

ENVIRONMENTAL PROTECTION SERVICE
ECOLOGICAL PROTECTION GROUP

RIDLEY ISLAND PORT CONSTRUCTION ACTIVITIES - 1982

Background and Environmental Monitoring

Regional Program Report No: 83-02

By

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ABSTRACT

Site visits were made in June, July and August 1982 to assess the environmental impact of port construction activities in the Ridley Island area of Prince Rupert, B.C.

On southern Ridley Island it was found that large quantities of sediment had escaped from the dredged material settling pond and been deposited on the intertidal areas along Porpoise Channel and southern Porpoise Harbour. This caused concern because of a possible smothering effect on intertidal organisms. Also, leachate from the peat disposal area was observed to be entering Porpoise Harbour via leaks in the berm. Continued monitoring of these problems is recommended.

On northern Ridley Island, coastal indentations were being infilled with rock. While organisms should be able to recolonize the rocky shore, the steeper slope and increased exposure to waves may change the composition of the intertidal community. It is concluded that continued infilling of Discharge Cove constitutes an encroachment on an adjacent intertidal area, but that the construction of road and rail causeways linking Ridley Island to Kaien Island has had a negligible effect on the flushing of pulp mill wastes from Porpoise Harbour.

No major adverse impact has yet been observed on wildlife. Bald eagles and herons were observed during site visits. Deer losses are expected to be small and due chiefly to animals being struck by vehicles on the Ridley Island access road.

The construction companies involved displayed good housekeeping habits: work and campsites were uncluttered, used lubricating oil was collected for recycling, explosives storage sites were well located and generally, care has been taken to minimize adverse environmental impacts.

RÉSUMÉ

En juin, juillet et août 1982, on a procédé à plusieurs inspections des lieux afin d'évaluer l'effet qu'avait pu avoir sur le milieu naturel les travaux d'aménagement entrepris dans le secteur de l'Ile Ridley près de Prince Rupert, C.-B.

Dans la partie sud de l'Ile Ridley on a constaté que de grandes quantités de sédiments provenant du bassin de décantation se sont déposés dans les zones intertidales s'étendant le long du chenal Porpoise et de la partie sud de Porpoise Harbour. Cette situation est préoccupante étant donné le risque d'étouffement qui menace les organismes vivant dans ces zones. D'autre part, on a observé un phénomène de lixiviation affectant le dépôt de tourbe, avec écoulement à travers les fissures de la digue vers Porpoise Harbour. Recommandation est faite de suivre ces problèmes de près.

Dans le nord de l'Ile Ridley, on a versé de la pierraille dans les indentations de la côte. Si les organismes devaient être en mesure de recoloniser les rochers de la côte, le caractère plus abrupt des pentes et une exposition accrue aux vagues peuvent avoir pour effet un changement dans la composition des colonies intertidales. En résumé, la poursuite de déversement de pierraille dans Discharge Cove se traduit par un envahissement de la zone intertidale adjacente, mais la construction des digues permettant le passage des routes et des voies ferrées reliant l'Ile Ridley à l'Ile Kaien n'a eu qu'un effet négligeable sur le drainage des effluents déversés par l'usine de pâte à papier dans Porpoise Harbour.

Aucun effet négatif majeur n'a jusqu'ici été observé sur la faune. On a pu voir des aigles à tête blanche et des hérons au cours des tours d'inspection. On ne craint pas que les cerfs soient réellement menacés dans leur existence; cette menace sera due surtout aux animaux écrasés par les véhicules sur la route conduisant à l'Ile Ridley.

Les sociétés de construction ont fait preuve de bonnes habitudes de propreté; pas de rebuts jonchant les chantiers et les campements, récupération de l'huile de graissage pour le recyclage, bon choix des dépôts d'explosifs; d'une façon générale, on peut dire qu'on a pris soin de réduire au minimum les effets négatifs sur le milieu naturel.

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1 INTRODUCTION

1.1 Scope and Purpose

This report contains the findings of an EPS program carried out in the summer of 1982 to monitor the effects on the receiving environment of port construction activities underway on National Harbours Board-owned Ridley Island and vicinity near Prince Rupert, B.C. It is anticipated that the monitoring program will continue over the next several years while major construction activities are proceeding.

Although the main thrust of the report is directed toward environmental questions, some general information is included for those interested parties with little knowledge of the background to Ridley Island port developments. While much of the material presented in the main body of the report and appendices is necessarily of a technical nature, an attempt has been made to explain matters using a minimum of technical language.

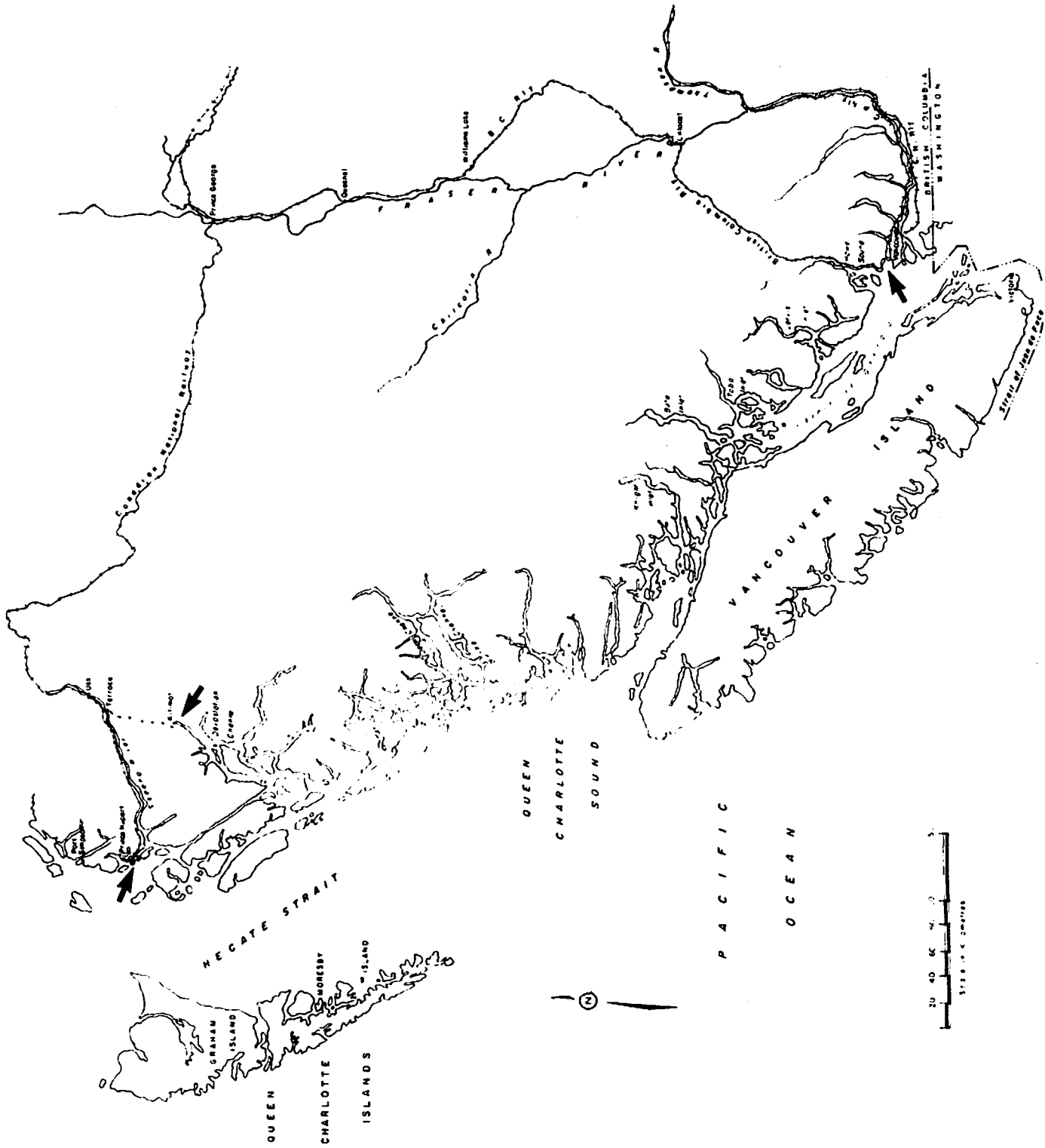


FIGURE I RAIL ACCESS TO COASTAL BRITISH COLUMBIA

2 BACKGROUND

2.1 How Ridley Island Was Chosen for Port Development

Potential port locations must satisfy three essential requirements to be seriously considered for development. The location must offer protection from the open ocean, while giving ease of access to maritime vessels of the size envisaged to carry products to and from the port. The second requirement is for enough land of low relief adjacent to tidewater to accommodate presently proposed port facilities and allow future expansion as required. The third basic requirement is for road and rail transportation access to the site. The rugged coastal geography of British Columbia strictly limits the number of areas satisfying the above criteria.

At present only three areas of the B.C. mainland coast have rail access to the interior: The Lower Mainland, Kitimat and Prince Rupert (Figure 1). The Lower Mainland already has highly developed port facilities and there are few opportunities for significant expansion into environmentally and socially non-sensitive areas. In addition, to alleviate transportation congestion it was deemed desirable to look for potential port sites outside the Lower Mainland.

The Kitimat area contains port development possibilities but the railway access is of a "light duty" nature and would have to be extensively rebuilt with lower grades, fewer sharp curves, better railbeds, and heavier rail and trestles to accommodate the new traffic. Thus, the rail link would have to be rebuilt, substantially increasing the capital cost of port development and delaying the opening of the port facility.

In the early 1900's the western terminus of the Grand Trunk Pacific Railroad (now CNR) was located in what is now Prince Rupert because its port development potential was recognized. It has a fine, ice-free harbour and lies about 800 km closer to the Orient than does Vancouver. Unfortunately Prince Rupert harbour cannot accommodate

the large (50,000-250,000 dwt) freighters presently used in world trade, so it was necessary to seek alternate sites. Studies were made to determine the most feasible site taking into account engineering, economic, environmental and social considerations. Ten potential sites were identified which a study of the engineering and economic aspects of port development (Swan Wooster, 1974) reduced to three best candidates: Ridley Island, Port Simpson and Kitson Island (see Figure 2).

2.2 NEAT Report

The five volume report of the Northcoast Environmental Assessment Team (NEAT 1975), prepared for a federal-provincial joint committee, analyzed the three proposed bulk terminal sites for their environmental acceptability and gave an opinion on the environmental impacts that likely would result from developing the various alternatives. It judged Kitson Island to be unacceptable because developing that site would require building a causeway across Flora Bank, an important area for salmon, herring and waterfowl. Environmental impacts were predicted to be low and about equal for the Ridley Island and Port Simpson sites, but anticipated adverse social impacts in the secluded Port Simpson area together with the higher port development costs of building the railway along Work Channel to Port Simpson combined to make Ridley Island the preferred candidate for a bulk loading terminal when all factors were considered. However, if major industrial development were to accompany port development, then Port Simpson was preferred for pollution control reasons.

It should be noted that the NEAT study was a general environmental assessment of alternatives and the authors recommended that, once the port site was selected, in-depth studies be made in order to minimize potential site-specific problems.

To reduce the regional impacts of Ridley Island development it was recommended¹ that detailed information on wind, waves and tides be

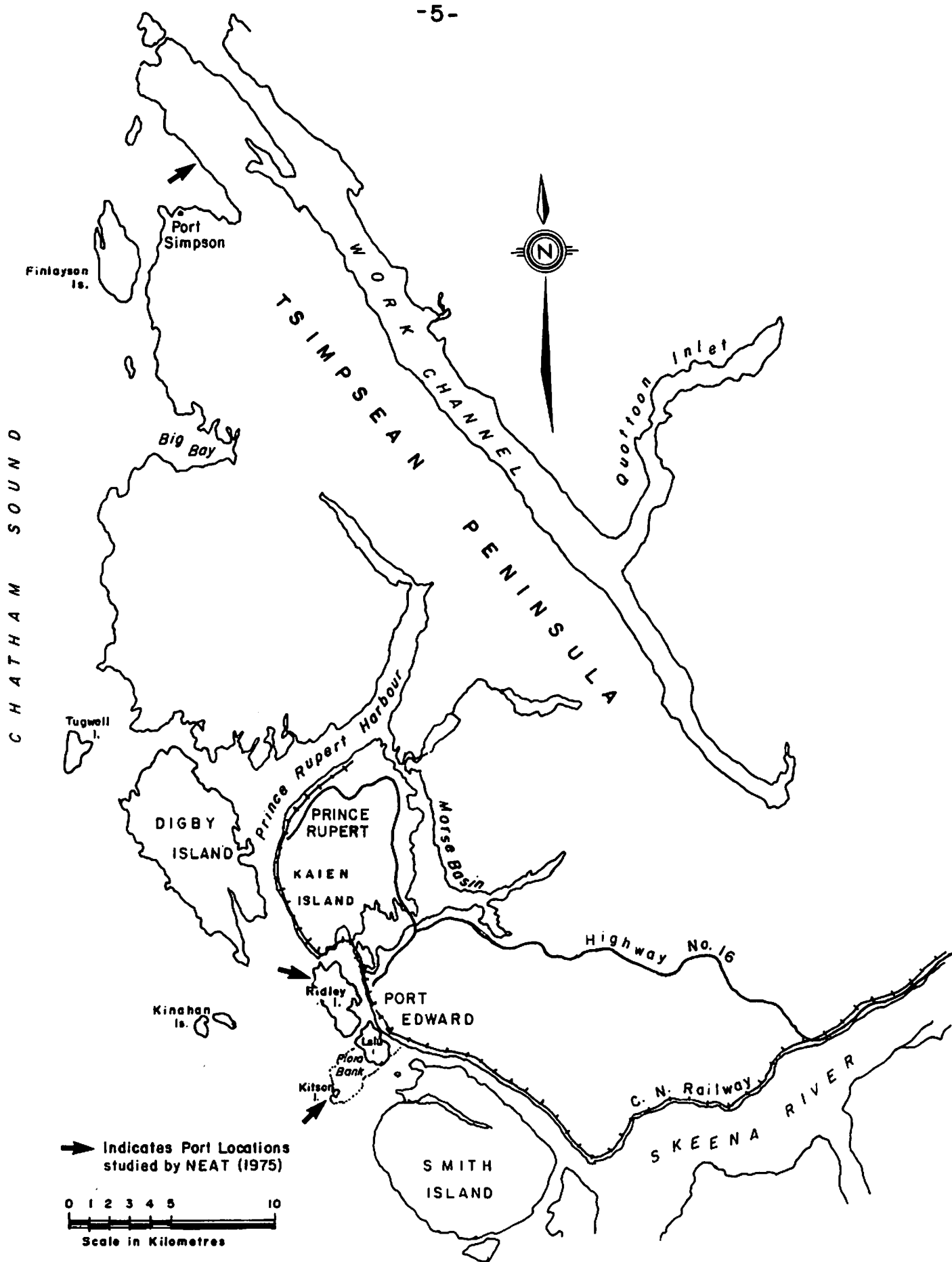


FIGURE 2 TSIMPSEAN PENINSULA SHOWING PORT LOCATIONS STUDIED BY NEAT (1975)

gathered and correlated with spill probabilities to identify those areas most threatened by spills. When combined with detailed biological studies to identify ecologically valuable areas, suitable pollution control measures could then be put into place.

To reduce on-site impacts, it was recommended that there be environmental input to the engineering design to minimize disruption of deer winter range and waterfowl habitat. Furthermore, it was recommended that the environmental study group develop manuals for environmentally sound construction and operating practices and emergency procedures.

Certain follow-up studies have been made. Of particular note are a detailed study of the Skeena River Estuary by Environment Canada (Hoos, 1975); a Canadian Wildlife Service study of bird use of Ridley Island mudflats (Cannings, 1979); a marine safety study (Det Norske Veritas, 1980); a federal-provincial study of the coal dust issue (Beak Consultants Ltd., et al., 1979, 1980); and continuing work on project design through the review of plans and permit applications in those aspects of the work which affect the environment. It is expected that the proposal to develop a petrochemical terminal on adjacent Kaien Island will receive further detailed environmental examination as recommended in the NEAT report.

2.3 NHB Ridley Island Master Plan

In 1978 a Master Plan for the development of Ridley Island was prepared for the National Harbours Board (CBA, 1978). While the NEAT report recommended that Ridley Island be used only for a bulk loading facility and not as an industrial site (in which case Port Simpson was preferred), the Ridley Island Master Plan considered the island suitable not only for "a coal and grain bulk loading facility (Phase I), but also subsequently for possible development of a fertilizer plant, a mini-mixed bulk terminal facility, pre-reduced iron ore plant, a forest products processing plant and a non-ferrous smelting and refining plant (Phase II)"². It is understood that an updated Master Plan is being prepared.

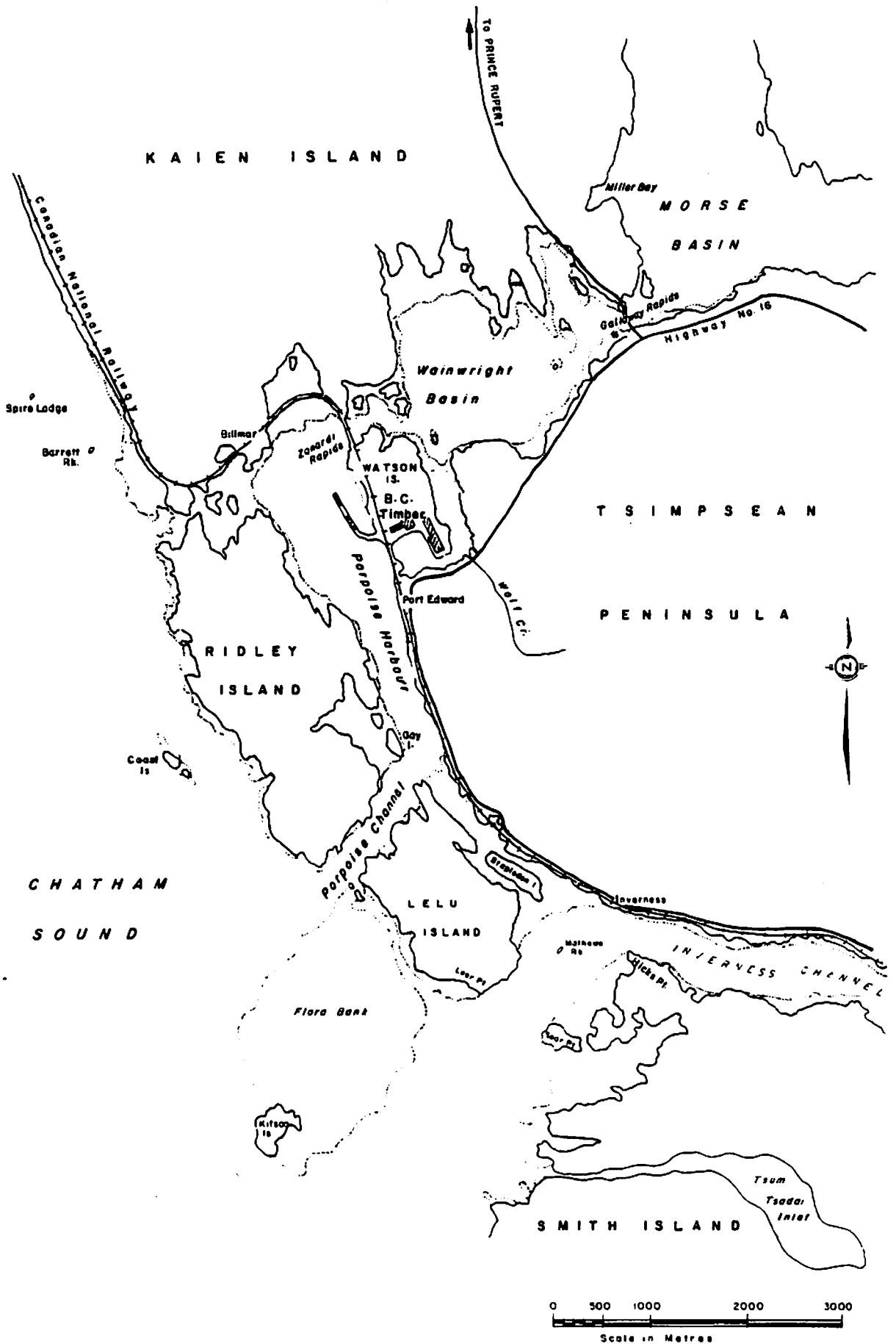


FIGURE 3 RIDLEY ISLAND AREA

2.4 Pre-Construction Environmental Condition of the Ridley Island Area

Ridley Island is a small island covered with muskeg and scrub forest. One km east of Ridley Island, directly across Porpoise Harbour, is the B.C. Timber (formerly Canadian Cellulose) pulp mill on Watson Island which has been in existence since 1950. Prior to the establishment of the pulp mill, adjacent water bodies such as Wainwright Basin were major herring spawning areas. Since the mill began operating, the biological productivity of Wainwright Basin has been drastically reduced. Although steps have been taken to improve water quality in the vicinity of the mill, pollution abatement measures have not always been unequivocal successes. For example, in the 1960's it was decided that instead of discharging toxic red liquor from the sulphite process mill into Wainwright Basin, it would be better to construct a pipeline across northern Ridley Island (Plate 1) and discharge the pulp waste into Chatham Sound with its greater dilution capability. Near the discharge point the impact on intertidal life forms was severe. According to a 1977 EPS report on work done in 1974, "Discharge Cove, the first area examined, was characterized by an appearance of almost complete sterility"³. In 1976 the sulphite process mill was shut down and converted to a kraft process mill with a lower oxygen demand effluent which is discharged into Porpoise Harbour. The red liquor line was then abandoned and by 1980 Discharge Cove was showing signs of recolonization according to EPS personnel.

Given that port development was to occur in the area, it may be better that Ridley Island was chosen rather than a more pristine area. Ridley Island's intertidal zone has been disturbed by partly diluted pulp mill effluent and there are no known rare or endangered species on the island. However there are a few deer, one sporadically used trapline and a crab fishery which has existed for some time in Porpoise Channel. Some waterfowl and shorebird use of intertidal mudflats in the Ridley Island area has been reported (Cannings, 1979).

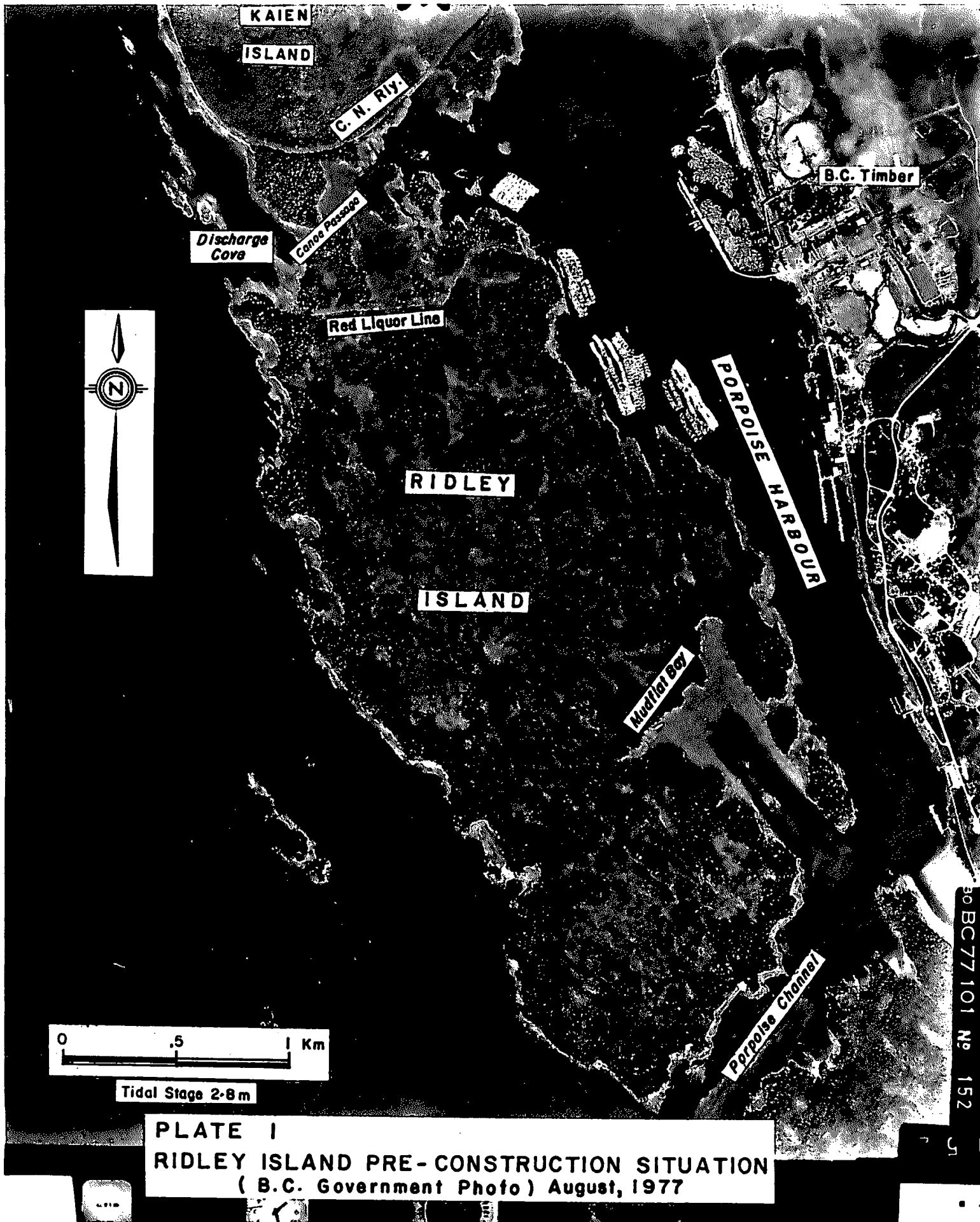


PLATE I
RIDLEY ISLAND PRE-CONSTRUCTION SITUATION
(B.C. Government Photo) August, 1977

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3 SETTING

3.1 Introduction

The following sections summarize the climate, geology, vegetation and the freshwater and marine environments of the Ridley Island area. A fuller discussion of these topics is found in a study of the Skeena River Estuary (Hoos, 1975).

3.2 Location and General Description

Ridley Island (54°13'N, 130°19'W) is situated about 10 km due south of Prince Rupert, B.C. Roughly rectangular in shape, it has a length of about 3.5 km and a width averaging 1.5 km with a total surface area of about 450 ha which gives it approximately the same area as Vancouver's Stanley Park. Low in relief (maximum elevation about 50 m), Ridley Island features ridge and swale topography with bedrock exposures, muskeg pockets and a scrub forest cover. Except at high tide, Ridley was linked with Kaien Island (on which Prince Rupert is situated) by an intertidal mudflat known as Canoe Passage. Now, with the construction of road and rail causeways across Canoe Passage, this link is permanent.

The coastline consists mainly of steeply sloping exposed bedrock and small indentations with cobble or sand beaches and intertidal mudflats. One of the more noticeable features of Ridley Island is the large (26 ha) intertidal mudflat bay in the southeastern corner of the island (Plate 1). For purposes of this report, this bay is called "Mudflat Bay".

3.3 Climate

The Prince Rupert area has a modified maritime climate characterized by moderate temperatures, generally cloudy skies, abundant precipitation and light southeasterly winds. The chief factors

TABLE 1 PRINCE RUPERT CLIMATE SUMMARY (1961-1980)

Temperature

	<u>JAN.</u>	<u>JULY</u>
Mean daily maximum	3.3°C	16.0°C
Mean daily	-0.2°C	12.8°C
Mean daily minimum	-3.7°C	9.6°C
Mean annual		6.7°C
Extreme maximum recorded (1908-1980)		32.2°C
Extreme minimum recorded (1908-1980)		-24.4°C

Precipitation

Mean total	2523.2 mm
Mean total for October (wettest month)	366.5 mm
Maximum precipitation in one day (1908-1980)	141.0 mm
Mean annual snowfall	151.7 cm
Mean number of precipitation days	233

Bright Sunshine

Mean duration	1224 hrs
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Wind

Prevailing wind direction	SE
Mean annual wind speed	14.8 km/hr

(Atmospheric Environment Service data)

determining its climate are the mid-latitude location, topography and proximity to the Pacific Ocean with its warm Japan Current and the dominating North Pacific Low.

Table 1 shows climate information for Prince Rupert. Close to sea level the mean annual temperature is about 7°C ranging from a January mean minimum of -4°C to a July-August mean maximum of about 16°C. With about 70 years of record, the extreme minimum and maximum recorded have been -24°C and 32°C, respectively. Frost occurs about 40 nights per year.

There is no dry season though the spring and summer months are drier than the fall and winter months. July is the driest month with a mean rainfall of 103 mm in 16 days, while October is the wettest month with over 365 mm in 24 days. The Digby Island weather station receives a mean yearly total of over 2520 mm (99 in.) of precipitation in 233 days compared with 628 mm in 166 days for Prince George and 1113 mm in 163 days at the Vancouver Airport weather station. Since precipitation is strongly correlated with elevation, areas just to the east of Prince Rupert at higher elevations likely receive even heavier precipitation than that recorded at the Digby Island station. About 6% of the precipitation received at sea level is in the form of snow (annual mean 151.7 cm), whereas the comparable figure for Prince George is 38% of annual precipitation.

The mean annual duration of bright sunshine is 1224 hours. The comparable figure for Prince George is 1925 and for Vancouver 1920 hours.

The prevailing winds are southeasterly, although in the summer months westerlies are common. The summer months account for 22 of the 27 annual days with fog.

3.4 Geology

Ridley Island lies in the transition zone between the Hecate Lowland and the Coast Mountains. Its rocks consist mainly of metamorphosed sediments in the form of various types of schist thought to date from the late Paleozoic or early Mesozoic era about 250 million years ago. The area has been extensively faulted and intruded and much younger

(100 million year old) plutonic rocks are exposed on northern Ridley Island in the form of coarse-grained diorite dykes. There is no known mineral potential on Ridley Island.

Ten thousand years ago the area was covered by the Kitimat Range ice sheet. It is thought that the glacier gouged out the Skeena Valley, Work Channel, Tuck Inlet and Prince Rupert Harbour, as well as scouring the northwest trending ridge and swale microtopography of the coastal lowland as the ice moved in a generally northwesterly direction along Chatham Sound.

The Prince Rupert area is in Building Code Seismic Zone 3, an area of high earthquake risk. The zone of most frequent seismic activity lies to the west around the Queen Charlotte Islands. In 1929 an earthquake of magnitude 7 occurred with its epicentre in Hecate Strait. At Digby Island the same earthquake had a measured intensity of 4 and a local tsunami was experienced.

3.5 Vegetation

Behind the timbered coastal fringe, much of Ridley Island is covered with muskeg - a mosaic of bogs, small pools and islands of non-merchantable scrub pine, cedar and hemlock. The bogs, formed in poorly-drained depressions gouged in the bedrock by the passing Pleistocene glacier, now contain peat deposits up to 5 m in thickness. One of the problems faced by Ridley Island developers was the disposal, in an environmentally acceptable manner, of the huge amounts of peat that covered the bedrock in the grain and coal terminal areas.

The area of the proposed petrochemical terminal on adjacent Kaien Island contains a large stand of red alder that has grown up in an area cleared for a World War II shore battery.

3.6 Freshwater Environment

While Ridley Island itself has no known aquifers or freshwater resources other than a few muskeg pools, developments there could affect regional freshwater resources in a number of ways:

First, Ridley Island operations will require a certain amount of freshwater for drinking and washing purposes. It is proposed to withdraw water from the Wolf Creek watershed which now supplies the needs of the B.C. Timber operation.

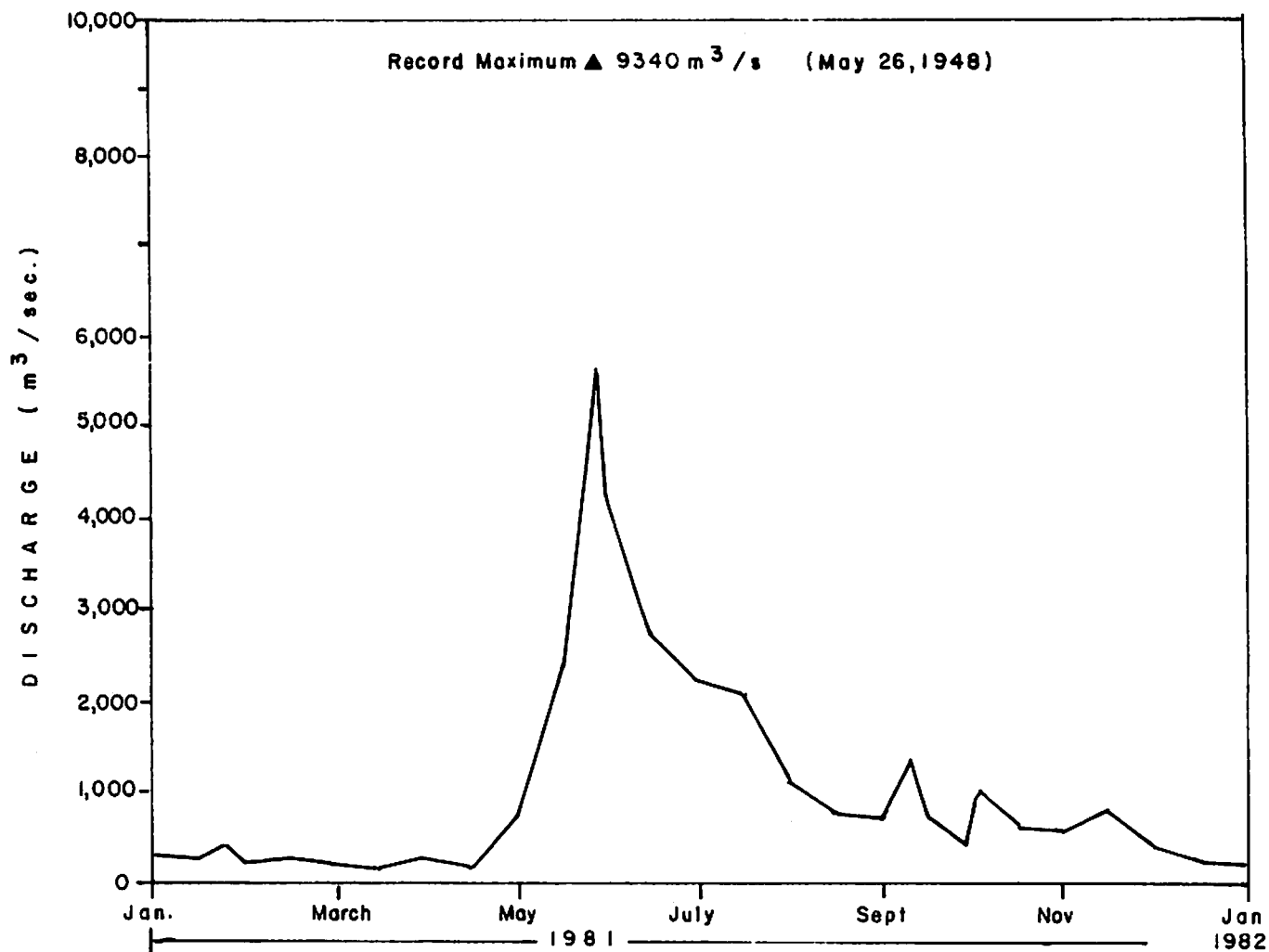
Second, products to be shipped from Ridley Island terminals are expected to arrive via the CNR line along the Skeena River. Rail accidents could lead to transported products being spilled into the Skeena. If the spilled products happened to be of a hazardous or toxic nature, e.g. petrochemicals, the effects could be very serious.

The Skeena is one of the principal rivers of British Columbia in terms of drainage area, discharge and sediment load. Figure 4 shows the discharge hydrograph for the river at Usk (upriver from Terrace) for 1981, a fairly typical year. The annual runoff peak occurs in May or June as a result of snowmelt. Usually there is a smaller autumn peak which is caused by heavy rainfall. Except in the form of snow, there is little in the way of storage capacity in the Skeena River system. The average annual discharge at Usk is about 900 m³/s. The minimum recorded flow is 52 m³/s. The median annual flood peak is 4730 m³/s., while the flood peak in 1948, the highest recorded, was 9340 m³/s. Obviously such large variations in flow directly affect the volume of freshwater and river-borne sediment present in the Skeena Estuary.

3.7 Marine Environment

Ridley Island lies in the Skeena Estuary. Estuaries are very important from a biological point of view because they form the transition zone from fresh to salt water. They are rich in nutrients brought in by the fresh water but the wide salinity ranges found there are restrictive to some marine and freshwater organisms.

The Skeena Estuary is particularly important because of the large number of salmon that pass through on their way to spawn and because young salmon spend time there while adjusting from fresh to salt water. Young salmon find shelter in eelgrass, a marine plant that is found in



Mean Discharge 925 m³/s
Maximum Daily 5600 m³/s on May 27, 1981
Minimum Daily 186 m³/s on March 14, 1981
Total Discharge 29,200,000,000 m³

FIGURE 4 SKEENA RIVER HYDROGRAPH AT USK - 1981
(Data adapted from Inland Waters Directorate,
Environment Canada)

shallow, protected waters with a sandy or muddy bottom. A study of the Skeena Estuary (Hoos, 1975) refers to a 1972 Fisheries Service study that estimated Flora Bank supports 50-60% of the total eelgrass in the estuary⁴.

Flora Bank (Figure 3), situated 500 m south of Ridley Island and about 3 km south of the coal terminal, is a large area formed from deposits of Skeena River sediment. It will be recalled from Sec. 2.2 that the NEAT report eliminated Kitson Island as a possible port location chiefly because of anticipated adverse consequences to Flora Bank. It is equally important that the development of Ridley Island does not have adverse effects on Flora Bank.

From what is known so far, the currents in that area generally trend in a northwesterly direction, that is, from Flora Bank to Ridley Island. Aside from the influence of the Skeena River, other factors affecting the circulation of water in Chatham Sound are tides and winds. Tides in this region are of the mixed type with two highs and lows each day. The tidal range is the largest on the Canadian west coast with average amplitudes of 5 m and extreme values of 7.5 m (about 25 feet).

4 1982 MONITORING PROGRAM

4.1 Summary of 1982 Construction Activities

Grain and coal terminals were under construction on northwestern Ridley Island and a proposal has been made to construct a petrochemical terminal on southwestern Kaien Island, adjacent to Ridley Island (see Figure 5). This report will deal primarily with the grain and coal terminals.

A paved 6 km access road from Highway 16 to Ridley Island was completed in August 1982. It crosses the CNR mainline via a reinforced concrete bridge and crosses Canoe Passage to Ridley Island via a causeway. In August, Discharge Cove was being infilled with rock from the coal dumper pit.

At the southern end of the causeway is the grain terminal site (Figure 5). It occupies a 15 ha site and 2 ha waterlot on northwestern Ridley Island. It is due to be completed by December 1984 and is designed to export 3 million tonnes of grain per annum. During the first half of 1982 site grading work was in progress but a labour dispute stopped work during the latter part of the summer. The coastal indentations on the western side of the grain terminal were being "straightened" by construction of a new haul road between the headlands.

The coal terminal is situated just south of the grain terminal (Figure 5). It occupies a 25 ha site and is due to be completed by late 1983. It is projected to export 8 million tonnes of coal per year. Site preparation requires moving 1.7 million m³ of overburden and the blasting of 2.25 million m³ of rock using 1,450 tonnes of explosives (Globe and Mail, August 2, 1982). In August, rock was being blasted from the dumper pit area and was being used to infill the foreshore areas of northwestern Ridley Island.

Organic overburden from both the grain and coal sites was stripped and transported on the haul road to Mudflat Bay where it was dumped behind rock berms.

During May and June, dredging was carried out in Chatham Sound in the area of the future docking facilities for the coal port. An estimated 730,000 m³ of dredged material was pumped via a pipeline to the southern part of Mudflat Bay where a settling pond was formed behind rock berms, next to the peat disposal area. While the dredging was in progress substantial amounts of fine-grained dredged material escaped from the settling pond and were deposited along Porpoise Channel and southern Porpoise Harbour.

Between southern Kaien Island and northern Ridley Island a railway causeway was being constructed. It will carry about 20 tracks when completed. Construction of the road and rail causeways has closed off Canoe Passage. Peaty overburden has been dumped into West Billmor Bay also (Figure 5).

4.2 Scope and Purpose of 1982 Monitoring Program

The construction of grain and coal port facilities on NHB-owned Ridley Island in 1982 and the likelihood of other major developments occurring in the vicinity, such as the Kaien Island petrochemical terminal, required the implementation of a dual purpose environmental monitoring program.

The primary purpose was to monitor those construction activities presently underway to determine their environmental effects on Ridley Island and vicinity and to make an assessment of the significance of these impacts.

The secondary purpose was to gather some additional baseline data from which future environmental impact assessment may begin.

The program was begun by reviewing previous studies (e.g. NEAT, 1975) and holding discussions with EPS personnel with prior involvement in the Ridley Island area to determine specific potential environmental effects to be investigated.

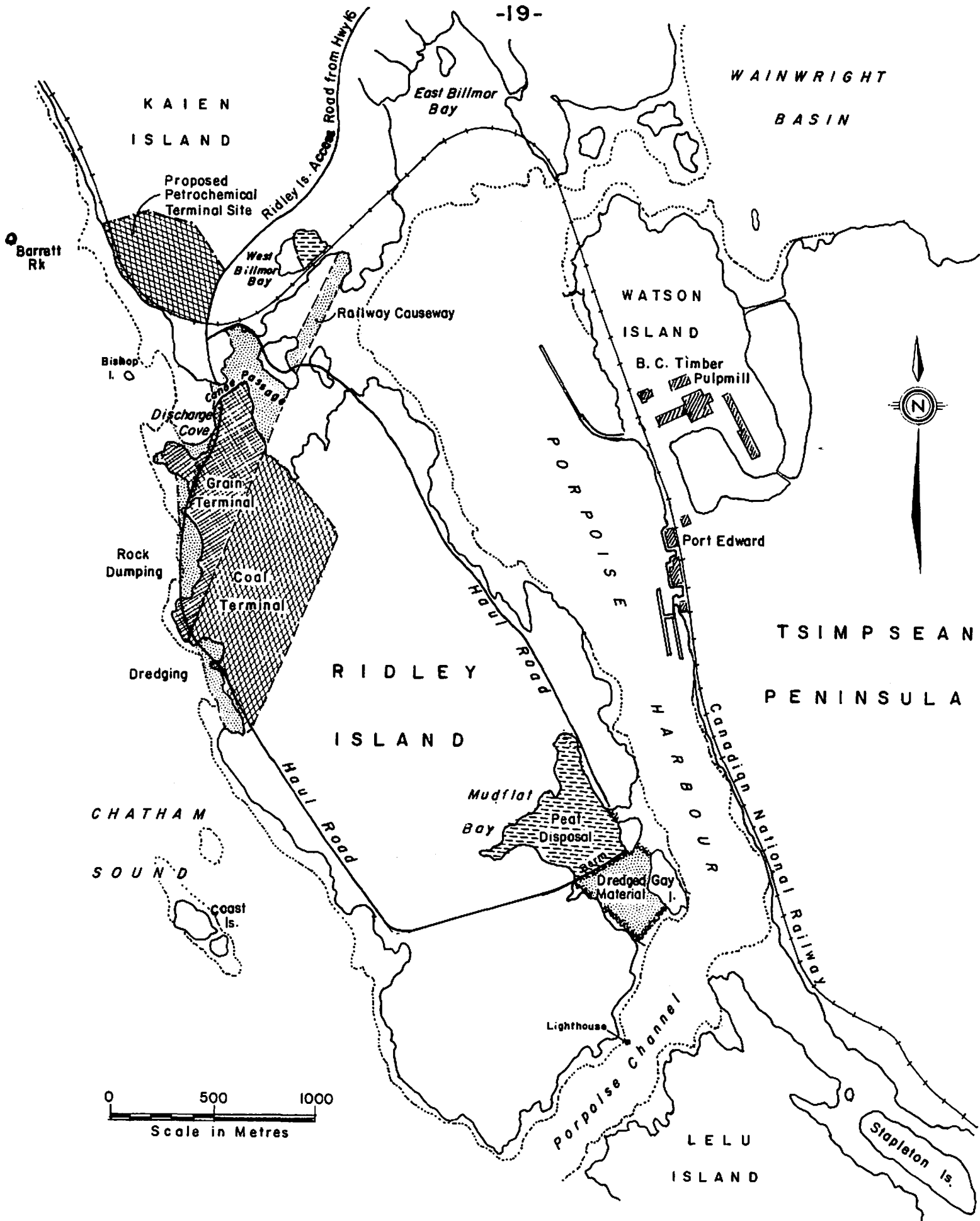


FIGURE 5 RIDLEY ISLAND CONSTRUCTION SITUATION - 1982

These were:

- unnecessary encroachments on lands and intertidal areas adjacent to construction sites, i.e. spillover effects resulting from poor project design or sloppy construction practices;
- changed flow conditions in Porpoise Harbour as a result of road and rail causeway construction between Ridley and Kaien Islands. It was thought that the loss of water flow through Canoe Passage might reduce the flushing of pulp mill wastes from Porpoise Harbour and also result in changed intertidal deposition sites for silt and logs;
- deposition of eroded construction materials such as sand and gravel or other by-products of the construction process on intertidal areas;
- reduced water quality as a result of leachate from the peaty overburden dumped into the intertidal bay in southeast Ridley entering the waters of Porpoise Harbour;
- reduced numbers of deer caused by the loss of winter range and the increased accessibility of the island to hunters and other predators such as wolves;
- loss of intertidal communities as a result of the infilling of coastal indentations in the project area.

4.3 Methods

Aerial photographs taken before construction commenced (e.g. Plate 1) were acquired and information was gathered from reports to obtain a "picture" of the Ridley Island area prior to present construction activities.

Site visits were made in June, July and August 1982 to observe the construction process, to collect evidence of adverse environmental effects and to gather baseline data that may be useful for subsequent studies. Water and sediment samples were taken for laboratory analysis (See Appendices II and III). Areas of sediment deposition were measured and the effects on intertidal biota were observed. Surveys of the plants



PLATE 2
RIDLEY ISLAND. August 1982 (Enlargement of Energy, Mines and Resources Photo)

and animals inhabiting the intertidal zone (see Appendix I-Intertidal Transects) were made to allow assessment of construction effects on the intertidal community over a period of time.

Conversations were held with representatives of federal (Fisheries and Oceans, Canadian Wildlife Service and National Harbours Board) and provincial (Waste Management Branch and Fish and Wildlife) agencies to determine their particular concerns with Ridley Island developments. Conversations were also held with representatives of CBA Engineering Ltd., the firm in charge of site engineering for NHB, to learn about the construction methods being used with a view to determining their environmental adequacy.

4.4 Definitions of Degrees of Environmental Impacts

In this report observed environmental impacts are classified as major, minor or negligible.

Major Impacts: those of considerable consequence to the environment because of their sheer size, large areas or long term nature.

Minor Impacts: those of lesser consequence because of their smaller size, limited extent or short term nature.

Negligible Impacts: those assessed as having no appreciable adverse impact.

4.5 Environmental Impact Assessment

The main areas affected by construction activities by August 1982 were: the intertidal bay and shoreline areas of southern and eastern Ridley Island along Porpoise Channel and southern Porpoise Harbour; northern and western Ridley Island where the coal and grain terminals will be situated; Canoe Passage and some small areas of southern Kaien Island



PLATE 3
LEAK IN PEAT CONTAINMENT BERM

including West Billmor Bay. Altogether 15-20% of the land area and 50-60% of the shoreline of Ridley Island have been affected directly by the construction process or indirectly by sediment deposition.

4.5.1 Southern Ridley Island. Mudflat Bay is about 26 ha in area. At one time this bay was used as a log booming ground. A study (Cannings, 1979) reported some use of this mudflat by waterfowl and shorebirds, but concluded that many areas in the vicinity provide habitat of similar size and quality.⁵

Rock berms have been built to enclose this bay and divide it into two sections: the northern section of about 18 ha was used as a place to dump the thick peaty overburden stripped from the grain and coal terminal sites, while the southern section of 8 ha was used as a settling pond for the dredge spoil taken from the area of the future coal docks (Plate 4). Although there was opposition to losing an intertidal mudflat for a peat disposal area, it was felt that this solution made better environmental sense than the ocean dumping of up to 10 million m³ of peat which could pose a serious problem because of oxygen depletion as it decomposes and because of the significantly increased water turbidity that dumping at sea would likely cause.

Rock for the berms was blasted from work sites on northern Ridley Island and was dumped directly onto the mud substrate. A report done for the U.S. Army Corps of Engineers (Little, 1974) suggests that this practice may lead to slumping problems because of foundation shear failure⁶. The berms were then sealed by lining them with glacial till which is a mixture of clay, sand, gravel and boulders. Depending on the size and distribution of the clay fraction, glacial till is not necessarily impermeable, as the numerous leaks that were observed in the berms over the summer attest (Plate 3).

4.5.1.1 Peat disposal area. The peat was dumped into the northern section of the bay where it had spread by gravity flow alone. No

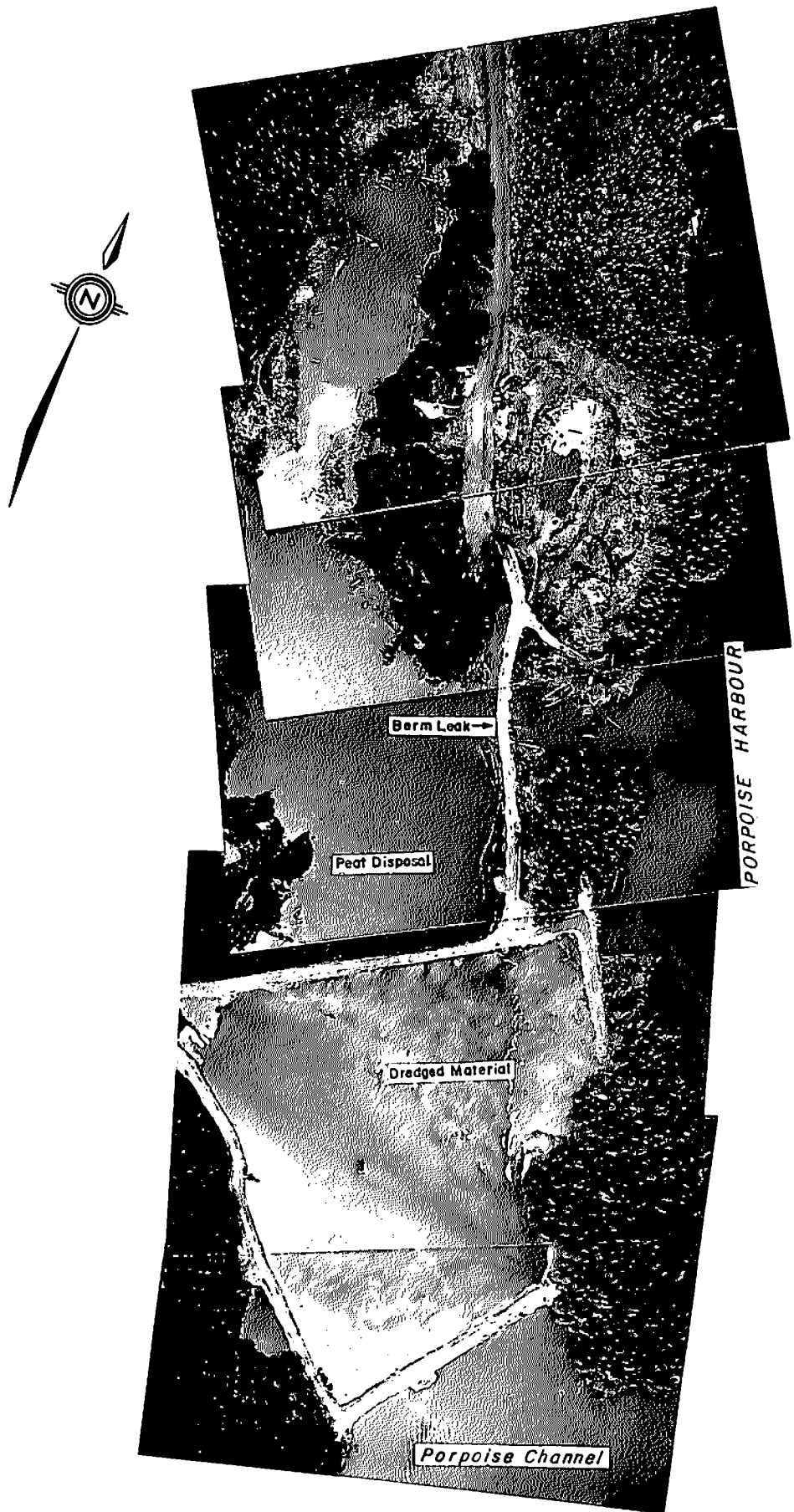


PLATE 4
AERIAL VIEW OF PEAT AND DREDGED MATERIAL CONTAINMENT AREAS
- August, 1982 -

particular problems were noticed except for leaks in the berm which allowed leachate to run into Porpoise Harbour (Plate 3). Lab analysis of the leachate did not reveal unacceptable levels of toxic components (see Appendix II). Considering the nearby pulp mill effluent outfall, the relatively small quantity of leachate from the peat containment area would seem to pose a negligible additional adverse impact on Porpoise Harbour so far, but periodic monitoring should be done to ensure that this continues to be the case.

4.5.1.2 Dredged material disposal area. An estimated 730,000 m³ of marine sediment was piped to the settling pond constructed on the southern part of the Mudflat Bay (Plate 4). The dredged material entered at the northwestern corner of the settling pond and it was thought that the solid material would settle before the water reached the wooden weir at the southeast corner. Water flowed over the weir and into a sump which was drained by six steel pipes that let the water pass through the berm and into Porpoise Channel. Polyethylene sheeting was placed on the area below the outfall pipes to reduce erosion of the berm.

While the dredging operation was in progress, on the June 1982 visit it was observed that the water entering Porpoise Channel had a very high sediment content and indeed appeared almost as black as the dredged material entering the settling pond. The failure of all the sediment to settle likely was due to the very fine particle size of the marine sediment which was composed mainly of silt and clay. Modifications to the design of the settling pond to allow a longer residence time and to reduce turbulence would have contributed to the solution to this problem which was, admittedly, of short duration.

A sample of the water flowing into Porpoise Channel in June revealed extremely high phosphate (98.9 mg/l) and ammonia (2.15 mg/l) readings (see Appendix III). Further samples taken in July, by which time the dredging program was complete, revealed only background levels of these nutrients. The unusually high June nutrient readings remain a mystery for which no explanation is offered.



PLATE 5 SEDIMENT DEPOSITION : PORPOISE CHANNEL
Note Channels made by Berm Leaks



PLATE 6 SEDIMENT DEPOSITION : PORPOISE HARBOUR
Smothering Effect on Intertidal Organisms feared

At low tide on June 9, 1982, it was observed that there were several substantial leaks in the berm facing Porpoise Channel. Sediment laden water was escaping from the containment pond and a sizeable delta had formed along the full length of the berm. By July, measured at a tidal stage of about 0.3 m, the delta was 200 m long and varied in width from about 10 m near the outfall pipes and up to 50 m near the western end of the berm (Plate 5). The depth varied from up to 1 m near the berm to 30 cm about 30 m out from the berm. Assuming an average depth of 40 cm, the total volume of material deposited in front of the berm would be in excess of 2000 m³.

A June sample of the water from one of the leaks in the berm revealed high nutrient levels with an ammonia level even higher than the overflow water sample described above (see Appendix II). After the termination of the dredging program, nutrient levels dropped sharply. Sediment deposited outside the berm had a strong odour of H₂S, but this is considered normal for the reducing conditions that would have existed in their depositional environment.

As noted above, in June there were numerous large leaks in the berm and the water in them, as well as the overflow water, contained large quantities of suspended sediment. By August the number and size of the leaks were significantly smaller and the outfall water was noticeably clearer. There had been no dredging for about six weeks by the time of the August observations.

4.5.1.3 Porpoise Channel. The northern shoreline of Porpoise Channel as far west as Chatham Sound contained intertidal deposits of escaped dredged material. In August, the thickness of the deposited material varied from about 30 cm near the berm to only pockets of deposited sediment at the western end of Porpoise Channel (Figure 6). Although it appears the dredged material did not contain unacceptable levels of toxic components (Appendix II), the sheer amount of sediment deposited is of concern as it may smother intertidal organisms (Plate 6). A cursory

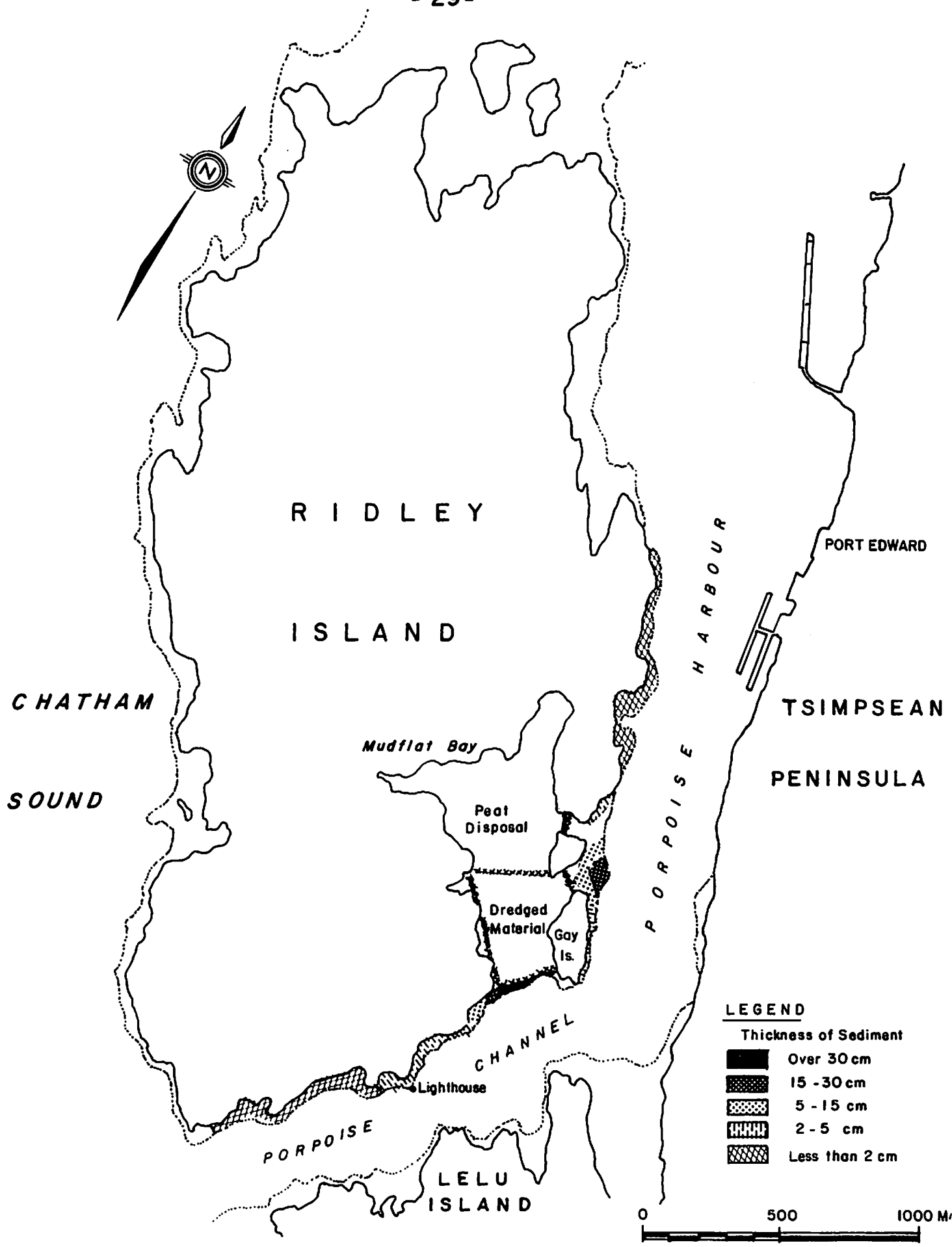


FIGURE 6 SEDIMENT DEPOSITION AREAS

examination of the rocky slopes close to the berm showed the intertidal community to be composed chiefly of barnacles.

West of the lighthouse, where sediment deposition was increasingly thin and patchy, there was more intertidal diversity. Eelgrass, clams, crayfish and shorebird tracks were observed.

4.5.1.4 Porpoise Harbour. Significant quantities of fine-grained sediment have been deposited on the western shore of Porpoise Harbour. The quantity of deposited sediment was greatest in the intertidal area in front of the berm where the sediment lay in depths of up to 20 cm. Away from the berm the quantity diminished as shown in Figure 6.

The intertidal transect on Gay Island (see Appendix I) showed low diversity as compared with the transect run on western Ridley Island. It is conjectured that this may be the result of pulp mill effluent discharge into Porpoise Harbour. Because of the already existing low diversity of intertidal life, it may be that sediment deposition in Porpoise Harbour is less important than it might otherwise be. It seems likely that with the passage of time, the strong tidal currents in the area will redistribute this sediment and compact the rest, making it suitable for recolonization by those species able to tolerate the existing conditions in Porpoise Harbour.

4.5.2 Northern Ridley Island

4.5.2.1 Northwestern Ridley Island. It is from this area that the peaty overburden has been stripped to expose the underlying bedrock. The rock has been leveled for the grain terminal site, while in the coal area considerable blasting has occurred to level the ground and to create the dumper pit. Rock has been dumped along the shoreline of the grain and coal areas, infilling the indentations to "even off" the coastline. This rock was fairly free of organic materials and did not appear to be increasing the turbidity of the receiving water. It is surmised that

intertidal organisms will be able to recolonize the rocky shore, although the steeper slope and more exposed shoreline may lead to a changed make-up of the intertidal community.

In August, large quantities of rock were being dumped into Discharge Cove, adjacent to the site of the proposed petrochemical terminal on southwest Kaien Island. The continued infilling of Discharge Cove, perhaps out to Bishop Island, to provide additional flat land for industrial expansion would constitute an encroachment onto an adjacent intertidal habitat and would require evaluation.

4.5.2.2 Canoe Passage. The railway causeway being constructed across Canoe Passage from northern Ridley Island to southern Kaien Island at a point between East Billmor Bay and West Billmor Bay will eventually support 20 sets of tracks. The construction method entailed covering the underlying mud substrate with sand to support the rockfill. Overburden from south Kaien Island was being dumped into West Billmor Bay. From Zanardi Rapids, the CN mainline will be relocated which will require some infilling of East Billmor Bay on both sides of the present rail line. In August, the fate of the ponded area between the road and rail causeways had not been decided. According to NHB, discussions were proceeding with CN regarding the possible infilling of this area for CN rail yard use.

Waterfowl and shorebird use of the mudflats between Ridley and Kaien Islands and of West and East Billmor Bay has been reported (Canning, 1979). Present construction will result in the mudflat areas of Canoe Passage, West Billmor Bay and some of East Billmor Bay being unavailable for such bird use in the future.

Concern has been expressed over the reduced flushing of pulp mill wastes discharged into Porpoise Harbour as a result of the closure of Canoe Passage. No study of this was carried out prior to causeway construction and at this time it is difficult to establish even the minimum height of tide required for there to have been water passing

through Canoe Passage. An examination of aerial photos taken prior to construction, in conjunction with the calculated tidal stage at the time of the photographs, backed up by incidental information contained in various reports (e.g. Ker, Priestman, 1970), all lead to the conclusion that water lay in Canoe Passage only at high tide and that the volume of water must have been quite small as compared with Zanardi Rapids and Porpoise Channel. The loss of this flow should have a negligible impact on the flushing of pulp mill effluent from Porpoise Harbour.

4.5.3 Other Areas of Environmental Concern

4.5.3.1 Deer. It has been suggested that construction activities on Ridley and southern Kaien Islands will result in reduced numbers of deer on Ridley Island. The reasons given are loss of deer winter range on south Kaien and increased predation by wolves and man because of improved access to Ridley Island.

An official of the provincial Fish and Wildlife Branch in Prince Rupert expressed the opinion that the deer population of Ridley is small relative to that of adjacent areas and that the loss of winter range due to construction would not be too significant. Regarding the question of increased predation by wolves as a result of construction of the causeways, it was noted that Ridley Island always had been readily accessible since Canoe Passage was inundated only at high tide. Ridley Island, like Kaien Island, will be closed to the discharge of firearms so human predation should not be a problem. However it was pointed out that the building of the access road from Highway 16 will likely lead to deer being killed by vehicles, especially in times of poor driving conditions. In view of the above comments, the question of deer losses is classified as a minor effect.

4.5.3.2 Construction camps. Brief inspection of the Peter Kiewit and Sons work camp at Miller Bay showed a clean site with no debris or garbage in evidence. The Waste Management Branch has issued a permit for the discharge of 8000 gal/day of waste water into Miller Bay. It appears that human sewage flows first into a septic tank before being discharged. The camp site is being expanded to house more workers and the WMB permit has been amended to allow the discharge of 16,000 gal/day from the expanded camp. It should be noted that there is no sewage treatment facility in Prince Rupert - all sewage is discharged untreated into Prince Rupert Harbour.

4.5.3.3 Used lubricating oil. Peter Kiewit equipment maintenance staff stated that the used lubricating oils are stored in a prominently marked holding tank and collected by a private contractor for recycling. At the time of the August visit, the Northern Construction site (grain terminal) was shut down by a labour dispute so it was not possible to confirm their practice in this regard.

5 CONCLUSIONS AND RECOMMENDATIONS

In view of the degraded environmental situation that existed in the area because of the pulp mill and the absence of rare or endangered species, it seems that Ridley Island was not an unreasonable choice for port development. However, it is close to Flora Bank, an important area for fish and waterfowl, and care must be taken to ensure that developments on Ridley Island do not adversely affect the productivity of that area.

By August, 15-20% of the land area and 50-60% of the shoreline of Ridley Island had been directly affected by the construction process or indirectly by sediment deposition. Considering the large scale of the construction activities, reasonable care was being taken to minimize their adverse consequences. Sites were maintained in an orderly state, there was little debris scattered over the sites, used lubricating oil was collected for recycling and there was the feeling of a well organized operation. However, a number of points of concern will require continued monitoring:

- Berm design and construction were less than ideal as the numerous leaks indicated. While the number and size of the leaks seemed to get smaller over the course of the summer, periodic checks should be made to ensure that the situation does not change for the worse. In conjunction with this, the quantity and quality of leachate from the peat disposal area should be monitored to see that Porpoise Harbour is not adversely affected.
- A great deal of sediment escaped from the dredged material settling pond, particularly during the dredging phase of the operation. Much of this sediment was deposited on intertidal areas of southeastern Ridley Island. Although this material was not toxic in nature, the large quantity involved likely had a smothering effect on intertidal

organisms. With the passage of time, it is believed that the sediment will be redistributed by tidal action and that the remaining sediment will be compacted and should prove a reasonable substrate for recolonization by intertidal organisms. It is recommended that periodic observations be made to determine whether this is, in fact, the case.

- Aerial photographs taken prior to construction and indirect evidence from various reports (e.g. Ker, Priestman, 1970) suggest that the closure of Canoe Passage has resulted in a negligible reduction in the rate of flushing pulp mill wastes from Porpoise Harbour.
- Only limited waterfowl and shorebird use of the intertidal mudflats of Mudflat Bay, Canoe Passage and East and West Billmor Bay has been reported (Cannings, 1979). While the loss of any one of these areas is not considered critical to bird life, the loss of all of them is not favourably regarded and so it is recommended that the area of East Billmor Bay utilized for the railway be kept to a minimum.
- The intertidal community of Discharge Cove has come back remarkably well since the discharge of sulfite mill effluent was discontinued in 1976. This area at the western entrance to Canoe Passage should not be infilled before an evaluation of the habitat is carried out.
- It is expected that recolonization of the new rocky shores of north-western Ridley Island will readily occur. However, the steeper slope and increased exposure to Chatham Sound may alter the make-up of the intertidal community relative to the pre-existing one. Periodic observations of the recolonization process should be made to determine how the intertidal community has been affected.

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APPENDIX I

INTERTIDAL TRANSECTS

An intertidal transect is a way of surveying the plants and animals inhabiting the shoreline between the high and low tide marks. Information is gathered on the number of individuals and diversity of species so that different sites may be compared (e.g. for evidence of environmental stress), or so that a site may be observed over a period of time to see if, and in what way, the intertidal community changes.

In these intertidal transects a qualitative rather than a quantitative approach was taken. Dominant species in the upper, middle and lower intertidal zones were noted. The division into the three zones was rather arbitrary, being based on changes in slope, elevation, substrate and the inhabiting organisms. The upper zone is exposed to the atmosphere except at high tidal levels, while the lower zone is exposed only at extremely low tides and the middle zone alternates frequently between being covered and exposed. All intertidal transects were run at near extreme low tides (0 to +1.5 m).

Intertidal transect "A" was located on the west coast of Ridley Island (see Figure 7), at a point just south of the coal terminal construction site, in an area untouched by construction activities. The site was chosen to be useful in gauging the effects that infilling the coastal indentations will have on adjacent areas and, in addition, for comparing the species colonizing the new intertidal zone with the pre-existing one. The area chosen had a large number of individuals from diverse species (see Table 2).

Intertidal transect "B" is situated on the east coast of Gay Island on Porpoise Harbour. Overall diversity and numbers appeared low as compared with transect "A". This may be the result of the pulpmill effluent which is discharged into Porpoise Harbour.

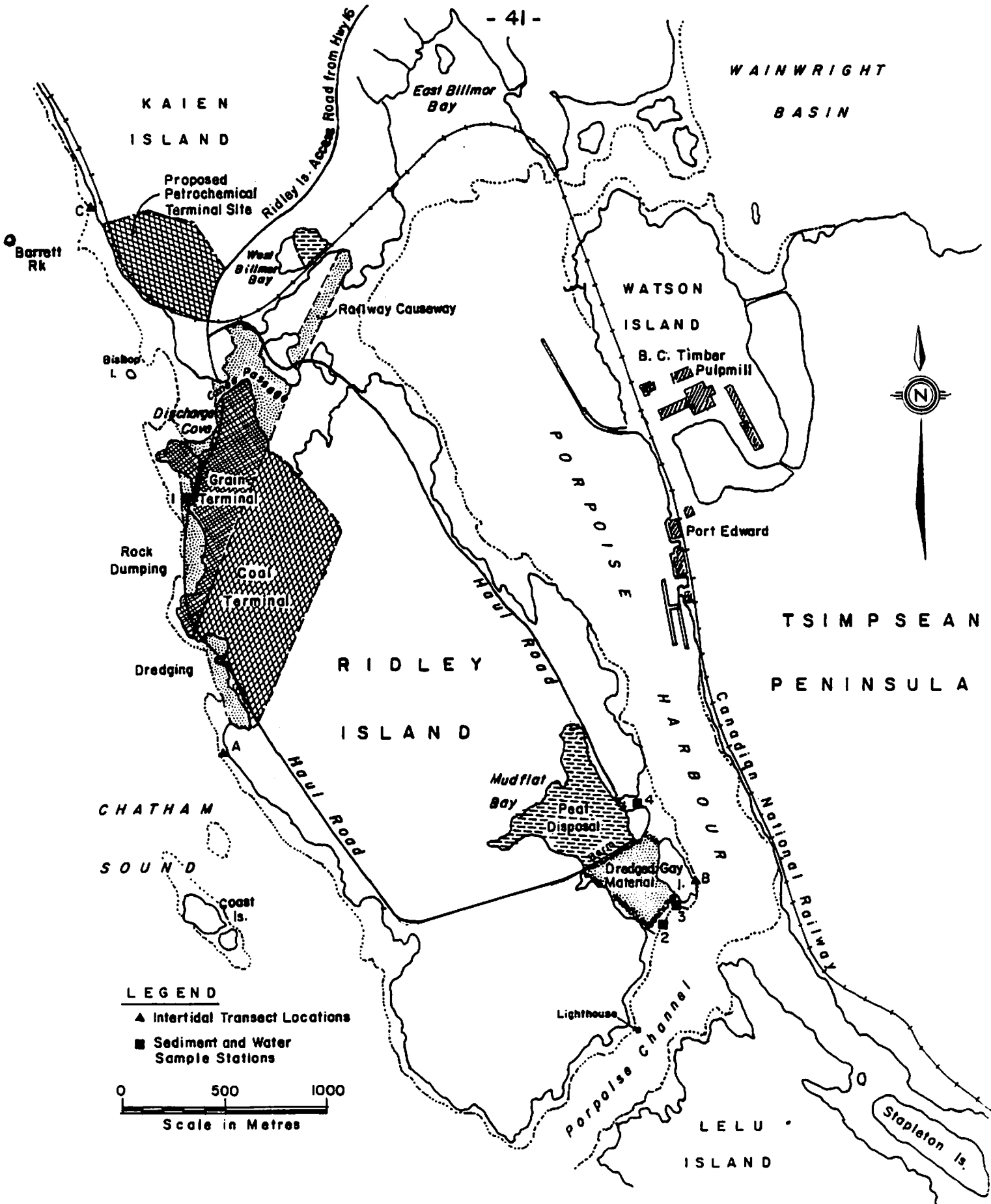


FIGURE 7 INTERTIDAL TRANSECT LOCATIONS AND SEDIMENT AND WATER SAMPLE STATIONS

Intertidal transect "C" is located on Kaien Island, just north of the proposed petrochemical terminal site. Transect "C" showed both lower numbers and diversity than transect "A" and in addition, the fauna present tended to be small which suggests a relatively young community. It is tempting to attribute this to residual effects of the pulpmill effluent which was formerly discharged into Chatham Sound about 1 km south of the transect location. However, a study (Packman, 1977) carried out in the same area with similar results commented that the intertidal community found there was "characteristic for that type of beach and had not suffered significantly from the presence of the red liquor discharge".⁷

TABLE 2 INTERTIDAL TRANSECTS

"A"	"B"	"C"
<u>UPPER</u> (0-12 m from forest)	(0-12 m from forest)	(10-21 m from spur line)
STEEPLY SLOPING BEDROCK <i>Acmaea scutum</i> (limpet) - many <i>Littorina</i> sp. (snail) <i>Balanus glandula</i> (barnacle) <i>Fucus gardneri</i> (rockweed - algae) <i>Mytilus edulis</i> (mussel)	STEEPLY SLOPING BEDROCK <i>Fucus gardneri</i> - widespread <i>Balanus glandula</i> - scatted groups <i>Acmaea scutum</i> <i>Mytilus edulis</i> (above fauna generally small in size)	1 m BOULDERS <i>Balanus glandula</i> <i>Acmaea scutum</i> - many <i>Littorina</i> sp. <i>Fucus gardneri</i> - sparse
<u>MIDDLE</u> (12-19 m)	(12-16 m)	(21-30 m)
GENTLE SLOPES, BOULDERS & COBBLES <i>Fucus gardneri</i> <i>Enteromorpha intestinalis</i> (algae) <i>Mytilus edulis</i>	STEEPLY SLOPING BEDROCK <i>Balanus glandula</i> (widespread) <i>Fucus gardneri</i> - sparse <i>Mytilus edulis</i> - very few	GENTLE SLOPE - 50 cm BOULDERS <i>Balanus glandula</i> <i>Acmaea scutum</i> - many, small <i>Littorina</i> sp. - many, small <i>Enteromorpha intestinalis</i>
<u>LOWER</u> (19-37 m)	(10 m-water)	(30 m-water)
STEEPLY SLOPING BEDROCK <i>Fucus gardneri</i> <i>Mytilus edulis</i> <i>Balanus glandula</i> <i>Acmaea scutum</i> <i>Littorina</i> sp. <i>Katharina tunicata</i> (chiton) <i>Nereocystis leutkeana</i> (kelp)	STEEPLY SLOPING BEDROCK <i>Enteromorpha intestinalis</i> <i>Balanus glandula</i> (much of this zone is covered with a thin layer of sediment)	GENTLE SLOPE, COBBLES & SAND <i>Enteromorpha intestinalis</i> <i>Balanus glandula</i> - sparse <i>Laminaria</i> sp. (kelp) <i>Nereocystis leutkeana</i> - offshore
<u>TIDAL STAGE</u>		
July 21 - 8:30 am PDT 0.0 m	August 19, 1982 - 10:30 am PDT 1.4 m	August 20, 1982 - 8:15 am PDT 0.6 m

APPENDIX II

LABORATORY ANALYSIS

Sediment Samples

Sample #1 was taken from a beach in northwest Ridley Island close to the grain terminal (Figure 7). Samples #2 and #3 were taken from the delta formed by escaped dredged material outside the berm on Porpoise Channel in southeast Ridley. Sample #2 was taken in June and sample #3 was taken in July. Sample #4 was a beach sample taken from a site near the peat containment berm facing Porpoise Harbour.

All samples contained 10-20% very fine sand (.063 - .15 mm), but in addition, the two beach samples (#1 and #4) contained about 75% coarse to fine sand while the two delta samples (#2 and #3) were composed of over 80% silt and clay. Thus, the delta samples are very different from the beach samples in terms of particle size.

Results of the physical and chemical analysis of the delta samples (#2 and #3) correspond very closely with the results obtained in an EPS sediment sampling program at the 10 fathom depth off northwest Ridley Island in October 1981. The dredged sediments now on southeast Ridley Island came from the same vicinity as the October 1981 samples.

TABLE 3 SEDIMENTS

PARTICLE SIZE DISTRIBUTION

	SAMPLE 1 (NW Ridley, June 82)	SAMPLE 2 (Delta, June 82)	SAMPLE 3 (Delta, July 82)	SAMPLE 4 (Porpoise Harbour)
SAND (< 0.15 mm)	75.8%	0.7%	0.3%	78.3%
VERY FINE SAND (.063 - 0.15 mm)	21.6%	9.9%	16.0%	11.8%
SILT AND CLAY (< .063 mm)	2.6%	89.4%	83.7%	9.9%

ANALYSIS FOR METALS

	----- ug/g -----			
Ba	96.1	76	91.6	140
Be	< .2	< .2	.4	< .2
Cd	2.6	1.3	.3	.8
Cr	12.1	26	29.6	28.7
Cu	12.1	24.4	26.4	25.5
Mn	273	454	484	385
Mo	< .8	< .8	4.4	< .8
Ni	3	19	20	11
Pb	< 3	5	< 3	4
Sn	< 2	< 2	2	< 2
Sr	37.4	45.2	50.9	43.4
V	33	60	77	71
Zn	154	75	90	74
Ti	738	1170	1530	1200
Si	3160	4870	4410	3940
Mg	4020	8730	9420	8780
P	487	1000	1220	1100
Ca	7500	6600	7890	5870
Na	1080	2590	3010	2620
Al	7090	18800	21700	17500
Fe	12400	31500	32900	29200

APPENDIX III

LABORATORY ANALYSIS

Water Samples

The water samples were taken in the same vicinity as the correspondingly numbered sediment samples. All water samples were taken in June. Where resampling was done in July, the July figure is shown in brackets beside the corresponding June figure.

It will be noticed that the suspended sediment (non-filterable residues) content of samples #2 and #3 dropped precipitously from June to July, corresponding to the termination of the dredging program after the June sampling period. As mentioned elsewhere in the text, the nutrient level (phosphate and ammonia) also dropped from June to July and it is postulated that this also resulted from the termination of dredging. The phosphate level in sample #4 increased from June to July, but as it was still at a low level this may be due to sample variability.

TABLE 4 WATER SAMPLES

	SAMPLE 1 (NW Ridley)	SAMPLE 2 (Leak in Dyke)	SAMPLE 3 (Settling Pond Outfall)	SAMPLE 4 (Peat Leachate)
	----- mg/l -----			
NON FILTERABLE RESIUIDES	140	17000 (280)	94000 (30)	25 (36)
pH	7.3	7.5	7.5	7.5
TOTAL PO ⁴	0.195	4.13 (0.471)	98.8 (0.145)	0.021 (0.105)
NITRITE	0.012	0.035	0.031	0.023
NITRATE	0.99	0.02	0.01	0.17
AMMONIA	< 0.005	2.40 (0.576)	2.15 (0.009)	0.11 (0.012)
RESIN ACIDS	TRACE	TRACE	N/A	TRACE
METALS	TRACE	AS PER SEDIMENT SAMPLES #2 & 3		TRACE