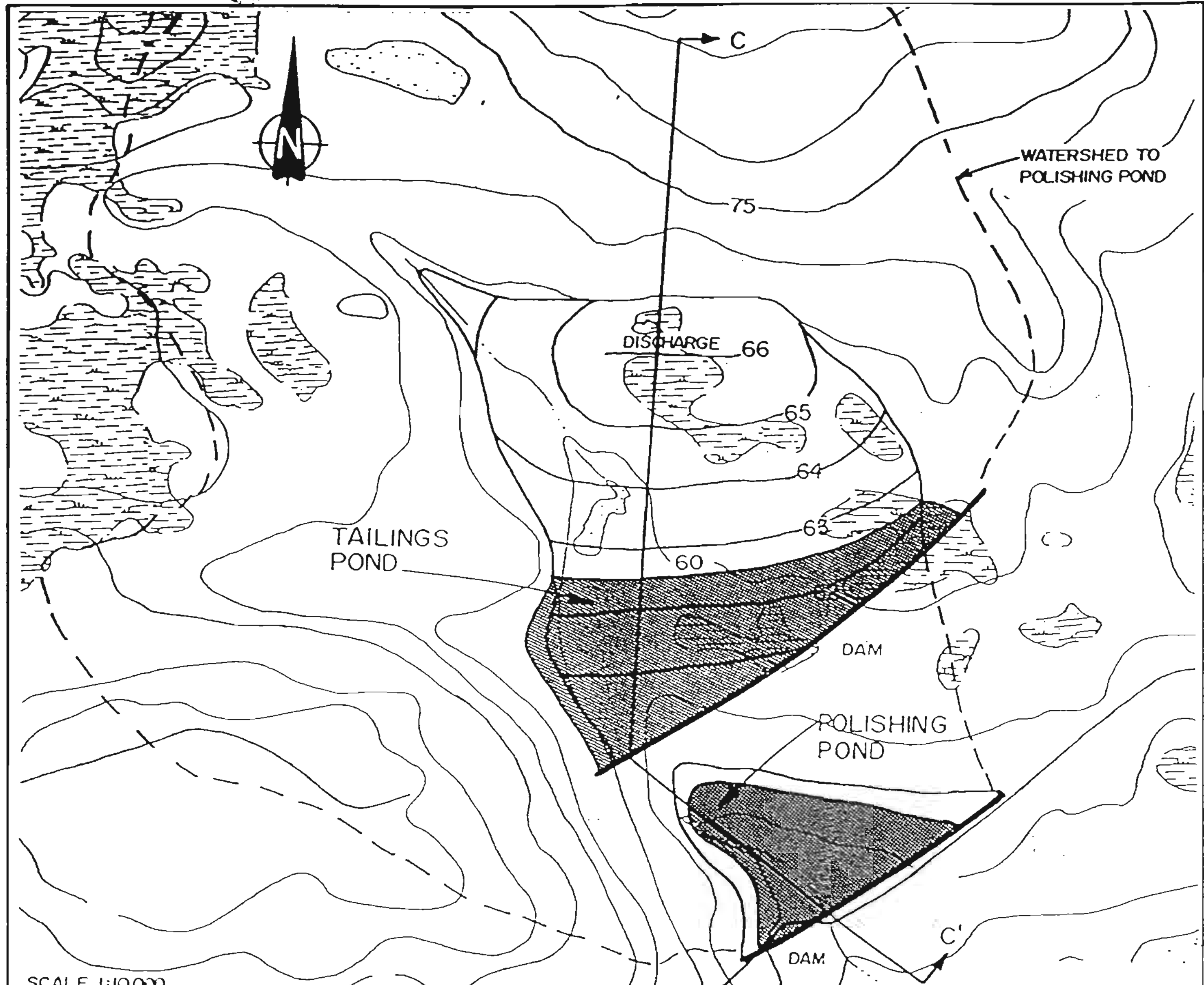
FIGURE 5

EXPLORATION OREX
GOLDBORO PROJECT

TAILINGS DISPOSAL SITE
AREA 'B', INITIAL DEVELOPMENT

NOLAN, DAVIS & ASSOCIATES

Drawn By DSP	Checked By G.G.
Date NOV. 1989	Project No. H89 227



NOTES: AREA C

TAILINGS POND:

Available Tailings:	
Storage Volume (m^3)	865,000
Pond Volume (m^3)	
- Total	131,700
- Depth $\geq$ 2 m	28,980
Retention Time (days)	6.4
Dam (s) Characteristics:	
- Length (m)	840
- Maximum Height (m)	9.5
- Volume (m^3)	65,600

POLISHING POND:

Volume (m^3)	114,400
Retention Time (days)	26.6
Dam Characteristics:	
- Length (m^3)	510
- Maximum Height (m)	5
- Volume (m^3)	12,100

Spillway Details Not Shown.

Refer to Drawing No. H89227-01 for Location.

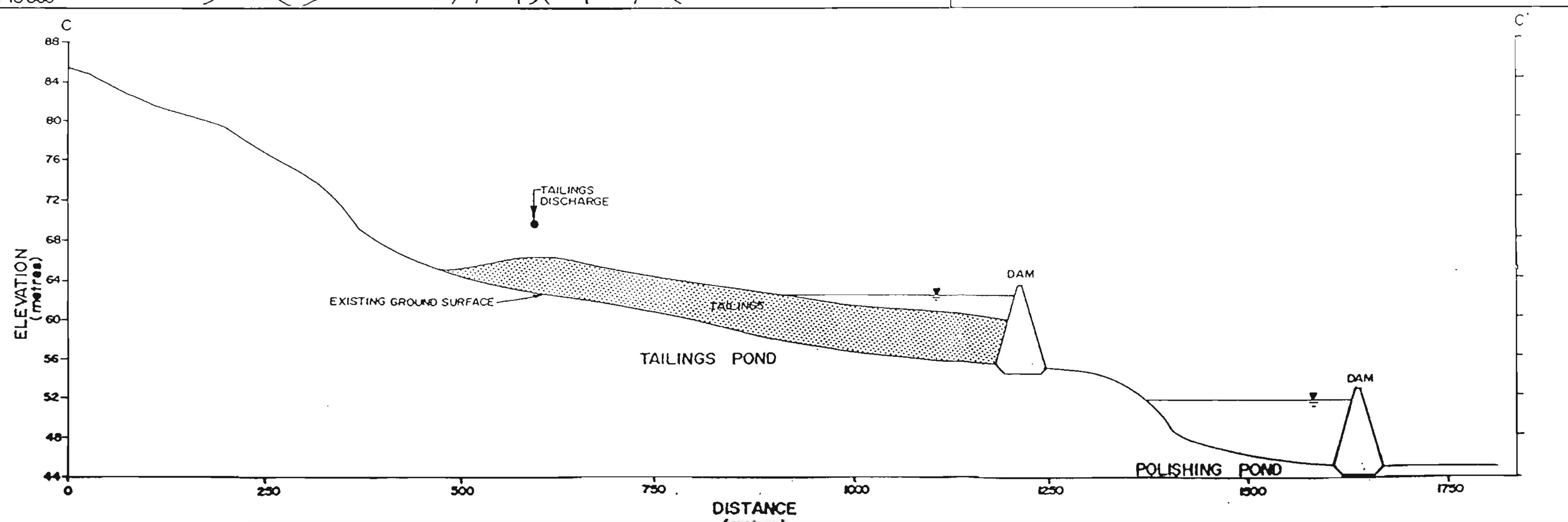
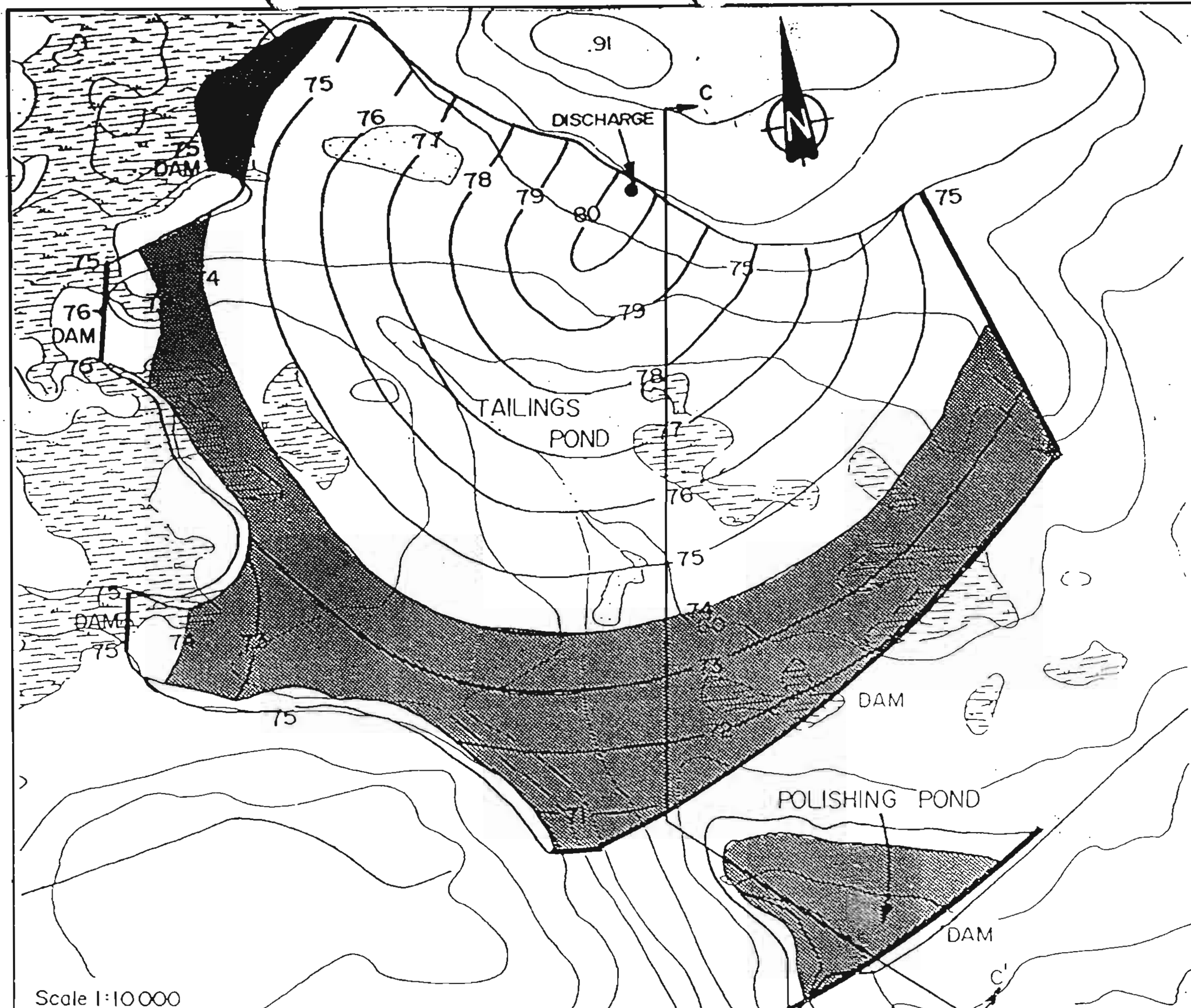


FIGURE 6A
EXPLORATION OREX
GOLDBORO PROJECT
TAILINGS DISPOSAL SITE
AREA 'C', INITIAL DEVELOPMENT

NOLAN, DAVIS & ASSOCIATES

Drawn By DSP	Checked By G.G.
Date NOV. 1989	Project No. H89 227



NOTES:

AREA C

TAILINGS POND:

Available Tailings:

Storage Volume (m^3)	9,640,250
Pond Volume (m^3)	
- Total	451,000
- Depth ≥ 2 m	115,300
Retention Time (days)	23.2
Dam (s) Characteristics:	
- Length (m)	1860
- Maximum Height (m)	21
- Volume (m^3)	794,000

POLISHING POND:

Volume (m^3)	114,400
Retention Time (days)	24.1
Dam Characteristics:	
- Length (m^3)	510
- Maximum Height (m)	5
- Volume (m^3)	12,100

Spillway Details Not Shown.

Refer to Drawing No. H89227-01 for Location.

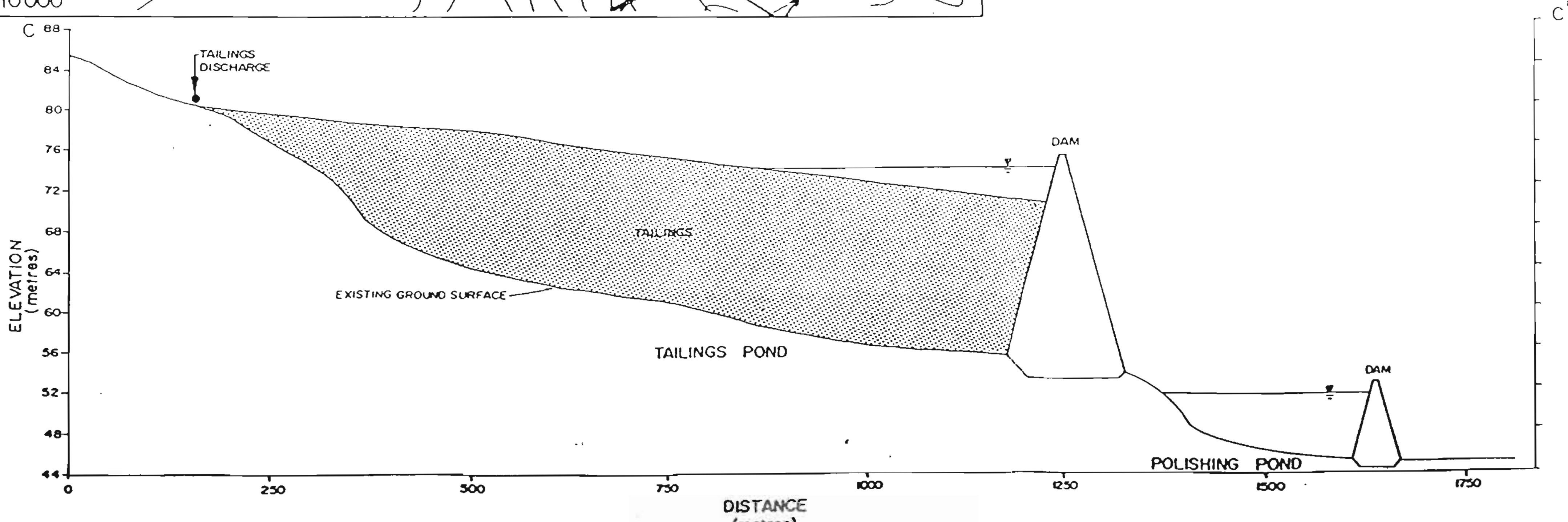
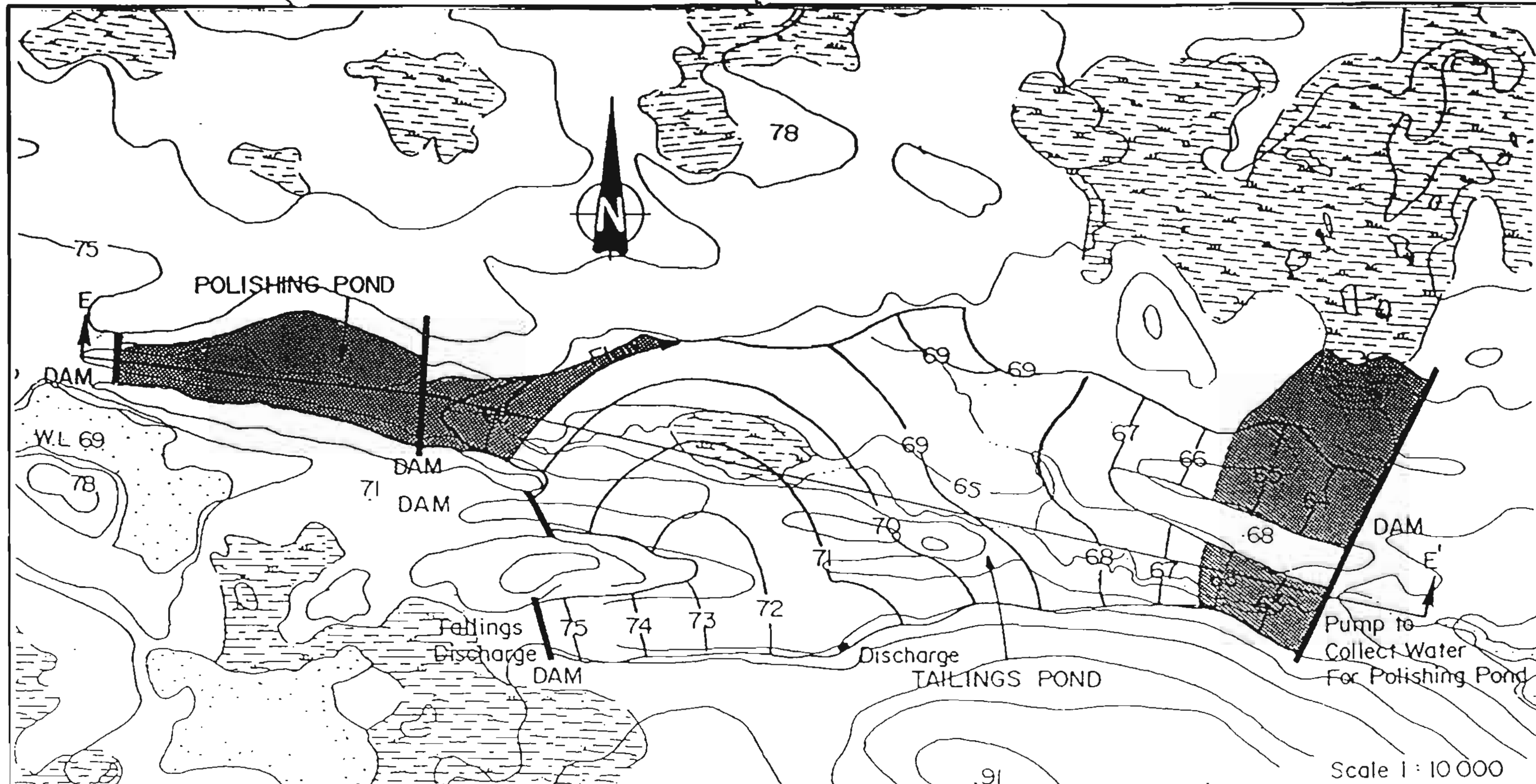


FIGURE 6B
EXPLORATION OREX
GOLDBORO PROJECT
TAILINGS DISPOSAL SITE
AREA 'C', 30 yrs. DEVELOPMENT

NOLAN, DAVIS & ASSOCIATES

Drawn By H.T.	Checked By G.G.
Date Nov. 1989	Project No. H89227



NOTES: **AREA E**

TAILINGS POND:

Available Tailings:

Storage Volume (m^3)	1,129,050
Pond Volume (m^3)	
- Total	63,300
- Depth > 2 m	13,500
Retention Time (days)	4.3
Dam (s) Characteristics:	
- Length (m)	930
- Maximum Height (m)	8.5
- Volume (m^3)	47,176

POLISHING POND:

Volume (m^3)	110,250
Retention Time (days)	39.1
Dam Characteristics:	
- Length (m)	80
- Maximum Height (m)	5.5
- Volume (m^3)	2,255

Spillway Details Not Shown.

Refer to Drawing No. H89227-01 for Location.

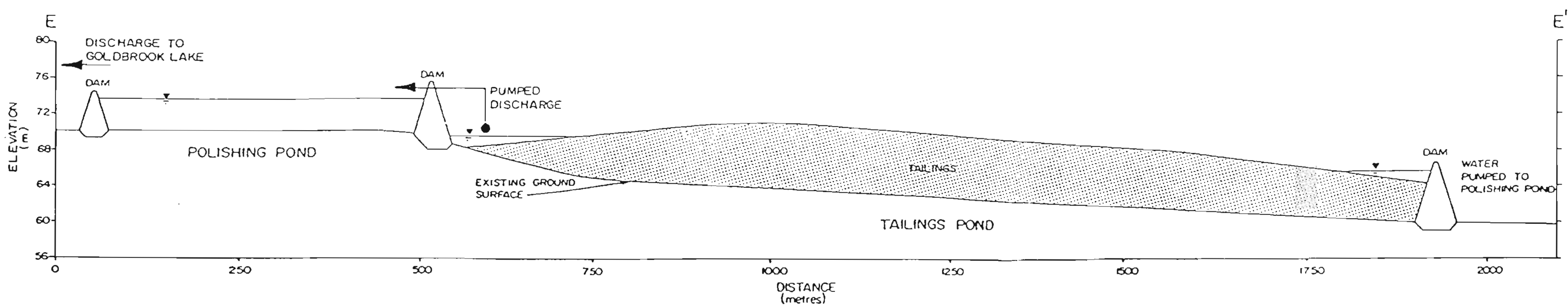
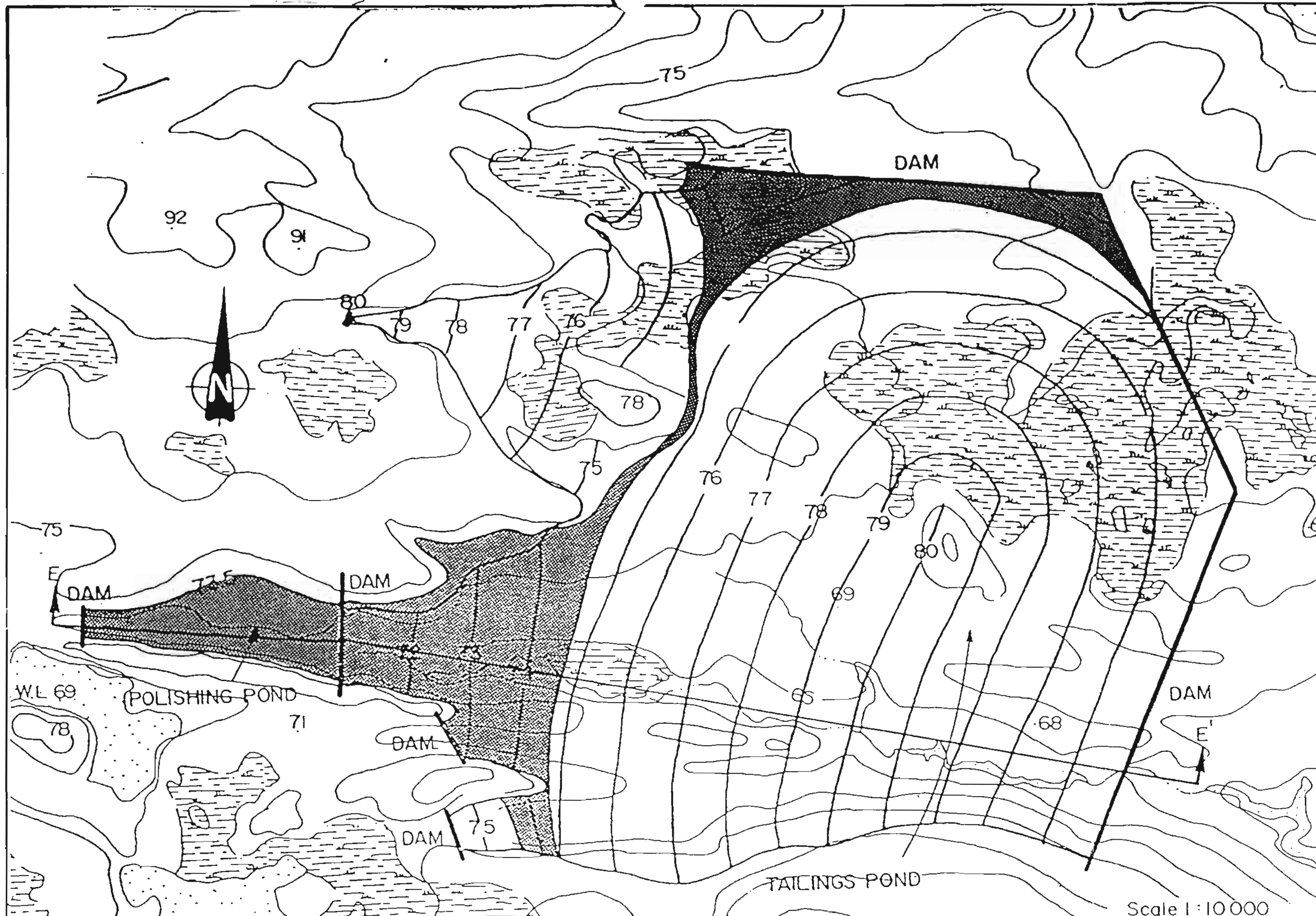


FIGURE 7A

EXPLORATION OREX
GOLDBORO PROJECT
TAILINGS DISPOSAL SITE
AREA 'E', INITIAL DEVELOPMENT

NOLAN, DAVIS & ASSOCIATES

Drawn By H.T. & D.S.P.	Checked By G.G.
Date Nov. 1989	Project No. H89 227



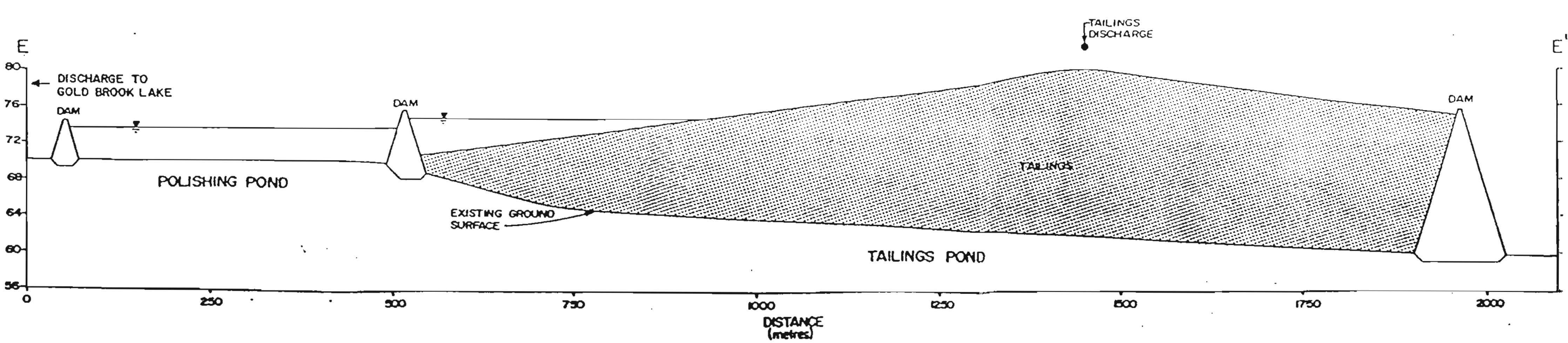
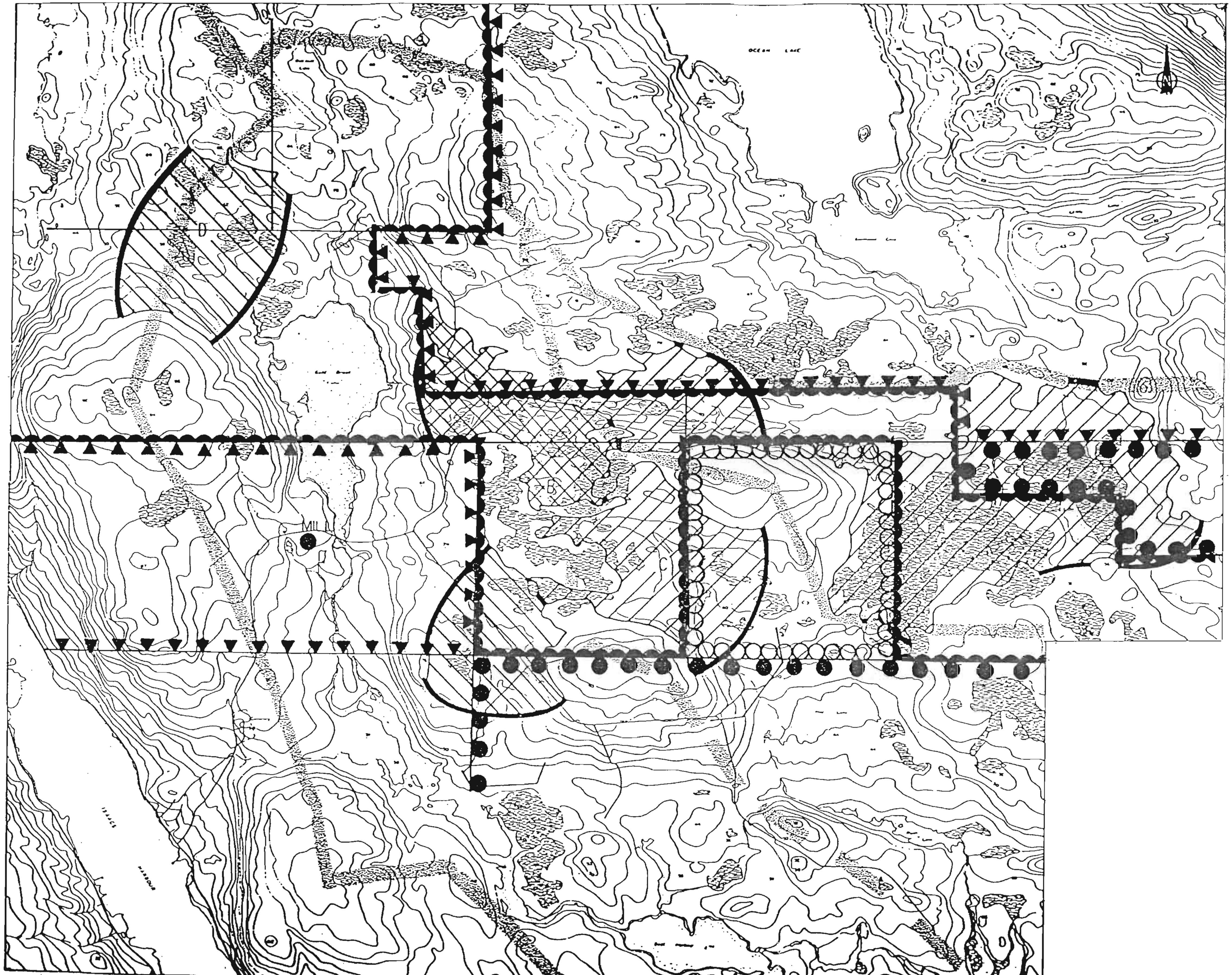


FIGURE 7B
EXPLORATION OREX
GOLDBORO PROJECT
TAILINGS DISPOSAL SITE
AREA 'E' WEST FLOWING, 30 yr. DEV.

NOLAN, DAVIS & ASSOCIATES

Drawn By H.A.T & D.S.P	Checked By G.G.
Date Nov. 1989	Project No. H89227



Giant Meguma

Exploration Orex

Seabright Exploration

Narex

LEGEND

- Road
- Brook/Stream
- Lake
- Swamp/Marsh
- Potential Tailings Dam
- Boundary of Areas A through F
- Possible Location of Polishing Pond
- Watershed Boundary
- Sub-watershed Boundary

Scale 1 : 30,000

FIGURE 8
EXPLORATION OREX
GOLDBORO PROJECT
MINERAL RIGHTS OWNERSHIP

NOLAN, DAVIS & ASSOCIATES

Drawn By H. Trynor	Checked By GG
Date Oct. 1989	Drawing No. H89227-01

TABLE 2

Summary of Site Evaluation Data - First 3 Years of Operation

Disposal Alternative	Dam Vol. for 1st 3 yrs (m)	Tailings Storage Volume (m^3 x 10^6)	Tailing Pond Volume @ 3 yrs (m^3)	Av. Pond Retention @ 3 yrs (days)	Polishing Pond Dam Volume (m^3)	Polishing Pond Storage Volume (m^3)	Polishing Pond Average Retention (days)	Environmental Constraints	Environmental Advantages	Expansion Potential	Comments
Site A	98,400	1.13	69,800	5.1	28,100	65,500	31.7	None	Same watershed	Would require supplementary area	Option eliminated due to high initial cost and limited expansion potential
Site B	35,700	1.52	144,600	19.5	3,000	73,100	29.9	Inundates trout habitat	Same watershed	Would require supplementary area	Lowest cost option but eliminated due to environmental contrraints
Site C	65,600	0.86	131,700	6.4	12,100	114,400	26.6	None	Same watershed (different sub-basin)	Expandable to storage capacity of 9.6 x $10^6 m^3$ tailings	Preferred option
Site E	47,176	1.13	63,300	4.3	2,300	110,300	39.1	Different watershed but discharge could be pumped into Gold Brook Watershed	After 3 years dams would be raised resulting in gravity flow into Gold Brook Watershed	Feasible but expensive	Cost effective for initial option but eliminated due to reliance on pumping effluent and high expansion costs

APPENDIX C

Water Chemistry of Gold Brook Lake by
N.S. Department of Lands & Forests

RESULTS TO : John Underwood, N.S.D.O.E.
Barry Sabean, Lands & Forests

BILL TO : N.S.D.O.E.

NOVA SCOTIA LAKE SURVEY 1985. (Shared by Dept of Lands & Forests and the Dept of Environment)

(All results are expressed in milligrams/liter)

E 985	LAB. NO.	LOCATION	Latitude line	Longitude line	Conductivity (uomh/cm)	pH (Units)	Sodium	Potassium	Calcium	Magnesium	Alkalinity	Sulfate	Chloride	Ortho - Phosphorus (P)	Total Phosphorus (P)	$NO_3 + NO_2$ (N)	NH_3 (N)	Total Nitrogen	O.O.C.	Acidity	METALS (Expressed in UG/L) Al	Fe	Mn	Color (T.C.U.)
24	P7220	Bower Lk. (Yarm. Co.)	44° 07'	65° 47'	32.4	5.99	4.0	.23	1.05	.65	2.3	2.8	6.8	.003	.003	<.01	<.01	.09	0.9	3.5	<10	<7	<3	7.5
ly22	P7221	South Carrying Lake	44° 10'	65° 48'	37.9	4.91	3.8	.25	.90	.64	<.1	3.4	6.7	.004	.004	<.01	.02	.17	8.0	4.4	130	102	10.4	75
ly23	P7222	Middle Carrying Lake	44° 11'	65° 48'	32.4	5.03	3.7	.25	.88	.63	<.1	3.6	6.5	.004	.004	<.01	<.01	.19	5.5	3.6	90	37.5	12.4	30
ly29	P7223	Pearl Lake (Yarm. Co.)	44° 02'	65° 49'	32.4	4.66	3.6	.10	.74	.53	<.1	2.9	6.0	.003	.007	<.01	.01	.28	15.7	8.3	319	184	<3	150
ly30	P7224	Beaverhouse Lake	44° 03'	65° 48'	31.9	5.27	4.1	.15	.90	.66	<.1	3.1	6.5	.003	.005	<.01	<.01	.22	10.2	5.5	187	95.4	<3	70
ly31	P7225	Hamilton Pond	44° 06'	65° 55'	35.6	5.68	4.5	.15	1.15	.94	1.7	3.9	7.2	.002	.003	<.01	.01	.23	6.2	4.9	87	59.8	<3	55
ug 2	P7226	Olson Lake	45° 21'	61° 57'	36.7	5.76	5.4	.32	.83	.64	2.1	2.2	8.7	.003	.005	<.01	<.01	.17	4.7	3.8	22	82.0	97.5	15
ug 6	P7227	Unnamed Lake	45° 22'	61° 57'	22.1	5.98	2.3	.25	1.01	.73	3.3	2.1	3.3	.002	.004	<.01	<.01	.14	3.7	4.2	<10	20.8	<3	15
ug 7	P7228	Sandy Lake	44° 44'	63° 55'	26.5	5.29	2.9	.30	1.19	.45	<.1	3.7	4.5	.002	.003	<.01	<.01	.18	5.6	3.8	146	28.1	<3	25
ug 15	P7229	Taylor Lake	44° 45'	63° 50'	37.8	5.08	4.9	.20	1.10	.49	<.1	4.2	7.8	.003	.003	<.01	<.01	.15	5.0	3.7	92	21.6	<3	20
ug 15	P7230	Schmidt Lake	44° 43'	63° 45'	23.8	4.96	2.3	.23	.90	.41	<.1	4.1	3.2	.003	.003	<.01	<.01	.15	5.3	4.1	103	56.3	13.6	25
ug 13	P7315	Wilson Lk. (Yarm.)	43° 56'	65° 53'	31.9	4.88	3.9	.15	.74	.59	<.1	2.8	6.3	.001	.006	<.01	<.01	.23	11.4	7.6	260	228	13.6	125
ug 14	P7316	Stewart Lk. (Guys.)	45° 22'	60° 55'	22.5	6.02	2.5	.23	.80	.75	3.4	2.1	3.5	<.001	.004	<.01	<.01	.15	3.4	5.7	<10	8.2	<3	10
ug 14	P7317	Bennetts Lk. (Yarm.)	43° 55'	65° 54'	31.9	4.83	3.9	.25	.85	.62	<.1	2.7	6.3	<.001	.006	.01	<.01	.22	11.4	7.7	252	170	<3	100
[illegible]	[illegible]	Seal Harb. ([illegible])	45° 13'	61° 38'	23.2	5.21	2.7	.18	.50	.41	<.1	2.3	3.9	.001	.005	.01	<.01	.17	9.4	7.5	227	153	<3	87.5

APPENDIX D

Water Chemistry Results for Samples Collected by Orex

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: January to June (included) 1989 — Type of sample: Liquid

Station: G-1 (Effluent of mine water pond) — Incidence of sampling: Normal

MONTH	Number of Samples	Arsenic Average (mg/L)	Arsenic MAM Limit (0.5 mg/L)	Susp.Solids Average (mg/L)	Susp.Solids MAM Limit (25 mg/L)	pH Average (in units)	pH MAM Limit (6.5<pH<9.0)
January	26	0.106		3.6		7.4	
February	16	0.121		1.8		7.4	
March	24	0.202		2.2		7.2	
April	16	0.253		2.1		7.6	
May	15	0.235		4.5		7.3	
June	8	0.223		1.6		7.6	
July							
August							
September							
October							
November							
December							
Average for period		0.190	-0.310	2.6	-22.4	7.4	Within Lim.

N.B. (-) means below Monthly Arithmetic Mean (MAM) Limit - MAM applies to mining effluents

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: January to May (included) 1989 — Type of sample: Liquid

Station: G-4 (Outlet of Gold Brook Lake at road) — Incidence of sampling: Normal

MONTH	Number of Samples	Arsenic Average (mg/L)	MAM Limit (0.5 mg/L)	Susp.Solids Average (mg/L)	MAM Limit (25 mg/L)	pH Average (in units)	MAM Limit (6.5<pH<9.0)
January	26	0.000		0.9		4.8	
February	16	0.002		1.1		5.0	
March	24	0.000		1.1		4.8	
April	16	0.000		1.7		5.2	
May	15	0.007	(*)	2.7		5.0	
June							
July							
August							
September							
October							
November							
December							
Average for period		0.002	-0.498	1.5	-23.5	5.0	Too low

N.B. (-) means below Monthly Arithmetic Mean (MAM) Limit - MAM applies to mining effluents
(*) Change in sampling spot may receive influence from old tailings
Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: January to September (included) 1989 — Type of sample: Liquid

Station: G-1 (Effluent of mine water pond) — Incidence of sampling: Special

PARAMETER to DETERMINE	LIMIT (MINING EFF) (mg/L unless spec.)		MAM	MAM	MAM	MAM	MAM	MAM
	Grab	MAM	January	February	March	April	May	June
Ammonia (N)	2.4	1.2	0.615	0.255	0.000	0.000	0.000	0.000
Arsenic	1.0	0.5	0.130	0.120	0.180	0.250	0.295	0.223
Iron	7.0	3.5	0.430	0.170	0.267	0.110	0.810	0.163
Lead - HGA	0.4	0.2	0.000	0.000	0.000	0.000	0.001	0.001
Copper	0.6	0.3	0.000	0.000	0.000	0.005	0.000	0.000
Zinc	1.0	0.5	0.008	0.015	0.020	0.008	0.000	0.008
Suspended Solids	50.0	25.0	2.875	13.300	1.733	1.600	5.600	1.500
pH (in Units)		6.5 - 9.0	7.375	7.250	7.433	7.150	7.050	7.700
Total Org. Carbon			3.775	2.900	9.100	3.575	7.650	3.975
Aluminum			0.075	0.040	0.093	0.128	0.065	0.015
Nickel	1.0	0.5	0.000	0.000	0.000	0.000	0.000	0.000
Mercury			0.000	0.000	0.000	0.000	0.000	0.000
Oil and Grease			0.000	0.000			11.900	

MAM means Monthly Arithmetic Mean

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: January to September (included) 1989

Station: G-1 (Effluent of mine water pond)

PARAMETER to DETERMINE	LIMIT (MINING EFF) (mg/L unless spec.)		MAM	MAM	MAM	MAM	MAM	MAM	Average for Period
	Grab	MAM	July	Auygust	September	October	November	December	
Ammonia (N)	2.4	1.2	0.000	0.000	0.000				0.097
Arsenic	1.0	0.5	0.365	0.440	0.355				0.262
Iron	7.0	3.5	0.380	0.180	0.098				0.272
Lead - HGA	0.4	0.2	0.000	0.381	0.003				0.043
Copper	0.6	0.3	0.000	0.000	0.000				0.001
Zinc	1.0	0.5	0.025	0.006	0.000				0.010
Suspended Solids	50.0	25.0	4.725	2.620	0.625				3.842
pH (in Units)		6.5 - 9.0	7.075	6.820	7.600				7.273
Total Org. Carbon			5.650	5.880	6.700				5.679
Aluminum			0.018	0.010	0.013				0.051
Nickel	1.0	0.5	0.000	0.000	0.000				0.000
Mercury			0.000	0.000	0.000				0.000
Oil and Grease									3.967

MAM means Monthly Arithmetic Mean

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: January to September (included) 1989 — Type of sample: Liquid

Station: G-4 (Outlet of Gold Brook Lake at road) — Incidence of sampling: Special

PARAMETER to DETERMINE	LIMIT (MINING EFF) (mg/L unless spec.)		MAM	MAM	MAM	MAM	MAM	MAM
	Grab	MAM	January	February	March	April	May	June
Ammonia (N)	2.4	1.2	0.000	0.000	0.000	0.000	0.000	0.000
Arsenic	1.0	0.5	0.002	0.000	0.000	0.000	0.005	0.010
Iron	7.0	3.5	0.315	0.210	0.197	0.145	0.183	0.238
Lead - HGA	0.4	0.2	0.000	0.000	0.000	0.000	0.000	0.001
Copper	0.6	0.3	0.000	0.000	0.000	0.005	0.000	0.000
Zinc	1.0	0.5	0.000	0.000	0.007	0.000	0.000	0.000
Suspended Solids	50.0	25.0	0.825	1.400	1.467	2.375	1.700	1.400
pH (in Units)		6.5 - 9.0	4.700	4.750	4.800	4.875	4.950	4.950
Total Org. Carbon			10.875	12.900	7.700	5.100	6.275	7.600
Aluminum			0.275	0.235	0.200	0.245	0.170	0.223
Nickel	1.0	0.5	0.000	0.000	0.000	0.000	0.000	0.000
Mercury			0.000	0.000	0.000	0.000	0.000	0.000
Oil and Grease			0.000	0.000			12.000	

MAM means Monthly Arithmetic Mean

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: January to September (included) 1989

Station: G-4 (Outlet of Gold Brook Lake at road)

PARAMETER to DETERMINE	LIMIT (MINING EFF) (mg/L unless spec.) Grab	MAM	MAM July	MAM Auygust	MAM September	MAM October	MAM November	MAM December	Average for Period
Ammonia (N)	2.4	1.2	0.000	0.000	0.000				0.000
Arsenic	1.0	0.5	0.011	0.026	0.032				0.010
Iron	7.0	3.5	0.213	0.184	0.260				0.204
Lead - HGA	0.4	0.2	0.000	0.001	0.003				0.001
Copper	0.6	0.3	0.000	0.000	0.000				0.001
Zinc	1.0	0.5	0.000	0.000	0.000				0.001
Suspended Solids	50.0	25.0	1.700	2.400	2.875				1.794
pH (in Units)		6.5 - 9.0	4.575	4.300	4.900				4.756
Total Org. Carbon			7.625	8.360	9.950				8.189
Aluminum			0.220	0.206	0.243				0.224
Nickel	1.0	0.5	0.000	0.000	0.000				0.000
Mercury			0.000	0.000	0.000				0.000
Oil and Grease									4.000

MAM means Monthly Arithmetic Mean

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: May to September (included) 1989 | Type of sample: Liquid

Station: G-5 (Gold Brook Riv. at mine water effl.) | Incidence of sampling: Special

PARAMETER to DETERMINE	LIMIT (MINING EFF) (mg/L unless spec.) Grab	MAM	MAM January	MAM February	MAM March	MAM April	MAM May	MAM June
Ammonia (N)	2.4	1.2					0.000	0.000
Arsenic	1.0	0.5					0.003	0.103
Iron	7.0	3.5					0.215	0.240
Lead - HGA	0.4	0.2					0.000	0.001
Copper	0.6	0.3					0.000	0.000
Zinc	1.0	0.5					0.000	0.000
Suspended Solids	50.0	25.0					2.000	0.700
pH (in Units)		6.5 - 9.0					4.900	6.875
Total Org. Carbon							3.600	7.225
Aluminum							0.195	0.153
Nickel	1.0	0.5					0.000	0.000
Mercury							0.000	0.000
Oil and Grease								

MAM means Monthly Arithmetic Mean

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

SUMMARY OF ANALYTICAL RESULTS FOR THE GOLDBORO PROJECT

Sampling period: May to September (included) 1989

Station: G-5 (Gold Brook Riv. at mine water effl.)

PARAMETER to DETERMINE	LIMIT (MINING EFF) (mg/L unless spec.) Grab	MAM	MAM July	MAM Auygust	MAM September	MAM October	MAM November	MAM December	Average for Period
Ammonia (N)	2.4	1.2	0.000	0.000	0.000				0.000
Arsenic	1.0	0.5	0.038	0.090	0.073				0.061
Iron	7.0	3.5	0.210	0.210	0.260				0.227
Lead - HGA	0.4	0.2	0.001	0.001	0.004				0.001
Copper	0.6	0.3	0.000	0.000	0.000				0.000
Zinc	1.0	0.5	0.000	0.000	0.000				0.000
Suspended Solids	50.0	25.0	1.675	2.380	3.000				1.951
pH (in Units)		6.5 - 9.0	5.900	6.060	6.600				6.067
Total Org. Carbon			8.050	8.060	9.950				7.377
Aluminum			0.188	0.162	0.203				0.180
Nickel	1.0	0.5	0.000	0.000	0.000				0.000
Mercury			0.000	0.000	0.000				0.000
Oil and Grease									

MAM means Monthly Arithmetic Mean

Compiled & verified by: Guy Duchesne, St-Michel Geoconseil Inc.

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

Final Effluent (00-G-1) September 1988

DAY	NH3 (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Zn (mg/L)	Org. C (mg/L)	Al (mg/L)	Ni (mg/L)	Hg (µg/L)	Oil/Gr. (mg/L)	As (mg/L)	Susp. Sol. (mg/L)	pH
7	<0.05	0.35	<0.002	<0.01	<0.01	11.1	0.34	<0.02	<0.05		<0.005	1.6	5.9
8											0.02	1.6	5.7
9											0.02	2	5.7
12	0.1	2.7	<0.002	<0.01	<0.01	7.2	0.24	<0.02	<0.05		0.31	16.4	7.1
13											0.29	1	7.3
14											0.29	3	7.4
15											0.29	1	7.5
16											0.31	4	7.3
19	0.87	1.8	<0.002	<0.01	<0.01	6.3	0.2	<0.02	<0.05	1	0.19	9	7.3
20											0.19	2	7.5
21											0.21	2	7.4
22											0.17	2	7.4
23											0.19	2	7.1
26	0.93	1.7	<0.002	<0.01	<0.01	8.2	0.25	<0.02	<0.05	1	0.26	4	7.3
27											0.14	6	6.9
28											0.2	4	7.1
29											0.19	6	7.2
30											0.15	2	7.1
AVG	0.479	1.64	<0.002	<0.01	<0.01	8.2	0.26	<0.02	<0.05	1	0.19	3.87	7.2
MAX	0.93	2.7	<0.002	<0.01	<0.01	11.1	0.34	<0.02	<0.05	1	0.31	16.4	7.5
MIN	<0.05	0.35	<0.002	<0.01	<0.01	6.3	0.2	<0.02	<0.05	1	<0.005	1	5.7
MGS	2.4	7	0.4	0.6	1			1	0.2	1	1	50	5
MAM	1.2	3.5	0.2	0.3	0.5			0.5	0.1	1	0.5	25	

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

NOTE: For days 7, 8 and 9, there probably was an error in sample identification with 00-G-4, which would explain lower pH values.

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

Final Effluent (00-G-1), October 1988

DAY	NH3 (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Zn (mg/L)	Org. C (mg/L)	Al (mg/L)	Ni (mg/L)	Hg (µg/L)	Oil/Gr. (mg/L)	As (mg/L)	Susp. Sol. (mg/L)	pH
3	1.9	2.1	<0.002	<0.01	<0.01	5.8	0.13	<0.02	<0.05	1	1.9	6	7.4
4											0.04	8	7.2
5											0.09	2	7.3
6											0.16	26	7.2
7											0.17	2	7.5
11											0.11	2	7.6
12											0.15	2	7.7
13											0.13	2	7.9
14											0.15	4	7.6
17	1.5	3.1	<0.002	<0.01	<0.01	5.4	0.16	<0.02	<0.05		0.14	5.5	7.7
MGS	2.4	7	0.4	0.6	1			1	0.2	1	1	50	5
MAM	1.2	3.5	0.2	0.3	0.5			0.5	0.1	1	0.5	25	

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

September and October 1988

East tailings (00-G-2)

DATE	As (mg/L)	Susp. Sol. (mg/L)	pH
09-20	2.5	2	6.3
10-12	1.2	2	6.4
MGS MAM	1 0.5	50 25	5

West tailings (00-G-3)

DATE	As (mg/L)	Susp. Sol. (mg/L)	pH
09-20	0.16	6	6
10-12	0.07	<2.0	5.6
MGS MAM	1 0.5	50 25	5

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

Lake Gold Brook (00-G-4) September 1988

DAY	NH3 (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Zn (mg/L)	Org. C (mg/L)	Al (mg/L)	Ni (mg/L)	Hg (µg/L)	Oil/Gr. (mg/L)	As (mg/L)	Susp. Sol. (mg/L)	pH
7	<0.05	3.9	<0.002	<0.01	<0.01	8.4	0.19	<0.02	<0.05		0.31	7.2	7
8											0.29	7.6	7
9											0.22	7.2	7.1
12											0.06	6.8	5.9
13											0.02	1	5.5
14											0.02	2	5.6
15											0.01	2	5.5
16											0.03	6	5.4
19	<0.05	0.32	<0.002	<0.01	<0.01	9.8	0.29	<0.02	<0.05		0.01	1	5.4
20											0.009	2	5.8
21											0.02	2	5.2
22											0.009	2	5.3
23											0.01	2	5
26	<0.05	0.38	<0.002	<0.01	<0.01	10	0.35	<0.02			0.02	2	5.1
27											0.008	2	5.4
28											0.007	2	5
29											0.04	2	5
30											<0.005	2	5.2
AVG	<0.05	1.53	<0.002	<0.01	<0.01	9.4	0.28	<0.02	<0.05		0.061	3.27	6.31
MAX	<0.05	3.9	<0.002	<0.01	<0.01	10	0.35	<0.02	<0.05		0.31	7.6	7.1
MIN	<0.05	0.32	<0.002	<0.01	<0.01	8.4	0.19	<0.02	<0.05		<0.005	1	5
MGS	2.4	7	0.4	0.6	1			1	0.2	1	1	50	5
MAM	1.2	3.5	0.2	0.3	0.5			0.5	0.1	1	0.5	25	

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

NOTE: For days 7, 8 and 9, there probably was an error in sample identification with 00-G-1, which would explain higher pH values.

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

Lake Gold Brook (00-G-4), October 1988

DAY	NH3 (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Zn (mg/L)	Org. C (mg/L)	Al (mg/L)	Ni (mg/L)	Hg (µg/L)	Oil/Gr. (mg/L)	As (mg/L)	Susp. Sol. (mg/L)	pH
3	<0.05	0.36	<0.002	<0.01	<0.01	10.9	0.31	<0.02	0.13	1	0.02	4	5.1
4											0.02	2	5.3
5											0.05	4	5.4
6											0.07	8	5.3
7											<0.005	2	5
11											<0.005	2	5.5
12											0.006	2	5.7
13											0.02	2	5.7
14											<0.005	2	5.1
15											0.009	2.5	5.4
17	<0.05	0.53	<0.002	<0.01	<0.01	12	0.39	<0.02	<0.05	1			
MGS	2.4	7	0.4	0.6	1			1	0.2	1	1	50	5
MAM	1.2	3.5	0.2	0.3	0.5			0.5	0.1	1	0.5	25	

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

Shaft Water, September 1988

DAY	NH3 (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Zn (mg/L)	Org. C (mg/L)	Al (mg/L)	Ni (mg/L)	Hg (µg/L)	Oil/Gr. (mg/L)	As (mg/L)	Susp. Sol. (mg/L)	pH
7	<0.05	7.1	<0.002	<0.01	0.02	5.2	0.15	<0.02	<0.05		0.15	15	6.8
8											0.16	19	6.8
9											0.14	29	6.7
12	1.1	5.2	<0.002	<0.01	<0.01	4.6	0.24	<0.02	<0.05		0.16	11.2	7
13											0.06	12	7.2
14											0.15	3	6.9
15											0.13	10	7
19	1.9	4	<0.002	<0.01	<0.01	4.2	0.21	<0.02	<0.05	1.1	0.15	6	7
20											0.1	2	7.2
22											2.6	350	7.2
26	2.3	8.4	0.022	0.02	0.05	3.8	0.15	<0.02	<0.05	1	0.31	105	6.9
28											0.07	6	6.7
29											0.06	4	6.8
30											0.07	8	6.9
AVG	1.34	6.18	0.007	0.013	0.023	4.45	0.19	<0.02	<0.05	1.05	0.308	41.4	6.97
MAX	2.3	8.4	0.022	0.02	0.05	5.2	0.24	<0.02	<0.05	1.1	2.6	305	7.2
MIN	<0.05	4	<0.002	<0.01	<0.01	3.8	0.15	<0.02	<0.05	1	0.06	2	6.7
MGS	2.4	7	0.4	0.6	1			1	0.2	1	1	50	5
MAM	1.2	3.5	0.2	0.3	0.5			0.5	0.1	1	0.5	25	

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

RESULTS OF WATER ANALYSIS, GOLDBORO PROJECT

Shaft Water, October 1988

DAY	NH3 (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Zn (mg/L)	Org. C. (mg/L)	Al (mg/L)	Ni (mg/L)	Hg (μg/L)	Oil/Gr. (mg/L)	As (mg/L)	Susp. Sol. (mg/L)	pH
3	1.8	5.3	0.008	<0.01	0.02	4.4	0.44	<0.02	0.85	1	0.16	22	7
4											0.05	10	7.2
7											0.22	14	6.9
12											0.09	2	7.4
13											0.1	8	7.3
14											0.11	12	7.4
17	1.6	4.1	0.003	<0.01	<0.01	3.3	0.05	<0.02	<0.05	1.1	0.16	6.5	7.7
MGS	2.4	7	0.4	0.6	1			1	0.2	1	1	50	5
MAM	1.2	3.5	0.2	0.3	0.5			0.5	0.1	1	0.5	25	

MGS: Maximum in a grab sample (Guidelines)
MAM: Monthly arithmetic mean (Guidelines)

WATER SAMPLE OCT 00-01

	A	B	C	D
1	DATE	As(mg/L)	S. Sol (Mg/L)	PH
2	10-1			
3	10-2			
4	10-3	1.9	6	7.4
5	10-4	0.04	8	7.2
6	10-5	0.09	2	7.3
7	10-6	0.16	26	7.2
8	10-7	0.17	2	7.5
9	10-8			
10	10-9			
11	10-10			
12	10-11	0.11	2	7.6
13	10-12	0.13	2	7.7
14	10-13	0.13	2	7.9
15	10-14	0.15	4	7.6
16	10-15			
17	10-16			
18	10-17	0.14	5.5	7.7
19	10-18	0.1	5	7.5
20	10-19	0.1	5.8	7.5
21	10-20	0.12	7.5	7.6
22	10-21	0.14	9	7.5
23	10-22			
24	10-23			
25	10-24	0.15	20	7.5
26	10-25	0.14	9.5	7.4
27	10-26	0.14	8.5	7.4
28	10-27	0.13	11	7.6
29	10-28	0.16	9	7.4
30	10-29	0.12	73.5	7.2
31	10-30	0.13	10	7.4
32	10-31	0.15	6.5	7.2
33	AVERAGE	0.209	10.72	7.53
34	MAXIMUM	1.9	73.5	7.9
35	MINIMUM	0.04	2	7.2

WATER SAMP OCT 00-G1-W

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	IRON	LEAD	Cu	Zn	ORG. C	Al	Ni	Hg	oil/Gr
2	10-1										
3	10-2										
4	10-3	1.9	2.1	0.002	0.01	0.01	5.8	0.13	0.02	0.05	1
5	10-4										
6	10-5										
7	10-6										
8	10-7										
9	10-8										
10	10-9										
11	10-10										
12	10-11										
13	10-12										
14	10-13										
15	10-14										
16	10-15										
17	10-16										
18	10-17	1.5	3.1	0.002	0.01	0.01	5.4	0.16	0.02	0.05	
19	10-18										
20	10-19										
21	10-20										
22	10-21										
23	10-22										
24	10-23										
25	10-24	0.69	4.9	0.002	0.01	0.03	8	0.1	0.02	0.05	
26	10-25										
27	10-26										
28	10-27										
29	10-28										
30	10-29										
31	10-30										
32	10-31									0.05	
33	AVG	1.363	3.367	0.002	0.01	0.017	6.4	0.13	0.02	0.05	1
34	MAX	1.9	4.9	0.002	0.01	0.03	8	0.16	0.02	0.05	1
35	MIN	0.69	2.1	0.002	0.01	0.01	5.4	0.1	0.02	0.05	1

	A	B	C	D	E
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH	
2	1	0.16	8	7.4	
3	2	0.17	7.5	7.4	
4	3	0.18	8.5	7.4	
5	4	0.15	6	7.6	
6	5	0.15	5.5	7.7	
7	6	0.15	7.5	7.6	
8	7	0.15	10	7.4	
9	8	0.14	9.5	7.5	
10	9	0.14	8.8	7.5	
11	10	0.15	12	7.3	
12	11	0.14	10	7.4	
13	12	0.17	10	7.3	
14	13	0.16	11	7.3	
15	14	0.16	9.5	7.4	
16	15	0.15	7	7.5	
17	16	0.17	10	7.5	
18	17	0.12	6	7.5	
19	18	0.13	8	7.5	
20	19	0.12	6	7.5	
21	20	0.12	6	7.7	
22	21	0.12	8	7.6	
23	22	0.09	5.5	7.3	
24	23	0.1	6.5	7.4	
25	24	0.1	8	7.5	
26	25	0.1	7.5	7.6	
27	26	0.1	5.5	7.7	
28	27	0.1	7.5	7.8	
29	28	0.09	6.5	7.6	
30	29				
31	30	0.1	4.5	7.5	
32	31				
33	AVERAGE	0.1555	8.74	7.51	
34	MAXIMUM	0.18	12	7.7	
35	MINIMUM	0.12	5.5	7.3	
36					

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
2	1										
3	2										
4	3										
5	4										
6	5										
7	6										
8	7	0.8	3.7	0.003	0.01	0.01	25	0.43	0.02	0.05	1
9	8										
10	9										
11	10										
12	11										
13	12										
14	13										
15	14										
16	15	0.9	4.1	0.004	0.01	0.02	3.7	0.47	0.02	0.05	1
17	16										
18	17										
19	18										
20	19										
21	20										
22	21	0.93	2.1	0.005	0.01	0.01	4.4	0.36	0.02	0.05	1
23	22										
24	23										
25	24										
26	25										
27	26										
28	27										
29	28	1.1	1.3	0.002	0.01	0.01	3.9	0.13	0.02	0.05	1
30	29										
31	30										
32	31										
33	AVG	0.933	2.8	0.004	0.01	0.013	9.25	0.348	0.02	0.05	1
34	MAX	1.1	4.1	0.005	0.01	0.02	25	0.47	0.02	0.05	1
35	MIN	0.8	1.3	0.002	0.01	0.01	3.7	0.13	0.02	0.05	1

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.09	5	7.5
3	2	0.08	5.5	7.4
4	3	0.08	7	7.3
5	4	0.08	7	7.4
6	5	0.08	1.5	7.4
7	6	0.11	5.5	7.4
8	7	0.07	1.5	7.5
9	8	0.06	1.5	7.3
10	9	0.06	2.3	7.3
11	10	0.06	3	7.3
12	11	0.06	4	7.2
13	12	0.06	3.8	7.6
14	13	0.07	6	7.3
15	14	0.07	6.5	7.3
16	15	0.07	5.8	7.4
17	16	0.05	3.5	7.7
18	17	0.05	2.3	7.4
19	18	0.05	3	7.4
20	19	0.05	4	7.8
21	20	0.05	3	7.5
22	21	0.06	3.5	7.4
23	22	0.07	4.3	7.5
24	23	0.08	4	7.5
25	24	0.09	4.3	7.5
26	25	0.08	4.5	7.6
27	26	0.09	4.8	7.8
28	27	0.09	3.8	7.7
29	28	0.06	4.5	7.4
30	29	0.08	4.3	7.4
31	30	0.08	4	7.5
32	31	0.08	2.8	7.5
33	AVERAGE	0.071	4.1	7.48
34	MAXIMUM	0.11	7	7.7
35	MINIMUM	0.05	1.5	7.2

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
2	1										
3	2										
4	3										
5	4										
6	5										
7	6	1.2	1.1	0.002	0.01	0.02	5.3	0.2	0.02	0.05	
8	7										
9	8										
10	9										
11	10										
12	11										
13	12	1.3	0.53	0.002	0.01	0.01	3.6	0.11	0.02	0.05	1
14	13										
15	14										
16	15										
17	16										
18	17										
19	18										
20	19	1.3	0.31	0.002	0.01	0.01	2.8	0.06	0.02	0.05	1
21	20										
22	21										
23	22										
24	23										
25	24										
26	25										
27	26	1.1	0.58	0.002	0.01	0.01	3.7	0.16	0.02	0.65	1
28	27										
29	28										
30	29										
31	30										
32	31										
33	AVG	1.225	0.63	0.002	0.01	0.013	3.85	0.133	0.02	0.2	1
34	MAX	1.3	1.1	0.002	0.01	0.02	5.3	0.2	0.02	0.65	1
35	MIN	1.1	0.31	0.002	0.01	0.01	2.8	0.06	0.02	0.05	1

WATER SAMP JAN 00-G-1 DAILY

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1	0.09	3.3	7.5
2	0.1	3	7.5
3	0.07	2.8	7.5
4	0.06	2.8	7.5
5	0.09	9.2	7.5
6	0.09	8	7.3
7	0.09	3.6	7.3
8	0.09	4	7.3
9			
10	0.11	2.4	7.4
11	0.13	4.8	7.5
12	0.1	4	7.5
13	0.13	3.2	7.5
14	0.13	2.4	7.6
15	0.13	2.8	7.4
16	0.1	3	7.2
17	0.1	5	7.1
18	0.12	3.5	7.3
19	0.11	3.5	7.3
20	0.11	3.5	7.3
21	0.12	3.5	7.3
22	0.12	2.8	7.3
23	0.12	3.5	7.4
24	0.13	3.3	7.4
25	0.12	2.5	7.2
26	0.1	3.3	7.3
27	0.1	2.5	7.4
28	0.11	2.3	7.5
29	0.1	2	7.7
30	0.2	2	7.4
31	0.1	1.8	7.6
AVERAGE	0.109	3.48	7.4
MAXIMUM	0.2	9.2	7.6
MINIMUM	0.06	1.8	7.2

WATER SAMP JAN 00-G-1 WEKLY

DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
1										
2	1	0.46	0.002	0.01	0.01	4.3	0.14	0.02	0.05	1
3										
4										
5										
6										
7										
8										
9									0.05	
10										
11										
12										
13										
14										
15										
16	0.43	0.39	0.002	0.01	0.01	4	0.06	0.02	0.05	1
17										
18										
19										
20										
21										
22										
23	0.53	0.73	0.002	0.01	0.01	4.2	0.1	0.02	0.05	1
24										
25										
26										
27										
28										
29										
30	0.5	0.15	0.002	0.01	0.01	2.6	0.05	0.02	0.05	1
31										
AVG	0.615	0.43	0.002	0.01	0.01	3.78	0.088	0.02	0.05	1
MAX	1	0.73	0.002	0.01	0.01	4.3	0.14	0.02	0.05	1
MIN	0.43	0.15	0.002	0.01	0.01	2.6	0.05	0.02	0.05	1

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1	0.11	2	7.5
2	0.09	2.3	7.5
3	0.11	2	7.5
4	0.09	2.3	7.4
5	0.09	1.8	7.5
6	0.09	2.6	7.3
7	0.1	2	7.6
8	0.11	1.8	7.5
9	0.12	2.3	7.5
10	0.1	1.8	7.6
11	0.12	1	7.4
12	0.12	2.5	7.3
13	0.15	24	7.2
14	0.14	2	7
15	0.14	1.2	7.1
16	0.18	1.6	7.3
17	0.14	1.2	7.2
18	0.17	1.6	7.3
19			7.3
20			7.4
21			7.25
22			7.25
23			7.3
24			7.2
25			7.35
26			7.25
27			7.3
28			7.4
29			
30			
31			
AVERAGE	0.12	3.11	7.37
MAXIMUM	0.18	24	7.6
MINIMUM	0.09	1.2	7

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1			
2			
3			
4			
5	0.23	1.2	7.4
6	0.25	1.2	7.5
7	0.26	2.4	7.3
8	0.27	2	7.2
9	0.27	1.2	7.2
10	0.27	1.6	7.2
11	0.27	2.4	7.3
12	0.13	1.2	7.1
13	0.14	1.6	7.6
14	0.14	2	7.2
15	0.13	1.6	7.1
16	0.14	1.6	7
17	0.14	2	7.1
18	0.15	2.4	7
19	0.17	2.8	6.8
20	0.15	2.4	7.2
21	0.23	0.8	7.7
22	0.14	2	7.2
23	0.15	6.8	6.9
24	0.13	2	7.1
25	0.14	2.4	7
26	0.15	2.8	7.4
27	0.28	2	6.9
28	0.3	3.2	7
29	0.22	2.4	7.2
30	0.22	2	7.2
31	0.28	2	7.2
AVERAGE	0.2	2.15	7.19
MAXIMUM	0.3	6.8	7.7
MINIMUM	0.13	0.8	6.8

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1	0.28	2	7
2	0.29	2	7
3	0.23	1.6	7.1
4	0.28	2	7
5	0.33	2.4	7.1
6	0.28	2.2	7.1
7	0.26	2.4	7.2
8	0.3	2	7.4
9	0.25	1.8	7.1
10	0.27	1.3	7
11	0.81	2.3	7.3
12	0.32	1.3	7.2
13	0.24	1.8	7.1
14	0.23	1.3	7.3
15	0.3	1.6	7.4
16	0.26	0.4	7.8
17	0.25	1.5	7.1
18	[illegible]	[illegible]	7.5
19	0.24	1.5	7.2
20	0.15	1.6	8.1
21	0.37	1.6	7.3
22	0.25	1.6	7.2
23	0.25	1	7.4
24	0.25	0.8	7.1
25	0.14	0.8	7.3
26	0.15	1.2	7
27	0.24	0.4	7.5
28	0.27	1.6	9.4
29	0.24	4.8	9.2
30	0.25	5.5	9.2
31			
AVERAGE	0.29	1.83	8.3
MAXIMUM	0.81	5.5	9.4
MINIMUM	0.14	0.4	7

WATER SAMPS MAY 00-G-1 WEEKLY

DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr
1										
2										
3										
4										
5										
6										
7										
8	0.05	0.62	0.002	0.01	0.01	7.7	0.05	0.02	0.05	
9										
10										
11										
12										
13										
14										
15	0.05	1	0.002	0.01	0.01	7.6	0.08	0.02	0.05	
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
AVG										
MAX										
MIN										

Jun

WATER SAMPLES [illegible] 00-G-1

DATE	NH3	AS	Fe	Pb	Cu	Zn	S. SOL	pH	ORG. C	Al	Ni	Hg	Oil/Gr.
1													
2													
3													
4													
5													
6													
7													
8													
9	0.05	0.22	0.05	0.002	0.01	0.01	0.8	7.7	2.9	0.05	0.02	0.05	
10		0.22					2.4	7.6					
11		0.25					3.2	7.7					
12		0.22					0.4	7.6					
13		0.22					0.8	7.7					
14		0.22					0.1	7.6					
15		0.21					0.8	7.8					
16	0.05	0.2	0.09	0.002	0.01	0.01	0.8	7.6	3.4	0.05	0.02	0.05	
17		0.2					1.5	7.6					
18		0.24					3.6	7.4					
19													
20													
21	0.05	0.22	0.26	0.002	0.01	0.01	2.8	7.9	4.9	0.06	0.02	0.05	
22													
23													
24													
25													
26													
27													
28	0.05	0.25	0.25	0.002	0.01	0.02	1.6	7.6	4.7	0.05	0.02	0.05	
29													
30													
31													
AVG	0.05	0.22	0.163	0.002	0.01	0.013	1.6	7.7	3.975	0.053	0.02	0.05	
MAX	0.05	0.25	0.26	0.002	0.01	0.02	3.6	7.7	4.9	0.06	0.02	0.05	
MIN	0.05	0.2	0.05	0.002	0.01	0.01	0.4	7.4	2.9	0.05	0.02	0.05	

WATER SAMPLE OCT 00-G2

	A	B	C	D
1	DATE	As(mg/L)	S. Sol (Mg/L)	PH
2	10-1			
3	10-2			
4	10-3			
5	10-4			
6	10-5			
7	10-6			
8	10-7			
9	10-8			
10	10-9			
11	10-10			
12	10-11			
13	10-12			
14	10-13			
15	10-14			
16	10-15			
17	10-16			
18	10-17			
19	10-18			
20	10-19			
21	10-20			
22	10-21	0.95	4.5	6
23	10-22			
24	10-23			
25	10-24			
26	10-25			
27	10-26			
28	10-27			
29	10-28			
30	10-29	0.04	30	5.5
31	10-30	0.13	48	5.4
32	10-31	0.96	4.5	6
33	AVERAGE	0.52	21.75	5.8
34	MAXIMUM	0.96	48	6
35	MINIMUM	0.04	4.5	5.4

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.85	3	5.9
3	2	0.91	4.5	6
4	3	0.61	3.5	5.7
5	4	0.8	3	6.1
6	5	0.08	6.5	6.7
7	6	0.04	3	6.6
8	7	0.96	4	5.7
9	8	0.73	4	5.9
10	9	0.81	5.5	6
11	10	0.76	3.8	5.9
12	11	0.96	5.5	6
13	12	0.56	4.5	5.9
14	13	0.62	4.5	6
15	14	0.66	5.5	4.9
16	15	0.59	1	5.8
17	16	0.55	2	5.7
18	17	0.54	3	5.9
19	18	0.42	4	5.7
20	19	0.05	6	5.6
21	20	0.39	1	6.1
22	21	0.39	4	5.3
23	22	0.36	2	5.4
24	23	0.33	2	5.4
25	24	0.91	4.5	5.7
26	25	0.51	2	5.7
27	26	0.26	2	5.3
28	27	0.31	4.5	5.5
29	28			
30	29			
31	30			
32	31			
33	AVERAGE	0.61	4.09	6.06
34	MAXIMUM	0.96	6.5	6.7
35	MINIMUM	0.04	1	4.9

WATER SAMP NOVEMBER 00-G-2-W

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
2	1										
3	2										
4	3										
5	4										
6	5										
7	6										
8	7	0.05	0.98	0.005	0.01	0.01	11	0.38	0.02	0.05	1
9	8										
10	9										
11	10										
12	11										
13	12										
14	13										
15	14										
16	15	0.05	1.2	0.002	0.01	0.02	6.7	0.25	0.02	0.05	1
17	16										
18	17										
19	18										
20	19										
21	20										
22	21	0.05	0.72	0.002	0.01	0.02	9	0.41	0.02	0.05	1
23	22										
24	23										
25	24										
26	25										
27	26										
28	27										
29	28	0.05	0.64	0.002	0.01	0.02	4.2	0.11	0.02	0.5	1
30	29										
31	30										
32	31										
33	AVG	0.05	0.885	0.003	0.01	0.018	7.725	0.288	0.02	0.163	1
34	MAX	0.05	1.2	0.005	0.01	0.02	11	0.41	0.02	0.5	1
35	MIN	0.05	0.64	0.002	0.01	0.01	4.2	0.11	0.02	0.05	1

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.33	1.5	5.1
3	2	0.34	2	5.3
4	3	0.54	7.5	5.3
5	4	0.2	3	5.1
6	5	0.63	7.5	5.5
7	6	0.92	4.5	5.6
8	7	1.7	4	5.8
9	8	6.4	4.5	5.9
10	9	LOCATION FROZEN		
11	10			
12	11			
13	12			
14	13			
15	14			
16	15			
17	16			
18	17			
19	18			
20	19			
21	20			
22	21			
23	22			
24	23			
25	24			
26	25			
27	26			
28	27			
29	28			
30	29			
31	30			
32	31			
33	AVERAGE	1.41	4.31	5.54
34	MAXIMUM	6.4	7.5	5.9
35	MINIMUM	0.2	1.5	5.1

WATER SAMPLE OCT 00-03

	A	B	C	D
1	DATE	As(mg/L)	S. Sol.(Mg/L)	PH
2	10-1			
3	10-2			
4	10-3			
5	10-4			
6	10-5			
7	10-6			
8	10-7			
9	10-8			
10	10-9			
11	10-10			
12	10-11			
13	10-12			
14	10-13			
15	10-14			
16	10-15			
17	10-16			
18	10-17			
19	10-18			
20	10-19			
21	10-20			
22	10-21	0.06	2	5.4
23	10-22			
24	10-23			
25	10-24			
26	10-25			
27	10-26			
28	10-27			
29	10-28			
30	10-29	0.03	70	4.2
31	10-30	1.3	7	6.3
32	10-31	0.06	3.5	5.8
33	AVERAGE	0.3625	20.63	6.46
34	MAXIMUM	1.3	70	6.3
35	MINIMUM	0.03	2	4.2

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.05	1.5	5.8
3	2	0.05	3	5.8
4	3	0.05	2.5	5
5	4	0.05	1	5.5
6	5	0.05	0.5	5.9
7	6	0.04	2	5.5
8	7	0.05	1.5	5.1
9	8	0.05	1.8	5.3
10	9	0.05	2.3	5.6
11	10	0.05	2	5.6
12	11	0.06	3.5	5.6
13	12	0.05	2.5	5.5
14	13	0.05	0.5	5.8
15	14	0.09	4.5	5.8
16	15	0.04	0.5	5.5
17	16	0.05	1	5.3
18	17	0.04	2.3	5.9
19	18	0.06	2	5.3
20	19	0.04	2	5.3
21	20	0.04	2	5.7
22	21	0.06	4	5
23	22	0.05	1.5	5.1
24	23	0.04	2	5.4
25	24	0.04	2	5.7
26	25	0.04	1	5.8
27	26	0.04	2	5.8
28	27	0.04	1.5	5.9
29	28			
30	29			
31	30			
32	31			
33	AVERAGE	0.051	2.04	5.6
34	MAXIMUM	0.09	4.5	5.9
35	MINIMUM	0.04	0.5	5

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
2	1										
3	2										
4	3										
5	4										
6	5										
7	6										
8	7	0.88	1.1	0.002	0.01	0.02	13	0.46	0.02	0.05	1
9	8										
10	9										
11	10										
12	11										
13	12										
14	13										
15	14										
16	15	0.63	0.88	0.002	0.01	0.01	9.6	0.32	0.02	0.05	1
17	16										
18	17										
19	18										
20	19										
21	20										
22	21	1.1	0.65	0.002	0.01	0.02	11	0.45	0.02	0.05	1
23	22										
24	23										
25	24										
26	25										
27	26										
28	27										
29	28	0.25	0.67	0.002	0.01	0.01	7	0.19	0.02	0.05	1
30	29										
31	30										
32	31										
33	AVG	0.715	0.825	0.002	0.01	0.015	10.15	0.35	0.02	0.05	1
34	MAX	1.1	1.1	0.002	0.01	0.02	13	0.46	0.02	0.05	1
35	MIN	0.25	0.65	0.002	0.01	0.01	7	0.19	0.02	0.05	1

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.06	6	5.2
3	2	0.04	1.5	5.2
4	3	0.04	2	5.5
5	4	0.03	2	6.4
6	5	0.03	3	5.8
7	6	0.04	1.5	6
8	7	0.03	2	6.1
9	8	0.02	11.5	5.9
10	9	0.03	1.8	6.2
11	10	0.02	1.5	6
12	11	0.02	2	6
13	12	LOCATION FROZEN		
14	13			
15	14			
16	15			
17	16			
18	17			
19	18			
20	19			
21	20			
22	21			
23	22			
24	23			
25	24			
26	25			
27	26			
28	27			
29	28			
30	29			
31	30			
32	31			
33	AVERAGE	0.033	3.16	5.98
34	MAXIMUM	0.06	11.5	6.4
35	MINIMUM	0.02	1.5	5.2

WATER SAMPLE OCT 00-G4

	A	B	C	D
1	DATE	As(mg/L)	S. Sol.(Mg/L)	PH
2	10-1			
3	10-2			
4	10-3	0.02	4	5.1
5	10-4	0.02	2	5.3
6	10-5	0.05	4	5.4
7	10-6	0.07	8	5.3
8	10-7	0.005	2	5
9	10-8			
10	10-9			
11	10-10			
12	10-11	0.005	2	5.5
13	10-12	0.006	2	5.7
14	10-13	0.02	2	5.7
15	10-14	0.005	2	5.1
16	10-15	0.009	2.5	5.4
17	10-16			
18	10-17			
19	10-18	0.009	2.5	4.9
20	10-19	0.009	2.5	4.9
21	10-20	0.01	2	4.9
22	10-21	0.01	1.5	4.9
23	10-22			
24	10-23			
25	10-24	0.006	7	4.7
26	10-25	0.007	8.5	4.7
27	10-26	0.005	9	4.6
28	10-27	0.005	16	4.7
29	10-28	0.03	2.5	4.8
30	10-29	0.02	2	4.8
31	10-30	0.009	0.1	4.7
32	10-31	0.03	1.5	4.6
33	AVERAGE	0.016	3.89	5.17
34	MAXIMUM	0.07	16	5.7
35	MINIMUM	0.005	0.1	4.6

WATER SAMP OCT 00-G4-W

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	IRON	LEAD	Cu	Zn	ORG C	Al	Ni	Hg	oil/Gr.
2	10-1										
3	10-2										
4	10-3	0.05	0.36	0.002	0.01	0.01	10.9	0.31	0.02	0.13	1
5	10-4										
6	10-5										
7	10-6										
8	10-7										
9	10-8										
10	10-9										
11	10-10										
12	10-11										
13	10-12										
14	10-13										
15	10-14										
16	10-15										
17	10-16										
18	10-17	0.05	0.53	0.002	0.01	0.01	12	0.39	0.02	0.05	1
19	10-18										
20	10-19										
21	10-20										
22	10-21										
23	10-22										
24	10-23										
25	10-24	0.05	0.56	0.002	0.01	0.01	13.8	0.23	0.02	0.05	
26	10-25										
27	10-26										
28	10-27										
29	10-28										
30	10-29										
31	10-30										
32	10-31									0.05	
33	AVG	0.05	0.483	0.002	0.01	0.01	12.23	0.31	0.02	0.077	1
34	MAX	0.05	0.56	0.002	0.01	0.01	13.8	0.39	0.02	0.13	1
35	MIN	0.05	0.36	0.002	0.01	0.01	10.9	0.23	0.02	0.05	1

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.007	1	4.6
3	2	0.006	1	4.6
4	3	0.02	1.5	4.6
5	4	0.04	0.5	4.9
6	5	0.005	0.5	4.8
7	6	0.005	0.5	4.7
8	7	0.02	0.5	5.3
9	8	0.006	1	4.8
10	9	0.005	0.8	4.7
11	10	0.006	1.5	5.3
12	11	0.01	0.5	4.7
13	12	0.005	0.5	4.6
14	13	0.005	0.5	4.6
15	14	0.005	0.5	4.6
16	15	0.06	3	4.7
17	16	0.04	2	4.6
18	17	0.009	1.5	4.6
19	18	0.03	2	4.9
20	19	0.005	2	4.6
21	20	0.005	4	4.8
22	21	0.008	2	4.5
23	22	0.03	7	4.8
24	23	0.01	1.5	4.6
25	24	0.01	1.5	4.6
26	25	0.04	9.5	4.7
27	26	0.006	1.5	4.6
28	27	0.007	2	4.6
29	28			
30	29			
31	30			
32	31			
33	AVERAGE	0.014	1.3	4.8
34	MAXIMUM	0.04	4	5.3
35	MINIMUM	0.005	0.5	4.5

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
2	1										
3	2										
4	3										
5	4										
6	5										
7	6										
8	7	0.05	0.45	0.002	0.01	0.01	15	0.38	0.02	0.05	1.4
9	8										
10	9										
11	10										
12	11										
13	12										
14	13										
15	14										
16	15	0.05	0.47	0.002	0.01	0.01	13	0.33	0.02	0.05	1
17	16										
18	17										
19	18										
20	19										
21	20										
22	21	0.05	0.38	0.002	0.01	0.01	13	0.33	0.02	0.05	1
23	22										
24	23										
25	24										
26	25										
27	26										
28	27										
29	28	0.05	0.33	0.002	0.01	0.01	12	0.31	0.02	0.05	1
30	29										
31	30										
32	31										
33	AVG	0.05	0.408	0.002	0.01	0.01	13.25	0.338	0.02	0.05	1.1
34	MAX	0.05	0.47	0.002	0.01	0.01	15	0.38	0.02	0.05	1.4
35	MIN	0.05	0.33	0.002	0.01	0.01	12	0.31	0.02	0.05	1

	A	B	C	D
1	DATE	As(Mg/L)	S. Sol(Mg/L)	pH
2	1	0.005	1.5	4.5
3	2	0.005	2	4.5
4	3	0.005	1.5	4.5
5	4	0.03	2	6.4
6	5	0.005	1	6.4
7	6	0.005	1.5	4.6
8	7	0.02	0.5	4.6
9	8	0.01	0.5	4.6
10	9	0.02	0.5	4.6
11	10	0.005	1	4.7
12	11	0.005	0.05	4.6
13	12	0.02	2	4.6
14	13	0.009	1.5	4.7
15	14	0.005	1	4.6
16	15	0.005	0.5	4.6
17	16	0.005	1.5	4.5
18	17	0.005	0.5	4.5
19	18	0.005	1.5	4.5
20	19	0.005	1.5	4.6
21	20	0.005	1	4.5
22	21	0.01	1	4.6
23	22	0.005	0.8	4.6
24	23	0.005	0.8	4.5
25	24	0.005	0.5	4.7
26	25	0.005	0.5	4.6
27	26	0.005	1.5	4.6
28	27	0.005	0.8	4.6
29	28	0.008	1	4.6
30	29	0.005	0.8	4.7
31	30	0.005	0.8	4.7
32	31	0.005	0.8	4.6
33	AVERAGE	0.008	1.04	5.3
34	MAXIMUM	0.03	2	6.4
35	MINIMUM	0.005	0.05	4.5

WATER SAMP DEC 00-G-4 WEEKLY

	A	B	C	D	E	F	G	H	I	J	K
1	DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
2	1										
3	2										
4	3										
5	4										
6	5										
7	6	0.05	0.41	0.019	0.51	0.43	6.5	0.21	0.02	0.05	1
8	7										
9	8										
10	9										
11	10										
12	11										
13	12	0.05	0.36	0.002	0.01	0.01	12	0.28	0.02	0.05	1.9
14	13										
15	14										
16	15										
17	16										
18	17										
19	18										
20	19	0.05	0.31	0.002	0.01	0.01	12	0.31	0.02	0.05	1
21	20										
22	21										
23	22										
24	23										
25	24										
26	25										
27	26	0.05	0.31	0.002	0.01	0.01	12	0.29	0.02	0.05	1
28	27										
29	28										
30	29										
31	30										
32	31										
33	AVG	0.05	0.348	0.006	0.135	0.115	10.63	0.273	0.02	0.05	1.225
34	MAX	0.05	0.41	0.019	0.51	0.43	12	0.31	0.02	0.05	1.9
35	MIN	0.05	0.31	0.002	0.01	0.01	6.5	0.21	0.02	0.05	1

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1	0.005	0.8	4.7
2	0.006	1.2	4.9
3	0.005	0.4	4.8
4	0.005	0.8	4.8
5	0.005	0.8	5
6	0.005	0.8	5
7	0.005	0.4	4.9
8	0.005	1.6	4.98
9			
10	0.005	0.4	4.7
11	0.005	1.2	4.7
12	0.005	0.4	4.7
13	0.005	0.4	4.7
14	0.005	1.2	4.7
15	0.005	0.4	4.7
16	0.005	0.3	4.6
17	0.005	1.5	4.6
18	0.005	1	4.6
19	0.005	1.5	4.6
20	0.005	2	4.6
21	0.005	1	4.6
22	0.005	0.8	4.6
23	0.005	1	4.4
24	0.005	0.8	4.8
25	0.005	1	4.9
26	0.005	1	5
27	0.005	0.8	5.4
28	0.005	1	4.9
29	0.005	0.8	4.8
30	0.005	0.8	4.9
31	0.005	1.3	4.8
AVERAGE	0.005	0.91	4.6
MAXIMUM	0.006	1.6	5.4
MINIMUM	0.005	0.4	4.4

WATER SAMP JAN 00-G-4 WEEKLY

DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
1										
2	0.05	0.32	0.002	0.01	0.01	12	0.31	0.02	0.05	1
3										
4										
5										
6										
7										
8										
9									0.05	1
10										
11										
12										
13										
14										
15										
16	0.05	0.32	0.002	0.01	0.01	12	0.31	0.02	0.05	1
17										
18										
19										
20										
21										
22										
23	0.05	0.27	0.002	0.01	0.01	10.4	0.25	0.02	0.05	1
24										
25										
26										
27										
28										
29										
30	0.05	0.35	0.002	0.01	0.01	9.1	0.23	0.02	0.05	1
31										
AVG	0.05	0.315	0.002	0.01	0.01	10.88	0.275	0.02	0.05	1
MAX	0.05	0.35	0.002	0.01	0.01	12	0.31	0.02	0.05	1
MIN	0.05	0.27	0.002	0.01	0.01	9.1	0.23	0.02	0.05	1

WATER SAMP FEB 00-G-4 DAILY

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1	0.005	1	5.7
2	0.005	1.5	5.7
3	0.005	1	5
4	0.005	1.5	5.1
5	0.005	1	4.7
6	0.005	2	4.9
7	0.005	1	4.7
8	0.005	1.3	4.7
9	0.005	1	5.9
10	0.005	1.3	4.8
11	0.005	1	4.8
12	0.03	1.5	6.7
13	0.005	0.8	4.6
14	0.005	1.2	4.7
15	0.005	0.6	4.7
16	0.005	1.2	4.8
17	0.005	1.2	4.7
18	0.005	0.8	4.7
19			4.55
20			4.65
21			4.6
22			4.5
23			4.55
24			4.6
25			4.65
26			4.65
27			4.5
28			4.55
29			
30			
31			
AVERAGE	0.006	1.17	5.46
MAXIMUM	0.03	1.5	6.7
MINIMUM	0.005	0.8	4.5

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1			
2			
3			
4			
5	0.005	2.4	4.9
6	0.005	2.8	4.8
7	0.005	1.2	4.9
8	0.005	1.2	4.8
9	0.005	0.4	4.8
10	0.005	0.4	4.7
11	0.005	0.4	4.7
12	0.005	1.2	4.8
13	0.005	0.4	4.7
14	0.005	0.4	4.8
15	0.005	1.6	4.7
16	0.005	0.8	4.7
17	0.005	1.2	4.7
18	0.005	1.2	4.8
19	0.005	1.6	4.7
20	0.005	1.2	4.8
21	0.005	1.2	4.76
22	0.005	0.8	4.8
23	0.005	2.4	4.9
24	0.005	2.5	4.8
25	0.005	2	5.2
26	0.005	1.2	4.8
27	0.005	0.8	4.8
28	0.005	0.8	4.8
29	0.005	0.8	4.8
30	0.005	0.4	4.8
31	0.005	0.4	4.8
AVERAGE	0.005	1.17	4.8
MAXIMUM	0.005	2.8	5.2
MINIMUM	0.005	0.4	4.7

DATE	As(Mg/L)	S. Sol(Mg/L)	pH
1	0.005	0.4	4.8
2	0.005	0.4	4.9
3	0.005	0.8	4.8
4	0.005	1.2	4.9
5	0.005	0.8	4.9
6	0.005	1.2	4.8
7	0.005	1.2	4.8
8	0.005	1.3	4.9
9	0.005	1.5	4.9
10	0.005	1	4.9
11	0.005	1.3	4.8
12	0.005	0.8	4.9
13	0.006	3	4.9
14	0.005	1.2	4.8
15	0.005	0.8	4.9
16	0.005	5.3	4.9
17	0.005	0.8	4.9
18	0.005	1.6	4.9
19	0.005	0.9	4.9
20	0.005	1.6	4.9
21	0.005	2	5
22	0.005	[illegible]	4.9
23	0.005	[illegible]	4.9
24	0.005	1.6	4.9
25	0.005	0.4	5
26	0.005	0.4	4.9
27	0.005	1.2	5
28	0.005	6.8	5
29	0.005	2.5	5.4
30	0.005	[illegible]	5.5
31			
AVERAGE	0.005	1.6	4.96
MAXIMUM	0.006	6.8	5.5
MINIMUM	0.005	0.4	4.8

DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
1										
2										
3										
4										
5										
6										
7										
8	0.05	0.16	0.002	0.01	0.01	6	0.16	0.02	0.05	
9										
10										
11										
12										
13										
14										
15	0.05	0.22	0.002	0.01	0.01	6.4	0.16	0.02	0.05	
16										
17										
18										
19										
20										
21										
22										
23										
24	0.05	0.14	0.002	0.01	0.01	6	0.19	0.02	0.05	
25										
26										
27										
28										
29										
30										
31	0.05	0.21	0.002	0.01	0.01	6.7	0.17	0.02	0.05	
AVG	0.05	0.183	0.002	0.01	0.01	6.275	0.17	0.02	0.05	
MAX	0.05	0.22	0.002	0.01	0.01	6.7	0.19	0.02	0.05	
MIN	0.05	0.14	0.002	0.01	0.01	6	0.16	0.02	0.05	

JUN
WATER SAMPLES ~~JULY~~ 00-6-1

DATE	NH3	AS	Fe	Pb	Cu	Zn	S. SOL	pH	ORG C	Al	Ni	Hg	Oil/Gr.
1													
2													
3													
4													
5													
6													
7													
8													
9	0.05	0.005	0.24	0.002	0.01	0.01	0.4	4.9	7.6	0.19	0.02	0.05	
10													
11													
12													
13													
14													
15													
16	0.05	0.005	0.22	0.002	0.01	0.01	2.4	4.9	7.6	0.29	0.02	0.05	
17													
18													
19													
20													
21	0.05	0.02	0.25	0.003	0.01	0.01	0.8	5	7.5	0.19	0.02	0.05	
22													
23													
24													
25													
26													
27													
28	0.05	0.01	0.24	0.002	0.01	0.01	2	5	7.7	0.22	0.02	0.05	
29													
30													
31													
AVG	0.05	0.01	0.238	0.00[illegible]	0.01	0.01	1.4	5	7.6	0.223	0.02	0.05	
MAX	0.05	0.02	0.25	0.003	0.01	0.01	2.4	5	7.7	0.29	0.02	0.05	
MIN	0.05	0.005	0.22	0.002	0.01	0.01	0.4	4.9	7.5	0.19	0.02	0.05	

DATE	NH3	Fe	Pb	Cu	Zn	ORG. C	Al	Ni	Hg	Oil/Gr.
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24	0.05	0.2	0.002	0.01	0.01	0.5	0.17	0.02	0.05	
25										
26										
27										
28										
29										
30										
31	0.05	0.23	0.002	0.01	0.01	7.2	0.22	0.02	0.05	
AVG	0.05	0.215	0.002	0.01	0.01	3.85	0.195	0.02	0.05	
MAX	0.05	0.23	0.002	0.01	0.01	7.2	0.22	0.02	0.05	
MIN	0.05	0.2	0.002	0.01	0.01	0.5	0.17	0.02	0.05	

JV.
WATER SAMPLES 00-G-5

DATE	NH3	As	Fe	Pb	Cu	Zn	S. SOL	pH	ORG. C	Al	Ni	Hg	Oil/Gr.
1													
2													
3													
4													
5													
6													
7													
8													
9	0.05	0.14	0.24	0.002	0.01	0.01	0.8	7	7	0.15	0.02	0.05	
10													
11													
12													
13													
14													
15													
16	0.05	0.18	0.26	0.002	0.01	0.01	0.4	6.9	7.1	0.12	0.02	0.05	
17													
18													
19													
20													
21	0.05	0.06	0.21	0.002	0.01	0.01	1.2	7	7.1	0.15	0.02	0.05	
22													
23													
24													
25													
26													
27													
28	0.05	0.03	0.22	0.002	0.01	0.01	0.8	6.6	7.7	0.19	0.02	0.05	
29													
30													
31													
AVG	0.05	0.1	0.233	0.002	0.01	0.01	0.8	6.9	7.225	0.153	0.02	0.05	
MAX	0.05	0.18	0.26	0.002	0.01	0.01	1.2	7	7.7	0.19	0.02	0.05	
MIN	0.05	0.03	0.21	0.002	0.01	0.01	0.4	6.6	7	0.12	0.02	0.05	

HEADFRAME PUMP

	A	B	C	D	E	F
1	DATE STARTED	TIME	DATE STOPPED	TIME	ON HRS.	OFF HRS.
2						
3	1/8/89	1100	2/8/89	700	18	
4	7/8/89	600	8/8/89	230	18.5	119
5	12/8/89	530	12/8/89	1630	12.5	99
6	16/8/89	215	16/8/89	1840	16.67	81.75
7	21/8/89	1730	22/8/89	-	-	118.84
8	27/8/89	1630	28/8/89	-	-	-
9	1/9/89	100	1/9/89	2200	21	-
10	6/9/89	1830	7/9/89	-	-	116.5
11	12/9/89	1600	13/9/89	400	22	-
12	17/9/89	2000	18/9/89	1315	19.15	114
13	22/9/89	2359	23/9/89	1600	16	106.75
14	27/9/89	1605	28/9/89	900	17	96.05
15	2/10/89	200	2/10/89	2030	20.5	89
16	6/10/89	1500	7/10/89	930	18.5	90.5
17	11/10/89	330	11/10/89	2200	18.5	90
18	14/10/89	800	15/10/89	130	15.5	58
19	18/10/89	430	18/10/89	2230	18	75
20	22/10/89	1700	23/10/89	530	14.5	90.5
21	26/10/89	2300	27/10/89	1630	17.5	89.5
22	31/10/89	1400	1/11/89	600	16	93.5
23	5/11/89	500	5/11/89	1030	17.5	95
24	7/11/89	630	7/11/89	1400	7.5	pump started manually
25	11/11/89	800	12/11/89	300	19	90
26	15/11/89	1800	16/11/89	1230	18.5	87
27						
28						
29						
30				AVERAGE HRS.	17.741	94.73

Note: average are calculated excluding line 24 7/11/89 when pump was manually started.

From shaft (pump gives 650 U.S. gal/min with 530' head) works 1/6 of the time. Aver. rate: 92 imp. gal/min

From ramp (pump gives 240 U.S. gal/min with 70' head.) works 1/2 of the time. Aver. rate: 20.5 imp gal/min

Water from the [illegible] area only: 92 - 20.5 = 71.5 imp. gal/min

APPENDIX E

Fish Landings from 1979 to 1988

TABLE A-1: Fish Landings (tonnes) and Values ($,000) for District 16 from 1979 to 1988

Species	19 79		19 80		19 81		19 82		19 83		19 84		19 85		19 86		19 87		19 88	
	Landings	Value	Landings	Value	Landings	Value	Landings	Value	Landings	Value	Landings	Value	Landings	Value	Landings	Value	Landings	Value	Landings	Value
Cod	202	78	291	121	405	217	328	176	234	120	65	27	97	50	95	66	76	77	21	14
Haddock	40	20	50	25	66	34	39	20	84	43	15	8	18	9	29	23	46	65	24	22
Redfish					-	0	-		-	-	-	-	-	-	-	-	-	-	-	-
Halibut	-	1	2	2	-	2	1	3	2	5	-	-	-	1	1	3	3	11	1	2
Plaice	4	1	7	3	14	5	18	6	21	7	2	1	1	1	2	1	9	6	4	3
Yellowfish	1	0	2	1	8	3														
Witch			1	0	-															
Winter Flounder	-	0																		
Unspecified Flounder	-	0																		
Pollock	-	0	1	0	-	0	-	0	1	-			36	11	49	19	15	7	14	4
Common or White Hake	3	1	1	0	-	1	6	1	3	-	-	-	3	-	16	6	12	6	3	1
Cusk	-	0	-	0	2	0											-	-		
Catfish	8	2	9	3	-	3	7	2	5	2	1	-	-	-	-	-	3	1	-	-
Total Groundfish	258	104	364	155	495	264	399	208	350	177	83	36	155	72	192	118	164	173	67	46
Herring	45	12	9	3	10	2	-	0	-	-	-	-	1	-	-	-			-	-
Mackerel	161	32	63	14	7	16	9	2	5	1	7	2	9	3	8	4	14	7	12	5
Swordfish																	-	1		
Dogfish	1	0	1	0																
Shark, Mako & Mackerel																	1	1		
Unspecified Shark																				
Total Pelagic	207	44	73	17	17	17	9	2	5	1	7	2	10	3	8	4	15	9	12	5
Alewives	4	0	1	0	80	0	1	0												
Salmon	-	0	-	1	3	1	-	1	-	-	-	-								
Smelt					-	1														
Total Estuarial	4	0	1	1	83	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Clams, soft shell					1	0	3	1												
Scallops	-	0			29	35	5	6			-	-					1	1		
Squid	-	0					1	1					-	-						
Lobsters	8	34	3	18	10	47	12	58	13	74	18	102	18	122	28	193	36	315	41	309
Crabs, Rock																	1	-		
Total Shellfish	8	34	3	18	40	82	21	66	13	74	18	102	18	122	28	193	38	316	41	309
TOTAL	477	183	441	190	635	366	430	278	368	252	108	140	185	198	228	314	217	499	121	360

APPENDIX F

Acid Generation Test Results

LAKEFIELD RESEARCH

185 Concession Street
Postal Bag 4300
Lakefield, Ontario
K0L 2H0

Facsimile No. (705) 652-6365
Telephone No. (705) 652-3341

To: Andre Cauchon Company: St Michel Géoconseil

From: Rene Jackman Fax. No.: 819-797-9214

Date: Apr 24/90 Reference: 3903

This transmission consists of 1 page(s), including this one.

COMBINED TAILINGS

Sample	% S	Acid Producing Potential, kg/t	Total Acid Consuming Ability, kg/t	Net Acid Consuming Ability, kg/t
AG-1	0.32	9.79	18.99	9.20
AG-2	0.32	9.79	21.07	11.28
AG-3	0.28	8.57	18.50	9.93

MINERALS ENGINEERING CENTRE

Technical University of Nova Scotia
P. O. Box 1000 Halifax Nova Scotia
Canada B3J 2X4
Telephone: (902) 429-8300
Telex: (TUNS) 019-21566

17 November, 1989

St-Michel Geoconseil.
209, 8E Rue.
Rouyn-Noranda.
Quebec.
J9X [illegible]

[illegible] Duchesne

Re: Results of analysis on submitted samples.

		%	lbs/Ton	
Sample	pH	S	Acid Producing Potential	Acid Consuming Ability
125A West Wall	6.22	0.36	22.1	24.6
125A [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ramp Waste	8.30	0.04	2.45	27.7

C. Cole

APPENDIX G

Terms of Reference

EXPLORATION OREX INC.
GOLDBORO PROJECT
GOLDBORO, NOVA SCOTIA

TERMS OF REFERENCE
FOR AN
ENVIRONMENTAL ASSESSMENT

Exploration Orex Inc.
Upper Penthouse
1660 Hollis Street
Halifax, Nova Scotia B3J 1V3

January 1990

EXPLORATION
ORex Inc.

January 19, 1990

Mr. W.A. Coulter, P.Eng
Environmental Assessment Administrator
Nova Scotia Department of the Environment
P.O. Box 2107
Halifax, NS
B3J 3B7

Dear Mr. Coulter:

RE: GOLDBORO PROJECT

We are pleased to submit ten (10) copies of our Terms of Reference for the Environmental Assessment Report for our Goldboro Project. These have been prepared in accordance with the final guidelines which you submitted to us on December 27, 1989.

Yours very truly,

Musetta Thwaites

Musetta Thwaites, MBA
Regional Manager

MT/ca

Upper Penthouse, 1660 Hollis Street, Halifax, Nova Scotia B3J 1V3
(902)423-1811 Telex 019-22826 Ans CENTBUSCENHFX Fax 420-0763

EXPLORATION OREX INC.
GOLDBORO PROJECT

TERMS OF REFERENCE
FOR
ENVIRONMENTAL ASSESSMENT

These Terms of Reference have been prepared in accordance with the requirements of the Nova Scotia Environmental Assessment Act and address the Final Guidelines issued on December 27, 1989 (see Appendix 1).

1.0 GENERAL

The consultant shall prepare a concise report with a table of contents reflecting the Final Guidelines and organized into five parts as follows:

- Part 1 Project Description
- Part 2 Existing Environment
- Part 3 Impact and Mitigative Measures
- Part 4 Residual Impacts
- Part 5 Proposed Effects Monitoring

A preface, executive summary and introduction will also be included. The report will be prepared in language easily understood by non-technical readers.

Except as otherwise noted, the report will be prepared on the basis of available data.

The report will be presented as an Orex document and will be signed by an officer of the company, thus signifying the commitment of the company to the contents of the report. Nolan, Davis and Associates (N.S.) Limited (the consultant) will be responsible for preparation of the report with inputs as noted from St. Michel Geoconseil.

2.0 PROJECT DESCRIPTION

This section of the report will be prepared by St. Michel Geoconseil and edited by Nolan, Davis to reflect a consistent style relative to the rest of the report.

The project description will include the following:

- Description of the location of all mine facilities in relation to existing infrastructure and environmental features.
- A review of past and present activity in the area, including a description of tailings facilities and old mine workings from the previous activity in the area.
- Reason for and alternatives to the proposed undertaking.
- A full description of the proposed mining facilities, including mining methods; mill buildings, including process flow diagram and water balance; water supply; water management methods, including liquid effluent, tailings disposal and waste rock, and domestic waste treatment/disposal, plus any other surface facilities.
- Profile of the proposed labour force for each phase of development and the proposed camp facilities.
- Review of alternative mining and beneficiation methods and the reason for selecting the scheme proposed.

Documentation supporting the tailings disposal concept and site selection will be included as an appendix to the report.

3.0 DESCRIPTION OF EXISTING ENVIRONMENT

This section of the report is already essentially complete and is organized to reflect the table of contents given in the Final Guidelines, as follows:

The report has been prepared on the basis of available data, with the exception of some biological field work undertaken to better understand the fishery resources of the area; an ecological overview of the proposed tailings disposal area; and interviewing of local community leaders to address local sociological and attitudinal aspects.

4.0 IMPACT AND MITIGATIVE MEASURES

This section of the report will be prepared by Nolan, Davis as an integration of Parts One and Two previously described. The format will reflect the following headings as in the Final Guidelines:

3.1 Potential Impacts
- 3.1.1 Impacts Requiring Mitigation

3.2 Waste Disposal System
- 3.2.1 Tailings
- 3.2.2 Cyanide Bearing Wastes
- 3.2.3 Other Wastes
- 3.2.4 Cyanide Destruction

3.3 Hydrogeology
- 3.3.1 Blasting
- 3.3.2 Dewatering
- 3.3.3 Underground Waste Disposal

3.4 Impacts on Surface Waters and Associated Habitat
- 3.4.1 Gold Brook Lake
- 3.4.2 Gold Brook River
- 3.4.3 Other Systems

3.5 Air Quality Impacts
- 3.5.1 Noise
- 3.5.2 Dust

3.6 Community and Land Use Impacts
  3.6.1 Social Impacts – on community resources and systems including health care, fire and police protection, housing, social services, water supply, transportation and schools.
  3.6.2 Land and Water Use Impacts
  3.6.3 Program of Public Information

3.7 Site Reclamation

3.8 Contingency Planning
  3.8.1 Cyanide Spills in the Mill
  3.8.2 Cyanide Spills on Transit to the Mill
  3.8.3 Cyanide Movement in the Groundwater System
  3.8.4 The Release of HCN Gas in the Active Workings Due to Migration of Cyanide in the Groundwater System

Particular attention will be given to the environmental issues associated with the use of cyanide (Sections 3.2.2 and 3.2.4). In this regard, the previous proposal to dispose of the cyanide-rich sulphide tailings underground has been abandoned by Orex in favour of land-based tailings disposal and treatment of cyanide residuals. The revised proposal will be thoroughly described as a function of Part One and its environmental implications addressed in Part Three.

A conceptual reclamation plan will be developed by Nolan, Davis for inclusion as Section 3.7. This will address the abandonment of the mill, mine, tailings disposal area and any other facilities.

A contingency plan will be prepared by Nolan, Davis in which potential release of contaminants such as cyanide or fuel oil will be addressed and proposed plans to minimize and mitigate such occurrences will be described.

This section of the report will include a description of Orex's Public Information Program, including activities conducted to date and proposed for the future.

5.0 PARTS FOUR AND FIVE

The final two parts of the report dealing with Residual Impacts and Proposed Effects Monitoring will be prepared by Nolan, Davis. Part Four will, in effect, be a summary of discussions presented in Part Three, emphasizing those impacts which will not be mitigated and thus represent a cost to society.

The monitoring program to be described in Part Five will be divided into two parts:

- Biophysical Environment
- Socio-economic and Community

APPENDIX 1

Final Guidelines

ENVIRONMENTAL ASSESSMENT REPORT

FINAL GUIDELINES
FOR THE PREPARATION OF
TERMS OF REFERENCE

Exploration Orex Inc.

Goldboro Project

NOVA SCOTIA

DEPARTMENT OF THE ENVIRONMENT

DECEMBER 27, 1989

FINAL GUIDELINES

FOR THE

PREPARATION OF TERMS OF REFERENCE

FOR AN

ENVIRONMENTAL ASSESSMENT REPORT

EXPLORATION OREX INC.

GOLDBORO PROJECT

INTRODUCTION

This document presents Final Guidelines for the preparation of Terms of Reference for an Environmental Assessment Report in accordance with the requirements of the Environmental Assessment Act and Regulations.

The guidelines were prepared in consideration of comments and concerns expressed by government reviewers and following a public review period from November 2, to December 12, 1989. These Final Guidelines are presented in the form of a modified Table of Contents (modifications are shown as underlined, bold face type) based on a document submitted to the Nova Scotia Department of the Environment for Exploration Orex Inc. by Nolan, Davis and Associates on September 6, 1989 (received on September 14, 1989).

FINAL GUIDELINES - OREX

The Environmental Assessment Report must address the requirements of Section 13 of the Environmental Assessment Regulations and therefore the Terms of Reference shall incorporate those requirements in their entirety. The Terms of Reference shall also address all items contained in the final Guidelines.

Since the Report may be examined by those without technical backgrounds it shall include an executive summary prepared in non-technical terms. The Report shall use non-technical language wherever possible.

FINAL GUIDELINES

PREFACE

EXECUTIVE SUMMARY

INTRODUCTION

Part 1 - Project Description

1.1 Location - **in relation to existing infrastructure as well as environmental features such as lakes, streams, etc.**

1.2 Past and Present Activity - **including a description of any environmentally sensitive remnants of previous activities that may be disturbed by this project.**

1.3 Reasons For and Alternatives To Proposed Undertaking

1.4 Proposed Development Facilities

- 1.4.1 Surface Facilities
- 1.4.2 Mine - **including proposed mining methods.**
- 1.4.3 Mill Facilities - **including process flow diagram with water balance if available.**
- 1.4.4 Water Supply
- 1.4.5 Waste Management
  - 1.4.5.1 Liquid Effluents
  - 1.4.5.2 Tailings Disposal
  - 1.4.5.3 Waste Rock
  - **1.4.5.4 Solid and Domestic Wastes**

1.4.6 Employment and Camp Facilities

1.4.7 Management of Hazardous Materials

1.4.8 Other Methods of Carrying Out the Undertaking e.g. open pit, heap leach, gravity, etc. (This section should present a discussion of the various options which are available to the proponent and which have been rejected. Reasons for the rejection for options should be presented along with reasons for the selection of the preferred options.)

Part 2 - Existing Environment

2.1 Study Area

2.2 Geology

2.2.1 Surficial Geology

2.2.2 Bedrock Geology

2.3 Climatology

2.3.1 Precipitation

2.3.2 Air Temperature

2.3.3 Wind

2.4 Surface Water Hydrology

2.4.1 Regional Hydrology

2.4.2 Surface Water Resource

2.4.3 Drainage Basin Morphology

2.4.4 Channel Morphology

2.4.5 Water Discharge

2.4.6 Water Chemistry

2.5 Hydrogeology

2.5.1 Hydrostratigraphic Units

2.5.2 Flow Systems - this section should include a detailed description of the groundwater flow systems which may be impacted by the disposal of cyanide rich waters and/or tailings in the Boston-Richardson workings.

2.5.3 Groundwater Chemistry

2.5.4 Groundwater Utilization and Resource Potential

2.6 Biological Resources

2.6.1 Fisheries - Freshwater and Marine (Seal Harbour and Coddles Harbour) including habitat and recreational and commercial use of the resource.

2.6.2 Wetlands

2.6.3 Mammals and Birds

2.7 Air Quality

2.7.1 Noise

2.7.2 Dustfall

2.8 Land Use and Sociology

2.8.1 Land Use in Study Area - this section should include an evaluation of other resource uses that may be denied as a result of the project. Examples would include forestry and recreation.

2.8.2 Local Attitudes to Project

2.9 Overview of Existing Environment

The Nova Scotia Museum Complex advises that an archaeological survey was conducted in the area in the fall of 1988 and showed nothing of particular significance. This work should be documented in the Report. Similarly, the Museum advises that they have no knowledge of any ecological features that would be threatened. If the Museum has not surveyed the project area for rare and endangered species of plant and animal life then a professional evaluation of the area should be undertaken.

PART 3 - IMPACT AND MITIGATIVE MEASURES

3.1 Potential Impacts

3.1.1 Impacts Requiring Mitigation - including construction, operation and abandonment phases of the project.

3.2 Waste Disposal System

3.2.1 Tailings - including geotechnical considerations and surface and groundwater characteristics of the preferred tailings disposal site.

3.2.2 Cyanide Bearing Wastes - this section should address the potential for migration of cyanide-laden groundwater from the abandoned mine to the active workings and the possibility of natural acidification of the waters resulting in the release of HCN gas in the active mine. The potential for the occurrence of a sulphide fire in the abandoned mine should be examined.

3.2.3 Other Wastes - this section should include an evaluation of the efficacy of both the existing ore and waste storage pads with reference to their ability to handle increased loading. Concepts for leachate collection and treatment for ore and waste rock storage areas should be presented in this section.

3.2.4 Cyanide Destruction - this section should present a comparison of the available processes for the removal of cyanide from effluents along with the reasons, including environmental considerations, for the selection of the preferred option.

3.3 Hydrogeology

3.3.1 Blasting

3.3.2 Dewatering

3.3.3 Underground Waste Disposal - this section should describe the proposed groundwater monitoring programme for the flow system(s) that may be impacted by the disposal of cyanide contaminated waters and sulphide rich tailings in the abandoned workings of the Boston-Richardson.

3.4 Impacts on Surface Waters and Associated Habitat

3.4.1 Gold Brook Lake

3.4.2 Gold Brook River

3.4.3 Other Systems - these systems should include the area of Seal Harbour into which Gold Brook River discharges.

3.5 Air Quality Impacts

3.5.1 Noise

3.5.2 Dust

3.6 Community and Land Use Impacts

3.6.1 Social Impacts - as construction camps may have a significant negative effect on the existing community this section should include a discussion of specific mitigative measures related to the community impacts of the camp. It is also recognized that the proposed undertaking has the potential to stress the service infrastructure in the vicinity. The Report should address the impacts of the project on such items as: health care, fire and police protection, housing requirements, social services, water supplies, transportation systems, schools, etc.

3.6.2 Land and Water use Impacts

3.6.3 Program of Public Information - the Report should contain a detailed discussion of any proponent initiated public information program including dates and locations, numbers of people in attendance, the issues discussed, and the outcome of the consultations including any commitments by the proponent. Any ongoing consultation procedures planned by the proponent should be described.

3.7 Site Reclamation

3.8 Contingency Planning

3.8.1 Cyanide spills in mill

3.8.2 Cyanide spills on transit to the mill

3.8.3 Cyanide movement in the groundwater system

3.8.4 The release of HCN gas in the active workings due to migration of cyanide in the groundwater system.

Part 4 - RESIDUAL IMPACTS

Residual Impacts are those impacts that cannot or will not be mitigated and thus represent the Environmental Costs of the proposed undertaking. In order to allow reviewers and decision makers to assess the environmental tradeoffs associated with the project it is essential that the Report contain a detailed discussion and evaluation of Residual Impacts.

Part 5 - PROPOSED EFFECTS MONITORING

5.1 Biophysical Environment

5.2 Socio-Economic and Community