APPENDIX D:

SPECIAL ENVIRONMENTAL CONSIDERATIONS

EXISTING CLIMATE

NOISE IMPACT OVERVIEW

POLLUTION IMPACT OVERVIEW

Prepared for:

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APPENDIX D

SPECIAL ENVIRONMENTAL CONSIDERATIONS

The factors of climate, noise, and chemical pollution are included in this appendix partly because they do not fit well into the other areas (Terrestrial, Cultural, and Aquatic), but mainly because these studies were carried out in a different fashion. The information included in Appendices A, B, and C was obtained through original field assessment as well as analysis of the work of others, but the climate, noise and pollution work was of an "overview" nature which involved no field work.

Accordingly, the following information is essentially "professional judgement" by people experienced in these fields as applied to the data developed by other members of NEAT and by Swan Wooster. When setting up the assessment program, it was recognized that these overview studies could only be started during the last stages of our study when baseline information was available, but it was felt detailed inputs in these fields would not be essential to the decision on site selection.

Under the supervision and editing of Mr. B.R. Hinton, the three parts of this appendix were prepared by Mr. J.B. Wright (climate), Mr. M.R. Noble (noise), and Dr. G.A. Vigers (pollution).

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SPECIAL ENVIRONMENTAL CONSIDERATIONS

APPENDIX D

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PART D1

CLIMATE

PART D1 - CLIMATE

D1.0 This assessment was prepared by Mr. J.B. Wright, formerly head of the Scientific Support Unit of Environment Canada's Atmospheric Environment Service (Pacific Region), and now an independent consultant.

D1.1 Data Sources and Adequacy

As is the case for most rugged, mountainous areas, the data available for the north coast of British Columbia are not adequate to portray the climatic variations associated with elevation, exposure, orientation and aspect. For the study area, only seven stations are listed by the Atmospheric Environment Service. These are shown on Map 741-D1, and details of location, elevation and parameters available are given in Annex D1. As can be seen, all are near sea level, skirting the coast. Nothing is available to allow the assessment of the probable climate away from the water and at higher elevations. Nevertheless, some extrapolations are possible using the known data, so at least a general climatology can be prepared.

The temperature parameter is probably the best defined, and lengthy records are available from both Prince Rupert (Marine Station on Digby Island) and Port Simpson. A shorter record, beginning in 1961, is available from Prince Rupert Airport. Standard relationships can be used to provide some indication of temperatures at higher levels. As most of the study area is maritime in nature, no great error is anticipated in extrapolating temperatures from these three sources.

Precipitation, either rain or snow, is a much more variable parameter. Long-term records are available from Prince Rupert and Port Simpson. Shorter records are available from Prince Rupert Airport, Montreal Circle and Roosevelt Park. It is very difficult to develop reliable precipitation maps of the total area from these five known tabulations. Hence, if detailed information in more precise form is needed for future engineering projects, representative sites should be monitored.

The wind flow over the area appears to be well documented by stations at Prince Rupert, Prince Rupert Airport, Lawyer and Lucy Islands. With these data and a thorough knowledge of terrain and synoptic features one can assess the probable winds in most areas. One lack is in records of the strong outflow winds that flow down the Skeena River and Portland Canal in winter. Fortunately, the possible sites on the study are generally sheltered from these winds.

D1.2 General Climate of Tsimpsean Peninsula Area

The Tsimpsean Peninsula, located on the north coast of British Columbia, has a marine-type climate, brought on by its proximity to the north Pacific Ocean and by the prevailing storm track across the north coast. The ocean modifies the temperatures of the area and provides the abundant moisture that falls in the form of rain or snow. Storms cross the coast at rather frequent intervals in the fall and winter seasons but less frequently in the late spring and summer.

Temperatures are relatively uniform at sea level, varying about one degree in the yearly mean from south to north. Extreme temperatures vary about 2 to 4 degrees over the same distance. Seasonal and elevational changes are much more marked. Close to sea level the mean annual temperatures will be about 45°F, with a range from 35°F in January to 57°F in August. Extremes of temperature range from -10°F recorded at Port Simpson in February to 90°F recorded at Prince Rupert in June. Frost can be expected at night on the average of 71 days but has never been recorded in June, July, August or September.

Precipitation amounts and intensities are greatly dependent on the ruggedness of the terrain and the above noted storm track. Variations occur because of elevation, aspect, exposure and orientation of the site. Little information is available on these variations because of the lack of data available and because of the extreme difficulty in extrapolating from site to site. The average yearly precipitation approaches the 100 inch mark near sea level and will probably greatly exceed this in many of the more exposed and higher areas. Amounts are in general heavy in the fall season, reaching 12 to 14 inches on the average in October. Summer precipitation is about one-third of the October fall, averaging 4 to 5 inches per month in each of May, June, July and August. Precipitation occurs on just over one-half of all days, ranging from 24 days on the average in October to 16 days in each of June, July and August. The greatest recorded total precipitation in a 24-hour period was 5.55 inches at Prince Rupert and 6.66 inches at Montreal Circle, both in October.

Snow occurs in each month November through April and has occured on at least one occasion in both October and May. The total seasonal snowfall reaches 44 to 52 inches in the Prince Rupert area and about 40 inches at Port Simpson. The heaviest 24 hour fall was 16.6 inches recorded at Prince Rupert, Montreal Circle.

The prevailing wind direction is from the south-east on a year round basis but westerlies predominate during June and July at both Prince Rupert and Lucy Island. Average wind speeds vary from about 7 miles per hour at Prince Rupert (Marine Station) to 13 at Lucy Island. The strongest recorded winds were southeast at 66 miles per hour at Prince Rupert (Marine), southeast 46 at Lawyer Island and southeast 57 at Lucy Island. Winds tend to be very seasonal with the mean strengths at a maximum in the fall season, associated with the frequent storms and at a minimum in the summer.

Fog may be a navigational problem for ships entering the study area. Fog occurs on relatively few days during the winter but is much more common during the summer months - June, July, August and September. This pattern is associated with the general synoptic weather of north-western British Columbia. Fog forms generally over the open sea. In the winter, storms are frequent and the fogs are broken up and dissipated at fairly regular intervals. In the summer, storms are less frequent, winds are lighter and periods of quiet, stable weather persist for days. Hence, the fog has a chance to develop and become widespread, particularly over low lying land areas at night and offshore during the day, but under ideal conditions may persist onshore for the full 24 hours.

.1.3 The Probable Climates of Specific Sites

Port Simpson

The temperature and precipitation climate of the Port Simpson area is suitably documented from records taken over the 20 year period 1886 to 1907. While these refer to the townsite, they are applicable to the study site across the harbour, with only minor modifications. The monthly mean temperature in January is 34.0°F and in August reaches 56.7°F. Extreme temperatures range from -10°F recorded in February to 88°F recorded in both June and July.

The annual precipitation averages 92 inches, while snowfall measures 40 inches. The driest months are June and July with recordings of less than 5 inches in each. Fall and winter falls are heavy with in excess of 10 inches being recorded in each of October, November and December. The rate of fall of precipitation has not been measured near this site but rates for Prince Rupert will be applicable.

The Port Simpson harbour area is well sheltered from the prevailing south-easterly winds, and from the north-easterlies that blow out of Portland Canal in the winter. It is exposed to the summer westerlies but these are, in general, lighter in nature with speeds averaging somewhat less than 10 miles per hour, and maximum hourly values less than 40 miles per hour.

Fogs at Port Simpson should be similar in nature to those recorded at Prince Rupert Airport. They will occur with greatest frequency in August when, on the average, 6½ days may be expected to record fog for at least one hour. They are a relatively minor problem in the fall, winter and spring.

Access to Port Simpson involves rail construction along Work Channel and road construction to Prince Rupert. Little information is available on precipitation intensities and amounts over these routes. Runoff of the rather heavy precipitation is likely to create engineering problems.

Kitson Island

No climate data are available from this site but data from Prince Rupert (Marine Station) and Prince Rupert Airport should adequately describe the patterns.

Temperatures will be very similar, with no significant departures from recorded data to be expected. Precipitation is likely to be a little less and snowfalls considerably less on the Island but access routes will have amounts similar to the Prince Rupert figures.

The Kitson site is the most exposed of all sites to the prevailing southeasterly winds of winter and the westerlies of summer. Lawyer Island shows a mean annual speed of 10.5 m.p.h., a January speed of 15.2 m.p.h., and a maximum hourly record of 47 m.p.h., all from the southeast. Mean speeds at Prince Rupert are somewhat lower than those at Lawyer Island but the maximum recorded one-hour speed is higher - 66 m.p.h. - probably due to the funnelling through the entrance to Prince Rupert Harbour. These values should reflect in general the pattern to be expected at Kitson Island and in the anchorage area off the Kinahan Islands. Summer westerlies are lighter and unlikely to create major problems.

Fog records from Prince Rupert Airportshould provide some indication of conditions to be expected at Kitson Island. However, since the fog is of a marine nature, it may be more persistent with less chance of afternoon break-ups at Kitson.

Ridley Island

The site on Ridley Island is sufficiently close to the Prince Rupert Weather Station (Marine) to have the same general climate. Temperatures and precipitation should be almost identical. Southeast winds will prevail. Westerly winds can be expected in the summer months but will in general be much lighter than the southeasterly storm winds of winter. The remarks about fogs at Kitson Island should be applicable to Ridley Island.

Fairview Point

The Fairview site is closest to the climatological stations and so its climate is most adequately described.

Mean temperature should vary from 35.3°F in January to 57.1°F in August. Extreme temperatures will range from a low of -6°F in January to a high of 90°F in June.

Annual total precipitation should approximate 100 inches and snowfall 50 inches. Expected maximum 24 hour falls of rain should be 6 inches and snow about 16 inches. The number of precipitation days during the year will be close to 220 on the average with a probable 25 days of snow.

Wind flow should be similar to that measured at Prince Rupert (Marine Station) although funnelling and convergence associated with the proximity to higher ground may make for slightly higher peaks.

Fogs should be almost the same as those noted at Kitson and Ridley Islands although their duration may be shorter at Fairview because of its distance from the open sea.

General Inner Harbour Area

The recorded data provided should adequately portray the climate of the inner harbour area. Temperatures and precipitation should vary little. Winds in the inner harbour should be lighter in general than those recorded at the Prince Rupert Marine Station on Digby Island. Fogs, coming in from the open sea, should be less frequent and of shorter duration.

PART D2

NOISE

PART D2 - NOISE

D2.0 This phase of the NEAT study was carried out as a brief "office" assessment by Mr. M. R. Noble of Barron & Strachan, Consulting Acoustical Engineers, under the supervision of Mr. R. A. Strachan.

D.2.1 Introduction

The development of a bulk loading terminal in the Prince Rupert region raises many questions of an economic, ecological, and environmental nature. This report will be concerned solely with the acoustical implications of such a development, in terms of noise impact on the environment and on local residents. It is understood that a bulk loading facility, capable of the tonnage through-put required, is an essentially noisy operation. During this phase of the study, we will be concerned only with the impact of the terminal noise and associated transportation noise on surrounding communities. Mitigation of the noise at source will not be considered here, but should be studied once a final site is selected and detailed plans are available.

The report will examine the acoustical suitability of each of the ten sites selected by Swan Wooster Engineering Co. Ltd., and discussed in the report entitled "Phase I, Bulk Marine Terminal Sites in the Prince Rupert Area of B.C. (Engineering Aspects)", and will rank them in order of preference. This ranking will then be compared with the other parameters used in the engineering study, and an overall rank will be assigned to each of the final final five sites selected. The report will conclude with some additional comments on the suitability of these sites for further industrial expansion.

D.2.2 Acoustical Description of Sites

Port Simpson

This site is situated on reasonably flat land at the northern tip of the Tsimpsean Peninsula, on the north shore of Port Simpson Harbour. The selected site faces the settlement of Port Simpson across the harbour, at a distance of approximately 3,000 yards. The bulk loading facility will thus be clearly visible from all areas of Port Simpson. The acoustical implications are clear; since no natural barrier exists between the bulk loading facility and the town, the populace will be exposed to whatever noise is generated at the terminal, attenuated only by geometrical spreading and atmospheric absorption. (See Annex D-2).

The town of Port Simpson has a present population of 1,200. The only existing industry of any consequence is a cannery, still under construction, the operation of which is largely seasonal. We expect noise from the cannery to be insignifcant compared with loading noise from the proposed terminal. If this site is selected it will be necessary to examine in greater detail the existing noise climate at Port Simpson, and also to predict with accuracy the expected increase in that noise climate due to terminal operations.

Land transportation access to the site will involve exposing hitherto inaccessible wilderness areas to, in the first instance, construction noise, and later to road and rail traffic noise on a continuing basis. The proposed rail access will be along the west side of Work Channel, so that Port Simpson itself will be sheltered by the terrain from rail noise for all but the last mile or so of track leading to the terminal, The proposed road will link the terminal with Prince Rupert via Georgetown Lake. The road will not pass closer than approximately two miles to the existing settlement, so that noise exposure due to road transportation is expected to be minimal.

Smith Island

This site is situated about twelve miles south of Prince Rupert, and about 5,500 yards south of the nearest habited area (Inverness). More populous Port Edward, located about 8,000 yards to the north, will be sheltered from most of the terminal noise by Lelu Island. Even without the shielding effect of the island, it is doubtful that the Port Edward community will be impacted to any appreciable extent by loading operations on Smith Island, since the area is already exposed to noise from the existing Canadian Cellulose mill, and its associated road and rail links. Any additional impact from the Smith Island site is likely to be negligible.

Kitson Island

This site is in line of sight of Port Edward, through Porpoise Passage, but it is distant at 6,000 yards to the south. Noise impact on Port Edward due to terminal operations is expected to be negligible, The comments made for the Smith Island site, regarding existing industrial operations at Port Edward, apply equally in this case.

Ridley Island

This site is approximately 2,500 yards to the west of Port Edward, with a maximum elevation of the intervening land of approximately 50 feet. About two-thirds of the line of sight distance is over water (Porpoise Harbour). When allowance is made for the height of the loading plateau above mean sea level, the 50 feet elevation is considered insufficient to shield the Port Edward area from terminal noise. The impact on the community, however, is expected to be small, as a result of the existing industrial operations at the pulp mill. Additional significant noise impact due to road and rail access is not anticipated, due to the existing road and rail services.

Digby Island

This site is situated to the southwest of Prince Rupert at a distance of approximately 6,000 years. The site is sheltered from line of sight of the Prince Rupert residential area by the shoulder of Mount Hays, and is similarly shielded from Port Edward. No direct noise exposure of these communities is expected from the terminal operations.

The proposed rail access route to this site almost completely encompasses Prince Rupert Harbour, with consequent exposure of the Prince Rupert community to rail noise propagated across the harbour from the northern shore. The additional noise impact on the community must be assessed carefully with respect to the existing impact from present rail operations in Prince Rupert, and also from the cargo facilities at Fairview Point. A discussion of sound propagation over water can be found in Annex D-2.

Melville Arm

This site is in direct view of most of the Prince Rupert settlement, being situated just across the harbour to the northwest of the town, at a distance of approximately 2,000 yards. The whole of Prince Rupert would be impacted by terminal noise and rail access noise from this site. There is no possibility of the erection of any barrier between the wharves and Prince Rupert, and it is expected that impact could be high.

Bacon Cove

This site is situated almost due north of Prince Rupert across the harbour, at a distance of approximately 2,000 yards. Noise exposure of the Prince Rupert area is expected to be high from this site, for the same reasons as mentioned for Melville Arm.

Schrieber Point

This site is also situated on the north side of Prince Rupert Harbour, and smaller problems of noise exposure to Melville Arm and Bacon Cove are to be expected. The noise impact will be slightly mitigated by the increased distance to the main population areas of Prince Rupert (approximately 3,000 yards).

Pethick Point

This site is directly adjacent to Prince Rupert to the northeast, only separated from it by Fern Passage. The distance of the principal residential areas of Prince Rupert is only 2,000 and 3,000 yards. Exposure of these areas is expected to be high, since no natural barriers exist to divert the sound. Noise due to rail access is also expected to be high since the line to the terminal will pass close to the northeast end of Prince Rupert, crossing Fern Passage at its narrowest point.

Osborne Cove

This site is situated near the northern end of Prince Rupert Harbour, about 7,000 yards from the town of Prince Rupert. Shieldingof some parts of Prince Rupert may be expected by the shoulder of the hills around Beatty Point. This will probably only be effective for a small area of the community situated at a large distance from the waterfront. Most of the residential area of Prince Rupert will be exposed to terminal noise from this site, the path predominantly being over water. The proposed rail right-of-way follows that suggested for Pethick Point, thus exposing a section of Prince Rupert to rail noise.

The noise exposure of the community as a result of a bulk facility at this site is expected to be lower than for the other sites in Prince Rupert Harbour.

D2.3 Acoustical Ranking Of The Sites

Based on the comments made in the previous section, the following rank order of the sites was prepared, based solely on the acoustical suitability of each site:

1. Smith Island
2. Digby Island
3. Kitson Island
4. Ridley Island
5. Osborne Cove
6. Port Simpson
7. Equal: Melville Arm, Bacon Cove, Schrieber Point, Pethick Point

D2.4 Other Factors

The Swan Wooster study has eliminated all sites in the Prince Rupert Harbour area from further consideration, due to navigational limitations. The study has reduced the number of possible sites to a short list of three, based on the parameters of available land, land transportation access, and ocean transportation access. These three sites were Port Simpson, Ridley Island, and Kitson Island. They also considered split operation with the coal terminal either at Kitson Island or Ridley Island and general cargo being handled through expansion of the existing facility at Fairview Point. The acoustical considerations for split operation are identical with those for a combined operation on the same site, therefore we will not be concerned with the split operation possibilities. The acoustical ranking of the viable sites is as follows:

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

D2.5 Possible Future Expansion

Noise from a bulk loading facility of the size postulated is expected to be fairly constant with time. An expansion of the facilities to accommodate increased through-put is not expected to increase the noise generated by the plant to an appreciable extent. However, the availability of easy transporation and raw materials access may attract other heavy industry to the terminal site. The noise contribution from a major industrial facility, such as a steel mill, could be considerable, and its impact on the local communities would need to be carefully evaluated. Some consideration must be given to the housing of employees at this facility. Accommodation considerations at the Kitson Island and Ridley Island sites have been included in this evaluation because it is understood that these new residents will be assimilated by the existing Prince Rupert and Port Edward communities. We understand that the same situation has been proposed for the site at Port Simpson, with the work force being transported by road daily from Prince Rupert. Further industrial development of the Port Simpson site, however, will mean that some people will want to live at the north end of the Tsimpsean Peninsula. The location and design of any future town site in the Port Simpson region should be determined by careful evaluation of the acoustic environment, taking into account noise produced by the bulk loading facility, as well as the future industrial developments.

D2.6 Conclusions

The ten proposed port sites for the bulk loading facility in the Prince Rupert area have been evaluated with respect to their acoustic impact on the environment, with the impact on existing residential settlements emphasized. The sites have been ranked in terms of acoustic parameters, and a rank ordering of the three short listed sites has been made. Factors which have been considered as influencing the acoustic choice of the sites include terrain, climatalogical parameters, and location of surrounding communities.

PART D3

POLLUTION OVERVIEW

PART D3 - CHEMICAL POLLUTION

D3.0 This overview was prepared by Dr. G. A. Vigers of E.V.S. Consultants, professional waste water consultants, for the NEAT Study Team.

D3.1 Introduction

This report is restricted to an overview assessment of what are considered to be the pollutants of major concern. Specifically these are spilled oil from vessel traffic, land storage depots and rail traffic; and coal dust from bulk loading facilities and rail transport.

The present work is directed at evaluating the prevailing vectors by which these materials will come in contact with sensitive environmental elements, where those elements are located, and relate the impact from pollutants according to site location.

Some estimate is also made for the probability of pollution discharges which may cause significant impacts.

D3.2 Oil in the Environment

The least studied and least understood consequence of an oil spill is the effect of oil on fish and marine ecosystems. Thus quantitative prediction of the impact of an oil spill on fisheries is somewhat speculative. Nevertheless, in lieu of adequate hard data, such speculation may provide order of magnitude estimates for serious environmental impacts.

For most oil spills, acute and short term effects are related to physical impacts. These impacts are largely dependent on the characteristics of the oil spilled. (Crude oil, Bunker C., Fuel Oil grades, and so forth.) In particular, physical effects include smothering of the benthos, coating and smothering plankton, suffocation and surface fouling of gills of fish. Oil slicks can also physically prevent surface reoxygenation of marine waters, resulting in lowered dissolved oxygen and secondary suffocation of aquatic species.

Acute and short term effects can be related to lethal concentrations of toxic constituents of oil. These effects are, however, likely to be far less operative for any given oil spill than physical effects, since the toxicity of most oil constituents to aquatic organisms is not high.

Notable exceptions are some of the aromatic hydrocarbons (for example, naphthalene) and the volatile mercaptans which exhibit LC 50's in the range of 0.1 - 5 ppm. However these latter constituents, because of their volatility, exist in the aquatic environment at lethal concentrations for only brief periods of time. Indeed, the oil left within 48 to 72 hours of an oil spill is comprised primarily of residues not directly harmful to fish.

Chronic and long term effects are considered to be of greater consequence to fisheries resources than acute effects. For example, incorporation of oil into sediments can cause long-term changes in organoleptic properties of shellfish and bottom dwelling organisms. Carcinogens such as Benzopyrenes undergo biological magnification through the food chain and may render commercial species unfit for human consumption. Sensitive elements in the food chain also can be destroyed, lending to the reduction or destruction of fisheries resources. (Oil emulsions destroy habitats such as kelp beds which are valuable for herring spawning.)

Oil-contaminated sediments, and indeed oil slicks themselves, have been shown to concentrate pesticides such as p p' - DDT to levels of 1 ppm. Transfer and magnification of these components to higher trophic levels, and ultimately to commercially valuable fish stocks, may also render fish stocks unacceptable for human consumption. From an economic loss point of view, such situations would be as undesirable as outright kills of commercial fish stock.

The known effects of oil pollution in the marine environment are summarized in Table 1.

Some of the effects of oil spills on waterfowl are much more direct. Those birds which use the water (waterfowl in general, and including shorebirds) become coated with oil and unable to fly. In preening their feathers to remove the oil, they often ingest lethal quantities.

The oil also removes the natural protective oil in the birds' feathers, permitting the penetration of water. Quite frequently, this causes pneumonia and death.

These aspects are most critical during the winter, when large concentrations of birds are present in coastal bays. However, ecological impacts assume greater proportions during the summer months. Oil destroys or contaminates many marine invertebrates, coats shallow rooted vegetation, and causes a loss or contamination of fish. Accordingly, the food chain for waterfowl is interrupted.

TABLE 1

KNOWN EFFECTS OF OIL POLLUTION IN THE MARINE EVIRIONMENT[1]

	Crude Oil	Refined Products	Dispersants + Oil
Plankton/Bacteria	Toxic to some and utilized by others.	Toxic to some and utilized by others.	Inhibits some bacterial degradation.
Fish	Suffocation, surface foulding, hemorrhaging of capillaries, non-fatal tainting, disruption of food chain.	Carcenogenic tumors from refinery wastes, increased apparent toxicity of oil with a decrease in oxygen, non-fatal tainting, loss of equilibrium.	Loss of equilibrium and orientation, destruction of gills and olfactory epithelial, cells, breakdown of protein, reproduction inhibited.
Shellfish	Surface and ingested tainting, suffocation poisoning, incorporation of oil into egg yolks, breaks down protective mucous coating of gill epithelium. Larval forms most sensitive.	Tainting, suffocation, incorporation of carcenogenic compounds, changes in amino acid content. Larvel forms most sensitive.	Breaks down protective mucous and water coatings, inhibits growth and normal development. Larval forms most sensitive. Larvae development inhibited Smothered by sinking oil.
Marine Plants	Suffocation, inhibition of flowering, leaf damage during photoinductive period.	Breakdown of fatty constitutents of cytoplasmic membrane. Inhibition of chloroplast activity.	Increases the toxic effects of the oil and the rate of uptake of the oil. Periphyton smothered by sinking oil.
Sediments	Incorporation of oil into sediments causes long-term tainting of shellfish and bottom-dwelling organisms, selective concentration of chlorinated pesticides in oil-rich muds. Biological magnification of carcinogens.	Same as for Crude Oil	Incorporation of oil into sediments is enhanced by most dispersants and sinking agents.
Waterfowl	Physical coating, poisoning, starvation, destruction of protective habitat.	Poisoning by ingestion during preening, possible changes in reproduction (thin egg shell), concentration of certain fractions from contaminated food chain organisms (deposited in fatty tissues).	Removes natural protective oily body coatings, increases susceptibility to pneumonia. Increases wetability of feathers.

[1]Modified from Dolan, Savage & Clark, Environmental Statement on the proposed leasing of Puget Sound Shorelands and Beds of Navigable Waters for Oil and Gas Explorations, 1970.

With specific reference to the Tsimpsean Peninsula, it should be noted that the most important waterfowl areas are the large intertidal flats between Digby Island and Port Simpson. With tide changes of the order of 25 feet, many square miles of this flat foreshore could be covered with oil in the event of a spill. Thus, the problems associated with waterfowl become more acute in this area than in areas of steeper foreshore or smaller tides.

D3.2.1 Probability of Oil Spills

While an estimate of the probability of oil spills is always a difficult task, it is made more difficult for this study by the lack of a local data base. No reliable estimate of spills in the Prince Rupert area exists. However, the following information is relevant:

1. There are now 1,200 ship movements per year in Prince Rupert Harbour.
2. There are now 37,000 ship movements per year in the Port of Vancouver. and 50,000 in the entire Strait of Georgia.
3. The Ministry of Transport and the Environmental Protection Service of Environment Canada estimate that 1,000 oil spills per year occur in the Vancouver area. Three hundred of these are reported, and less than 100 are expected to have any measurable environmental effects.
4. An average of one collision per year (one per 50,000 movements) occurs in the Vancouver and Strait of Georgia area.
5. In the past 14 years (about 15,000 movements) there have been two collisions in the Prince Rupert area. (one collision per 7500 movements).

Using the above and recognizing the narrow data base available on Prince Rupert itself, we feel the following may be a reasonable estimate of the effects of adding about 650 movements per year to either the Ridley Island or Kitson Island area, including about 40 to 60 vessel movements to or from the Port Simpson anchorage:

1. These should average less than $\frac{650}{37,000} \times 100 = 1.75$ spills per year of a size likely to cause some environmental damage (assumed to be over 20 barrels, or about 840 gallons of oil). One tenth of these should occur in Port Simpson or Chatham Sound. Use a total of one per year for this report.

2. There should be additional collisions on the average of once every $\frac{7,500}{650}$ movements = 11.5 years based on Prince Rupert data, or once every $\frac{50,000}{650}$ = 77 years based on Vancouver data. Assume an average of once in 25 years.

Spills and accidents should be less frequent if Port Simpson is the chosen location for a bulk loading facility because it requires about 10 percent fewer movements, it has no major ship traffic at the moment, and its wind, current, and approach characteristics are better than either Ridley or Kitson.

Therefore, assume one collision in 35 years for Port Simpson, and an average of 0.8 other spills per year over 20 barrels in size.

Further information on the types of operational discharges involved in the non-collision related spills is included in Annex D-3.

D3.2.2 Movement of Oil Spills and Resultant Impact

The movement of oil spills depends mainly upon the currents, tides, and wind at the point and time of the spill. There is an almost infinite variety of movements which can occur with these variables. The problem of prediction is complicated by the variability with the seasons. For example, in the summer, bacterial activity consumes the oil more rapidly than in the winter. Then again, most rearing fish are unlikely to be in the area in the winter. However, large populations of waterfowl are likely to be more affected by a winter spill than a summer one. Tides are higher in the winter, fresh water surface currents are stronger in the spring, the prevailing southeast winds of winter are stronger than the westerlies of summer, and fog (related to ship collision probability) is more frequent in the summer.

We have attempted to develop a simple mathematical model for oil spills within the study area, which takes some account of these and other variables. The details of the variables are presented in other parts of the NEAT report, but some analysis of their interactions is presented here. A vector matrix was established using a binary weighting system to analyse impacts on biologically sensitive areas. A value of zero is applied for no impacts, and a value of one was applied where important impacts would be expected. This system was used since, in considering oil spills, there are only two situations, no impact (zero value) or a negative impact (value of one). It is assumed there are no positive environmental aspects to an oil spill.

Thus the site with the lowest point total represents the area from which the consequences of an oil spill would be least damaging.

The first step in the analysis involves the establishment of vector scores as shown on the following sheets. The ecologically sensitive areas are as defined below:

Inner Estuary	Includes Ridley Island, Flora Bank, Lelu Island, and the north shore of Smith Island.
Digby-Venn Passage	Includes the foreshore around Digby Island and the north shore of Prince Rupert Harbour from Bacon Cove to Tugwell Island and Duncan Bay.
Lucy-Rachael Islands	Includes the two island groups with their associated reefs.
Big Bay-Pearl Harbour	Includes the west coast of the Peninsula from Ryan Point north to Sara Point, halfway up Finlayson Island.
Port Simpson	Includes the area from Sara Point to Maskelyne Point on the northern tip of the Tsimpsean Peninsula.

No other areas are felt to be significantly endangered by spills related to bulk loading facilities at Ridley, Kitson, or Port Simpson.

The vector scores were then assessed against the environmental value of each designated area with weights of one to five assigned according to data interpreted in other parts of the NEAT report. The results are shown in Table 5. Also shown in the table is an allowance for the probability of accident or collision as developed above. Port Simpson is given a weight of 0.8, while Kitson and Ridley are weighted 1.0. The probability of a spill in Port Simpson as a result of developing a port at Ridley or Kitson is weighted 0.1.

TABLE 2

OIL SPILL

PORT SIMPSON - VECTOR MATRIX

Season	Current	Tide	Wave Action	Wind	SCORE	Area
Winter	Weak westbound current exiting via Dundas Passage	Less than one knot; mean amplitude of 16'	W. 25% S.W. 2.3% Not Recorded 72.7%	Prevailing southeasterly - specific data not available	0	Inner Estuary
					0	Digby-Venn Passage
					0	Pearl Harbour
					1	Port Simpson
					0	Lucy-Rachael Islands
Spring	Weak westbound current exiting via Dundas Passage	Less than one knot; mean amplitude of 20'	W. 25% S.W. 2.3% Not Recorded 72.7%	Prevailing southeasterly - specific data not available	0	Inner Estuary
					0	Digby-Venn Passage
					0	Pearl Harbour
					1	Port Simpson
					0	Lucy-Rachael Islands
Summer	Westbound current through Dundas Passage strongest due to freshet	Less than one knot; mean amplitude of 16'	Westerly - no data available	Prevailing westerly or southeasterly - specific data not available	0	Inner Estuary
					0	Digby-Venn Passage
					0	Pearl Harbour
					1	Port Simpson
					0	Lucy-Rachael Islands
Fall	Weak westbound current exiting via Dundas Passage	Less than one knot; mean amplitude of 20'	W. 25% S.W. 2.3% Not Recorded 72.7%	Prevailing southeasterly - specific data not available	0	Inner Estuary
					0	Digby-Venn Passage
					0	Pearl Harbour
					1	Port Simpson
					0	Lucy-Rachael Islands

TABLE 3

OIL SPILL

RIDLEY ISLAND - VECTOR MATRIX

Season	Current	Tide	Wave Action	Wind	SCORE	
Winter	Northbound from Kitson along mainland coast of Tsimpsean Peninsula	1 - 2 knots mean amplitude 20'	S. 31.4% W. 13.7% S.W. 9.1% Not Recorded 45.8%	S.E. 46.8% N. and N.W. 32.9% Other 20.3%	0 1 1 1 0	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands
Spring	Northbound from Kitson along mainland coast of Tsimpsean Peninsula and possibly into Prince Rupert Harbour	1.5 - 2.5 knots; mean amplitude 20'	S. 31.4% E. 13.7% S.W. 9.1% Not Recorded 45.8%	S.E. 43.0% N. and N.W. 31.4% Other 25.6%	0 1 1 1 0	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands
Summer	Northwest bound from Kitson along mainland coast of Tsimpsean Pen. and towards Lucy Islands	1 - 2 knots mean amplitude 20'	No data South to Southwesterly	S.E. 38.3% N. and N.E. 33.2% W. 26.1% Other 2.4%	0 1 1 1 1	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands
Fall	Northbound from Kitson along mainland coast of Tsimpsean Peninsula	1.5 - 2.5 mean amplitude 20'	S. 31.4% W. 13.7% S.W. 9.1% Not Recorded 45.8%	S.E. 55.6% N. and N.E. 25.0% Other 19.4%	0 1 1 1 0	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands

TABLE 4

OIL SPILL

KITSON ISLAND - VECTOR MATRIX

Season	Current	Tide	Wave Action	Wind	Score	Area
Winter	Northbound from Kitson along mainland coast of Tsimpsean Peninsula	1 - 2 knots mean amplitude 20'	S.E. 19% S.W. 11.4% W. 10.2% N.W. 5.7% S. 6.2% Not Recorded 47.5%	S.E. 60.6% S.W. 9.2% Other 30.2%	1 1 1 1 0	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands
Spring	Northbound from Kitson along mainland coast to Tsimpsean Peninsula and possible into Prince Rupert Harbour	1.5 - 2.5 knots; mean amplitude 20'	S.E. 19% S.W. 11.4% W. 10.2% N.W. 5.7% S. 6.2% Not Recorded 47.5%	S.E. 49.1% N.W. and W. 22.6% Other 28.3%	1 1 1 1 0	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands
Summer	Northwest bound from Kitson along mainland coast of Tsimpsean Pen. and towards Lucy Islands	1 - 2 knots mean amplitude 20'	No data available. Southerly to Westerly?	S.E. 42.3% N.W. and W 26.1% Other 31.6%	1 1 1 1 1	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands
Fall	Northerly from Kitson along mainland coast of Tsimpsean Peninsula	1.5 - 2.5 mean amplitude 20'	S.E. 19% S.W. 11.4% W 10.2% N.W. 5.7% S. 6.2% Not Recorded 47.5%	S.E. 65.4% S.W. 8.3% Other 26.3%	1 1 1 1 0	Inner Estuary Digby-Venn Passage Pearl Harbour Port Simpson Lucy-Rachael Islands

Table 5

WEIGHTED IMPACT ASSESSMENT OF OIL SPILLS

AREA	ENVIRONMENTAL WEIGHTED Seasonal	VECTOR SCORE Port Simpson	VECTOR SCORE Ridley Island	VECTOR SCORE Kitson Island	TOTAL IMPACT SCORE Port Simpson	TOTAL IMPACT SCORE Ridley Island	TOTAL IMPACT SCORE Kitson Island	SEASON
Inner Estuary	2	0	0	1	0	0	2	
Digby - Venn Passage	3	0	1	1	0	3	3	
Big Bay - Pearl Harbour	5	0	1	1	0	5	5	
Port Simpson	2	1	1	1	1.6	0.2	0.2	WINTER
Lucy-Rachael Islands	3	0	0	0	0	0	0	
Inner Estuary	5	0	0	1	0	0	5	
Digby - Venn Passage	4	0	1	1	0	4	4	
Big Bay - Pearl Harbour	4	0	1	1	0	4	4	
Port Simpson	3	1	1	1	2.4	0.3	0.3	SPRING
Lucy - Rachael Islands	4	0	0	0	0	0	0	
Inner Estuary	4	0	0	1	0	0	4	
Digby - Venn Passage	3	0	1	1	0	3	3	
Big Bay - Pearl Harbour	4	0	1	1	0	4	4	
Port Simpson	1	1	1	1	0.8	0.1	0.1	SUMMER
Lucy - Rachael Islands	3	0	1	1	0	3	3	
Inner Estuary	2	0	0	1	0	0	2	
Digby - Venn Passage	3	0	1	1	0	3	3	
Big Bay - Pearl Harbour	4	0	1	1	0	4	4	
Port Simpson	1	1	1	1	0.8	0.1	0.1	FALL
Lucy - Rachael Islands	3	0	0	0	0	0	0	
TOTALS					5.6	33.7	46.7	

Rounding the figures to the nearest whole number yields the following pollution impact score:

Port Simpson	
Ridley Island	34
Kitson Island	47.

It must be noted that these figures do not mean that Ridley is six times as likely to have an oil spill as Port Simpson. They are simply a rough mathematical expression of the fact that Ridley Island poses an overall environmental threat due to pollution greater than that presented by Port Simpson, and that Kitson Island is somewhat more of an environmental problem than Ridley.

D3.3 Coal Dust in the Environment

Coal is black, highly visible and has a strong potential for soiling via air-borne transport of dust from the point of generation to surrounding areas. Accordingly, it is pollution type which frequently receives publicity beyond its real impact characteristics. Such coal dusting is believed not to present a hazard to human health, since the quantity of respirable coal dust, at most a few micrograms/m^3 within terminal areas, is at least two orders of magnitude below the industrial hygiene limit of 50 million particles per $foot^3$. However, in recent years even aesthetic pollution (dustfall or soiling) has become unacceptable, and has resulted in some increased attention to control of dust flight by bulk loading facilities. The use of binders to control highly visible coal dust plumes has found widespread acceptance but also presents a secondary source of chemical pollution. Because poly-vinyl binders are biodegradable, they contain biocide preservatives which are harmful to aquatic life. A review of studies conducted at Roberts Bank gave no indications however, that these biocide preservatives are leached from coal piles at rates that might be toxic to marine life forms.

Also, the types of coal handled at Roberts Bank (Balmer, Fording) were examined for their toxic effects to fish under catastrophic conditions, i. e., derailment or ship collision, resulting in a major coal spill. No adverse effects could be demonstrated in terms of acute toxicity. However, a catastrophic spill may have some effect on Benthos productivity by physical smothering bottom organisms. Although this might not be compatible with biological conditions at Port Simpson or Ridley Island, the scouring and silting activities of the Skeena during freshet at the Kitson Island site might be physically similar to a coal spill. Impacts at this site might be rated as neutral.

A selection of sites on the basis of adverse effects of accidental coal spills or dusting on physical or biological elements would be marginally in favour of Kitson Island, but all impacts would be considered as minor.

One important impact must be mentioned, however, in relation to the Ridley Island site. Here, the movement of coal trains past Port Edward may cause the deposit of coal dust on boomed pulp logs in and around Porpoise Harbour.

Coal dust is not likely to have any effect on sawmill production of lumber. However, if this dust settles on logs destined for processing into lumber and/or wood chips, the wood chips would not be suitable for use in the Sulphite or Kraft pulp mills on Watson Island.

Coal dust that enters into the pulping process, via contaminated logs, could cause a very serious economic loss to the pulp mill.

Carbon does not bleach out and remains extremely visible in the pulp. As a result all pulp so contaminated could be used only for lower value pulp and paper products. High quality pulp used for low value products would cause severe losses to the pulp mill and ultimately could affect the viability of the pulp mills.

Unless hydraulic barking can effectively remove all coal from logs, all log storage booms in the vicinity of a bulk loading facility, would have to be relocated, or steps taken to prevent blowing coal dust.

There is the possibility of air borne coal pollution on finished pulp in storage or shipping areas. Fine particles of coal dust (or mineral ore dust) will adhere to the pulp surfaces causing the same loss of value mentioned above.

The problem of controlling coal dust was discussed with the Port Manager for Westshore Terminals (Kaiser Resources Ltd.). It is our understanding that coal dust from coal cars can be controlled by a combination of the following measures:

1. By leaving 18 inches of unfilled space in a coal car.
2. Spraying the loaded coal with a surface binder.
3. Reducing train speeds to 5 to 15 m.p.h. at critical points.
4. Washing empty cars to remove dust.

ANNEX D-1

CLIMATIC STATIONS

ANNEX D-1 STATION DATA

1. Prince Rupert B. C. Latitude 54° 17'N Longitude 130° 23' W
   Elevation 170 feet A.S.L.

   (Marine Station, Digby Island). Temperature and precipitation, 1941 to 1970 or adjusted published. Wind, published table of wind frequency and speed 1955 to 1962.

2. Prince Rupert, Montreal Circle. Latitude 54° 19' N Longitude 130° 17' W
   Elevation 280 feet A.S.L.

   Precipitation 11 years since August 1959.

3. Prince Rupert Roosevelt Park. Latitude 54° 18' N Longitude 130° 20' W
   Elevation 298 feet A.S.L.

   Precipitation - recorded since July 1966.

4. Prince Rupert Airport. Latitude 54° 18' N Longitude 130° 26' W
   Elevation 110 feet A.S.L.

   Rate of rainfall recorded since October 1969. Wind January 1961 to December 1971.

5. Port Simpson. Latitude 54° 30' N Longitude 130° 36' W
   Elevation 26 feet A.S.L.

   Temperature and precipitation 22 years 1886 to 1907.

6. Lawyer Island. Latitude 54° 07' N Longitude 130° 21' W
   Elevation 25 feet A.S.L.

   Wind October 1969 to February 1973.

7. Lucy Island. Latitude 54° 18' N Longitude 130° 36' W
   Elevation 45 feet A.S.L.

   Wind October 1969 to February 1973.

ANNEX D-2

NOISE PROPAGATION OVER WATER

ANNEX D-2 NOISE PROPAGATION OVER WATER

In the absence of disturbing influences, sound waves spread spherically, which implies that sound level decreases by 6 dB for each doubling of distance. This is known as the inverse square law.

Under conditions of temperature inversion there is no flow of sound energy upwards and the spreading is cylindrical. The level then decreases by only 3 dB per doubling of distance. The effective distance at which the attenuation changes from 6 dB per doubling to 3 dB per doubling depends on the height of the inversion.

Sound propagating over land may be dissipated by soft earth, grass, trees, etc. and at large distances reflections from the ground can be out of phase with the direct sound, causing cancellations. We expect negligible dissipation over water, and random phase at large distances, therefore these effects should be minimal.

It may be seen that sound propagation over water with temperature inversion conditions can give rise to enhanced transmission This situation can exist for any of the proposed sites which are separated from an inhabited area by a body of water, in particular the Prince Rupert Harbour and Port Simpson sites. Since the former have already been excluded on navigational grounds, this discussion applies to Port Simpson. The weather conditions necessary to induce inversion occur mainly during the summer moneths; when stable, calm conditions persist for days, accompanied by sea fog. Such conditions will give rise to the worst noise exposure for the residents of Port Simpson, since scattering of sound by the sea surface will also be at a minimum. The height of the inversion layer and its frequency of occurrence must be assessed before an estimate can be made of the increased noise exposure due to climatic conditions.

ANNEX D-3

TYPES OF DISCHARGES INVOLVED IN NON-COLLISION RELATED SPILLS

ANNEX D-3 TYPES OF DISCHARGES INVOLVED IN NON-COLLISION RELATED SPILLS

Categories of waste water generated by vessels are as follows:

- Ballast water. Source: cargo ships, tankers.
  Expected pollutants: fuel oil, crude oil, oil products.

- Tank washings. Source: dry cargo ship deep tanks.
  Pollutants: oil products.

- 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, septic sewage.

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. The elimination of the dumping of these pollutants in international waters is the ultimate aim of the Inter-Governmental Maritime Consultative Organizations (IMCO). It is hoped that by 1975 or 1980 that pumping of ships' bilges and disharging of ship and barge ballast and tank cleanings at sea will be prohibited by national and international laws. If this occurs it will require the installation of on-shore receiving facilities for the water from these vessels unless each vessel has its own processing system.

Fuel quantities on large ships are up to 4,000 tons of fuel on a 150,000 DWT vessel. However these ships would tend to obtain their bunker C elsewhere other than in Prince Rupert and would therefore only be partially loaded at their destination, say 3,000 tons. Generally fuel is carried in four individual tanks, it would therefore indicate that the probable maximum spill would be in the order of 800 tons if one tank were ruptured, a much lesser probability for two tanks (1600 tons), or nearly impossible for all four tanks which would indicate a spill of 3,000 tons.