TSIMPSEAN PENINSULA

FEDERAL - PROVINCIAL

JOINT COMMITTEE

PHASE I

BULK MARINE TERMINAL SITES

IN THE PRINCE RUPERT AREA

OF

BRITISH COLUMBIA

(ENGINEERING ASPECTS)

Prepared by: H. Krigolson

D. Krefting

Approved by: J. V. MacDonald

Swan Wooster Engineering Co. Ltd.
Consulting Engineers
1525 Robson Street
Vancouver, B.C.
V6G 1C5

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PREFACE

This volume encloses the initial engineering report (Phase I) on Bulk Marine Terminal Sites in the Prince Rupert Area of British Columbia as well as an Addendum covering information supplied to the Environmental Consultant (NEAT) during the course of Phase II.

EXECUTIVE SUMMARY

1. This Study, Bulk Marine Terminal Sites in the Prince Rupert Area of British Columbia (Engineering Aspects), was commenced by Swan Wooster Engineering Co. Ltd. on August 13th, 1974 at the request of the Federal Provincial Joint Committee. The major purpose of this Study was to select sites for an Environmental Analysis with a secondary intent of providing engineering background for the Environmental Study.

2. The given Terms of Reference were related to three major factor categories to develop general specifications for bulk terminal site locations in this area. The three factors were land transportation, ocean transportation and site development.

3. The land transportation specifications were found to be unrestricted rail access for unit and freight trains and good road access for both product and employee transportation.

4. Ocean transportation was reviewed and it was determined that a total of 250 to 300 vessels would be necessary to handle the throughput being considered. This number of sailings indicated that three berths would be required and the proposed terminal must be easily accessible in order to avoid any delays to berthing and loading operations. The Terms of Reference specified a vessel size range of up to 150,000 DWT., it is felt that this could well be exceeded by the 1980's. The increased size would make it even more important to ensure that the

selected sites do not impose restrictions.

5. A wind and wave analysis was carried out to determine which areas would be sufficiently sheltered in order to avoid berthing delays. This analysis indicated that the major wave problem would be that created by the south-easterly winds. Swells were found to be insignificant in comparison with these wind generated waves.

6. When consideration was given to the vessel sizes most likely to carry the specified products it was found that water depths in excess of 65 ft. would be required at the coal berths and 45 ft. at the other two berths.

7. The site development specifications were that a reasonably level area, about elevation 35 would be necessary. The area should be some 100 acres in extent; 70 acres for coal, 30 acres for other products, with a shape of 800 to 1200 ft. wide by 5400 to 3600 ft. long.

8. A review of the study area indicated three zones in which site selection was governed by similar topographical features. The zones were along the Skeena River, along Work Channel and along the Outer Coast.

9. The first of these, the Skeena River zone, was found to have insufficient depth of water to allow passage of the large vessels

being considered. Overcoming this problem by dredging was considered infeasible because of the high sediment load carried in the river.

10. The next zone, Work Channel, was found lacking in the ocean navigation aspects. The problem was the restriction imposed by the extremely narrow channel entrance and the tidal currents in this entrance as well as the long, narrow channel itself. These factors would make it very difficult if not impossible for large vessels to enter this area.

11. The Outer Coastal zone was found to have three sub-areas within it: the Outer Coastal area from the northern tip of the Peninsula to Digby Island, Prince Rupert Harbour and that area between Digby and Smith Islands at the south end of the zone. The Outer Coastal area was found mainly inadequate from the point of view of both land and ocean transportation except at Port Simpson. The two southern areas, Prince Rupert Harbour and Digby Island to Smith Island, were determined as areas where possible bulk terminal sites could be found.

12. The three areas in the Outer Coastal zone found suitable for bulk terminal location were examined and possible sites were at:

1. Port Simpson
2. Smith Island
3. Kitson Island

EXECUTIVE SUMMARY (cont'd)

4. Ridley Island
5. Digby Island
6. Melville Arm
7. Bacon Cove
8. Schreiber Point
9. Pethick Point
10. Osborne Cove

13. Each of these sites was considered within the frame of the site specifications developed previously and it was found in the final analysis that only those sites at Port Simpson, Kitson Island and Ridley Island were satisfactory for a bulk terminal such as being considered in this study. The six sites in the Inner Harbour at Prince Rupert were considered not acceptable because of vessel size limitations (100, 000 DWT. maximum) while the Smith Island site was not considered acceptable because of its poor rating in all three major considerations.

14. The three factors in the site specifications; land transportation, ocean transportation and site development were also used as major sub-divisions in the site comparison section along with an additional factor, materials handling. These four factors were the areas examined for capital and differential costs in order to determine present worth comparative values for each site.

EXECUTIVE SUMMARY (cont'd)

15. While considering materials handling factors it was determined that another possibility for site location should be that of handling non-coal products at a more sheltered Inner Harbour site (Fairview Point) and the coal products at either Kitson Island or Ridley Island.

16. The five possible sites (Port Simpson, Ridley Island, Kitson Island, Fairview Point/Kitson Island and Fairview Point/ Ridley Island) were analyzed on the basis of cost differentials for the four major factors. These cost items were assimilated into a matrix which indicated a ranking in order of suitability of Fairview Point/Ridley Island, Fairview Point/Kitson Island, Ridley Island, Kitson Island and Port Simpson.

17. Three factors to which costs could not be applied were CNR ranking, Pacific Pilotage Authority preference and site expansion capabilities. These three items were combined in a matrix that indicated a ranking order of Port Simpson or Ridley Island equal and first with Fairview Point/Ridley Island second and Kitson Island, Fairview Point/Kitson Island equal and last.

18. The comparative present value cost matrix and the factor matrix were combined to produce an overall site ranking which indicated that either a combined site at Ridley Island or a split site at Fairview Point/Ridley Island were preferred above all other

sites. The Kitson Island site was last with the Port Simpson and Fairview Point/Kitson Island sites in between.

19. The report conclusion was that the most preferable site from the engineering point of view is either a combined site at Ridley Island or a split site alternative with the coal handled at Ridley Island and the non-coal products at Fairview Point. If further differentiation between the two alternatives is required a more detailed analysis must be done.

INDEX

LIST OF FIGURES

LIST OF FIGURES (cont'd)

1. INTRODUCTION AND TERMS OF REFERENCE

1.1 Introduction

1.2 Terms of Reference

1. INTRODUCTION AND TERMS OF REFERENCE

1.1 Introduction

This study "Bulk Marine Terminal Sites in the Prince Rupert Area of British Columbia (Engineering Aspects)", was commissioned by the Tsimpsean Peninsula Federal-Provincial Joint Committee in August of 1974. The Engineering Consultants, Swan Wooster Engineering Co. Ltd., commenced work on Phase I of this study on August 13th, 1974.

The purpose of this Study was twofold: one to select sites for environmental analysis and two, to provide engineering data as background for the environmental study. The study does not consider incremental development of the bulk terminal facilities as the major impact of the facility will only be reached when it is operating at the levels indicated in the Terms of Reference.

1.2 Terms of Reference

The Terms of Reference for Phase I of this study as outlined by the Joint Committee are as follows:

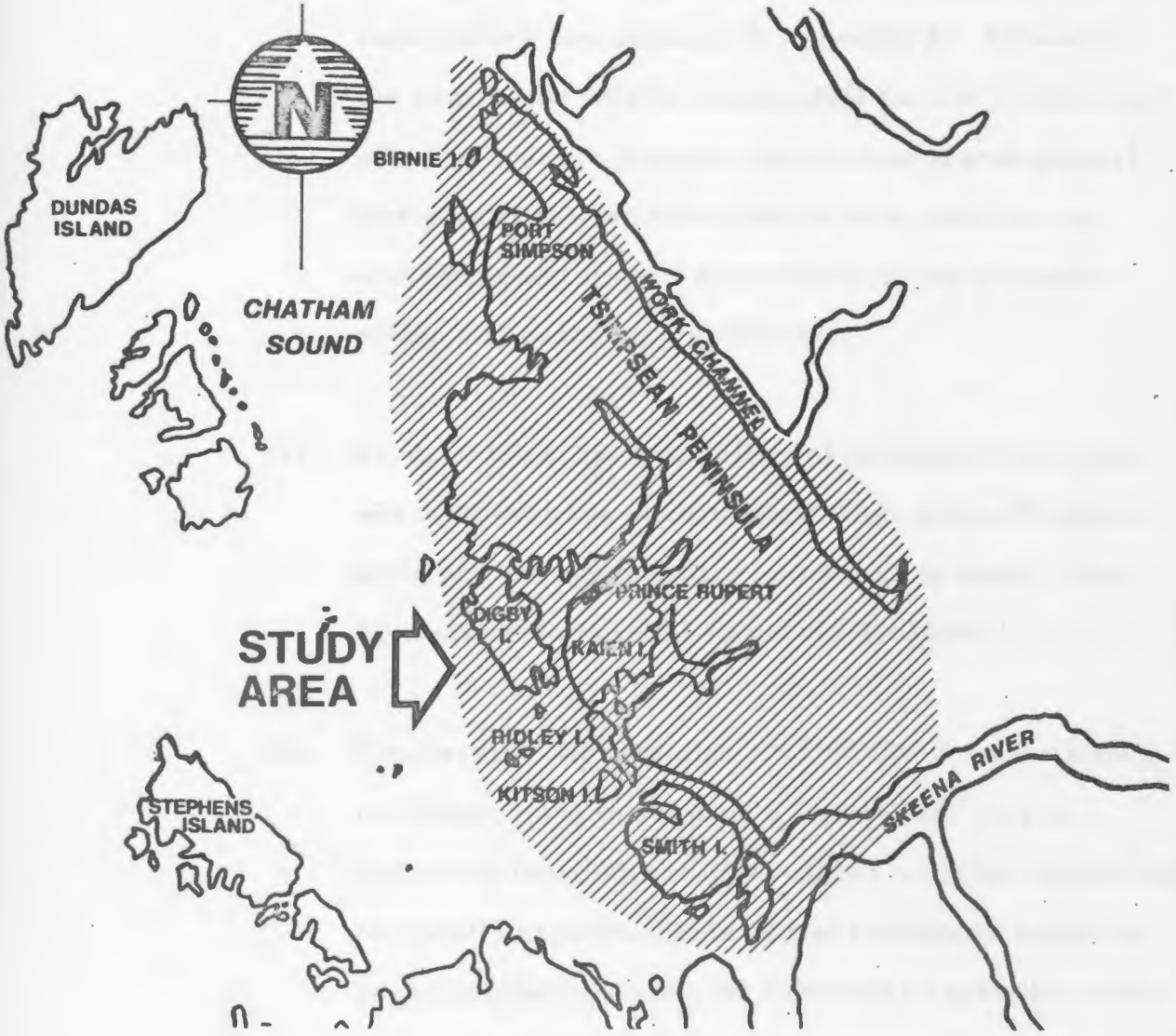
"General Objective

To identify alternative sites for bulk loading facilities in the Prince Rupert area (see map for area of reference) by assessing the suitability and feasibility of alternative locations in terms of the physical requirements of the proposed facility."

1. INTRODUCTION AND TERMS OF REFERENCE (cont'd)

1.2 Terms of Reference (cont'd)

FIGURE 1-1 REFERENCE AREA



1. INTRODUCTION AND TERMS OF REFERENCE (cont'd)

1.2 Terms of Reference (cont'd)

The specific objectives of this project will be as follows:

PHASE I - OVERVIEW & SITE CAPABILITY

Note: Guidelines for the physical requirements of proposed bulk loading are outlined in Appendix A. However the contractor will be responsible for the development of more specific physical requirements and general site plan of the facility to serve as a base for the environmental impact assessment of the proposed action and associated activities.

(1) To determine the availability of existing information and to assess the quality of existing pertinent information and its applicability to the task at hand. (See Appendix B for partial list of information.)

(2) To overview all potential sites within the area shown in Figure 1 and to prepare a "short list" of sites indicating those alternatives which could be considered physically capable. This initial evaluation would be based primarily on (A) the functional capability of the landscape at these alternative sites to accommodate the bulk loading facility and its support facilities, (B) evaluation of access corridors from the land base, (C) evaluation of potential access for berthing and manoeuvring of bulk carriers.

More specifically this phase is oriented to identifying the sites physically capable of supporting the proposed

1. INTRODUCTION AND TERMS OF REFERENCE (cont'd)

1.2 Terms of Reference (cont'd)

facility. Included will be:

(a) Determination of total area requirement from throughput projections for all commodities.

(b) Identification of capable sites from amongst the apparently capable locations within the area of reference. Criteria: area available for site; back up land available; shipping access (actual or potential); rail and road access (actual or potential).

(c) Determination of extent of works and the approximate costs at each site and the projected impacting factors (locational) -

e.g. - amount of dredging required
- amount of fill required
- ancillary works required, i.e. bridges, access trackage, upgrade of trackage, etc.

(d) Identification of status and ownership of each identified capable site.

(e) Presentation of report including the following will be required by

1. INTRODUCTION AND TERMS OF REFERENCE (cont'd)

1.2 Terms of Reference (cont'd)

1. Apparently capable sites.
2. Identified capable sites.
3. Basis for elimination of each discarded site.
4. Projected impacting factors of each identified capable site."

1. INTRODUCTION AND TERMS OF REFERENCE (cont'd)

1.2 Terms of Reference (cont'd)

APPENDIX "A"

PRINCE RUPERT ENVIRONMENTAL IMPACT STUDY

Proposed physical requirements of the bulk-loading facility:

1. The study will investigate the environmental impact of a bulk-handling facility in the Prince Rupert area. It is suggested that for the purpose of this study the assumption be made that coal and other potential mineral outputs may be handled at such a facility. The reasons for this suggestion are:

   (a) The facilities now under construction at Fairview are designed for general cargo.

   (b) If an expansion of the existing grain handling facilities will be required in the future the most suitable location of additional facilities would be adjacent to the Fairview terminal.

2. The bulk loading facilities should be based on the following estimated maximum annual throughput:

Item	Tons/Annum
Coal	10,000,000
Copper	1,500,000
Lead-zinc	50,000
Molybdenum	50,000
Asbestos	300,000

1. INTRODUCTION AND TERMS OF REFERENCE (cont'd)

1.2 Terms of Reference (cont'd)

3. The facilities should be designed to handle vessels of up to 150,000 deadweight tons.

4. A minimum depth of 65 feet (low water channel depth) will be required for berthing and manoeuvring of vessels of 150,000 DWT. The same depth may in the future be sufficient for vessels of up to 200,000 DWT.

2. PRELIMINARY ASSESSMENT

2.1 Site Specifications

2.1.1 Land Transportation
2.1.2 Ocean Transportation
2.1.3 Site Development
2.1.4 Materials Handling

2.2 General Assessment

2.2.1 Skeena River Zone
2.2.2 Work Channel Zone
2.2.3 Coastal Zone
2.2.4 Conclusion

2.3 Potential Sites

2.3.1 Analysis
2.3.2 Conclusions

2. PRELIMINARY ASSESSMENT

The four major factors affecting bulk terminal location are land transportation, ocean transportation, site development and materials handling. The first two factors, land and ocean transportation, are the major items. A measure of their importance with respect to the latter two items is obtained when total handling costs of bulk product movements are considered. The transportation portion is usually in the order of 80% to 90% of the total. It is, therefore, of prime importance to ensure that the proposed bulk handling facilities be located so that there is little or no impediment to the expeditious handling of the number and size of ships and trains required to handle both present and future volumes of traffic.

The subsequent sections of this chapter relate the Terms of Reference to the four factors mentioned above. The evolved site specifications are then applied to the study area, first on a general basis then to potential sites in order to determine which of them are capable of handling the specified traffic. The latter analysis will determine which of the potential sites are worthy of a more detailed site comparison.

2.1 Site Specifications

Site specifications for the Prince Rupert area bulk terminal were obtained by relating the annual throughputs to the four major considerations, land and ocean transportation, site development and materials handling.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

The specified annual throughput, to be handled in ships up to 150,000 DWT. in size, is as follows:

FIGURE 2-1		ANNUAL THROUGHPUT
1.	Coal	10,000,000 tons
2.	Copper	1,500,000 tons
3.	Lead/Zinc	50,000 tons
4.	Molybdenum	50,000 tons
5.	Asbestos	300,000 tons

2.1.1 Land Transportation

The commodities listed in Figure 2-1 indicate that the bulk of the traffic through the proposed terminal will be by rail car however some of the non-coal products could be transported to the terminal in trucks depending on the mine location.

The rail transportation system should be able to accommodate large unit train operations for the coal was well as mixed train operations for the other products. The mixed train operations, because the products will originate at many different locations, should be handled as car load shipments by the railway. This means that trains bringing the traffic to the Prince Rupert Area will terminate their cars at existing rail yards away from the site.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

The volumes of rail traffic generated by the specified throughput indicate a need for uninterrupted rail access, therefore water crossings by rail ferry systems are not feasible. This traffic volume also makes bridges over waterways carrying ship traffic infeasible. These bridges, unless they are costly heightened structures, would have to open and would therefore impose undesirable restrictions on both the railway and the waterway.

Road traffic for both product and employee transportation, indicates a need for a good quality two lane paved access highway. Ferries or opening bridges in the road system are acceptable but not desirable.

2.1.2 Ocean Transportation

The relationship between the specified throughput and the expected vessel size range is shown in Figure 2-2.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

FIGURE 2-2 VESSEL TRAFFIC

Product	Coal	Other Products
Probable Vessel Size Range	60,000 DWT. to 150,000 DWT.	15,000 DWT. to 50,000 DWT.
Average Vessel Size	100,000 DWT.	25,000 DWT.
Average Vessel Load	100,000 Tons	10,000 Tons to 15,000 Tons
Ship Calls	100	150 - 200

When the number of sailings derived above are considered along with the nature of the materials to be handled, it is indicated that a possible three berths will be required at this terminal. There should be one for each of the general categories of cargo, i.e. coal, copper concentrate and other specified products. The number of sailings indicated requires that these three berths operate at a high level of efficiency. In order to do this the proposed terminal must be easily accessible to all vessels within the size range and be reasonably sheltered to avoid weather delays to berthing and loading operations.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

It should be noted that the maximum vessel size specified, 150,000 DWT., will in all likelihood be exceeded in the coal trades by the 1980's. This factor indicates that special care must be taken in the site selection process to ensure that the larger vessels are not excluded by navigation limitations on any site.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

In order to determine possible locations where the shelter necessary as indicated above could be obtained, a wind and wave environment study was carried out. The wind information, obtained from the Weather Recording Station at the Prince Rupert Airport on Digby Island for the years 1964 to 1968 inclusive, was used to obtain a five-year mean of the winds which is shown graphically on Figure 2-3. The information indicates two major prevailing wind directions; in the spring and summer, moderate westerlies are common; in the fall and winter months, strong south-easterlies prevail. In the five-year period that was analyzed all winds in excess of 30 mph. were recorded from the south-east, south and south-west directions. It was also noted that there were no winds in excess of 63 mph. A further check on the maximum recorded wind speed in the area was made and it was determined that between 1939 and 1968 the speed was 66 mph. from the southeast with an estimated maximum gust velocity of 91 mph.

The wind data was then used to predict the extent of waves that could be generated in the area. The calculated wave information was checked by comparing the results against information obtained from a wave

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

recorder (wave rider) that the Marine Service Branch of Environment Canada had in place off of Prince Rupert as shown in Figure 3-1. The predicted wave environment indicated that the proposed facilities should be sheltered from south-easterly winds.

Another form of wave action that could affect this area, swells, would be generated by storms in the Gulf of Alaska. Weather maps of the North Pacific Ocean were obtained from the Department of Transport and used to determine the weather conditions in the Gulf of Alaska that could generate swells. A computer analysis was then done in order to determine the level of swell activity in the study area. This analysis revealed that in comparison to the wind generated waves in the immediate area swells would be insignificant.

A further consideration in ocean transportation is depth of water. The vessel sizes indicated in Figure 2-2 would require a minimum depth of water of 65 feet at the coal berth and 45 feet for the other berths.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

2.1.3 Site Development

The major consideration in site development is the amount and shape of land required. The annual throughput volumes shown on Figure 2-1 indicate the area requirement for this type of facility would be about 70 acres for coal and 30 acres for other products which gives a total of some 100 acres. The actual shape of this site could be imposed by either railway needs or by the coal stockpiling system. If the unit train concept is considered, the sites should have sufficient width for a turnaround loop, something in the order of 1200 feet. Alternatively, if the train handling is done off the site, a narrower width, something in the order of 800 feet to contain the stockpiles, would be suitable. These width figures, when combined with the required area, give approximate site dimensions of 800 to 1200 feet wide by some 5400 to 3600 feet long.

Another consideration is that this type of operation requires a level site fairly close to the loading elevation of the vessels. Although elevation 35 is desirable it can vary without creating handling problems.

2. PRELIMINARY ASSESSMENT (cont'd)

2.1 Site Specifications (cont'd)

2.1.4 Materials Handling

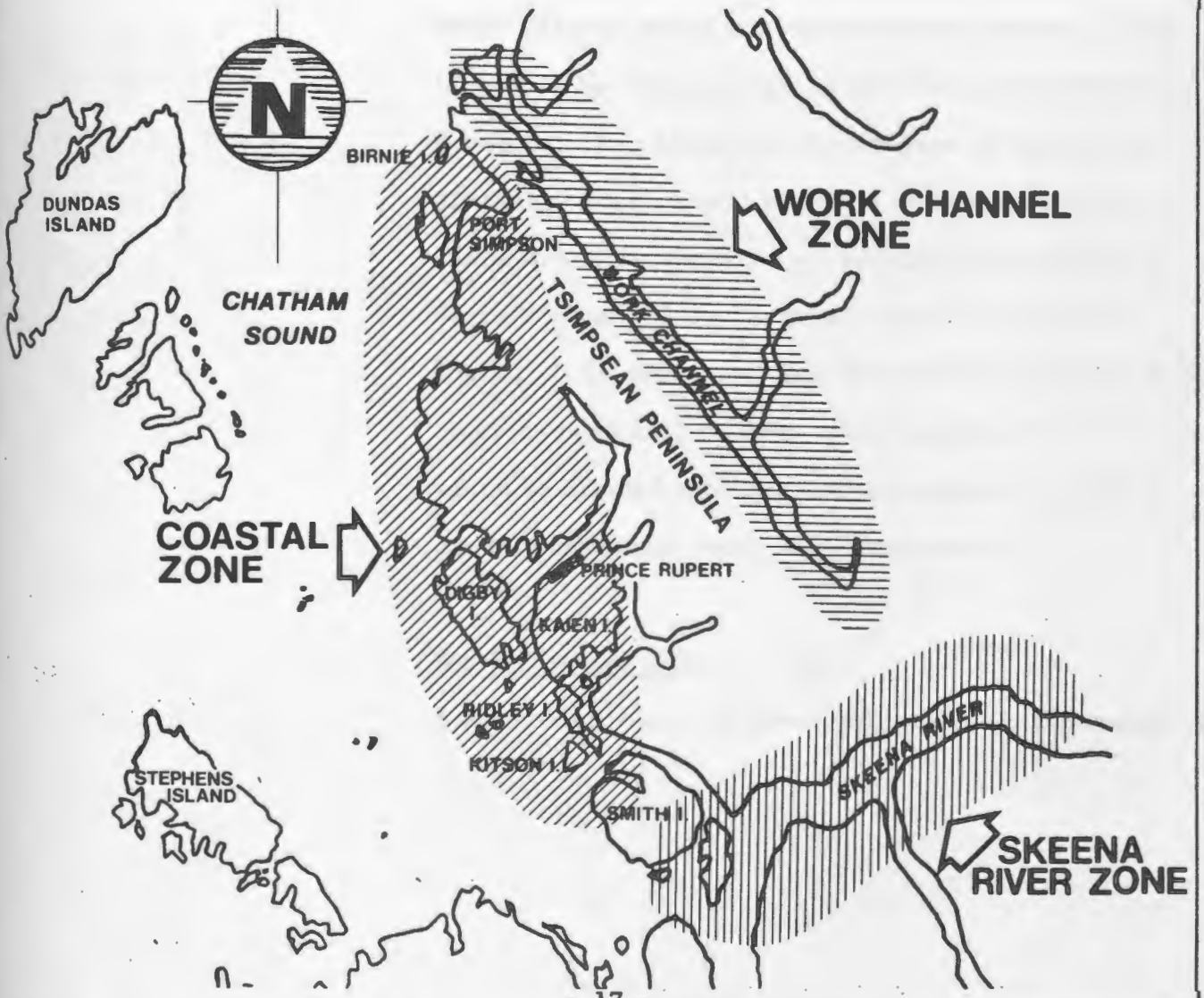
Materials handling considerations are not too important at this stage of the site selection. They do, however, become more important in the detailed site comparison. Therefore, consideration of materials handling requirements was restricted to the detailed site analysis in Chapter 3.

2. PRELIMINARY ASSESSMENT (cont'd)

2.2 General Assessment

The topography of the study area indicates three zones in each of which site selection is governed by similar topographical features. These zones, Skeena River, Work Channel and Coastal are shown on Figure 2-4. The zones were assessed on the basis of the site specifications which related to land transportation, ocean transportation and site development as established in Section 2.1 of this study.

FIGURE 2-4 STUDY AREA BASIC ZONES



2. PRELIMINARY ASSESSMENT (cont'd)

2.2 General Assessment (cont'd)

2.2.1 Skeena River Zone

The Skeena River zone is comprised of the river itself and its immediate delta and is located in the southern section of the study area. A review of the area indicated that it would be satisfactory from the point of view of land transportation and site development, however the ocean transportation considerations provided a major barrier to locating a site within this zone. The problem was related to the lack of sufficient water depth to allow passage of the large vessels being considered in this study. This lack of water depth could be overcome by extensive dredging. In addition to the expense of the initial dredging, there would be large volumes of maintenance dredging required on an almost continuous basis because of the large silt load in the Skeena River. It is estimated that the sediment load in this river system is 7 million cubic yards per year which is divided into suspended material 3 million yards and bottom load, 4 million yards.

2.2.2 Work Channel Zone

A review of this zone revealed major shortcomings

2. PRELIMINARY ASSESSMENT (cont'd)

2.2 General Assessment (cont'd)

in ocean transportation and site development. The problem with respect to ocean transportation is that the navigation access to the area is poor, the long narrow channel presents severe navigation problems for large vessels. The channel entrance, very narrow with extreme tidal currents (perhaps 4 to 6 knots), may make it impossible for the large vessels being considered in this study to enter. With respect to site development, no suitable land area adjacent to the deep water in the channel was found.

2.2.3 Coastal Zone

The third zone given consideration in the study extends from the northern tip of the Tsimpsean Peninsula down to the Skeena River delta. Three areas within this zone were considered, the outer coastal area from the tip of the Peninsula to Digby Island, Prince Rupert Harbour, and the area between Digby and Smith Islands.

The outer coastal area was found to present problems in both land and ocean transportation. The problem with respect to land transportation was lack of available access corridors. Rail access to the northern area was found feasible on only one

2. PRELIMINARY ASSESSMENT (cont'd)

2.2 General Assessment (cont'd)

corridor. This corridor followed a route from the Khyex River north along Work Channel to Port Simpson. Road access to most areas is feasible with the consideration of ferry links.

The problems related to ocean transportation in the outer coastal area were twofold:

- much of the area does not have deep water close to the shoreline.
- most of the coastline in this area is exposed to the prevailing south-easterly winds and therefore not sufficiently sheltered for a bulk terminal.

The only area where these problems were found to be minimal was in Port Simpson.

In the Prince Rupert Harbour area, land transportation access problems were fairly severe, while the water depth and shelter indicated this to be a likely area for location of bulk terminal sites.

The other section of this zone, the area between Digby Island and Smith Island, was considered and it was found that there were no serious problems with respect to either of the three major factors. Therefore this area was also considered to

2. PRELIMINARY ASSESSMENT (cont'd)

2.2 General Assessment (cont'd)

be a likely location for the proposed bulk terminal sites.

2.2.4 Conclusion

The general assessment of the study area was made on the basis of the three major considerations, transportation access, both land and ocean, and site development. Most of the study area was found lacking in one or two of these aspects. The locations found to be worthy of further consideration for bulk terminal sites were Port Simpson, Prince Rupert Harbour and part of the outer coast between Digby and Smith Islands.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites

The three areas that were found suitable for potential sites in the previous section of this report were studied in more detail. The study revealed ten locations that held potential as bulk terminal sites. The locations of these ten sites, Port Simpson, Smith Island, Kitson Island, Ridley Island, Digby Island, Melville Arm, Bacon Cove, Schreiber Point, Pethick Point, and Osborne Cove, are shown in Figure 2-5.

Once located, the ten potential sites were individually examined with respect to the specifications developed in Section 2.1. Part of this examination consisted of discussions with the CNR and the Pacific Pilotage Authority with respect to land and ocean transportation problems. Our written requests to these authorities and their comments are shown in Appendix A. Their comments are incorporated in the following discussions pertaining to each of the ten potential sites selected for examination. A possible site layout is shown for each location in the following discussions.

FIGURE 2-5 POTENTIAL SITE LOCATIONS

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

2.3.1 Analysis

a) Port Simpson

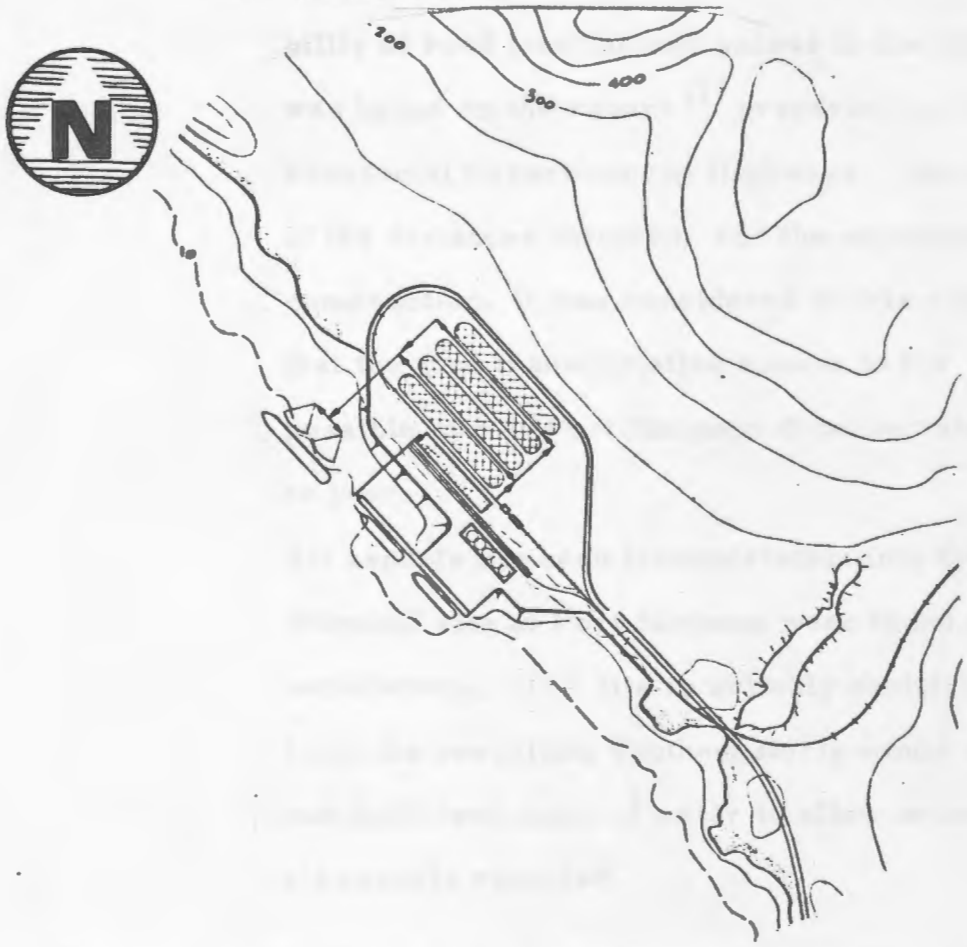


FIGURE 2-6 POSSIBLE SITE LAYOUT-PORT SIMPSON

Land transportation access into the Port Simpson site was found to be feasible. The rail access would be via a route from the Khyex River bridge on the existing CNR track, along the Lachmach River valley to Work

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

Channel and then along the west side of Work Channel to the vicinity of the Port. The feasibility of road location and access to the site was based on the report (1) prepared for the Provincial Department of Highways. Because of the distances involved, and the expensive construction, it was considered at this stage that the land transportation access to the possible site at Port Simpson must be rated as poor.

All aspects of ocean transportation into the potential site at Port Simpson were found to be satisfactory. The site is suitably sheltered from the prevailing south-easterly winds and has sufficient depth of water to allow access to all vessels required.

An area suitable for site development was found on the eastern side of the Port Simpson Harbour. This site, although it requires removal of solid rock, should be a satisfactory location for the 100 acre terminal site.

(1) Route reconnaissance of Prince Rupert to Port Simpson Highway prepared by F.F. Slaney and Co. Ltd., Vancouver, in November 1973.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

b) Smith Island

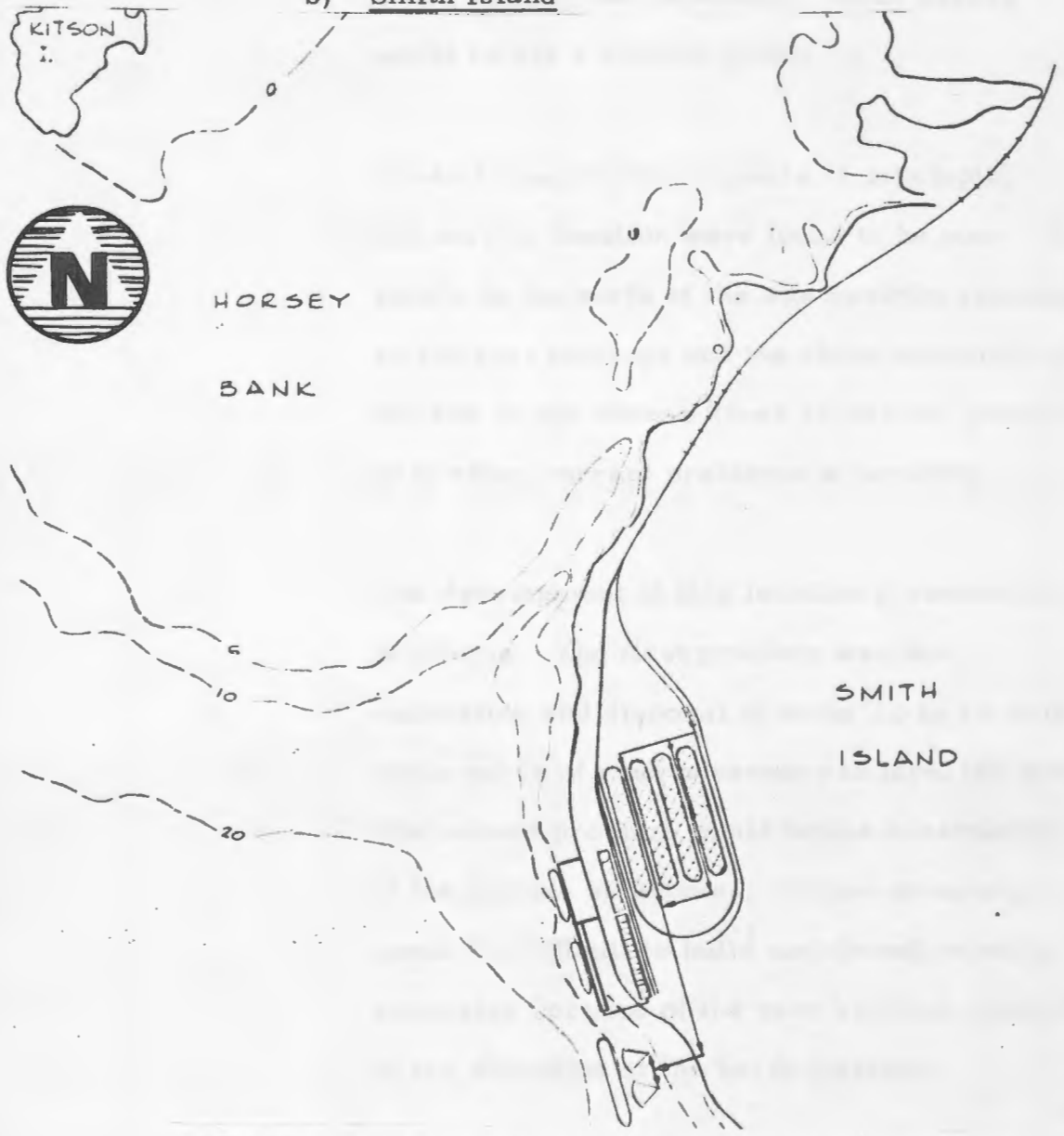


FIGURE 2-7 POSSIBLE SITE LAYOUT-SMITH ISLAND

A potential site was located on the north-west corner of Smith Island. Land transportation access to this site is poor. The rail access across Inverness Passage would require construction of a bridge with sufficient clearance for navigation by fishing vessels. This bridge

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

would be long and expensive. Road access would be via a similar route.

Ocean transportation aspects of developing a site on this location were found to be poor. The shoals to the north of the site restrict approaches for port landings and the close proximity of the site to the Skeena River raises the possibility of river current problems at berthing.

Site development at this location presented two problems. The first problem was the excavation and disposal of some 10 to 15 million cubic yards of rock necessary to level the site. The second problem would be the construction of the marine structures. These structures would be difficult to build and therefore very expensive because of the near vertical drop-off of the shoreline at the berth location.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

c) Kitson Island

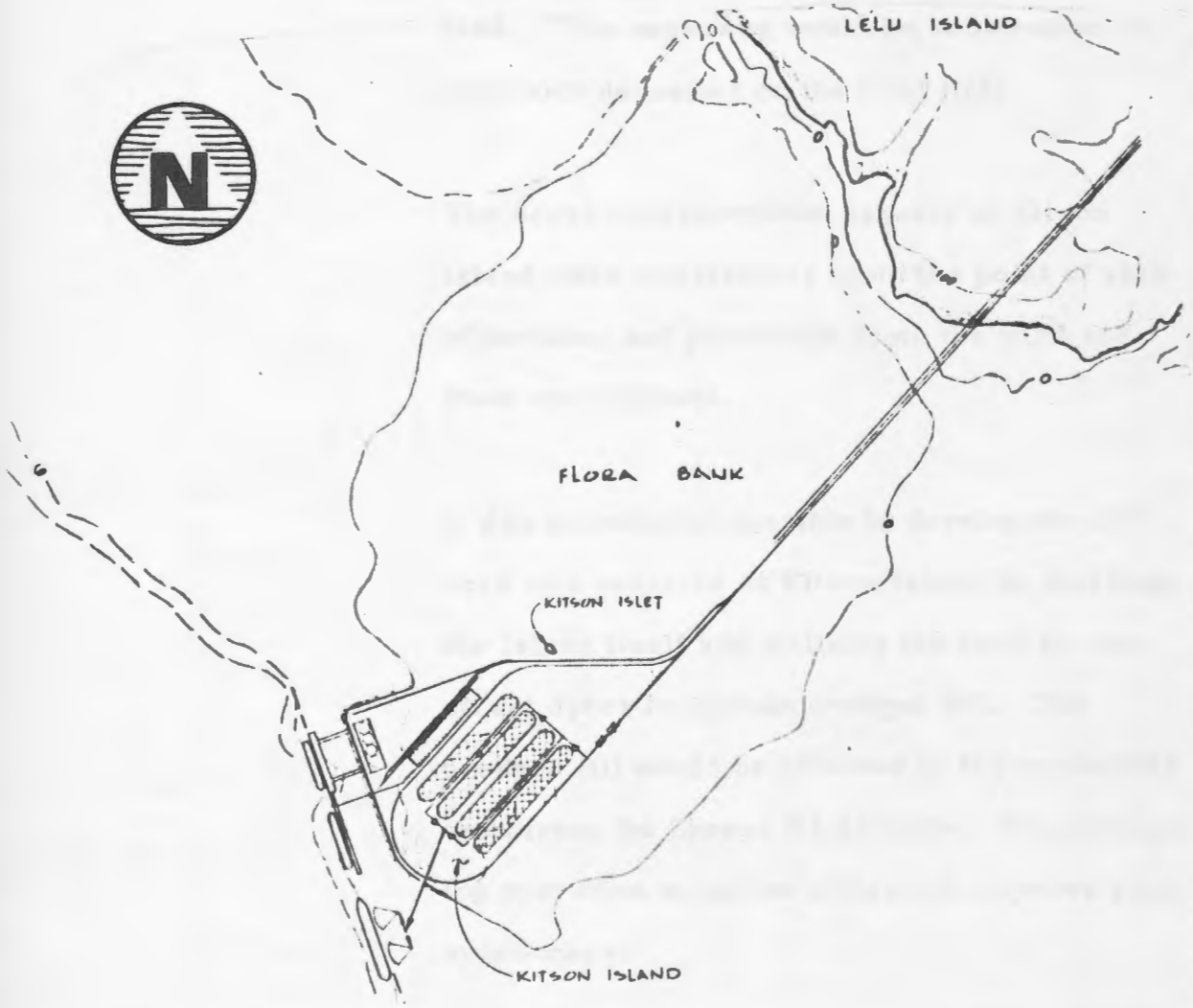


FIGURE 2-8 POSSIBLE SITE LAYOUT-KITSON ISLAND

Kitson Island, on the outer edge of the Skeena River Delta, was also considered a potential site location. The land transportation access to this site could be attained by construction of

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

a causeway some 2 miles long from the mainland. This causeway would be constructed of shot rock deposited on the tidal flats.

The ocean transportation aspects at Kitson Island were satisfactory from the point of view of berthing and protection from the wind and wave environment.

It was considered possible to develop the 100 acre site required at Kitson Island by levelling the Island itself and utilizing the rock to construct dykes to contain dredged fill. The dredged fill would be obtained in the immediate area from the Skeena River delta. This dredging operation would be utilized to improve ship approaches.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

d) Ridley Island

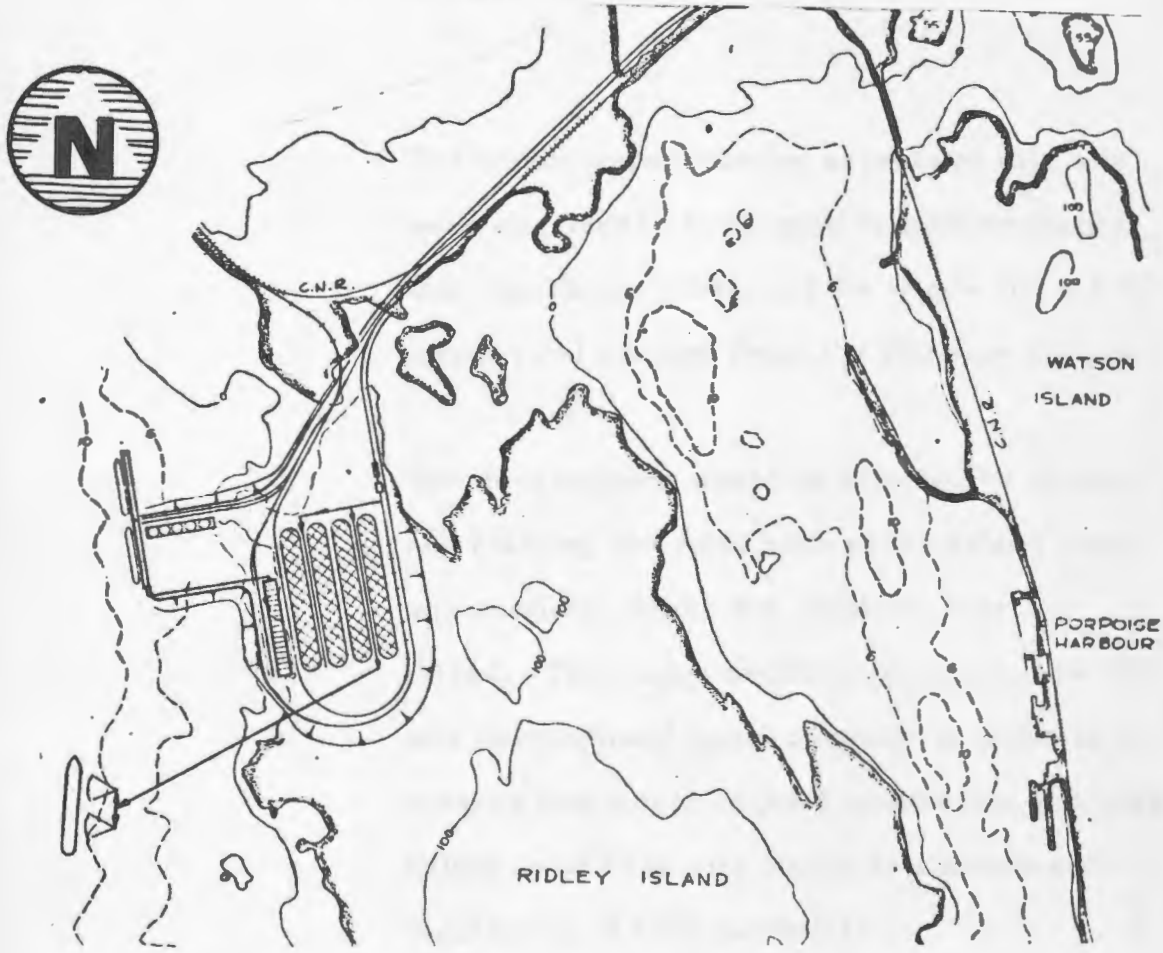


FIGURE 2-9 POSSIBLE SITE LAYOUT-RIDLEY ISLAND

A feasible location for a bulk terminal site was found on the north-west corner of Ridley Island. Transportation access to this site was good requiring the construction of some two miles of railway line and about four miles of road.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

The ocean transportation aspects of this site were considered to be good despite exposure to a significant portion of the winds and a 2 to 3 knot tidal current from the Harbour entrance.

Site development would be attained by drilling and blasting the solid rock of the Island itself and partially filling the shallows near the Island. The major problem in connection with site development could possibly be pockets of muskeg that would require excavation and back-filling before the site would be suitable for stockpiling of bulk materials.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

e) Digby Island

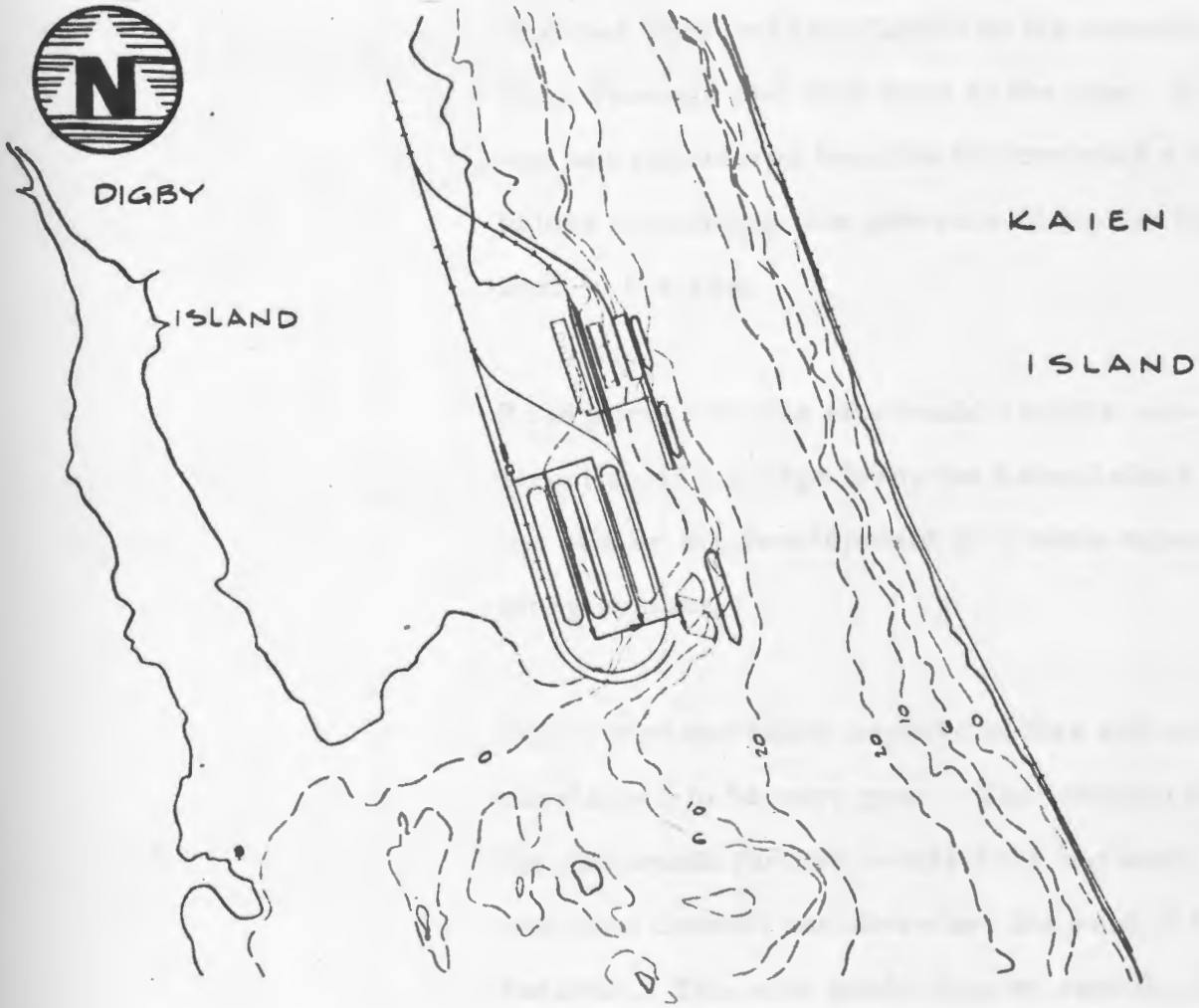


FIGURE 2-10 POSSIBLE SITE LAYOUT-DIGBY ISLAND

A possible site for a bulk terminal facility exists on the south-east corner of Digby Island. The land transportation access to this site would present severe problems. Rail access would require constructing some 32 miles of rail line along the eastern side of Kaien Island, across Fern Passage and then along the perimeter of the Harbour, crossing it at Tuck

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

Point and along the north shore of the Harbour to cross over to Digby Island in the vicinity of Venn Passage and then down to the site. It was not considered feasible to construct a rail bridge crossing at the entrance of the harbour over to the site.

Road access to this site would require construction of a bridge from the Kaien Island to the site or the development of a more extensive ferry system.

Ocean transportation aspects of this site were considered to be very poor. The location of the site would further restrict the harbour entrance channel and therefore the rest of the harbour. This site would only be capable of handling vessels of less than 100, 000 DWT.

Site development at this location would be good as the terrain is relatively flat. However there could be some problems with respect to muskeg pockets in the site area.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

f) Melville Arm

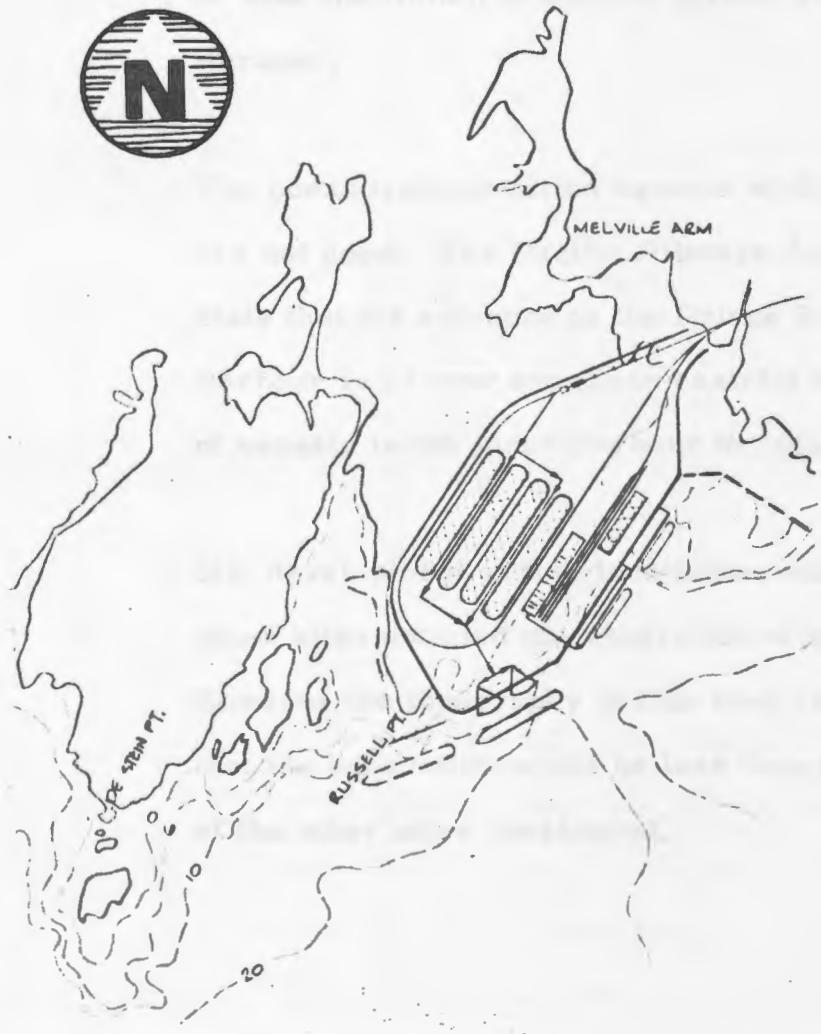


FIGURE 2-11 POSSIBLE SITE LAYOUT-MELVILLE ARM

The Melville Arm site is located at the west end of the north shore of the Prince Rupert Harbour. Land transportation access to this site is not good. The rail location would require construction of some 25 miles of railway along the same route as outlined for the Digby Island site. Road access would require

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

construction of a road along a similar route or else institution of a ferry system across the Harbour.

The ocean transportation aspects of this site are not good. The Pacific Pilotage Authority state that the entrance to the Prince Rupert Harbour is narrow enough to restrict the size of vessels in the Inner Harbour to 100, 000 DWT.

Site development at this location as with all other sites entailed the excavation of solid rock. However the topography in this area is such that the excavation would be less than at some of the other sites considered.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

g) Bacon Cove

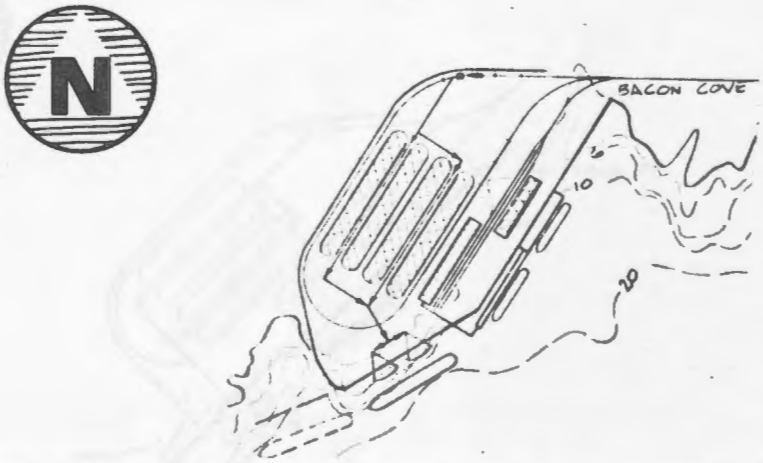


FIGURE 2-12 POSSIBLE SITE LAYOUT - BACON COVE

Bacon Cove is located in the middle of the northshore of the Prince Rupert Harbour. The problems with respect to both land and ocean transportation and site development are similar to those described for the Melville Arm location.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

h) Schreiber Point

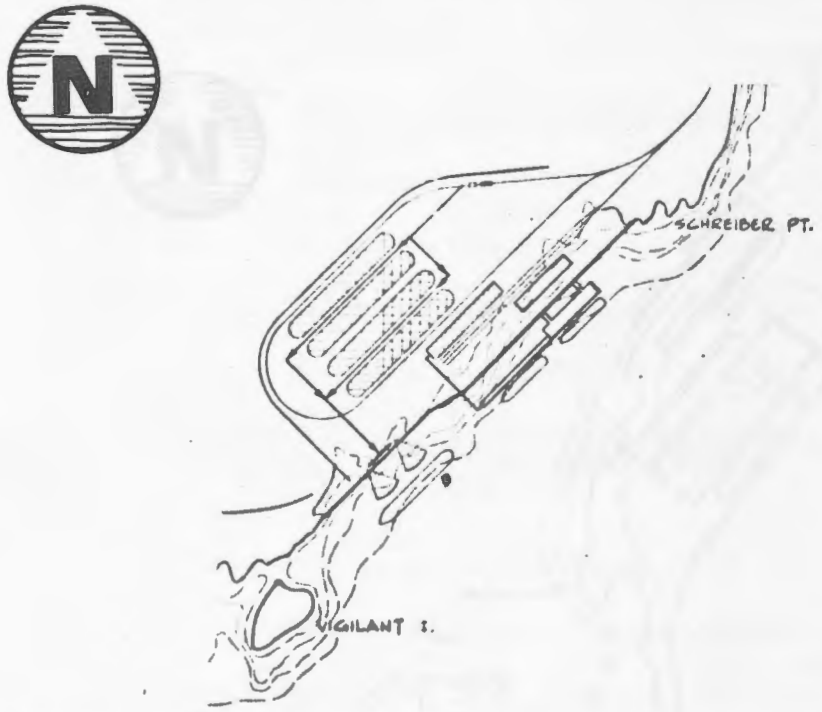


FIGURE 2-13 POSSIBLE SITE LAYOUT-SCHREIBER POINT

This site, located on the east end of the north shore of Prince Rupert Harbour, has problems similar to those outlined for the Melville Arm location. However there is one additional problem in that the vessel size would be further restricted to something less than 100, 000 DWT.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

i) Pethick Point

FIGURE 2-14 POSSIBLE SITE LAYOUT - PETHICK POINT

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

Pethick Point is located on the south shore of the Prince Rupert Harbour just to the east of Fern Passage. Land transportation access to this site is possible however it does involve the construction of a railway line along the southern and eastern edges of Kaien Island and across Fern Passage to the site. Road access to the site could be attained by construction of a bridge from Seal Cove over to the site itself.

Ocean transportation at this site is such that the vessel size is restricted to less than 100, 000 DWT. size.

Site development at this location would be difficult and expensive as it involves 15 to 20, 000, 000 cubic yards of rock with little option of using the excavated material as fill. In addition the construction of the marine structures would be difficult because of the precipitous sub-marine topography. This precipitous topography could require either very expensive conventional wharf structures or floating structures which, if not impractical, would be extremely difficult to construct because of the 26 foot tide range.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

j) Osborne Cove

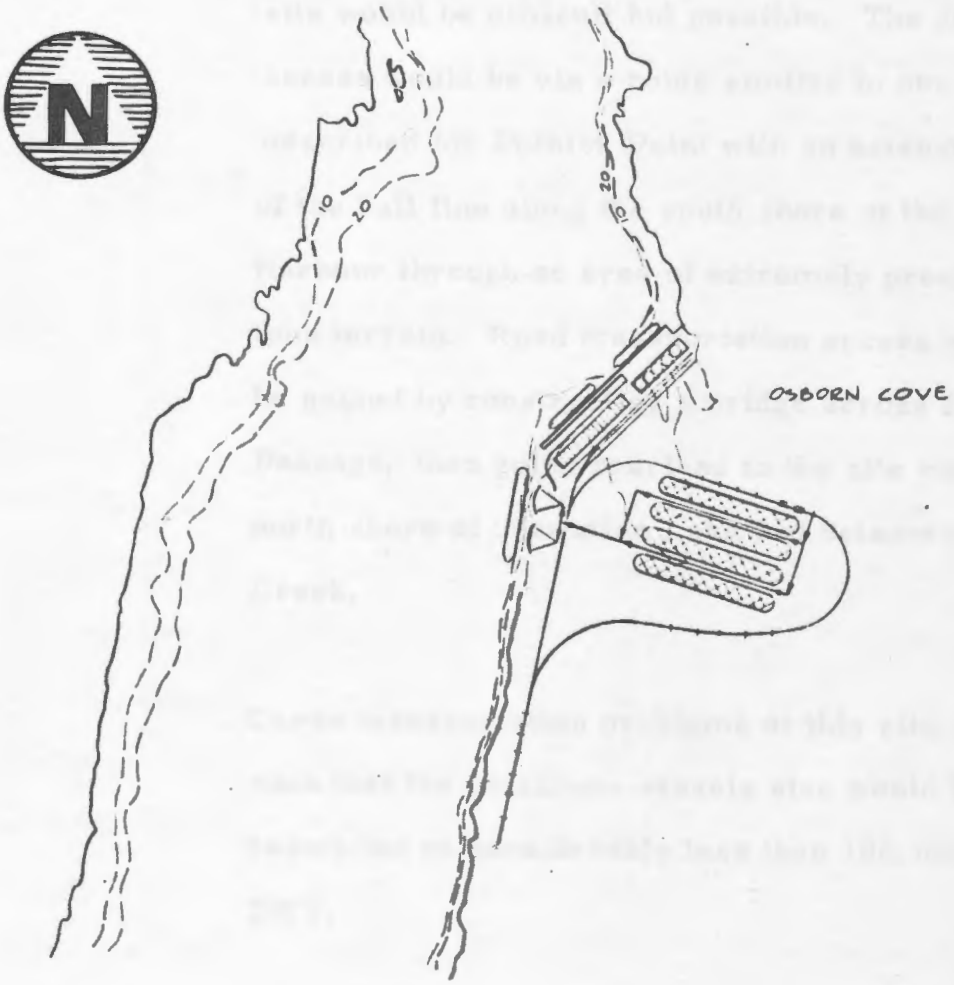


FIGURE 2-15 POSSIBLE SITE LAYOUT-OSBORNE COVE

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

This last potential site is located up the narrow arm from the Prince Rupert Harbour on the south side. Land transportation access to this site would be difficult but possible. The rail access would be via a route similar to one described for Pethick Point with an extension of the rail line along the south shore of the Harbour through an area of extremely precipitous terrain. Road transportation access would be gained by constructing a bridge across Fern Passage, then going overland to the site via the north shore of Shawatlan Lake and Scissors Creek.

Ocean transportation problems at this site are such that the maximum vessels size would be restricted to considerably less than 100, 000 DWT.

Site development at this location would not be extremely difficult although excavation of solid rock is required as with all other sites. The construction of the marine facilities could present a problem similar to that described for the Pethick Point location.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

2.3.2 Conclusions

The three major factors (land transportation, ocean transportation and site development) as discussed in Section 2.3.1 were rated on the basis of good, poor or not acceptable in order to develop an approximate site comparison. This is shown in Figure 2-16, Potential Site Ratings.

FIGURE 2-16 POTENTIAL SITE RATINGS

Potential Site	Assessment Factors: Land Transportation	Ocean Transportation	Site Development
1. Port Simpson	Poor	Good	Good
2. Smith Island	Poor	Poor	Poor
3. Kitson Island	Good	Good	Good
4. Ridley Island	Good	Good	Good
5. Digby Island	Poor	N/A	Good
6. Melville Arm	Poor	N/A	Good
7. Bacon Cove	Poor	N/A	Good
8. Schreiber Pt.	Poor	N/A	Good
9. Pethick Pt.	Poor	N/A	Poor
10. Osborne Cove	Poor	N/A	Poor

The not acceptable (N/A) rating, applicable only to the ocean transportation factor for Sites 5 to 10 inclusive, eliminates these sites from further consideration. These sites are unacceptable as they

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

cannot be reached by vessels within the specified size range, i.e. 150,000 DWT. This factor has major impact on areas of importance in site development as follows:

1. Customer Acceptance - The selected site must not impose too great a risk or additional cost on the user fleet or the customers will buy elsewhere.

2. Operation Cost - Restrictions in user vessel size (i.e. restricting movements to smaller more costly vessels) will bring about unacceptable cost increases.

3. Terminal Throughput - Small vessels carrying the throughput means more vessel movements requiring additional berths and possible limitations to total throughput.

Of the four remaining sites left for consideration, Site 2,Smith Island,is also unacceptable. This site rates poor in all three major assessment factors and therefore has no redeeming features.

2. PRELIMINARY ASSESSMENT (cont'd)

2.3 Potential Sites (cont'd)

The other three Sites - Port Simpson, Ridley Island and Kitson Island - are capable of supporting a bulk terminal facility as specified in the Terms of Reference. Therefore these sites will be analyzed further in order to develop more detailed comparison factors so that the best site from the Engineering point of view may be determined.

3. SITE ANALYSIS

3.1 Comparison Factors

3.1.1 Land Transportation
3.1.2 Ocean Transportation
3.1.3 Site Development
3.1.4 Materials Handling

3.2 Site Details

3.2.1 Port Simpson
3.2.2 Ridley Island Site
3.2.3 Kitson Island Site
3.2.4 Fairview Point/Ridley Island
3.2.5 Fairview Point/Kitson Island

3.3 Comparison of Sites

3. SITE ANALYSIS

The previous chapter found 3 potential sites that were capable of supporting a bulk terminal facility within the Terms of Reference. These 3 sites (Port Simpson, Ridley Island and Kitson Island) are analyzed in more detail in this chapter in order to evolve better comparison characteristics. The analysis was done on a basis similar to the previous section. That is, each site is analyzed and compared on the basis of four major factors:

1. Land Transportation
2. Ocean Transportation
3. Site Development
4. Materials Handling

The first section of this chapter discusses the common parts of these four factors and defines the areas of comparison. In this section the materials handling consideration indicates a need for considering splitting the terminal so that coal is handled at one location and the non-coal products at another. This concept gives rise to the consideration of two additional alternatives, both consider handling the non-coal products through Fairview Point while the coal is handled over Ridley Island or Kitson Island.

The second section defines comparable characteristics of the five site possibilities in detail within the framework of the four major factors.

3. SITE ANALYSIS (cont'd)

The last section summarizes the site alternatives and compares them to determine which, if any, of the sites is best from an engineering point of view.

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors

The comparison factors used in the detailed site analysis, as mentioned previously, are land transportation, ocean transportation, site development and materials handling.

Within each of these major factors there are areas where operating cost differences could occur. These areas are outlined in this section in order to point out where the differential costs used in the site comparison are derived. Other elements of the major factors which are relevant to this study and common to each of the sites are also discussed.

3.1.1 Land Transportation

In the analysis of each individual site, railway costs considered were construction capital costs, operating costs and maintenance costs. The differential cost items identified in the latter two items were crew transport costs, costs of supply and operating pusher locomotives over increased grades, fixed maintenance of way cost, switching costs for transfer of non-coal products from existing adjacent yard areas, and the unit train costs directly variable with increased mileage (crew, fuel and maintenance of equipment and track).

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

Road access to each site was considered essential for free movement of employees and for operational flexibility. In the study the only differential road costs considered were capital, fixed maintenance and ferry operation costs.

3.1.2 Ocean Transportation

Ocean transportation factors are significant in differential site analysis. In this study, consideration was given to wind, waves, water depth, berth availability and other miscellaneous factors. These factors were all related to two differential cost items for each site, vessel demurrage and tug assistance for berthing and unberthing vessels.

The wave analysis results are summarized for each of the sites on Figure 3-1.

The effect of wind speed on berthing was also considered and it was assumed that ships would be unable to berth in winds in excess of 25 mph. From the wind information shown on Figure 2-3, it can be seen that the berth downtime for any occasion in the area would be about 3%. It should be noted that there will be an overlap between downtime from wave conditions and wind conditions, therefore these percentages should be aggregated.

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

3.1.3 Site Development

The major factor in site development analysis was capital cost incurred during construction. The capital cost items considered in this study under site development included land preparation, marine facilities (wharves, approach dredging, etc.) and provision of site services (water and power). Because the type of construction varied between sites, maintenance of the above facilities could also vary. This latter factor was assessed on the basis of a percentage of capital cost.

Service requirements for a bulk terminal facility will not vary between sites but the environmental impact could vary with location. Therefore the following brief description of typical site water supply, storm drainage and waste water treatment and disposal facilities is included.

Fire protection, dust suppression and equipment washdown requirements will impose the major water demand. Potable water requirements will be minimal. Salt water supply may be used to meet the fire protection requirements. Coal storage pile sprinkling requirements, because of product contamination, must be fresh water, not necessarily of potable quality. This fresh water supply could also

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

fulfill the needs for potable water by treatment.

Waste water from the washing systems and dust suppression systems will be collected in sedimentation basins and recycled. These sedimentation basins will also be utilized as part of the storm drainage with overflows from the basins running directly to the sea. Sewage disposal will be by septic tank and disposal field.

Power supply for each of the sites was assumed to be available in the Prince Rupert area. The only consideration given to power supply was the cost of constructing a transmission line from the nearest area where it was assumed power would be available. The availability of the amount of power required was not verified with B.C. Hydro as the problem would be common to all sites in the area.

Additional items considered briefly in this section but not on a costs basis are land status, ease of expansion and availability of backup land.

3.1.4 Materials Handling

Materials handling costs were considered on the basis of capital and differential operating costs. The capital cost factor did not vary between sites because of a reasonable level

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

of uniformity between sites. Operating differential costs were related to transport of personnel to and from the site and extra costs incurred transporting asbestos, molybdenum and zinc between the warehouse and the dock where significant distance differences occur. Personnel transportation costs were based on current longshoring contracts.

In determining the materials handling aspects of the sites it was noted that there are significant differences in the operations required to handle the coal and the non-coal products. These differences are in the truck/train receiving area, in the storage of the materials, and at the waterfront in the loading operations. They occur mainly because of the value of the commodity and the total throughput volumes. This results in different handling rates and smaller shipments for the high value products. In fact it appears that there is a significant degree of incompatability between the coal and non-coal areas of the combined terminal. This indicates that consideration should be given to two separate facilities for handling the total throughput.

One obvious alternative would be to handle the unitized cargo through a site such as that being developed by the National Harbours Board at Fairview Point, or elsewhere in the Inner Harbour, with coal still moving through one or another of the more favourable sites discussed above, i.e. Ridley

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

Island or Kitson Island. These two alternatives are analyzed in detail along with the three single sites in the next section of this report.

Because the end use of the land generates environmental disturbances that could be significantly different at each site, a discussion of the materials handling factors pertaining to all sites is included in this section.

The area required for the terminal, as discussed in Chapter 2 is a total of some 100 acres comprising 70 acres for coal operation and 30 acres for the copper concentrate and unitized cargo operations. This acreage will accommodate the rail-car trackage, car dumping facilities, storage and shiploading operations. In each of the sites considered the layouts were based on the use of a loop track for the coal traffic. For convenience the storage facilities were considered within this loop and to some extent the pile configuration was selected on the basis of the resulting land made available. However, a loop track is not necessary for reasons of terminal operation in itself and should there be some other means of handling trains, alternative storage layouts are possible. For instance, a longer, narrow coal storage site could be advantageous in the event that a limited number of grades of coal needing storage pile separation are handled.

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

The coal terminal operations, because of the large volumes being handled, will require a high degree of automation. The machinery utilized in this portion of the site will be capable of handling coal at rates probably in excess of 5,000 tons per hour. The high volume of throughput dictates the use of unit train operations on the railways which will require an automated rotary railcar dumper system. The coal from the dumpers will go either to open storage or directly to ships. Stored coal will be reclaimed by bucket wheel equipment and conveyed to the waiting ships. In essence, the system used would not be significantly different from those at Westshore and Neptune Terminals in the Port of Vancouver. This portion of the terminal could require a staff of 75 people.

The 30 acre copper and unitized cargo section of the terminal will be markedly different from the coal side of the operation. The necessary facilities will not be as highly specialized as much of these cargoes will probably arrive from many origins and by a variety of conveyances including random railcars and trucks. Moreover the storage will have to be covered for protection from the weather. A multiplicity of products and grades requiring separated storage and low handling capacity will result in varied systems of handling equipment, including fork lifts and front end loaders. Shiploading equipment will be varied and

3. SITE ANALYSIS (cont'd)

3.1 Comparison Factors (cont'd)

include bulk handling machinery for the loading of concentrates and unitized cargo handling equipment for the other commodities. Handling rates in this non-coal section of the terminal are likely to be moderate and in the order of 1000 to 1500 tons per hour. The multiplicity of products and low volume also indicate that the operation will probably not be highly automated. Because of this lack of automation a total staff of some 125 men will probably be employed.

3. SITE ANALYSIS (cont'd)

3.2 Site Details

In the previous chapter three sites were judged to be feasible for further consideration as bulk terminal facilities. These three sites, Port Simpson, Ridley Island and Kitson Island, are considered in detail in the following section of the report. The other two possibilities, split sites with non-coal products handled at Fairview Point and coal over Ridley Island or Kitson Island, are also examined.

This site comparison is done on a differential cost basis. That is, the operational areas where expected cost differences are suspected are isolated and costed. Total expected capital costs are developed for each site.

It should be noted that all cost items are on an order-of-magnitude basis and in some cases are not representative of total cost. The differential operating costs are presented as annual costs in the write-up and at their present value in the summary. The present value is based on 12% over infinite time.

3.2.1 Port Simpson

The aspects and costs of developing a bulk terminal facility at Port Simpson, as shown in Figure 3-2, are related to the relevant comparison factors in the following sections.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

a) Land Transportation

The first and most major land transportation access problem is construction of a rail line into the port site. Two possible routes were considered, one from the Khyex River up along Work Channel and into the port area, the other from the existing line along the side of Prince Rupert Harbour and then overland to the port area. The first of these two routes, which requires 35 miles of construction and will have a rail distance from Terrace similar to the Kitson Island site, was considered more feasible.

The construction of a rail line from Khyex River Bridge along Work Channel and then overland to Port Simpson would involve building some 35 miles of railway with an estimated cost of $30 million. As well as being costly in terms of capital outlay, the rail line will impose additional operating problems. The most important of these is the $1\frac{1}{4}\%$ grade necessary to attain the summit between Work Channel and the Skeena River basin.

The operating cost incurred by the extra power required to move traffic over this grade was included in the cost of unit train operations and other train operations.

The movement of coal by unit train into this site will incur a differential cost estimated at $3.7 million annually. The major item in this cost is the operating of three extra locomotives between Terrace and the port in every train. It

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

also includes the cost of transporting the crews to and from Prince Rupert for each run.

The location of the port, some 70 miles away from the nearest railyard at Prince Rupert, creates a problem with respect to the less than train load traffic. This traffic, typically the non-coal commodities, will have to be marshalled into trains at either Terrace or Prince Rupert and handled as special freight hauls rather than in the normal way-freights that travel between Terrace and Prince Rupert. The additional expense incurred by operating special trains from Terrace to the port site was estimated at $0.2 million per year.

Finally, precipitous terrain and the high snow fall in this area will impose maintenance of way problems on the line. The major one of these problems will probably be created by slides. An allowance was made of $0.1 million per year for this problem.

Road access to this site will involve construction of 19 miles of road from the north shore of Prince Rupert Harbour along Tuck Inlet pastGeorgetown Lake and then by existing logging roads overland to Port Simpson. This road connection would involve a 1.4 mile ferry connection across Prince Rupert Harbour at a location shown in the report entitled,

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

"Route Reconnaissance, Prince Rupert to Port Simpson Highway" dated November 19th, 1972 prepared by F. & F. Slaney & Co. Ltd., Vancouver, B.C. for the Department of Highways, B.C. Although this report estimated the cost for the system as being $4.6 million, it is our opinion that the heavier vehicles and increased volumes of traffic would require an improved system, and that the current estimate of cost of such a road system would be $10 million. The two differential cost items with respect to the road were fixed maintenance and ferry operation. The annual cost of these items was estimated at $0.1 million and $1.0 million respectively.

b) Ocean Transportation

The deepsea navigation access into Port Simpson Harbour does not appear to be a problem, although there are three shoal patches in the harbour mouth and in the harbour itself that will require removal before there is adequate room for manoeuvring and anchoring. The cost of removing these shoals is included in the site development costs.

Navigational access into the harbour is good and it is considered that the one knot current produced by tidal change in the harbour entrance would not be inhibitory to vessels traversing this passage.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

Tug assistance will be required for berthing and turning vessels at this site which is normal, however the distance that these tugs will have to travel (about 50 miles) from Prince Rupert Harbour does represent an operational problem. The estimated annual cost of tug boat operations at this site is $2.2 million.

Wave analysis was carried out as described in Chapter 2 of this study and is summarized graphically on the wave rose shown on Figure 3-1. This record shows that a total of 2700 annual hours of wave action can be expected to occur at this site. However most of this wave action will be within the 0 to 2 foot range and should not affect berth operations. Based on the information shown on the wave rose, a berth availability factor of some 95% is expected. This factor combined with tug boat availability could generate a total of 50 days of ship delays costing some $0.5 million per year.

c) Site Development

The required 100 acres necessary for terminal development at this site could be constructed by a cut and fill operation involving movement of some 4 million cu. yds. of excavation. This excavation, mainly in solid rock, would be used to extend the edge of the site towards the berth face. The expected cost of this construction is some $18 million.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

The marine structures at the site could be developed as shown on Figure 3-2. Construction of these facilities could be difficult because of the need to socket the piles into solid rock ocean floor. Another relative construction problem at this site will be its remote location with no existing access other than water or air available. These factors are considered in the estimated cost of wharves, $10 million.

The site service aspect of Port Simpson is very similar to the outline given in Section 3.1.5. It is expected that a satisfactory water supply can be obtained from an intake on Stumaun Creek which is some 4-5 miles southwest of the site. The estimated cost of $4 million for site services includes construction of a power line from Prince Rupert to the port site.

The maintenance factor in the capital cost items in site development was estimated at 1% of capital cost per year or $0.3 million.

This site has good expansion capability with room for marine structures, 6 additional berths and backup land, about 3,000 acres, both at moderate cost. The land status for the proposed site and the surrounding area is believed to be crown land.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

d) Materials Handling

The materials handling aspects of the plant at this site would be the same as those discussed in Section 3.1.4 of this report and should present no serious problems. However, the transportation of operating personnel to and from the site or, alternatively, the construction of a town site adjacent to the site, could add significantly to the total operating costs. This study considered the transportation of employees to be viable and estimated the annual cost of this to be $0.6 million. The capital cost of the materials handling equipment was estimated at some $30 million.

e) Summary

The differential cost items were brought to present value and summarized along with the capital costs in Figure 3-3.

FIGURE 3-3 SUMMARY OF PRESENT VALUE COMPARATIVE COSTS OF A BULK TERMINAL FACILITY AT PORT SIMPSON

ITEM		COST
1.	Land Transportation	
a)	Rail - Capital Cost	30.0
b)	Rail - Operating Cost	33.3
c)	Road - Capital Cost	10.0
d)	Road - Operating Cost	9.2
	Sub-Total	82.5
2.	Ocean Transportation	
a)	Tug assistance	18.0
b)	Demurrage	4.0
	Sub-Total	22.0
3.	Site Development	
a)	Capital Cost	32.0
b)	Maintenance	2.2
	Sub-Total	34.2
4.	Materials Handling	
a)	Capital Cost	30.0
b)	Operating Cost Differential	5.0
	Sub-Total	35.0
	TOTAL	174.0

Notes:

1. Costs shown in millions of 1974 dollars.
2. Operating costs shown as present worth of differential costs.
3. Columns may not add due to rounding.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

3.2.2 Ridley Island Site

The Ridley Island site located just south of Prince Rupert near the Harbour entrance is discussed in this section. A possible site layout for the development of this site is shown on Figure 3-4.

a) Land Transportation

Land transportation access development into a site at Ridley Island is relatively straightforward. Rail access would come off the CNR mainline in the vicinity of the Zinardi Rapids and then by causeway out to the site. This would involve the construction of about 2 miles of track. It is estimated that the construction of this track would cost about $1 million and would not involve any significant grade change.

The differential costs associated with railway operations at Ridley Island were related to unit trains, $0.2 million, and switching operations, $0.1 million. The major item in the unit train cost is crew transfer while the switching charges accrue because the site is 5 miles from the existing yard.

Road access can be developed by extending Highway 16 from its crossing of the Knight Basin along the north shore of the basin out to the site. It is estimated that this four

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

miles of road construction would cost some $2 million and bear an annual maintenance cost of less than $0.1 million.

b) Ocean Transportation

The major problem in the ocean transportation sector for vessels berthing and unberthing is the close proximity of the rocky shoreline, particularly in view of the 5300 annual hours of wave activity and the 2 to 3 knot tidal currents in the area. This problem affects future operations in that the tug boats assisting in the berthing and turning operations will have to have more horsepower than would normally be required. This converted to an estimated annual cost of $2.0 million.

Another but lesser factor is that the facilities are located in the entrance to Prince Rupert Harbour. While the volumes of traffic arriving and departing from this Harbour are low, such a potential hindrance at the entrance could prove to be a modest shortcoming in future developments.

Wind and wave data based on the Prince Rupert Port records is summarized on Figure 2-3, Wind Records and Figure 3-1, Wave Data. An analysis of these data seems to show that the combined effects of wave and wind will result in an estimated berth availability of about 95%. These problems are expected to combine and thereby create vessel delays

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

totalling 50 days per year for an annual cost of $0.5 million.

c) Site Development

Development of the land necessary for a terminal is expected to cost $12 million at Ridley Island. This cost covers drilling and blasting solid rock for site levelling and fill as well as removal and disposal of the organic overburden.

Wharf construction at this location is estimated to cost $13 million. The wharves built could be as much as 1500 feet from the edge of the site because of the expected location of the deep water contours. Wharf construction also involves socketing the piles into the solid rock ocean floor.

The site services required at Ridley Island would be in line with that discussed in Section 3.1.5. It is proposed that an adequate water supply be obtained by constructing an intake and supply main from Alwyn Lake or its drainage outlet at Wolf Creek approximately 10 miles from the site. The estimated cost of $3 million also includes money for construction of a power line from the vicinity of Port Edward over to the site.

Annual maintenance costs for site development were estimated at 1% or $0.3 million per year.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

The Ridley Island site has fair expansion capabilities with an availability of room for 2 additional deepsea berths and some 800 acres of land at a moderate cost.

d) Materials Handling

The materials handling aspects of the plant at this site would be similar to those outlined in Section 3.1.4 above and should present no serious problems. The capital cost of the materials handling equipment will be in the order of $30.0 million. The differential cost item, crew transport is anticipated at $0.3 million per year.

e) Summary

The major cost comparison factors, both capital and differential, are summarized for the Ridley Island site in Figure 3-5.

FIGURE 3-5 SUMMARY OF PRESENT VALUE COMPARATIVE COSTS OF A BULK TERMINAL FACILITY AT RIDLEY ISLAND

ITEM			COST
1.	Land Transportation		
	a)	Rail - Capital Cost	1.0
	b)	Rail - Operating Cost	2.9
	c)	Road - Capital Cost	2.0
	d)	Road - Operating Cost	0.1
		Sub-Total	6.0
2.	Ocean Transportation		
	a)	Tug assistance	16.6
	b)	Demurrage	4.2
		Sub-Total	20.8
3.	Site Development		
	a)	Capital Cost	28.0
	b)	Maintenance	2.7
		Sub-Total	30.7
4.	Materials Handling		
	a)	Capital Cost	30.0
	b)	Operating Cost Differential	2.4
		Sub-Total	32.4
		TOTAL	90.0

Notes:

1. Costs shown in millions of 1974 dollars.
2. Operating costs shown as present worth of differential costs.
3. Columns may not add due to rounding.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

3.2.3 Kitson Island

The development of a possible bulk terminal at Kitson Island, as shown on Figure 3-6, is discussed herein.

a) Land Transportation

Transportation access to the site is gained by constructing a causeway from the vicinity of the CNR mainline behind Lelu Island across tidal flats, to Kitson Island and then across Flora Bank to the site.

Although the exact location of the access corridor in the vicinity of Lelu Island is not yet determined. It would be generally as shown, some 2 miles in length, carrying both road and railway. The railway portion of the cost is estimated to be $3 million.

The railway operation at this site would prove somewhat of a problem in that as with the other sites, the unit train is terminating at a location remote from established train operations. The anticipated annual operating cost differential for these trains is estimated to be in the order of $0.2 million. The movement of non-unit train traffic to the sites from Prince Rupert is expected to have a differential cost of some $0.2 million per year.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

Road access would be from an existing road that services the canneries in the area along the causeway to the site. The anticipated capital cost of the road, $3.0 million, includes upgrading the existing roads back to the vicinity of Port Edward as well as a portion of the causeway construction cost. Fixed maintenance costs are expected to be negligible.

b) Ocean Transportation

The navigational access aspects of this site are good with no major problems apparent at this time.

The wind and wave action which was analyzed and shown on Figures 2-3, Wind Action and 3-1, Wave Data, appears to indicate 5300 annual hours of wave action. However, it is important to note that a greater percentage of these waves are higher than 2 feet than at the other sites. It is expected however, that the berth availability at this site will be similar to the others, i.e. something in the order of 95%. It is expected that ship berthing operations will be normal and that only standard tug boats will be required. The annual tug boat cost was estimated to be $2.0 million while vessel delays amounted to 50 days worth some $0.5 million yearly.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

c) Site Development

Site development at this location will involve a combination of cut and fill and dredging. It is proposed that Kitson Island itself be levelled by drilling and blasting the solid rock to contribute a significant portion of the fill requirements. The solid rock obtained from this operation would be used to construct a dyke around the perimeter of the site to contain the dredged material as well as to construct a portion of the transportation access causeway. It is estimated that the total rock excavation will be some 1.0 million yards and that approximately 4-5 million yds. of dredged material will be required. It is anticipated that the dredged fill material will be found immediately adjacent to Kitson Island as shown on Figure 3-6. This material will probably have a high silt content and involve significant dredge losses. The fill made from this dredged material will have to be pre-loaded in order to minimize site settlement. The anticipated cost of preparing the terminal land is $12 million.

Construction of the marine structures is not expected to pose any significant problems. As a matter of fact, it is expected that this is the only site where conventional pile driving methods can be used, an important consideration in achieving economical marine construction. This is reflected in the estimated cost of marine structures, some $10 million.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

The site services aspects of this location would be as outlined in Section 3.1.4 of this chapter. The water and power supply would be similar to that of Ridley Island in that a main would be constructed from Alwyn Lake to the site via the transportation access corridor and power would be supplied from the vicinity of Port Edward. Site service costs are expected to cost some $3 million.

The estimated maintenance factor for this site, 1.5% of capital or $0.4 million per annum, is higher than at the other sites because of increased wave action and site settlement problems.

The status of the land and Kitson and Lelu Islands was checked and it was found that ownership rested with the Crown.

This site offers fair expansion capabilities with more than 6 deepsea berths available and approximately 2000 acres of land which can be developed at a high cost. However, the end use of the developed land may be restricted because of poor foundation conditions on the dredged fill.

d) Materials Handling

The materials handling aspects of the plant at this site will be similar to those discussed in Section 3.1.4 of this report

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

and should present no serious problems. As with the other sites the estimated capital cost of materials handling equipment is some $30.0 million. The differential operating costs at this location are $0.4 million for crew transport and an additional $0.1 million per annum for handling asbestos, molybdenum, and lead-zinc. This cost is incurred by having to move the products a greater distance from the warehouse to wharf face than at any of the other sites.

e) Summary

The accumulated capital costs and present worth of the operating cost differential are summarized in the major comparison categories in Figure 3-7.

FIGURE 3-7 SUMMARY OF PRESENT VALUE COMPARATIVE COSTS OF A BULK TERMINAL FACILITY AT KITSON ISLAND

ITEM			COST
1.	Land Transportation		
a)	Rail -	Capital Cost	3.0
b)	Rail -	Operating Cost	3.4
c)	Road -	Capital Cost	3.0
d)	Road -	Operating Cost	-
		Sub-Total	9.4
2.	Ocean Transportation		
a)	Tug assistance		16.6
b)	Demurrage		4.2
		Sub-Total	20.8
3.	Site Development		
a)	Capital Cost		25.0
b)	Maintenance		3.3
		Sub-Total	28.3
4.	Materials Handling		
a)	Capital Cost		30.0
b)	Operating Cost Differential		4.0
		Sub-Total	34.0
		TOTAL	93.0

Notes:

1. Costs shown in millions of 1974 dollars.
2. Operating costs shown as present worth of differential costs.
3. Columns may not add due to rounding.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

3.2.4 Fairview Point/Ridley Island

This split site alternative considers the handling of non-coal products over a facility adjacent to the N.H.B. development at Fairview Point and the coal over a facility on Ridley Island. A possible layout for the development of this operation is shown on Figure 3-8. The following sections discuss the various aspects of this development.

a) Land Transportation

The land transportation aspects for the coal handling operation will be the same as those described in Section 3.2.2. The capital cost connected with railway service development will be $1.0 million and the operating cost differential connected with unit train operations will be $0.3 million for crew transport and increased operating distance.

Road development into the Ridley Island portion of the development will also be the same as in Section 3.2.2 and will cost $2.0 million capital with an overall fixed maintenance cost of less than $0.1 million per year.

Road and rail developments for the Fairview Point section would be in conjunction with existing facilities and would not incur significant capital or operating differential costs.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

b) Ocean Transportation

As with land transportation, the ocean transportation considerations for the coal movements will be as described in Section 3.2.2. The cost of tugboats and vessel demurrage will be $1.9 million and $0.4 million respectively.

The costs for both tug and berthing delays connected with the non-coal operations are included in the above figures.

The non-coal movements will have an advantage and a disadvantage with respect to ocean transportation. The advantage to this scheme is the avoidance of moving ships to pick up loads at two points as vessels handling partial loads of non-coal products will probably also call at Fairview Point. The disadvantage lies in the increased congestion created at Fairview Point, on the Harbour entrance channel, by more vessel calls. It was felt that no meaningful differential cost could be derived for these and that they would tend to offset each other.

c) Site Development

Site development for this scheme will consist of construction of 70 acres of land at Ridley Island and 30 acres at Fairview Point. The 70 acres at Ridley Island will be developed by methods similar to those described in Section 3.2.2. The 30 acres at Fairview Point will be constructed just to the

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

south of the N.H.B. development by filling with shot rock obtained adjacent to the site. The combined capital cost of these two development is estimated to be $8.0 million.

Wharf construction at these two sites would be just as described for the other sites with the coal berth at Ridley Island and copper and other cargo berths at Fairview Point. The wharf facilities were estimated to cost $8.0 million.

Site services at Ridley Island will be as described previously while it is expected that services for the Fairview Point development will already be in existence. The capital cost of services to Ridley Island will still be about $3.0 million.

The annual maintenance costs at these sites will be 1% of the capital cost or $0.2 million per year.

Land status, expansion potential and backup land availability will be as described previously at Ridley Island and will be limited in all aspects at Fairview Point.

d) Materials Handling

The materials handling aspects of this alternative will be as described in Section 3.1.4 except that they will take place at two different locations. Moving the handling of non-coal products into Fairview Point reduces the differential cost factor to $0.1 million per year. Total capital cost of materials

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

handling equipment should be some $30.0 million.

e) Summary

The summary of capital and the present worth of differential costs for this split site alternative are shown in Figure 3-9.

FIGURE 3-9 SUMMARY OF PRESENT VALUE COMPARATIVE COSTS OF A BULK TERMINAL FACILITY AT FAIRVIEW POINT/ RIDLEY ISLAND

ITEM			COST
1.	Land Transportation		
a)	Rail	Capital Cost	1.0
b)	Rail	Operating Cost	2.3
c)	Road	Capital Cost	2.0
d)	Road	Operating Cost	0.1
		Sub-Total	5.4
2.	Ocean Transportation		
a)	Tug assistance		15.8
b)	Demurrage		3.3
		Sub-Total	19.1
3.	Site Development		
a)	Capital Cost		19.0
b)	Maintenance		1.8
		Sub-Total	20.8
4.	Materials Handling		
a)	Capital Cost		30.0
b)	Operating Cost Differential		0.9
		Sub-Total	30.9
		TOTAL	76.0

Notes:

1. Costs shown in millions of 1974 dollars.
2. Operating costs shown as present worth of differential costs.
3. Columns may not add due to rounding.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

3.2.5 Fairview Point/Kitson Island

This split site alternative is the same as the previous one except that the coal is handled at Kitson Island. A possible layout for the two sites in this scheme is shown in Figure 3-10.

a) Land Transportation

The rail transportation aspects of coal handling will be the same as those described in Section 3.2.3 with a capital cost of $3.0 million and an operating differential of $0.2 million.

Road development to the Kitson Island site, at a cost of $3.0 million will be as was described in Section 3.3.

Road and rail developments at Fairview Point are expected to be an extension of those developed for the N.H.B. and as such will not generate any significant costs.

b) Ocean Transportation

The ocean transportation aspects for this alternative will be as described in Section 3.2.3 for coal and 3.2.4 for non-coal products. The estimated cost of tugs and demurrage should respectively be some $1.9 million and $0.4 million per year.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

c) Site Development

Site development for the 70 acre coal terminal at Kitson Island will be as described in Section 3.2.3 except that less dredging will be necessary. The Fairview Point facilities will be as described in the previous section. The estimated capital cost for this part of the construction is $8.0 million.

Site development at Kitson Island, at a cost of $3.0 million, will be the same as described in the previous section. Provision of Site Services at Fairview Point is not expected to generate any significant costs.

Wharf construction at those two locations has been previously described and is expected to cost $7.0 million.

Maintenance on the site development item is anticipated to be 1% of capital cost or $0.2 million per year.

Land status, as expansion potential, and backup land availability will be as described in the previous two sections.

d) Materials Handling

The materials handling aspects of this split site alternative will be as described in Section 3.2.3 for coal and 3.2.4 for non-coal. The capital cost is estimated at $30.0 and operating differential cost at $0.1 million per year.

3. SITE ANALYSIS (cont'd)

3.2 Site Details (cont'd)

e) Summary

This split site alternative bears a capital and present worth differential cost total as summarized in Figure 3-11.

FIGURE 3-11 SUMMARY OF PRESENT VALUE COMPARATIVE COSTS OF A BULK TERMINAL FACILITY AT FAIRVIEW POINT/ KITSON ISLAND

ITEM			COST
1.	Land Transportation		
a)	Rail	Capital Cost	3.0
b)	Rail	Operating Cost	2.0
c)	Road	Capital Cost	3.0
d)	Road	Operating Cost	-
		Sub-Total	8.0
2.	Ocean Transportation		
a)	Tug assistance		15.8
b)	Demurrage		3.3
		Sub-Total	19.1
3.	Site Development		
a)	Capital Cost		18.0
b)	Maintenance		1.5
		Sub-Total	19.5
4.	Materials Handling		
a)	Capital Cost		30.0
b)	Operating Cost Differential		1.2
		Sub-Total	31.2
		TOTAL	78.0

Notes:

1. Costs shown in millions of 1974 dollars.
2. Operating costs shown as present worth of differential costs.
3. Columns may not add due to rounding.

3. SITE ANALYSIS (cont'd)

3.3 Comparison of Sites

The major comparison factors of the 5 sites studied are capital costs and differential costs. These items, shown as land transportation, ocean transportation, site development and materials handling costs, are summarized in Figure 3-12.

This matrix shows that the optimum sites would be the split site alternatives with non-coal products at Fairview Point (or a similar inner harbour site) and coal at either Ridley or Kitson Island. The next sites in the ranking are the combined terminals at either Ridley or Kitson Islands. The least attractive site is the Port Simpson site mainly because of the large land transportation cost the site bears.

As a part of the study the Canadian National Railways were asked to comment on the possible sites listed in Chapter 2 and to rank the sites analyzed in Chapter 3. Our request and their reply are attached to this report in Appendix A. They prefer the split site alternative with the non-coal products handled at Fairview Point and the coal at a site on Ridley Island.

As mentioned earlier we also contacted the Pacific Pilotage Authority with regard to their preference of sites (see Appendix A). The Pilotage Authority feel that Port Simpson

FIGURE 3-12 MATRIX OF PRESENT VALUE COMPARATIVE COSTS OF BULK TERMINAL SITES ON THE TSIMPSEAN PENINSULA

Cost Item	SITES				
	Port Simpson	Ridley Island	Kitson Island	Fairview Point Ridley Island	Fairview Point Kitson Island
1. Land Transportation	82.5	6.0	9.4	5.4	8.0
2. Ocean Transportation	22.0	20.8	20.8	19.1	19.1
3. Site Development	34.2	30.7	28.3	20.8	19.5
4. Materials Handling	35.0	32.4	34.0	30.9	31.2
TOTAL	174.0	90.0	93.0	76.0	78.0

Notes:

1. All costs shown in millions of 1974 dollars.
2. Cost figures represent present worth of all differential operating costs and capital costs.
3. Columns may not add due to rounding.

3. SITE ANALYSIS (cont'd)

3.3 Comparison of Sites (cont'd)

is the best location with both Ridley Island and Kitson Island sites being acceptable. They were not requested to specifically comment on the split site alternatives however we feel that they would prefer a combined site outside the harbour in order to avoid congestion.

Another factor that could be significant and was not accounted for in Figure 3-12 was expansion capabilities. The three combined site alternatives all have room for expansion with Port Simpson being the best. The combined site alternatives have good expansion possibilities for the coal facilities but very little for the non-coal products at Fairview Point.

These factors, CNR ranking, Pilotage preference and expansion factors are summarized in Figure 3-13.

3. SITE ANALYSIS (cont'd)

3.3 Comparison of Sites (cont'd)

FIGURE 3-13 NON-COST RANKING FACTORS

Site	CNR	Pilotage	Expansion
Port Simpson	5	1	1
Ridley Island	3	2	2
Kitson Island	4	3	3
Fairview Point/ Ridley Island	1	4	3
Fairview Point/ Kitson Island	2	4	3

This matrix shows that Port Simpson and Ridley Island would be preferable, however the CNR indicates that $1\frac{1}{4}\%$ gradient on the rail approach to Port Simpson exceeds their standards for mainline railways. Therefore we shall assume that Ridley Island is Number 1.

When the cost factors are combined with this ranking as shown in Figure 3-14, the preferred alternatives are Ridley Island combined site and the Fairview Point/Ridley Island split site.

3. SITE ANALYSIS (cont'd)

3.3 Comparison of Sites (cont'd)

FIGURE 3-14 COMBINED FACTORS RANKING

Site	Cost	Non-Cost
Port Simpson	5	2
Ridley Island	3	1
Kitson Island	4	4
Fairview Point/ Ridley Island	1	3
Fairview Point/ Kitson Island	2	5

It is our conclusion that the preferred sites from an Engineering point of view are a combined site at Ridley Island or a split site with coal at Ridley Island and non-coal products at Fairview Point. If further differentiation between these two possibilities is required, a more detailed analysis must be done.

APPENDIX A

Please note Drawings referred to in Swan Wooster letters appear elsewhere in this Report.

October 8, 1974
File: 3198/01

B.C. Pilotage Authority
1200 West Pender Street
Vancouver, B. C.

Attention: Captain R. Covington

Subject: Prince Rupert Area
Bulk Marine Terminal Sites

Dear Sirs:

We are currently engaged in a study of the Engineering Aspects of locating a bulk terminal in the Prince Rupert area. Part of this study requires an assessment of the navigational aspects of the proposed terminal. As discussed with our Mr. Krigolson we would appreciate your opinions with regards to accessibility to vessels and ship handling, including tug horsepower required, at each of the ten possible sites shown on the attached sketch and located as follows:

1. Port Simpson - east side of the Bay
2. Smith Island - northwest corner
3. Kitson Island
4. Ridley Island
5. Digby Island - southeast corner
6. Melville Arm
7. Bacon Cove
8. Vigilant Island to Schrieber Point
9. Pethick Point - northeast from the Point
10. Osborne Cove

The proposed terminal, which may be located at any one of the above sites, will have three berths: 1 berth for 10,000,000 tons of coal to be handled in approximately 100 ships varying in size from 50,000 to 150,000 DWT; 2 berths for handling 1.9 million tons of concentrates and asbestos to be handled in approximately 150 to 200 ships varying in size from 15,000 to 50,000 DWT.

For your further information, we also enclose a copy of three drawings showing the approximate berth arrangement and terminal layout for the sites at Port Simpson, Kitson Island and Ridley Island. Our study has not gone into sufficient detail at the other seven sites and we have not prepared layout drawings for these sites. However, the requirements and arrangement would be similar to that shown for the other three sites.

We would very much appreciate receiving your comments at your earliest convenience. If further information is required please contact the undersigned.

Yours very truly,

SWAN WOOSTER ENGINEERING CO. LTD.

H. Krigolson

HK:pn

Enclosures

PACIFIC PILOTAGE AUTHORITY

605 - 1200 West Pender Street
Vancouver, British Columbia V6E 2T9
Telephone (604) 666-6771
Telex 04-53357

ADMINISTRATION de PILOTAGE du PACIFIQUE

October 11, 1974

Swan Wooster Engineering Co. Ltd.
1525 Robson Street
Vancouver 5, B. C.

Attention H. Krigolson

Dear Sir:

Thank you for your letter of October 8th, 1974 concerning the study of the Engineering Aspects of locating a bulk terminal in the Prince Rupert Area which you are presently engaged on.

The Pilots have persued the plans you have provided and our comments are as follows:

1. The Port Simpson site is most favoured with regard to accessibility for vessels. At this stage of discussion our only comment is that the berths should be in line in order to allow for both Port and Starboard Landings in all conditions. It is our understanding that the 9 fathom Rock in Inskip Passage would be removed.

2. Both the Ridley Island and Kitson Island sites are acceptable however the Ridley Island site is preferable. In the case of the Ridley Island site, here again we would stress that the berths should be in line to permit access in all conditions. The berths in this location would be subject to current conditions and would be difficult to approach in heavy SE weather. The anchorage shown to the SE of Lima Point is not acceptable.

It would be necessary in the case of Kitson Island site to increase the dredge line at the South end in order to permit a straight in approach. When approaching from the South vessels would be subject to a cross current from the river. It would also be necessary to dredge the shoal to the North of the berths to allow for a straighter approach when making a Port Landing. The Pilots also feel it would be desirable to remove the 6 fathom patches directly off the berths.

.....2

The Port Simpson, Ridley Island and Kitson Island sites are acceptable for the size of vessels anticipated at the facilities.

3. With regard to Sites 6 and 7 we are of the opinion that the maximum size of vessels acceptable would be 100,000 D.W.T. due to restrictions imposed in the harbour and entrance.

4. Sites 2,5,8,9, and 10 are not acceptable. In the case of sites 8,9, and 10, size of vessel would have to be restricted and in addition landings at these locations would have to be made at Slack Water.

Site 5 restricts the channel and the size of vessel would be restricted.

Site 2 does not permit accessibility for vessels due to the shoals to the north restricting approach for a Port Landing. In addition due to close proximity to the river, approaches to the berth would be influenced by River current.

5. In our opinion the following tug requirements would be suitable for the size of vessels anticipated in this area.

Vessels of 150,000 DWT - 4 tugs of 4000HP each

Vessels of 50,000 DWT - 2 tugs of 4000HP each

The Pilots and the Authority reserved the right to amend the foregoing opinions when further engineering details and information is available. I trust this is the information you required, however if any of our comments require clarification, please do not hesitate to call me.

Yours very truly,

V. R. Covington

V. R. Covington
Superintendent of Operations

VRC/mw

cc Capt. J. Kirkham
B. C. Coast Pilots Ltd.

October 25, 1974
File: 3198/01

Mr. W.D. MacKay
Assistant to Vice President
Mountain Region
Canadian National Railways
777 Hornby Street
Vancouver, B.C.

Subject: Bulk Terminal Study - Prince Rupert
Area of British Columbia

Dear Sir:

We have been engaged by the Federal/Provincial joint committee on the Tsimpsean Peninsula to select a site, on an engineering basis, for a proposed bulk terminal. This terminal, according to the terms of reference set by as a committee, will be required to handle million tons of coal, 1.5 million tons of copper, 50,000 tons of lead zinc, 50,000 tons of molybdenum and 300,000 tons of asbestos and should be capable of berthing 150,000 DWT. vessels.

In the course of this study, we selected ten possible sites as shown on the attached sketch and located as follows:

1. Port Simpson
2. Smith Island
3. Kitson Island
4. Ridley Island
5. Digby Island
6. Melville Arm
7. Bacon Cove
8. Schreiber Point
9. Pethick Point
10. Osborne Cove

These ten sites were examined further and it was found that only site No. 1, Port Simpson, No. 3, Kitson Island, and No. 4, Ridley Island, would be capable of handling the specified tonnages and vessel size range.

Another alternative was also introduced into the study at this point. It was to consider expanding the National Harbours Board Fairview Point

..../2

site to handle the non-coal products while the coal would be moved over either the Ridley Island or Kitson Island sites. The schematic layout of these five alternative sites, including the proposed rail access arrangement, is shown on the attached drawings. It should be noted that the rail access shown for Ridley Island and Kitson Island will be wyed in order to allow rail access from Prince Rupert.

We would very much appreciate receiving your general comments on site No. 2 and 5 to 10 inclusive and your specific comments on the remaining sites and the Fairview Point alternatives, as well as your ranking as to preferability from the point of view of railway operations.

The information obtained so far with respect to site 1, 3 and 4 is as follows:

Site 1 - Port Simpson

Rail access into the Port Simpson area was considered to be feasible on the following route. The proposed route would leave the interesting main line at the present Kayaks River Bridge, then cross over the summit along the Lachmach River and along Work Channel up to the vicinity of Port Simpson where it would cross over the height of land via Neaxtoalk Lake. This route is some 35 miles long and has a $1\frac{1}{4}\%$ grade necessary to attain the summit between Work Channel and the Skeena River basin. There are no major water crossing in this route. The route will be mainly constructed by cutting in solid rock on side slopes subject to both snow and mud slides.

Site 2 - Kitson Island

Rail access to Kitson Island starts on the present main line in the vicinity of Lelu Island. The channel between Lelu Island and the main land would be crossed by a rock fill. Lelu Island would be crossed and cut and the remainder of the distance out to Kitson Island would be constructed from rock fill. The required access is some 2 miles in length and does not involve any grade.

Site 4 - Ridley Island

Rail access for Ridley Island would start on the CNR main line in the vicinity of the Zinardi Rapids bridge and be carried to the site on a rock fill cross-way. This would involve the construction of about 2 miles of track including the site loop. There is a probability that this track would have some adverse gradient in it necessary to attain a satisfactory elevation for the site development.

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We look forward to receiving your comments on these various sites and should you require further information, please contact the undersigned at your convenience.

Yours very truly,

SWAN WOOSTER ENGINEERING CO. LTD.

D. Krefting

DK/cc

REC'D.	NOV 7 1974		
TO	ACT	Note	DONE/DATE
DK			
HK			
JM			
FILE			

Canadian National Railways

7 November 1974

File - 8000 - 2.1

Swan Wooster Engineering Co. Ltd.
1525 Robson Street
VANCOUVER, British Columbia

Suite 2000
777 Hornby Street
VANCOUVER, B.C.
V6Z 1S4

Attention: Mr. D. Krefting

Gentlemen:

This is in response to your letter dated 25 October 1974 concerning CN views on various bulk terminal site alternatives in the Prince Rupert area relative to railway operations.

As requested, general comments on Sites 2, 5, 6, 7, 8, 9 and 10 are as follows:

Site 2 - Smith Island

Rail crossing of Inverness Passage is necessary which would require some opening for small boat traffic. A low level opening would result, we think, in intolerable rail interruptions and a high level span would result in long gradients which are undesirable. In addition, Smith Island is somewhat removed from the centre of our operations for servicing, etc.

Site 5 - Digby Island

We have no objection to this location but obviously would require a major bridge crossing at the only deep sea entrance to Prince Rupert Harbour. The existing mainline rail elevation should be maintained on Kaien Island and consequently expensive and limiting rail gradients are likely to be a feature of such a bridge.

. . . 2

Sites 6, 7 and 8 - North Shore Prince Rupert Harbour

These locations appear to add unnecessarily to the length of rail haul presumably by way of two bridge crossings at Fern Passage and Tuck Narrows and presents poor servicing aspects. In addition, all traffic to such a destination would traverse the entire length of the City of Prince Rupert unless another rail route was constructed from Zanardi Rapids to Fern Passage on the easterly side of Kaien Island. Access by rail solely to serve a bulk terminal in this remote area would seem to present operating and environmental disadvantages.

Sites 9 and 10

These sites are somewhat better than Sites 6, 7 and 8 because of closer proximity to Prince Rupert and only one bridge crossing but basically the same comments apply.

Specific comments requested on the remaining Sites 1, 3 and 4 and Fairview are as follows:-

Site 1 - Port Simpson

At today's costs rail access is likely to be in the 30 million dollar range and would exceed CN design limits of 1% gradients. Roughly $4,000/mile annual labour maintenance for 35 miles would be a direct burden to the bulk facility. Servicing at a terminal so far removed from our existing Prince Rupert motive power and car equipment facilities would call for increased operating costs and perhaps some form of split operation. There would also be crewing implications in having two separate port facilities on what is effectively two separate 35 mile branch lines.

Site 3 - Kitson Island

Rail access would cross Stapelton Channel and while possibly not as severe, comments on crossing a navigable channel as in Site 2 apply. However, if a solid rock fill would be permitted as you suggest, then from a rail operations point of view, this would be feasible.

. . . 3

Site 4 - Ridley Island

This location is relatively close to our rail terminal where engines can be serviced and crews changed easily while indexed unloading takes place. We feel that the McIntyre-Porcupine Company study had merit in that rail grades were maintained level around the shore and bulk stock piles were placed on plateaus at a higher elevation.

Your reference to construction of about two miles of track including the site loop does not appear to be sufficient. Any unit train facility will require a minimum of 14,000 lineal feet of track merely to place a whole train before and after the dumper, and any site would perhaps involve three to four miles of track.

While we prefer the loop operation, a wye configuration with 7,000 ft. legs as suggested by the McIntyre-Porcupine study might be considered initially, which as volumes built up could be converted to a longer, but level loop by extending the stub end of the wye around the Island. We are aware of the objection to Ridley as a coal terminal by the former owners of the pulp mill at Watson Island account of the potential drift of coal dust onto chip piles, but we do not know how severe this might be.

Fairview

At the request of NHB we examined the feasibility of a coal terminal at Fairview but discouraged this on the basis that:

a) Cargo and bulk docks are dissimilar
b) Coal is generally incompatible with forest products
c) Fish processing close by
d) Site expansion for general cargo limited
e) necessary to break up unit trains

. . . 4

Canadian National Railways

7 November 1974

In summary, from a rail operations point of view, we believe that Ridley, on a level rail grade, provides the best alternative for large bulk volumes such as coal, and Fairview provides the best site for handling general cargo, forest products and bulk arriving in only a few cars at a time from multiple origins. This is generally in agreement with the proposal shown on your Plan No. D-3198-01-007.

We appreciate being consulted and if further comment is required please contact the undersigned. We ask that the Committee to which your Company is reporting provide CN with a draft of the report before it is submitted in final form.

Sincerely

W. D. Mackay
Assistant to Vice-President

WDM/pk

TSIMPSEAN PENINSULA

FEDERAL - PROVINCIAL

JOINT COMMITTEE

PHASE II

BULK MARINE TERMINAL SITES

IN THE PRINCE RUPERT AREA

OF

BRITISH COLUMBIA

File: 3198/02

Swan Wooster Engineering Co. Ltd.
Consulting Engineers
1525 Robson Street
Vancouver, B.C.
V6G 1C5

February 14th, 1975

INDEX

1. INTRODUCTION

The following Addendum contains much of the additional information prepared by Swan Wooster for the use of NEAT in the preparation of their Report, "Environmental Assessment of Alternatives". This work was carried out under Phase II of the overall assessment.

The data contained herein revises our initial report in minor ways, clarifies several aspects of it, and mainly supplements it. It does not cover the entire work carried out by the Engineering Consultant as much of the contribution took the form of commentary on data contained in the environmental report.

In keeping with the format of the Phase I Report this Addendum information is segregated into the major categories of Land Transportation, Ocean Transportation, Site Development, Materials Handling and Economic Analysis. The data is displayed in point form as it was generated.

2. LAND TRANSPORTATION

2.1 Questions with respect to the rail route up to Port Simpson as asked by the environmental consultant.

The first question dealt with archeological sites at two specific locations along Work Channel. Available data was reviewed and it was determined that neither of the archeological sites would pose significant problems in railway construction. The sites in all probability could be avoided with minimal expense.

The second was concerned with construction damage to the marshes at the mouth of the Khyex River and to a lesser extent, the bogs between the C.N.R. mainline and the mountains. The marshes at the mouth of the Khyex River are not on the route of the proposed railway and should therefore be undamaged. However the bog area between the C.N.R. mainline and the mountains to the north would be crossed by either of the proposed alternative locations for this railroad.

The third dealt with location of the rail access line to Port Simpson where it passes near Neaxtoalk Lake immediately behind the port facility. Although the immediate lakeshore can probably be avoided the alignment would not be too far from the lake, approximately 100-200 feet in some areas, due to the rise in terrain behind the lake.

2. LAND TRANSPORTATION (cont'd)

2.2 One environmental problem associated with the rail line into the Ridley Island site is the possibility of fouling of the log and chip stockpiles and the paper mill itself at Port Edward. In order to avoid this problem several operating restrictions may have to be imposed. According to NEAT, these restrictions would be: a speed limit on all coal train traffic of 5 to 10 miles per hour in the mill area; no cars to be loaded within 18" of the top; the coal in all of the cars to be sprayed with a binder; all cars to be washed on the site after dumping. The restrictions were examined and it was determined that the expenses involved would be negligible. The practice of hauling coal in cars with 18 inches of freeboard and of spraying binder on the surface of the coal carried in these cars is fairly standard practice on existing coal haul operations in B.C. It has been found that the additional cost of deeper cars and the binder is more than offset by the decreased coal losses. The practice of spray washing the cars after being dumped is now being carried out at the Roberts Bank operation. While this imposes an additional expense the cost in comparison to the overall operation would be insignificant.

2.3 Possible reduction of rail transportation differential costs on the Port Simpson alternative by lowering the gradients on the proposed connection was examined.

2. LAND TRANSPORTATION (cont'd)

The cost differential, incurred because of an expected $1\frac{1}{4}\%$ adverse gradient, was based on certain arbitrary assumptions made by Swan Wooster, namely: that the coal train origin would be unknown; that the train will be made up of about 80 one hundred ton cars; that the train power consist would be two 3,000 horsepower locomotives. This latter item was derived from power requirements on the Canadian National mainline between Prince George and Prince Rupert.

On the basis of assumptions, similiar to those above, it was found that reducing the gradient to a possible minimum of 0.8% could result in an overall reduction in the differential rail cost to Port Simpson. The reduced gradient, attained at higher capital cost, will reduce the operating costs.

Achieving this grade reduction may be possible by assuming a take-off point some 2 miles east of the Khyex River. This revised location would require one mile of steep side-hill construction above the existing mainline as well as a long high fill and bridge across the Khyex River and its flood plain. A more detailed study would be necessary before the cost figures in the port could be reduced.

Reducing the $1\frac{1}{4}\%$ gradient by means of a long deep cut at the summit, would appear infeasible because of the significant problems in water drainage and snow removal

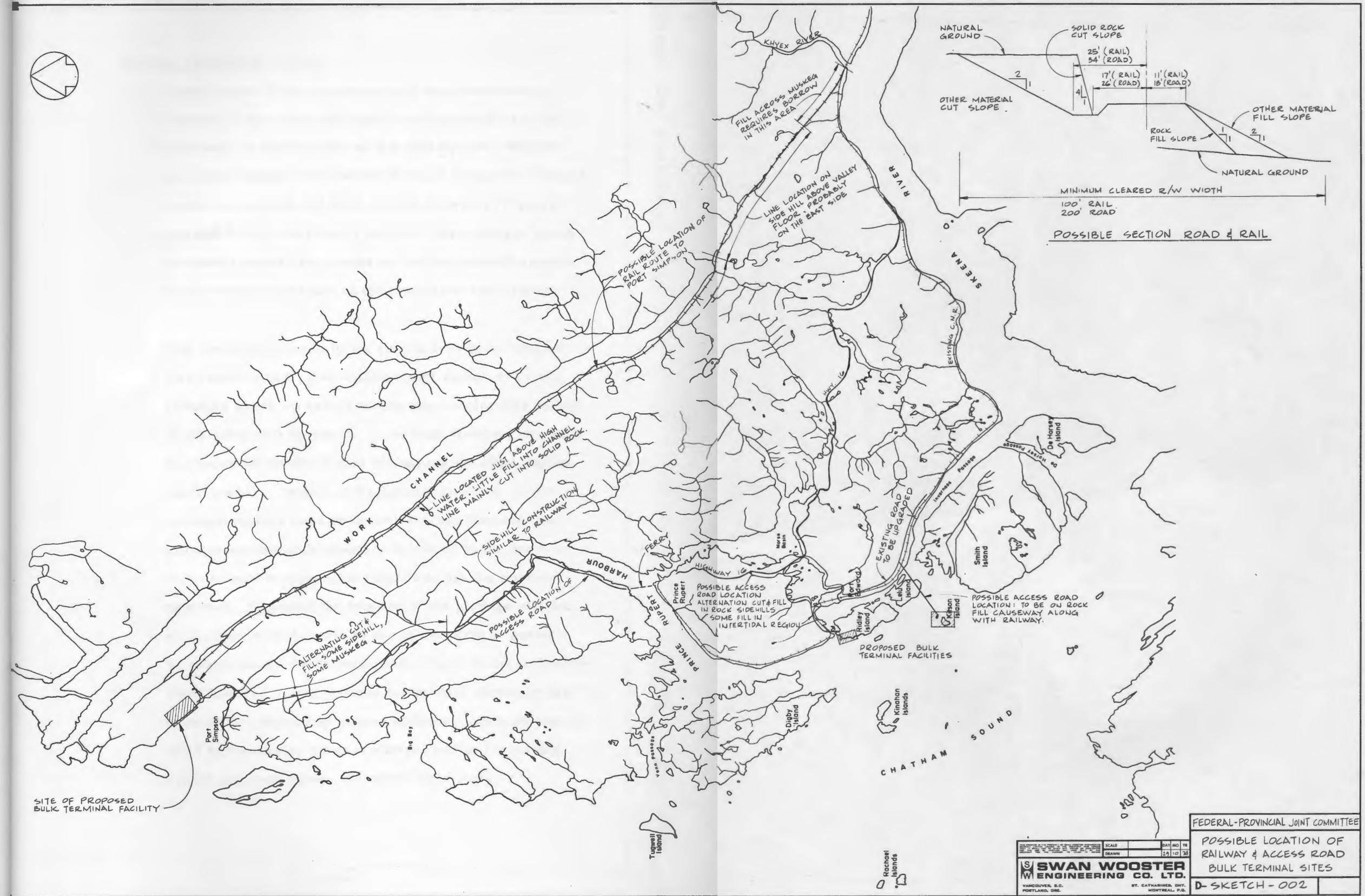
2. LAND TRANSPORTATION (cont'd)

thereby created.

The 1% acceptable adverse gradient mentioned in the C.N.R. letter appended to our report was based on a specific assumption of train origin. It was assumed that the coal trains would originate in an area where sufficient power to negotiate a 1% gradient would be on the train (i.e. in the vicinity of Chetwynd, B.C.).

2.4 The approximate location of road and rail access as well as typical sections of these were prepared and are shown on Sketch -002, a copy of which follows. Temporary access for construction of the facilities will be along the same routing.

2.5 In the course of their examination of the environmental aspects of the development, NEAT discovered that the access road to Port Simpson would be constructed by the Provincial Department of Highways regardless of the location of the bulk terminal facility. The road location and operation costs for this alternative were subsequently reduced to $2.0 million and $0.1 million respectively. These represent the order of magnitude costs for building and maintaining a road from the existing settlement of Port Simpson to the proposed site.



POSSIBLE SECTION ROAD & RAIL

	SCALE		DAY	MO	YR
	DRAWN		29	10	74

SWAN WOOSTER ENGINEERING CO. LTD.
VANCOUVER, B.C. PORTLAND, ORE. ST. CATHARINES, ONT. MONTREAL, P.Q.

FEDERAL-PROVINCIAL JOINT COMMITTEE

POSSIBLE LOCATION OF RAILWAY & ACCESS ROAD BULK TERMINAL SITES

D-SKETCH-002

3. OCEAN TRANSPORTATION

3.1 In the course of the examination of the environmental aspects of this study additional climatological data was obtained. A brief review of this data by Swan Wooster personnel indicated that while it would change the findings shown on the wind and wave record drawings (Figures 2-3 and 3-1) in the Phase I Report, these changes would not have a significant impact on the navigational aspects of the various sites nor on the findings of this report.

3.2 The navigation access to the alternatives being studied was re-examined. The existing pilot station at Triple Island is where all vessel traffic approaching this section of the coast pick up pilots. If the bulk terminal site were located in the southern part of the area the Pilot Station would probably remain at its present location. If the terminal facility were to be built in Port Simpson the pilotage station could possibly be moved to the north in order to enable approaching traffic to use the northern approach. Changing the location of the pilotage station or the approach channels to any of the ports is possible by regulation as the Pilotage Authority is Federal Government Agency. If any changes are made it should be kept in mind that they could impose additional costs on specific sites by increasing pilotage charges and by increasing vessel approach times, therefore their costs.

3. OCEAN TRANSPORTATION (cont'd)

3.3 Vessel anchorage locations for the alternative sites were examined. It was found that the only available sheltered location for long term anchorage of large, i.e. greater than 50,000 dwt. vessels, was in Port Simpson harbour regardless of the terminal location.

For a terminal in the Ridley-Kitson Island area anchorage in Port Simpson would, in all probability, only be used by the larger vessels for waiting periods in excess of one day. It was felt that this could possibly occur to some 20 to 30 vessels in the course of a year with 50 vessel-days occurring with one ship in the harbour and an additional five days where two ships would be in the harbour. The length of stay in the harbour for these vessels could easily double every two to three years due to sudden strikes and other labour and equipment problems. The number of vessels affected however would probably not change significantly. An example of the possible variance in these figures is the extent of delay incurred at a terminal because of a strike in another country. It was found that 70% of the vessels using the facility were anchored an average of $7\frac{1}{2}$ days each. The remote strike created a temporary surplus of shipping in that particular industry which resulted in vessels using the terminal area for anchorage.

3. OCEAN TRANSPORTATION (cont'd)

Anchorage of smaller vessels, which will carry the non-bulk unitized cargo, will be available in the existing Prince Rupert Harbour. The tonnage of non-bulk unitized cargo to be handled over the facility indicates that a probable berth occupancy of over 80% would occur on a single berth on a 24 hour per day basis. As a berth occupancy rate this high would create vessel delays that would be prohibitive, two berths were designed for the facility. These two berths would have sufficient space available that in all likelihood berthing delays would be minimal. In the event of labour problems the carriers in this type of trade would probably divert to other ports for other cargoes rather than sit idle. The large coal carriers, because of their special nature, are unable to do this.

3.4 In Chapter 2 of the Phase I Report potential sites were rated partially on the basis of ocean transportation access. Some of the potential sites considered were rated as not acceptable because "they cannot be reached by vessels within the specified size range, i.e. 150,000 dwt." This statement is not strictly correct as it may well be possible to move vessels of the stated size to these sites. However it is thought that the vessel tug boat time required to accomplish this manoeuvre could be prohibitive. The vessel time factor could be such that it would limit the terminal capacity as only a small number of vessels of

3. OCEAN TRANSPORTATION (cont'd)

this size could be berthed per year. (Berthing conditions would have to be ideal, i.e. slack tide, no fog, light winds and daylight.) This problem would not be alleviated by increasing the number of berths as the capacity limitation is in the approaches.

An additional factor in this could be the complete blocking of Prince Rupert Harbour entrance for hours at a time.

3.5 Dredging in the entrance and at some locations in the Port Simpson Harbour will be required if the terminal is to be located there. This dredging is very limited in extent and only involves blasting and removal of about four rock pinnacles that are some 10 fathoms below low water. This dredging will not be required if this site is only used for anchorage as the depth water over them is sufficient for vessels carrying only ballast.

3.6 The costs estimated for tug boat assistance at each of the sites were based on a possible need for 4 tugs of approximately 3,750 horsepower each. It was assumed that each of these tugs would cost about $1.5 million.

The capital cost of the tugs was apportioned to the sites on the basis of expected utilization relative to each site. The four southern alternatives (Ridley Island, Kitson

3. OCEAN TRANSPORTATION (cont'd)

Island, Fairview Point/Ridley Island, and Fairview Point/ Kitson Island) would be serviced by tugs based in the Inner Prince Rupert Harbour that would have a fairly high utilization of work other than that connected with the bulk terminal. The other alternative (Port Simpson) would have lower overall utilization because only two of the four tugs would be based in Prince Rupert and available for other work. The other two tugs would probably be based at Port Simpson because of its remote location with respect to the existing Prince Rupert Harbour.

3.7 Categories of waste water generated by vessels are as follows:

- Ballast water. Source: dray cargo ships, tankers. Expected pollutants: fuel oil, crude oil, oil products.
- Tank washings. Source: dry cargo ship deep tanks. Pollutants: oil products and other cargo remains.
- Tank washings. Source: tankers. Pollutants: crude oil, oil products, solvents.
- Bilge water (includes oil slops tank). Source: all vessels. Pollutants: crank case lubricants, fuel oil, grit and scale, rust, oxidized oil, sediment, sludge, chemicals from bilge cleaning, boiler water, fuel oil and engine oil, solvents from tank cleaning, hull leakage, propellor shaft seepage, and septic sewage.

3. OCEAN TRANSPORTATION (cont'd)

In preparing waste water treatment facilities provision should be made for the following chemical pollutants: alkalinity, total dissolved solids, phenols, toxic metals, (arsenic, barium, cadmium, chromium and copper), iron, cyanide and oil and grease.

Facilities for receiving these wastes will be necessary at the selected site as Canadian regulations do not allow dumping of any oily wastes in their territorial waters. Further regulation is the ultimate aim of the Inter-Governmental Marine Consultive Organization (IMCO) which hopes to have similar regulations applicable throughout the world including the high seas. Canada is signatory to this IMCO agreement.

3.8 Vessels using the proposed facility will likely have a capacity for Bunker "C" fuel of up to 25,000 barrels. This volume of fuel would only be carried in vessels recently fueled. Vessels using the proposed terminal will possibly fuel elsewhere in the world and will therefore only carry a partial load of fuel, say 19,000 barrels.

The fuel is generally carried in four tanks, two to a side. This factor would indicate a probably maximum spill of 5,000 barrels in the event of grounding or collision. The likelihood of two tanks being ruptured (10,000 barrels) is remote while the rupture of three or more is highly improbable.

3. OCEAN TRANSPORTATION (cont'd)

3.9 Vessel traffic figures for Prince Rupert, Vancouver and the Georgia Straits were requested in order to relate Vancouver oil spill and collision data to the study area. Vessel movements were found to be:

Prince Rupert	1,200
Vancouver	37,000
Straits of Georgia	50,000

These figures were based on 1972 Statistics Canada data and exclude all fishing and private vessel movements.

3.10 In the course of the inquiry with regard to vessel pollution regulations we were advised by M.O.T. that the average size of oil spills in the Vancouver Harbour was about 1 to 5 barrels.

4. SITE DEVELOPMENT

4.1 The work forces necessary to construct the proposed facilities at each of the locations are given by number and type in Figure 4-1.

FIGURE 4-1 CONSTRUCTION PERSONNEL

Phase & Trade	Site: Port Simpson	Ridley Island	Kitson Island	Fairview Point: Ridley Island	Kitson Island
Site development & Transportation Access					
Operating Engineers	70	30	20	30	20
Labourers	30	10	10	10	10
Rock & Tunnel Workers	40	20	10	20	10
Teamsters	40	20	10	20	10
Supervision & Office	20	10	10	10	10
Catering	20	10	10	10	10
Dredging					
Operating Engineers	-	-	60	-	30
Supervision & Office	-	-	10	-	5
Wharf Construction					
Carpenters	20	20	10	20	10
Labourers	10	10	10	10	10
Iron Workers	10	10	10	10	10
Bridgemen	20	20	30	20	30
Miscellaneous	10	10	10	10	10
Catering	10	-	-	-	-
On Shore Structures					
Carpenters	20	20	20	20	20
Labourers	20	20	20	20	20
Iron Workers	10	10	10	10	10
Miscellaneous	20	20	20	20	20
Catering	10	-	-	-	-

4. SITE DEVELOPMENT (cont'd)

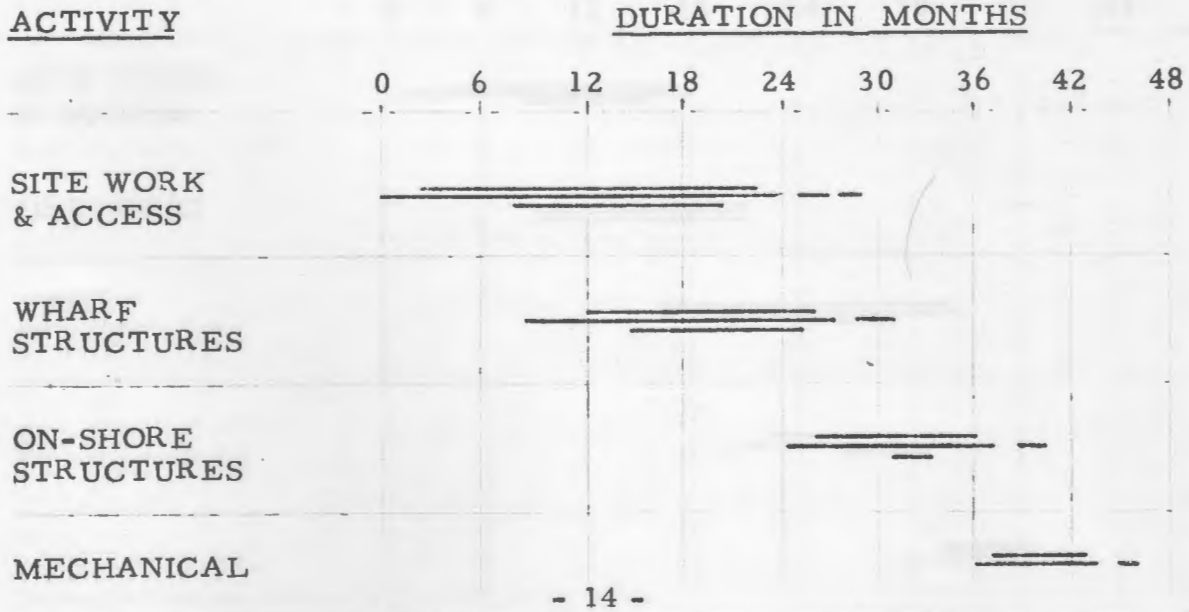
FIGURE 4-1 CONSTRUCTION FORCES (cont'd)

Phase & Trade	Site: Port Simpson	Ridley Island	Kitson Island	Fairview Point: Ridley Island	Fairview Point: Kitson Island
Mechanical Work					
Iron Workers	40	40	40	40	40
Electricians	10	10	10	10	10
Labourers	10	10	10	10	10
Miscellaneous	10	10	10	10	10
Catering	10	-	-	-	10

Note: The numbers of men shown are average and could be exceeded by as much as 50% at peak periods with corresponding decrease during start-up and shut-down periods.

4.2 The following approximate bar charts show the overlapping of the various work forces and indicates the intensity of the work force during construction as well as the duration.

FIGURE 4-2 CONSTRUCTION SCHEDULE - PORT SIMPSON



4. SITE DEVELOPMENT (cont'd)

FIGURE 4-3 CONSTRUCTION SCHEDULE - RIDLEY ISLAND & FAIRVIEW POINT/RIDLEY ISLAND

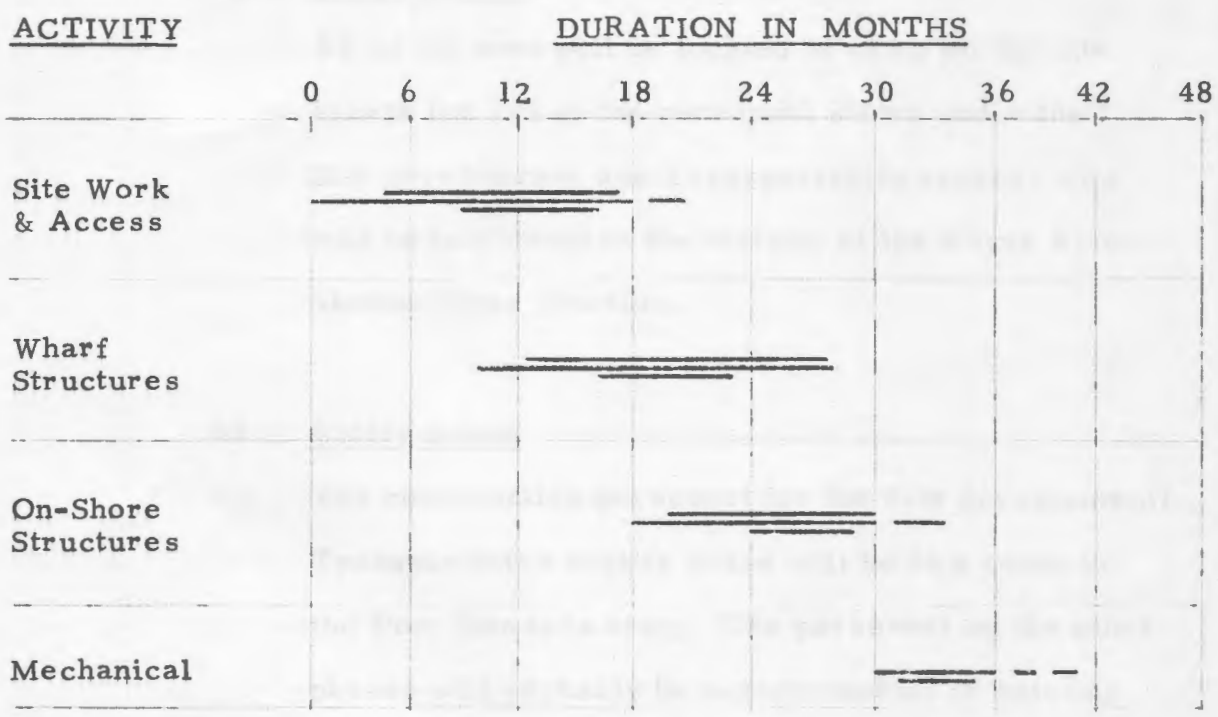
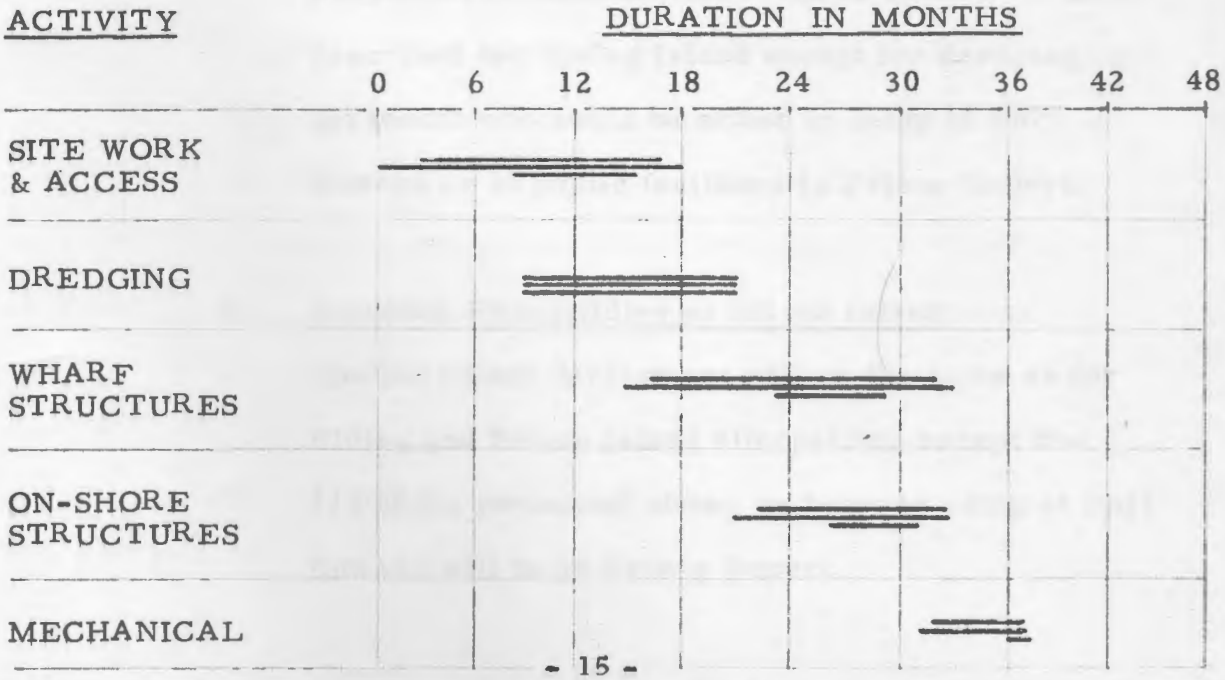


FIGURE 4-4 CONSTRUCTION SCHEDULE - KITSON ISLAND & FAIRVIEW POINT/KITSON ISLAND



4. SITE DEVELOPMENT (cont'd)

4.3 The deployment of the construction personnel will be as follows:

a) Port Simpson

All of the men will be located in camp on the site except for 1/3 of the personnel shown under the Site development and Transportation access, who will be in a camp in the vicinity of the Khyex River-Skeena River Junction.

b) Ridley Island

The construction personnel for the Site development/ Transportation access phase will be in a camp in the Port Edwards area. The personnel on the other phases will probably be accommodated in existing facilities in the Prince Rupert area.

c) Kitson Island

Personnel accommodations will be similar to those described for Ridley Island except for dredging personnel who could be either in camp in Port Edward or in public facilities in Prince Rupert.

d) Fairview Point/Ridley or Kitson Island

The personnel deployment will be the same as for Ridley and Kitson Island alternatives except that 1/3 of the personnel shown as being in camp at Port Edward will be in Prince Rupert.

4. SITE DEVELOPMENT (cont'd)

4.4 During the course of construction work camps will be located at Port Simpson (near the proposed site), Port Edwards and the Khyex River. Equipment and material storage as well as vehicle parking would probably be done on the site. Waste disposal will be either in existing garbage dumps, or in areas adjacent to the sites in accordance with Pollution Control regulations.

4.5 Construction of the terminal site at all alternatives requires removal of overburden, excavation of solid rock, and in the case of the alternative involving Kitson Island, dredging. The excavated rock at each of the sites would be used for fill and if suitable for crib mattresses, perimeter rip-rap protection, and on Kitson Island, for dykes.

Any materials encountered suitable for fill, other than rock, will be utilized in the core area of the fill as will any poorer quality rock. The unsuitable materials (organic soils) will be either burned, buried adjacent to the site, or used to restore vegetation on raw cut slope. Dredged material at Kitson Island will be used for fill. Volumes of excavation for each of the proposed sites are as shown in Figure 4-5.

4. SITE DEVELOPMENT (cont'd)

FIGURE 4-5 EXCAVATION QUANTITIES

Site	Material (Cubic Yards) Organic Waste	Solid Rock	Dredging
Port Simpson	200,000	4,000,000	-
Ridley Island	200,000	2,000,000	-
Kitson Island	25,000	1,000,000	8,000,000
Fairview Point/	25,000	750,000	-
Ridley Island	150,000	1,250,000	-
Fairview Point/	25,000	750,000	-
Kitson Island	25,000	1,000,000	3,000,000

Notes:

1) Material from silt or mud pockets in fill areas, below mean water line, will be disposed in water deeper than 20 fathoms generally within 2 miles of the site.

2) Any rock pinnacles encountered in the approaches and berth areas will be removed by drilling, blasting and clamshell dredging. Disposal as above.

3) Additional materials for site surfacing and riprapping may be required. It is expected that these will be obtained from commercial pits in the area.

4. SITE DEVELOPMENT (cont'd)

4.6 Typical sections of the proposed developments are shown in the following Figures.

FIGURE 4-6 TYPICAL SECTION - PORT SIMPSON & RIDLEY ISLAND

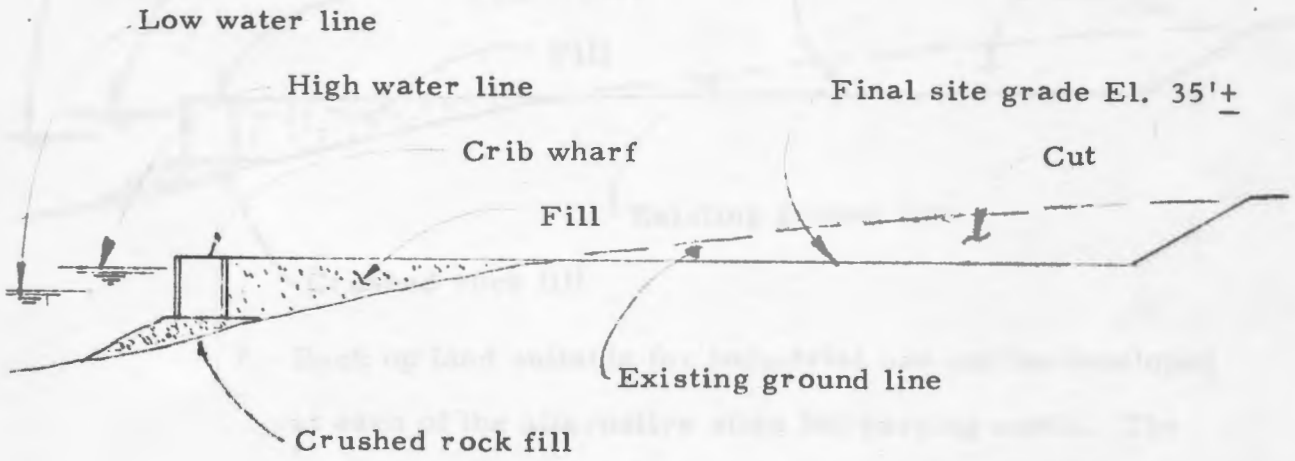
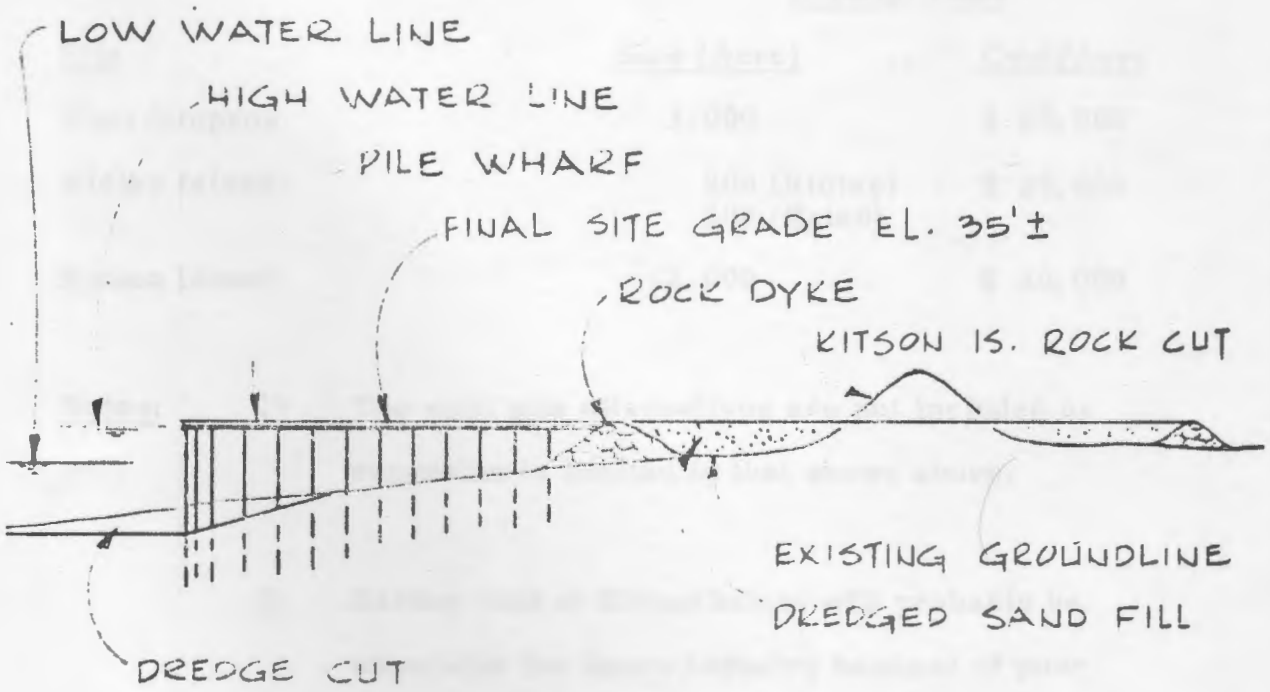
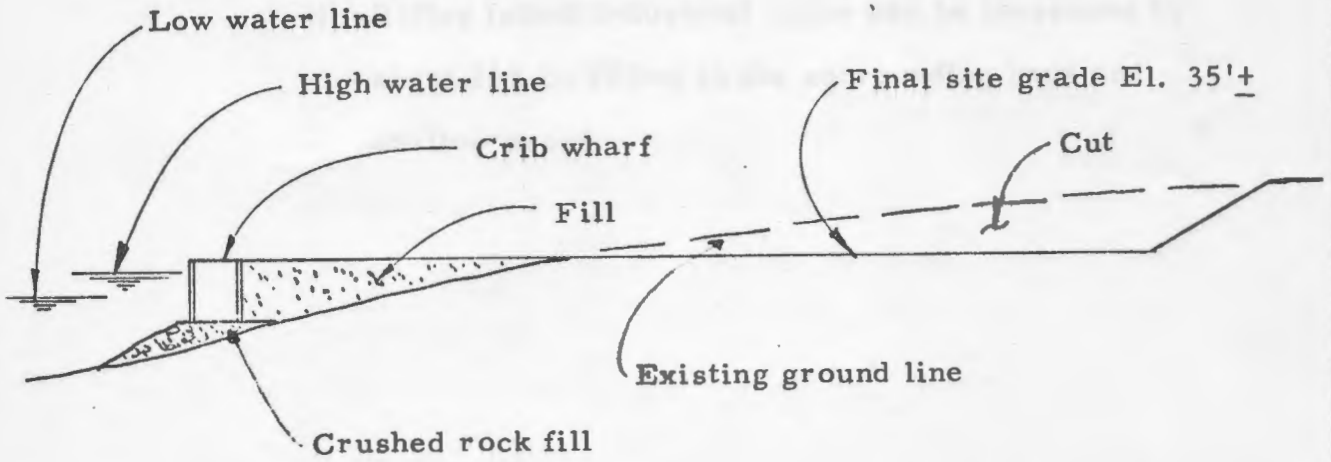


FIGURE 4-7 TYPICAL SECTION - KITSON ISLAND



4. SITE DEVELOPMENT (cont'd)

FIGURE 4-8 TYPICAL SECTION - FAIRVIEW POINT



4.7 Back up land suitable for industrial use can be developed at each of the alternative sites for varying costs. The approximate extent and cost for each site is shown in Figure 4-9.

FIGURE 4-9 BACKUP LAND AVAILABILITY

Site	Backup Land Size (Acre)	Cost/Acre
Port Simpson	3,000	$ 20,000
Ridley Island	800 (Ridley) 200 (Kaien)	$ 20,000
Kitson Island	2,000	$ 40,000

Notes:

1) The split site alternatives are not included as expansion is limited to that shown above.

2) Backup land at Kitson Island will probably be unsuitable for heavy industry because of poor

4. SITE DEVELOPMENT (cont'd)

foundation conditions.

3) Ridley Island industrial areas can be increased by about 25% by filling in the surrounding bays and shallow areas.

5. MATERIALS HANDLING

5.1 It is estimated that approximately 200 people will be employed during operation of the terminals. Twenty of these will be office and supervision staff. (Manager, Supervisors, Clerks, typists, etc.) The remaining 180 will all be ILWU (International Longshoremen and Warehousemen's Union) members and will include such trades as stevedores, mechanics, terminal equipment operators, etc.

5.2 In the alternatives where the materials handling operations are split (Fairview Point/Ridley Island, Fairview Point/ Kitson Island) the work force split will be 125 men at Fairview Point and 75 men at either Ridley or Kitson Island.

5.3 Fresh water demand at all of the alternative sites will be about 100,000 gallons per day with a peak of 500,000 gallons per day. The maximum system capacity would be 1,000 gallons per minute for a four hour duration. The latter flow would only be required for fire control.

6. FINANCIAL DATA

6.1 The engineering cost data used in the Phase I Report to arrive at a best "Engineering" terminal location was reviewed in order to ensure its compatability with the environmental aspects of this study.

In the Phase I Report the data was presented as the sumation of site construction costs and certain differences in annual operating costs brought to present value at a 12% discount rate over an infinite time period with no consideration given to inflation. While this approach and discount rate were normal for engineering comparisons they were unsatisfactory for an environmental impact study.

The basic cost data was summarized as shown in Figure 6-1 so that NEAT could apply the evolved 7% discount rate and inflation to both Engineering and environmental costs.

The impact of inflation on operating costs was examined briefly and it was felt that the current applicable inflation rate was about 14% per annum for operating costs. When the effective Canadian inflation rate of 12% is considered, these figures indicate a non-inflationary growth in value of operating costs of about 2% per year.

6. FINANCIAL DATA (cont'd)

FIGURE 6-1 ENGINEERING COST DATA

	Terminal Site				
	Port Simpson	Ridley Island	Kitson Island	Fairview Point Ridley Island	Fairview Point Kitson Island
Capital Costs					
Railway	30.0	1.0	3.0	1.0	3.0
Road	2.0	2.0	3.0	2.0	3.0
Site Development	32.0	28.0	25.0	19.0	18.0
Materials Handling	30.0	30.0	30.0	30.0	30.0
Total	94.0	61.0	61.0	52.0	54.0
Operating Costs					
Railway -operating	2.5	0.4	0.4	0.3	0.2
Railway -capital	1.2(1)	-	-	-	-
Road	0.1	0.1	-	0.1	-
Tugboats -operating	2.0	1.5	1.5	1.4	1.4
Tugboats -capital	0.6(2)	0.5(3)	0.5(3)	0.5(3)	0.5(3)
Demurrage	0.5	0.5	0.5	0.4	0.4
Site Maintenance	0.3	0.3	0.4	0.2	0.2
Materials Handling	0.6	0.3	0.5	0.1	0.1
Total	7.8	3.6	3.8	3.0	2.8

Notes:
1) Capital cost of locomotives 10.8 amortized over 15 years at 8%.
2) Capital cost of tug boats 5.1 amortized over 15 years at 10%.
3) Capital cost of tug boats 3.8 amortized over 15 years at 10%.

All costs in millions of dollars.

6. FINANCIAL DATA (cont'd)

In order to demonstrate the effect that changing discount rates could have on the engineering decision, Figure 6-2 was prepared.

FIGURE 6-2 PRESENT VALUE COMPARISON OF ALTERNATE SITES

	Discount / Inflation Rate		
Site	12% 0%	7% 0%	7% 2%
Port Simpson	159.8	206.9	254.7
Ridley Island	90.2	111.0	132.2
Kitson Island	91.8	113.9	136.3
Fairview Point			
-Ridley Island	76.2	93.4	111.0
-Kitson Island	76.5	92.6	108.9

Notes: All costs in millions of dollars.

Present Values taken over infinity write off periods.

It can be seen from the data in Figure 6-2 that varying the discount rate and the inclusion of 2% growth of value has no effect on the "Engineering" selection of the least cost site. It can also be seen from Figure 6-2 that rate selection has significant impact on a study where external costs, such as values of annual fish losses, are considered.

6. FINANCIAL DATA (cont'd)

6.2 The financial analysis carried out in the Engineering section of this study is elementary and could be further refined by such techniques as using the economic life of various components being considered in order to amortize their costs. These costs could then be returned to present value at an appropriate discount rate.

However, the use of such refinements, at this stage, are not warranted because of the nature of the basic cost data (order of magnitude only).