ENVIRONMENTAL ASSESSMENT REVIEW

OF TERMPOL SUBMISSION

REGARDING A MARINE OIL TERMINAL

AT KITIMAT, B.C.

FISHERIES & ENVIRONMENT CANADA

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PREFACE

On December 16, 1976 Kitimat Pipe Line Limited filed a TERMPOL submission with the Commissioner of the Canadian Coast Guard. The company is proposing the construction of a Marine Terminal at Kitimat, B.C. to receive shipments of oil by tanker from Alaska, the Middle and Far East ports for delivery by pipeline to U.S. Northern Tier refineries via Edmonton, Alberta. An interdepartmental group of experts was assembled by the Department of Transport to make an assessment of the application in accordance with the terms of the Code of Recommended Standards for the Prevention of Pollution in Marine Terminal Systems published by the Canadian Coast Guard.

The TERMPOL Coordinating Committee for the Kitimat proposal prepared a list of requests for supplementary information which was sent to the proponent under letter dated February 25, 1977. These requests were for information which would assist the Committee in making its assessment and report, having regard to the navigational and environmental risks associated with the proposed operation of a marine terminal for large oil tankers at Kitimat.

The TERMPOL Coordinating Committee established six working groups for the purpose of facilitating the review of the company's TERMPOL submission. One of these working groups was the Environmental Assessment Working Group. The report contained herein has been prepared by this working group as a component of the main report of the TERMPOL Coordinating Committee.

The Environmental Assessment Working Group was comprised of Regional and Headquarters staff of Fisheries and Environment Canada. Some useful input was also obtained from the Department of Energy, Mines and Resources. For further details with respect to the Working Group membership or details on this report please contact Mr. N. Tywoniuk 819 - 997-1730.

CHAPTER VIII

ENVIRONMENTAL ASSESSMENT REVIEW

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1 NATURE OF ENVIRONMENTAL ASSESSMENT REVIEW

1.1 Review Tasks. There were two main review tasks to accomplish. The first was to examine the material formally submitted by the proponent to see how completely it included the environmental aspects specified in the "Termpol Code" as being of concern to government. The criterion was essentially quantitative and the two questions posed were: "Has the proponent provided information on such-and-such an environmental aspect?", and "If the proponent has provided information on such-and-such an environmental aspect, is the answer adequate to conduct its review and for full understanding of the specific environmental concerns at this time?" No part of this task involved a judgement of the Termpol Submission. In contrast, the second task, which has resulted in this review report, has constituted an appraisal or judgement of the quality of the materials, answers, and proposals submitted by the proponent.

Before it is explained how each of these two main tasks was carried out, a few remarks will be made on the environmental parts of the Termpol Code. It is worth commenting about the comprehensiveness of the Code since much effort can be misapplied analyzing the finer points of adequacy of the Code. In preparing a Code such as this, two contrasting approaches could be followed, one favouring a few broad principles and the other endeavouring to list everything. The environmental parts of the Termpol Code come somewhere between these two extreme positions, and the important point is that these parts are not intended to be fully comprehensive. They are intended to indicate to potential proponents some of the major topics that should be included in such an environmental assessment. In a sense, then, they convey the general principles of sound development, and do not detail the very many specific environmental concerns that would appear in a comprehensive list. In conducting the review it was assumed the proponent has correctly interpreted the nature and intent of the Termpol Code and the proponent's submission was appraised

in the same light. In other words, absence of reference to a specific relevant concern in the Termpol Code does not constitute a reason for its omission in the Termpol Submission or in the review.

1.2 Requests for Supplementary Information. The purpose of the first task has been explained above; vis., using the Termpol Code as a reference document, to prepare a report on aspects of the proponent's submitted material that is considered to lack information required for review.

After the Termpol Submission had been received during December, 1976, it was realized that the above task was not as straightforward as had been imagined, because of the nature of the document. An engineering development can be viewed as involving five main phases: (i) feasibility and design concepts; (ii) final design; (iii) contract specifications; (iv) contract per- formance; and (v) monitoring of construction and operation. The present Submission falls somewhere between phases (i) and (ii). Final design is not present; hence many of the details required for full assessment are not present, and their absence greatly influenced the approach taken in formulating questions. It was recognized that it is impossible to know numerous details before the final design stage, but it was hoped that responses would be provided to these questions so that constructive review of the proponent's proposals would be possible and that the chances of important aspects not coming to light would be minimized.

The requests for supplementary information are not appended to this report since the relevant points are outlined and discussed in the sections which follow.

1.3 The Main Review or Assessment. The purpose of this section is to explain the nature of the main environmental review task and to provide the rationale for the form taken by the environmental assessment review report.

To avoid confusion in terminology it may be explained at the outset that the main environmental review or assessment, the results of which are found in the sections which follow, is essentially a review of the proponent's proposals. In the review process, the Termpol Code was used as a check-list or reference document of environmental concerns, but a variety of other documents have been used as sources of environmental knowledge.

The environmental component of the Termpol Submission, together with portions outlining the proposals relating to engineering, construction, operation, environmental interactions, etc., is often referred to as an environmental impact assessment. But although the review objective was to prepare a so-called assessment report, it has not, unlike the proponent, to conduct or support research studies eliciting new information on environmental interactions. The review report is not, therefore, an environmental impact assessment in the normally understood sense of this term and studies on environmental interactions were not undertaken. On the other hand, in reviewing the proponent's interpretations of environmental interactions and his translation of them into specific engineering proposals, the review has resulted in a somewhat parallel analytical process.

One feature of the review task which considerably increased the difficulty of the job of review arose from the Submission not being final design but rather somewhere between the feasibility/design concept stage and final design. In effect, it was difficult to apply two of the normal tests of conventional reviewing: (i) appraisal of the actions proposed, and (ii) appraisal of the basic data and methodology upon which the proposals are based. The reason for this, of course, is that comprehensive base data are largely absent from a feasibility stage that concentrates on principles, theory, and assurances. The requests for

supplementary information were often attempts to elicit the data necessary to bring the debate down from the theoretical to the practical. In the absence of many base data, and particularly because the assessment report has been prepared to a large extent without benefit of the complete or comprehensivse responses of the proponent.

1.4 Review Objectives. Perhaps the most difficult task was deciding on the form the review should take. In any review of this type, a number of options are available: one can consider the innumerable impacting actions of the proponent as the prime focus of attention and orient the review around the effects each of these impacting actions might have on a host of environmental components; one can reverse the orientation and consider how each environmental or impacted component might be affected by each of the various proposed activities; one can consider the construction stage as completely separate from the operation stage; and so on.

During the course of review efforts, the form of the review or the selection of topics to review seemed to arise more in a subjective than analytical way. The particular choices of topics were not necessarily project- or environment-oriented, but were certainly selected on the basis of considerable intuitive knowledge of processes and components of the environment.

Among the considerations or objectives for the review were: to review the known environmental resources and to complement, where possible, the detail documented in the Termpol Submission; to comment on the expected effects of the project, taking into account the efforts of other Working Groups; to evaluate the implications for environmental resources of the level of environmental protection proposed by the company, and; to identify additional protection measures which might be incorporated in the event that the project will be approved, and which would result in minimizing the

impact on the environment and on the fishermen and others who would be affected by the project.

A few further points may be made regarding the form of the review. First, the topics selected do not cover all the aspects by any means that could be selected for examination; however, they should cover those matters where major environmental concerns could directly or indirectly arise. Second, topic selection avoided the constraint of having to adopt either a project-oriented or environment-oriented approach. Individual topics embody either or both orientations. A third feature is that each topic write-up endeavours to be a complete account in itself, with limited need for cross-reference to other topic reports. This may make for some overlap, particularly where an aspect is developed more fully by another Working Group, for example, Contingency Planning. Where it was anticipated that coverage would be more detailed in another Working Group, the environmental assessment consideration of such topics was minimal.

2 SITE AND ROUTE SELECTION

2.1 Alternative Port Sites. One of the most significant considerations with respect to oil port development is one of port site selection. It is a consideration which has been dealt with by many Working Groups of the Termpol Coordinating Committee; a consideration which has broad implications with respect to potential environmental impact as well as to navigation safety, terminal facility design and operation, and so on.

From the environmental point of view there are two scales of consideration.

The first is the "coast-wide" scale consideration. This examines the broader questions and the large areas and concepts which may have some level of feasibility in fulfilling the intended objective of transporting oil from one point or points to another or others.

The Termpol Code states in Section 3.64

> "An important part of the plannning process should involve the examination of all practical site alternatives and the comparison of their environmental implications, whereby the projected adverse impacts could inherently be minimized through the better choice of site."

It should be noted that the Termpol Submission did not provide adequate "coast-wide" details and assessment. Similarly, the Working Group did not consider this question in depth due to time constraints and, perhaps more so, due to the implementation by the Pacific Region of the Department of Fisheries and the Environment of an in-depth study, "West Coast Deep Water Oil Port Comparison Study".

The second scale of consideration is the "regional". The Termpol Submission describes a number of alternate port sites on a regional basis and gives some reasons why they were considered less suitable than Kitimat.

Since the objective of the project overall is to provide a transportation terminus for oil bound for the north central United States, it is not obvious that the northern coast of British Columbia is the only possible port location. In addition, a detailed comparative base must be developed and described to clearly show the relative values of alternative sites. Included in such a study must be evaluation of alternative approach routes which are in fact simply an extension of the sites themselves.

It was evident that the information provided on the question of alternate port sites, both on the coast-wide and the regional basis, was not considered in the detail required. As a result, supplementary information for this subject was requested. The request included that the proponent provide, for all alternative port sites:

(a) order of magnitude of cost estimates, including system capital costs and throughput costs per barrel, as a comparison of the economic advantages of selecting Kitimat as the port location;

(b) a comparative analysis of the risk of oil spill accidents which would arise from the operation of each of the alternatives.

The proponent was further requested to provide an examination and comparison of alternate marine approach routes to Kitimat, including a discussion of navigational feasibility, environmental implications and relative probability of accidents which would result in damage to the environment.

It is noted that the proponent in the responses to the deficiency statements has indicated that he is not prepared to propose or undertake a project different from the one described in the Termpol Submission and that the proponent is, therefore, not prepared to commission further studies relating to alternative port sites. However, the Working Group emphasizes that site selection is not the only purpose that site comparison studies can serve. Comparisons of Kitimat with other alternatives are necessary in order that the Kitimat proposal can be put into proper perspective on a coast-wide basis, to aid in describing whether

or not the Kitimat proposal itself is optimal among the alternatives.

2.2 Route Selection. The previous section discussed the importance of port site selection at the very early planning stages. When a port site is selected, one is then faced with a number of options with respect to the marine route which should be utilized by the incoming and outgoing vessels.

Selection of the marine route involves the consideration of many factors and it is not until these are analyzed and considered that a final choice of route can be made. Among these are the physical and biological environmental factors (discussed below), factors related to navigation and ship safety. It should be evident, therefore, that a route cannot be selected on environmental grounds alone, but has to take into account the factors which were the subject of assessment by the other Working Groups.

During the course of considering possible alternate routes, the Termpol Coordinating Committee concluded that three possible routes were worthy of further study. These were as follows:

(a) Dixon Entrance to Triple Island, Hecate Strait, to Browning Entrance, Principe Channel, Nepean Sound, Otter Channel, across Squally Channel via Lewis Passage and Wright Sound, and then via Douglas Channel to Kitimat. This is the route described in the proponent's submission.

(b) Cape St. James at the southern tip of Queen Charlotte Islands to Browning Entrance, Principe Channel, and then as described in paragraph (a) to Kitimat.

(c) Cape St. James to Caamano Sound, then via Campania Sound, Squally Channel, Lewis Passage, Wright Sound and Douglas Channel;
or
Cape St. James to Caamano Sound, Campania Sound, Whale Channel into Wright Sound and Douglas Channel to Kitimat.

As might be concluded from the detail in the previous topic, "Alternative Port Sites", the very brief discussion of alternatives was considered to be a critical deficiency with respect to alternative routes. The proponent seriously considered only route (a) above, apparently assuming that it was the safest and most environmentally suitable. This assumption or the proponent's reasons for this choice are not apparent, except that it is the shortest Valdez-Kitimat marine route. The Termpol Submission could not be considered complete without consideration of an alternate route and. The proponent was requested to provide further information on this question.

Associated closely with route selection is the subject often referred to as "risk analysis". Basically, this is an analysis of the potential for spill incidents, and is discussed in the Termpol Code, pages 99 and 300, in the context of potential for spill incidents along the route, as follows:

> "The degree of adverse environmental impacts is related inter alia to the rate at which pollutants are introduced into the marine environment. Only in a few situations will the value of resources or uses be so high or so critical that no environmental risk can be afforded at all, that is, the proposal is clearly environmentally unacceptable. In many cases, however, it will be possible to achieve a balance between environmental disbenefits and social and economic return, providing there is adequate environmental planning. The estimation of the frequency and magnitude of environmental damage will require an estimation of the rates of the releases of pollutants, both accidental or deliberate.
>
> With respect to ship traffic, it is not possible to completely eliminate the possibility of a major spill, such as may result from a ship collision, grounding, or breakup. Based on the prevailing physical environmental conditions, aids to navigation, shipping density, the state of vessel traffic management systems, ship casualty statistics,

> the maneuverability characteristics of deep-draught vessels and so on, the proponent should identify the specific geographic locations along the traffic route and in the terminal area, where the navigational risk may be high, with particular attention to those periods when the risk is highest. This risk should be quantified in terms of accidents per ship call and/or accidents per year, and should include both seasonal and extreme event analysis. The analysis should also include an estimate of both the likelihood and maximum size of such spills, with emphasis on 'worst case'."

In reviewing the Termpol Submission, it was concluded that the proponent did not provide sufficient detail on this subject and requested further information. The request called for the Kitimat port proposal, for an estimate of probability including frequency and magnitude of pollution incidents that may arise from accidents to tankers in transit through the proposed and alternate approach routes, or at dockside, or while unloading.

3 PHYSICAL ENVIRONMENT CONSIDERATIONS

3.1 Oceanography: The oceanography considerations include hydrography, tides, waves, currents, and the physical/chemical parameters of oceans.

Hydrography. In consideration of the marine route, one of the most significant factors is the understanding of the hydrography of the route or routes selected and further understandings of the hydrography of the surrounding areas.

In the Termpol Submission, the proponent makes a number of references to this question. A number of the items illustrate certain questions with respect to the level of confidence of the hydrography and underlying necessity for a more extensive study of all possible routes, together with a careful and detailed consideration of all factors involved.

If the proponent's route is followed, ships must first navigate through Dixon Entrance to Triple Island without a pilot. Learmouth Bank is an area with tide rips and the proponent does not mention Rose Spit and its extensive off-lying shoal areas, with cross-currents as much as 3-1/2 knots. Picking up a pilot will frequently require stopping in what amounts to restricted areas with 2-knot currents.

Widths of channels are generally given shore to shore, rather than navigable width. For example, for a given width of 6350 feet, the width between the 20 fathom line is about 5,000 feet (page 36, Volume I). However, the proponent does clarify this in Appendix I.

Anger Anchorage is accepted in the submission as a safe anchorage for these ships. However, the holding ground is only "reported" as good. It is not known to have been used previously to the extent that it can be confirmed as a safe anchorage for large tankers.

Anger Anchorage is approximately 1 mile square and lies 1/2 mile off Azimuth and Anger islands. A recent echo sounder and sonar check by the Department of Fisheries and the Environment vessel, "Parizeau", generally confirmed the depths indicated on Chart 3746. The sonar indicated a rock bottom with a light overlay of mud. The "Parizeau" was anchored in 25 fathoms, at about the middle of the northern edge of the anchorage, and a bottom sample contained a mixture of mud, sand, shells, and stone. This anchorage is affected by the tidal influence from the Petrel and neighbouring channels. When the "Parizeau" weighed anchor, the anchor was found to be completely clean. Anger Anchorage will have to be more comprehensively investigated before it is designated as a safe anchorage.

Further comments with respect to the adequacy of hydrographic information within the proposed route and the possible options are in order. The complete approach to Kitimat from seaward has been surveyed, but the quality of the survey information and the extent of areal coverage varies with the time of survey. Most of Queen Charlotte Sound has been surveyed to modern standards while the majority of the Caamano Sound coverage was obtained in 1923. These latter surveys were conducted using lead line, hence they are far from adequate when compared to modern survey standards.

The Queen Charlotte Sound surveys cannot be considered completely adequate when considering tanker traffic with drafts of up to 83 feet. At the time these surveys were conducted, maximum drafts of ships were in the order of 30 feet. Consequently most areas not considered to be critical to shipping at the time of the original survey must now be re-examined. Some re-surveys in the Queen Charlotte Sound area will probably be required to assist the Department of Transport in the placement of navigational aids.

A complete re-survey of Caamano Sound plus supplementary surveys of critical areas within Queen Charlotte Sound is considered necessary. These surveys should be supplemented with a side-scan sonar survey of the total area to ensure that no critical rocks or shoals are missed.

The Canadian Hydrographic Service is planning to fulfil some of these requirements in 1977. The survey will be a major ship/launch operation and will take approximately 90 days. A smaller vessel will be used to conduct the side-scan sonar operation. The tidal current surveys would require about 6 weeks of major ship time.

Depending on the results obtained during the first year's surveys it may be necessary to conduct some additional work in 1978. If the tanker routing is determined to be via Dixon Entrance and Hecate Strait, then considerably more work would have to be undertaken as not only Principe Channel but also existing surveys in Dixon Entrance and Hecate Strait would require critical re-examination. Tidal current surveys in these passages would also be needed.

Tides and currents. Appropriate levels of knowledge of tides and currents are required both for navigational aspects of the project as well as for the prediction of possible environmental impacts, particularly in predicting the adverse impacts which may result in the event of oil spills. The Termpol Submission makes a number of references to tides and currents, for example, Attachment 3, Appendix XII contains a discussion on "Oil Spill Movement Predictions". It was concluded that the tides and current information is deficient and that additional information would have to be obtained prior to the commencement of project operations.

Some tidal current information for Caamano Sound and Queen Charlotte Sound will be obtained in conjunction with the hydrographic survey in 1977. However, in the event the Dixon Entrance and Hecate Strait route is chosen, further tidal work would be required in Principe Channel, Dixon Entrance, and Hecate Strait.

Physical Oceanography. In view of the urgency of work in the southern B.C. coastal areas, in the Beaufort Sea and northern areas, it has not been possible for government agencies to conduct any oceanographic studies off the northwestern British Columbia coast. The only oceanographic information available is that obtained years ago in very exploratory studies by the former Pacific Oceanographic Group of the Fisheries Research Board and a few isolated inlet studies carried out by the University of British Columbia. However, knowledge of the regional oceanography is required as inputs into the analysis of the various environmental factors relating to the proposed terminal and marine traffic network. A substantial increase in the amount of information is, therefore, considered to be essential.

To provide the necessary information, it was concluded that the proponent should undertake, or have undertaken on his behalf, prior to commencement of terminal operations, a three year study covering Douglas Channel and East Hecate Strait. It was felt that the field study would take two full years, and with the analyses, three full years. The objectives of such a study would be as follows:

(a) to develop vertically integrated numerical models of East Hecate Strait, and of channels and sounds leading into Kitimat. These would provide the basis for current prediction, both for navigation and oil spill problems, and would form a background against which measured current could be compared.

(b) to obtain field observations of currents, salinity/temperature structure, tidal heights and meteorological data. These would provide the required information to:

    (i) Test and compare with numerical models of tidal motion;
    (ii) Provide input to two-layer fjord circulation model, to determine surface flushing in the channels; and,
    (iii) to provide additional information on the variability of oceanographic properties,

response to changing wind and run-off conditions, low frequency (down to annual cycles) fluctuations in currents along the east shore of Hecate Strait, and so on.

3.2 Meteorology. The Termpol Code (pages 11 and 96) outlines the meteorological information that should be available to describe a quantitative assessment of the transit opportunities.

General. For mariners, meteorological elements of most concern are surface wind speed, surface wind direction, visibility, precipitation, wave height, wave period, and wave direction. Strong winds and high seas combined with heavy precipitation, particularly snow, freezing rain or mixed rain and snow create the most difficult conditions. Difficult conditions for navigation also occur in periods of light winds, for example when fog or precipitation reduces visibility to near zero. In addition there are times when atmospheric conditions interfere with radar propogation; melting snow, for example, attenuates radar strongly and may seriously inhibit the effectiveness of radar as a navigational aid.

Although there is a minimum of meteorological data available for the inland route it is estimated that adverse conditions may be expected 15 to 25 percent of the time hence introducing the problem of difficult navigation conditions and the risk of serious oil pollution. However, it is important to remember that meteorological conditions must be considered in other aspects of the oil tanker operation. For example:

(i) The movement of oil spilled on water is determined by water currents and winds. A knowledge of wind climate is thus necessary for developing oil spill contingency plans. Similarly, should a spill occur, it would be vital to have accurate wind measurements and forecasts to predict the motion of the oil, thus enabling effective counter measure actions with respect to any spill.

(ii) Oil spill clean-ups can be seriously hampered by adverse weather, for example, by strong winds, heavy snow, cold temperatures, or combinations of these elements.

(iii) Gaseous pollutants emitted by tankers discharging oil at the dock would be poorly or well dispersed, dependent on the wind strength and direction and the stability of the lower atmosphere. This is discussed more fully in 5.6 below.

Situated within the belt of zonal westerlies, the north B.C. coast is an area frequented by travelling depressions, i.e., mid-latitude extra-tropical cyclones. As a result, it is an area where weather conditions change often and rapidly, where strong winds and high seas are frequent, and where copious amounts of precipitation fall. It is also a zone of transition between the marine climate of the outer coast and islands and the continental climate of the interior. Thus winter precipitation on the coast proper falls mainly as rain, but snow is common at the heads of the inlets. In between there is often a zone of mixed rain and snow, or, on occasion, freezing rain.

The terrain of the north coast has a marked influence on the climate of the region. Precipitation is increased by the mountain ranges which run in a direction perpendicular to the westerly air flow. Winds are funnelled by valleys, blocked by mountain ranges. This is particularly true in winter when frigid Arctic air builds up over the Interior and comes rushing out to the coast through passes in the mountain ranges. Reaching the inlets, these northeasterlies or "squamishes" are at times of such a strength as to create problems to shipping in general. These winds also produce freezing spray during low temperatures.

Summer is considerably less stormy than winter, but is the period when fog is most common. Thus visibility, which can be restricted by precipitation in winter, can alternatively be restricted by fog in summer. From data obtained from land stations, it is estimated that visibility can be restricted to 1/2 mile or less 10% of the time during summer.

Data Availability. To assess quantitatively the impact of weather on the operation of the route, it is necessary to have a detailed analysis of the meteorological conditions along the route, or routes. No comprehensive study of the over-water climate of the north B.C. coast is known to exist. Data on surface winds, visibility and precipitation are available for a number of shore stations in B.C. and southeast Alaska. However, it must be kept in mind that (a) few of the stations have exposures that record winds representative of offshore conditions, (b) many of the stations have relatively short-term records, and (c) no stations are located on the various channels leading to Kitimat. Item (c) is highly significant as it is not now possible to determine the air flows in what is believed to be a critical section of the sea route, for example the approaches to Kitimat. The inlets and between- island channels on the approach to Kitimat make up a network through which the air must flow in complex and changing patterns. The strength of these winds, and the amount of turbulence created by abrupt changes in speed and direction are not known. It is known however that in other inlets on the north B.C. coast, wind speeds may reach at least 80 knots when strong "outflow" conditions develop. Considering the topography of the area, it is possible that wind speeds may, at times, equal or exceed that value somewhere along the route. Lacking measurements of winds in Douglas, Principe, or other channels leading to Kitimat, it is not possible to cofirm this.

Statistical summaries of the coastal waters of B.C. and the Alaska Panhandle have been published by the U.S. Naval Weather Service based on ship reports. The areas covered extend seaward to approximately 70 nautical miles west of the Queen Charlotte Islands. Since (a) ships are not required to report when within 50 nautical miles of the coastline, and (b) ships' masters attempt to avoid adverse weather, it is felt these summaries reflect "seaward" and "fair weather" biases. It is certain these do not reflect climatic conditions in the intricate network of channels on the route to Kitimat.

Meteorological records made by ships plying B.C. coastal waters (notably those of the M/V Queen of Prince Rupert) are available from Atmospheric Environment Service (AES) Headquarters.

Measured wave heights and periods are available for only one station, a point off Prince Rupert (54@11'09" North, 130@30'60" West). Wave data (based on visual estimates of height and period) are also published in the above-mentioned U.S. Naval Weather Service summary but probably reflect the biases already mentioned. Some of these data were taken into account in the analyses undertaken by the Atmospheric Environment Service.

Data Requirements

In reviewing the proponent's treatment of this subject, it was concluded that the lack of recorded data on the critical parameters of winds, visibility, icing conditions, etc., made the proposal difficult to assess and further studies were recommended.

This lack-of-data concern was communicated to the proponent. It was felt that this concern may possibly be resolved in part by analysis of the records of previous traffic in the area, by a clear definition of wind, icing and visibility conditions considered to be limiting for either the tankers or escort tugs, and by a well- substantiated analysis of the frequency, duration, and forecastability of these limiting conditions. It was further considered tha a three-year program of data collection of conditions in the approach channels should be undertaken. An outline of such a data collection was developed and forwarded to the proponent as a component of the deficiency statement. Moreover, it was felt that a substantial increase in observing and forecasting capability would be required. The detail with respect to the level to which the Meteorological Service would have to be augmented was also at this time provided to the proponent.

In the outline of deficiency, the request for further information was outlined as follows:

> "Define and substantiate the weather conditions considered limiting for the operation of the proposed tanker traffic and predict their frequency of occurrence, and duration in each critical locality. Indicate how the vessels of the system will avoid
>
> Provide a plan for the establishment and operation of an adequate marine weather forecasting service for the area of the terminal and approaches. Include complete details of meteorological elements needed to be observed and forecast to ensure safe navigation. Indicate in the plan the extent of data collection that will be undertaken prior to commencement of operation as a basis for final installation of a long-term forecasting system. An outline of what is considered necessary is contained in the Appendix as Item C."

Under an additional topic, the further information required was outlined as follows:

> "Research the available data not used so far, such as the U.S. Naval Weather Service document: 'Summary of Synoptic Meteorological Observations, North American Coastal Marine Areas, Volume XI', weather observations from ships like the MV Queen of Prince Rupert, wind data from Rose Spit and Triple Island and visibility records from Langara, Sandspit, and Prince Rupert. Compile this with the original data and discuss any revisions in meteorologic implications.
>
> Provide a description of general climatic conditions comprising the northeast Pacific and western North America to include:
>
> (a) Seasonal mean sea level pressure charts,
> (b) Preferred storm tracks by season,
> (c) Seasonal frequency of occurrence of cyclonic storms, their duration and rapidity of onset.

> Approximate the frequencies of freezing precipitation and fog, and joint probabilities of either of these occurring with strong winds.
>
> A discussion of the required studies is attached as Appendix C."

It should be noted that in the interim, that is, the time between which the Termpol Submission was received and when responses to deficiencies from the proponent were due, the Atmospheric Environment Service undertook to appraise and analyse available data. This was undertaken largely in support of a number of Working Groups involved in the assessment of the Termpol Submission, but has resulted in data which is of broader use. A preliminary report, entitled: "A Marine Climatology of the Approaches to Kitimat, British Columbia" was prepared in March by the Atmospheric Environment Service, and the proponent was informed of its availability.

It should be noted that, for all pratical purposes, the proponent did not respond to questions specifically relating to meteorological conditions and the need for improved meteorological services.

Meteorological Services Required

Already mentioned in this Section is the fact that, if the proposed project were approved a substantial increase in observing and forecasting capability would be required. Measures required to provide additional meteorological services would include: (i) improving the data base, (ii) improving the communication system to transfer data in real-time, (iii) issuing special forecasts, (iv) instituting a sea-state forecasting procedure, and (v) conducting research and training to improve forecasting methods.

The expansion of the data base would include:

(i) Establishing a weather station at the Kitimat Port to report wind, visibility,

Meteorological Services Required

precipitation and sea-state at regular 3-hourly intervals. This could be a manned station or an automatic station such as the AES MARS II.

(ii) Establishing a number of automatic weather stations along the chosen route.

(iii) Establishing a buoy-mounted automatic weather station in Hecate Strait to regularly record and transmit real-time observations of wind speed and direction, air and sea temperatures, fog, sea-state and sea level barometric pressure.

The buoy-mounted station in Hecate Strait is considered necessary in order to measure meteorological parameters in the open waters of this frequently stormy strait. Experience has shown that reports from land-based stations (Cape St. James, Sandspit, Ethelda Bay, in particular) are not representative of the water area.

These permanent automatic stations would be equipped with telemetry links so that data may be transmitted in real-time to Coast Guard stations, to the Pacific Weather Centre (PWC) at Vancouver, and to other Weather Offices requiring the information. It is assumed that an elaborate communication system would be established and meteorological data from the automatic stations would be transmitted by that means.

Special forecasts for the route leading to Kitimat would also be required. In addition to the usual elements, the forecasts would include sea-state, particularly for the terminal and the more open waters of Hecate Strait, Dixon Entrance and Queen Charlotte Sound.

Specific Review Comments

The remaining part of this section contains comments which are intended to indicate deficiencies in the data, or methods used relative to the meteorological sections of the submission. These comments are itemized as follows: (References are to section of the proponent's submission.)

(i) Section 3.2 Climatology and Meteorology

Re Section 3.2.1.3 Available Data -

Hourly wind data for Rose Spit (54 12N 131 39W) are available from 1971 onwards, and from Triple Island (54 18N 130 53W) from 1973. While these records are rather short, they are from important stations along the proposed route and should be considered. The data from Rose Spit are particularly important as they show a case in which northeasterly gales blew at speeds of over 40 mph (35 knots) every hour for a period of five consecutive days (January 31, 1975 - February 4, 1975).

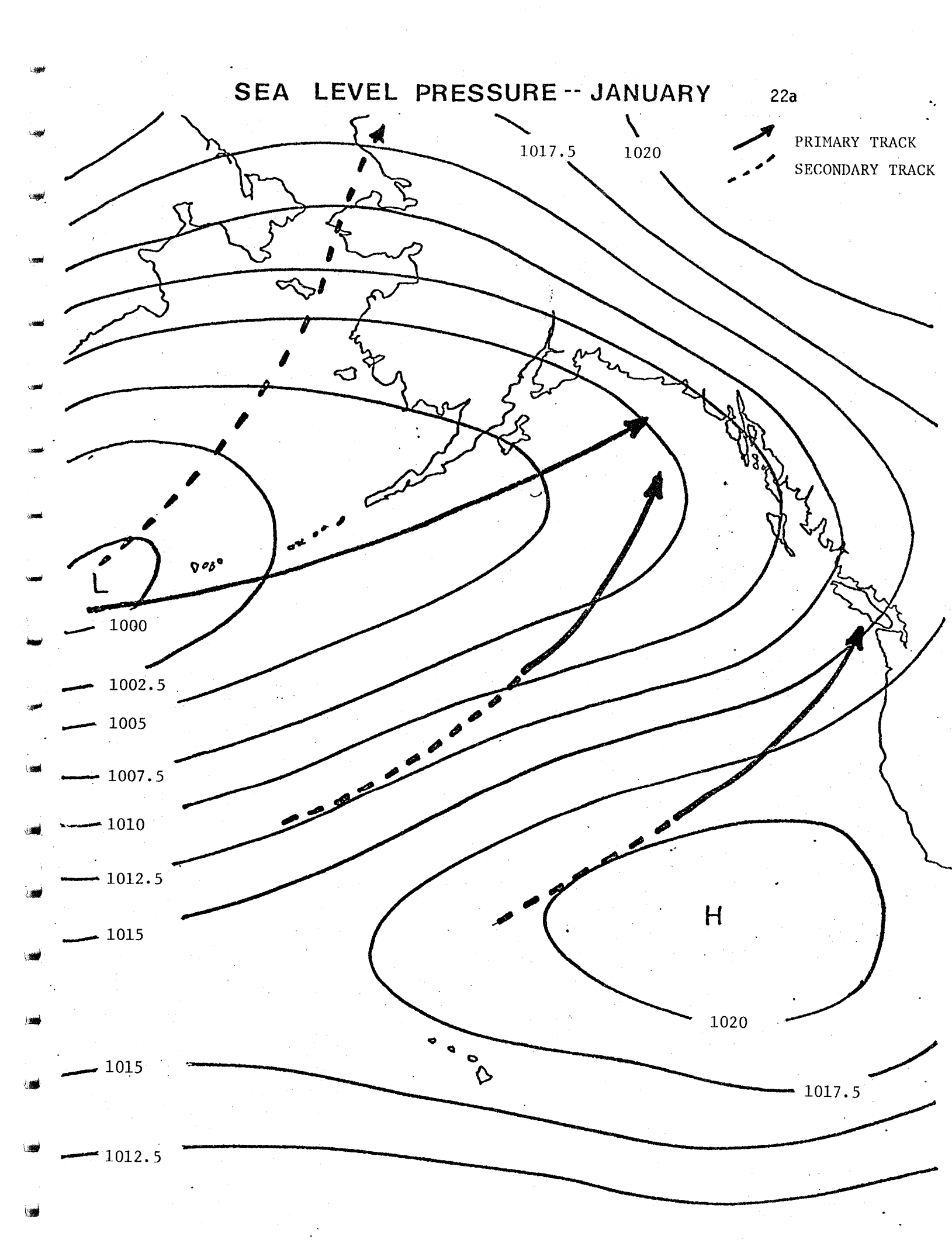
Re Section 3.2.1.4 General Climatic Conditions -

This section discusses the climate of the B.C. coast mainly from the viewpoint of precipitation and temperature. Since the elements of most concern for safe navigation are winds, visibilities and waves, emphasis should be placed on these elements. In general terms there should be a discussion of synoptic weather systems which cause them. Information on frequency of occurrence of these elements for broad areas could be included.

Figures 1 and 2 depict the mean sea-level pressure patterns in the northeast Pacific and western North America. Isopleths are in millibars. The figures also show the primary and secondary storm tracks in the same area. Since surface winds blow counter-clockwise around a centre of low pressure (in the northern hemisphere) and clockwise around a centre of high pressure,

SEA LEVEL PRESSURE -- JANUARY

22a



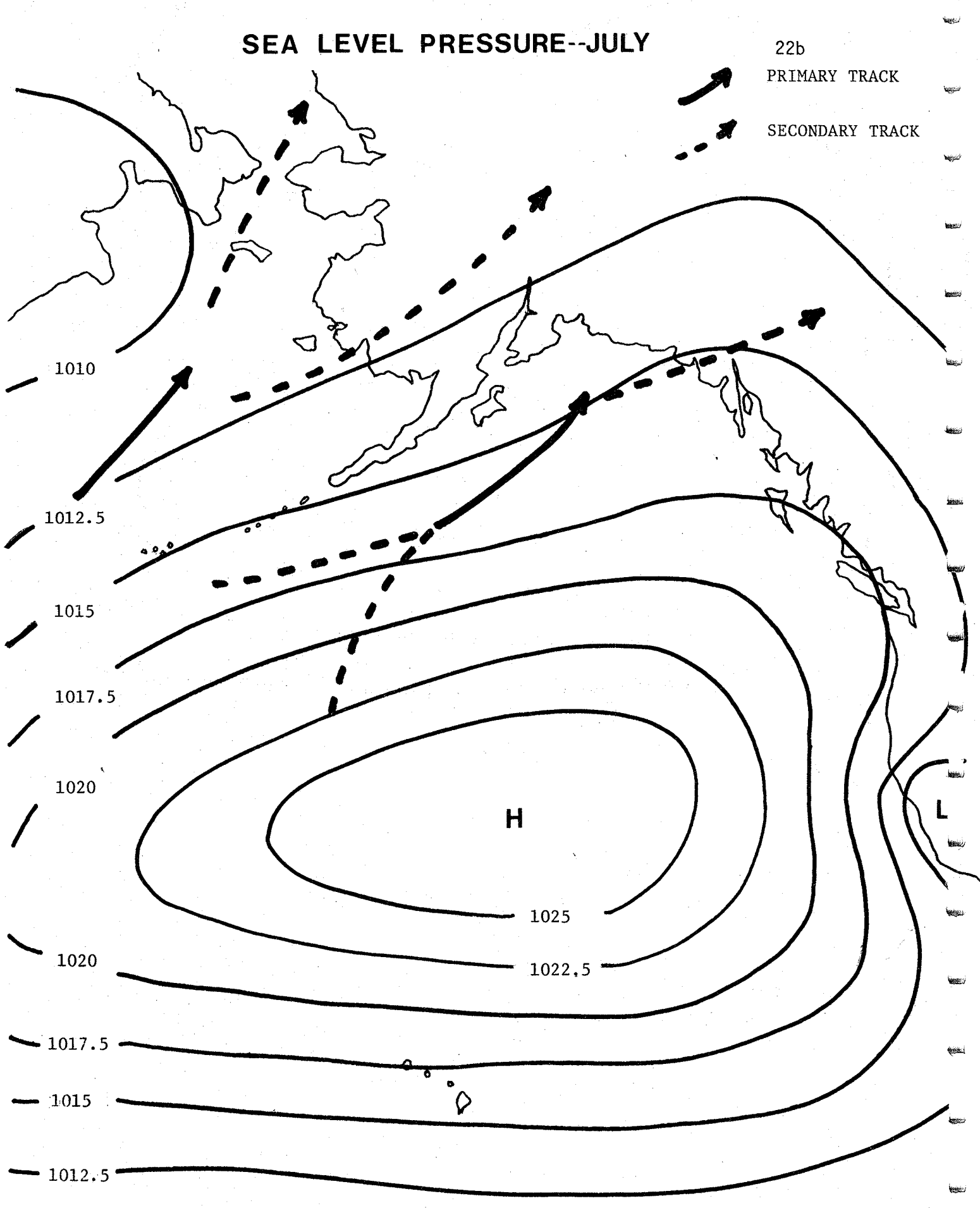


Figure 2 Sea Level Pressure - July

winds on the B.C. coast tend to blow from the southwest in winter, from the northwest in summer.

While the mean pressure patterns provide information on the prevailing winds, it is the travelling extra-tropical cyclones which cause the extremes of wind and weather. Transient cyclone frequencies for North America and adjacent waters in January and July are depicted in Figures 3 and 4 on which primary and secondary storm tracks are also shown. It is obvious that the Gulf of Alaska and the B.C. coast are areas of frequent winter storms. Since the storms which impinge on the B.C. coast are usually in a mature stage, they are usually intense. As well, they are often storms which develop rapidly and move rapidly making it difficult to forecast their motions and character.

Statistical summaries of winds, visibilities, state-of-sea and occurrence of various weather phenomena for the exposed areas of the B.C. coast have been published in the U.S. Naval Weather Service document, "Summary of Synoptic Meteorological Observations, North American Coastal Marine Areas, Volume XI". While these are for broad areas and probably reflect "seaward" and "fair weather" biases already noted, they do give an overall indication of the weather on the approaches to the coast and should have been considered in the Termpol Submission.

Re 3.2.1.5 Wind -

As noted above, data for Rose Spit and Triple Island are available. Analyses of these data should be included.

No attempt has been made in this section to estimate maximum wind speeds in Douglas and Principe channels. Field measurements of wind speeds at two locations, one in Principe Channel, the other on Hawkesbury Island are described in Appendix XIII. The

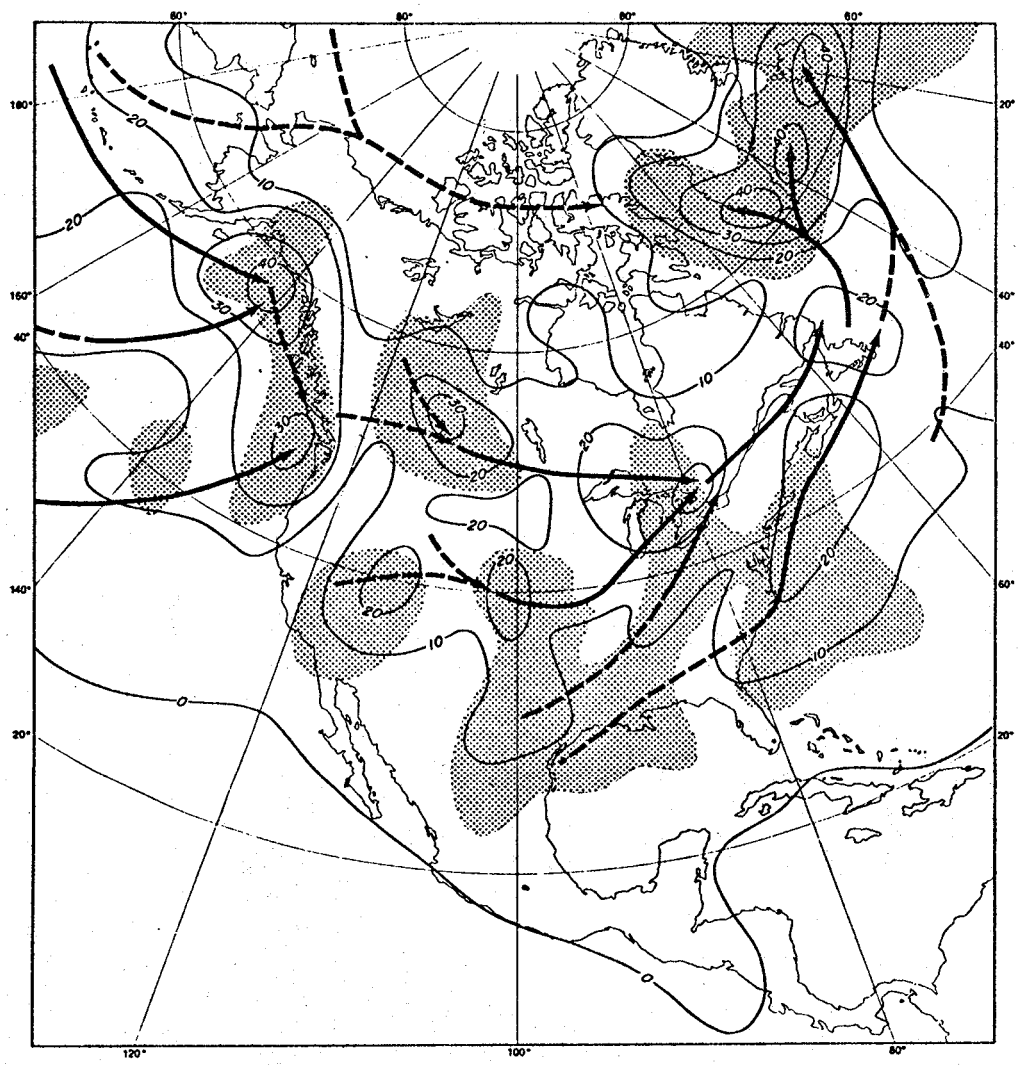


Figure 3

Transient cyclone frequencies for January. The isopleths show the number of cases in a chosen 20-year period (1909-14, 1924-37) when cyclones were centered in five degree squares (adjusted to the size of such squares at 45°N). Since no cyclone was counted in a given square more than once, stationary systems like heat lows were filtered out. Hurricanes were also excluded. The shaded area had more than 4 cases per five degree square of cyclogenesis during the same 20 years. Characteristic tracks of the cyclone centers are also shown. Dashed tracks are of minor importance. (From a study by Klein as quoted in Bryson, R.A. and F.K. Hare, 1974: Climates of North America, Elsevier Scientific Publishing Co., Amsterdam-London-New York.)

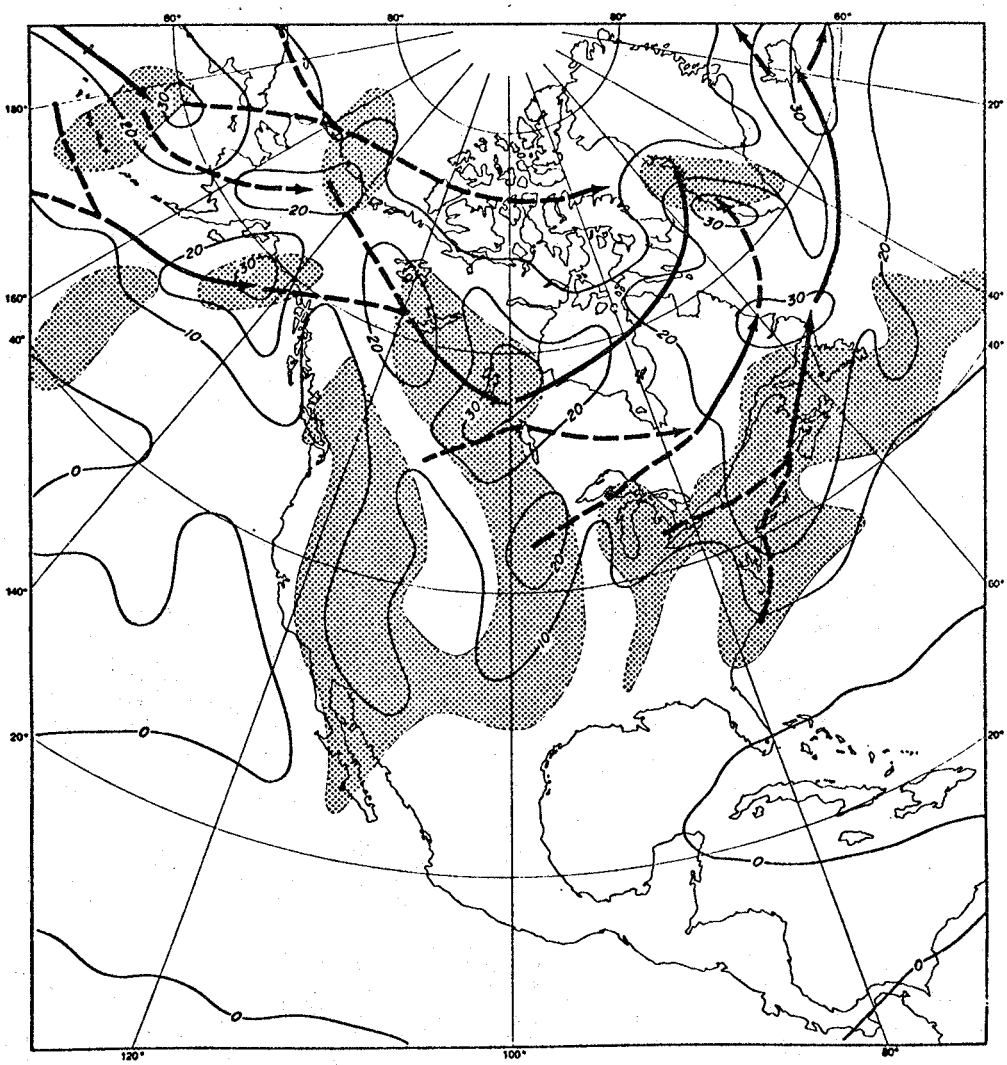


Figure 4

Transient cyclone frequencies for July, compiled like Figure 3.

shortness of the records (one month) make these measurements meaningless, particularly since they were made during a quiescent period on the B.C. coast.

An estimated ratio of wind speeds at Kitimat to those over the waters of Kitimat Arm of Douglas Channel was calculated (Appendix VI). It would, however, be scientifically unwise to use this ratio to estimate winds in areas more than about 10 miles distant from Kitimat.

Re 3.2.1.6 Visibility -

Data concerning visibility restrictions at Langara, Sandspit and Prince Rupert should be included. As noted in the proponent's submission, there are no data describing visibility restrictions within Douglas Channel. It should be noted also that the same is true for Principe Channel and the critical Wright Sound area.

Re 3.2.2 Kitimat Tanker Terminal

This appears to be an adequate analysis of existing data. Of most concern is the lack of data concerning visibility restrictions at Kitimat. Since the climate of Kitimat is more "continental" than the "marine" climate of Ethelda Bay, Bonilla Island and McInnes Island, it would be unreliable to extrapolate from the statistics for those sites. The distance between sites and the variety of exposures would also make extrapolation unrelaible.

(ii) The Project, Volume I

Although climatology of the various possible port sites was considered in making the Kitimat selection, apparently no assessment of weather conditions along alternate routes to Kitimat was carried out.

On page 26, Volume I, it is stated: "Winds in the Kitimat area are reported to be 55

mph maximum along the axis of the fjord". The analysis of winds at Kitimat indicate this is probably true in the immediate vicinity of Kitimat; however, there appears to be no justification to extrapolate this beyond about 10 miles from Kitimat. Indeed, this contradicts other estimates of maximum wind speeds in Douglas Channel.

It is stated (P. 41, Volume I) that winds are constrained to blow primarily along the channels and "winds on the bow or stern are more favourable than cross-winds". However, it is not pointed out that there are channels joining Douglas Channel and other route segments which are perpendicular to the route. At these junctions, it is difficult to assess the probable speed and direction of the winds. Similarly, it is not pointed out that winds in Wright Sound are likely to be very turbulent and variable. A tanker en route to or from Kitimat would have to make critical maneuvers in this area of variable winds.

A serious deficiency of the proponent's submission the lack of any proposal to improve meteorological services for the route. This has already been discussed above and the discussion need not be repeated.

A discussion of the effects of melting snow on radar operations is not included.

Summary

In summary, the Working Group concludes as following conclusions were made:

(i) Adverse weather conditions of the B.C. north coast would, at times, introduce the problem of difficult navigation conditions and the risk of serious oil pollution, and could hamper clean-up operations in the event of a spill. However, the lack of meteorological data, particularly for critical sections of the route such as Wright Sound, makes it impossible to estimate the risk in quantitative terms. To totally overcome this data deficiency long-term studies of a minimum of three years could be required.

(ii) It is essential that for any proposed operation: (a) the operational limits are clearly defined, and (b) measures be taken to improve the meteorological services in support of the operation.

The proponent's submission is deficient in providing a comprehensive discussion of the meteorology of the B.C. north coast and the meteorological services required. In part this is because of a lack of meteorological data although more complete analysis with the data available could have been undertaken by the proponent.

4 BIOLOGICAL ENVIRONMENTAL CONSIDERATIONS

4.1 Fisheries and Marine Resources. The Termpol Submission placed too much overall reliance upon the available literature regarding oil spills and their effects, rather than document the site-specific resource information which is necessary to predict the effect of an oil spill along the proposed route. There is little substitute for specific information when endeavouring to predict the effects of such events. While a comprehensive literature review was made of site-specific information and the field studies carried out to obtain some of this information were most inadequate.

Fishery resources along the proposed tanker route were not adequately documented and in some instances were omitted.

Only one tanker route was detailed in the Termpol submission and we consider that this is a major defiency of the document. Alternate routes, particularly an approach from the south, should have been researched, the resources along such routes identified and the probable effects of tanker movements and oil spillage assessed. A tanker route on the west coast of the Queen Charlotte Islands may have less impact upon the fishery resources if an oil spill occurred. This route would also reduce, but not eliminate, conflict with the fishing fleet.

Further studies of marine resources along alternate tanker routes are mandatory for an adequate asessment of this Termpol submission.

4.1.1 Invertebrates. There is very little documented information on invertebrates of the Queen Charlotte Islands. Some inventory of marine resources of the western coast of the Queen Charlotte Islands have been mapped by the Provincial Fish and Wildlife Branch (Northern B.C. Coaastal Wildlife Resources

Map). The Marine Biology Section of the B.C. Provincial Museum carried out collection of intertidal and subtidal communities near Langara Island, in Rennell and Tasu Sounds, and at Cape St. James in 1976, but analyses are incomplete. Aside from these surveys and the observations of local northern people (e.g. recreational fisheries for abalone in Pennell and Tasu Sounds, dungeness crabs in Port Louis, Berresford Bay and Security Inlet, king crabs in Long Arm and Skidegate Inlets), information is lacking.

There are significant stocks of shellfish, crustaceans and other invertebrates in the north coast region and it is necessary to document these in order to better evaluate the risks associated with the transport of oil into Kitimat.

Shellfish

Important shellfish species that are harvested include razor clams, butter clams, Japanese littleneck clams, native littleneck clams, abalone, and oysters. The proposed tanker route passes by the only commercial razor clam fishery in British Columbia and through many areas rich in other clams and abalone. The commercial fishery for shellfish, particularly for abalone, razor clams, and butter clams, was not adequately documented in the Termpol submission. That shellfish would probably recover after one year following an oil spill may well be a gross over-simplification. Populations may recover relatively quickly, but exploitation of the stocks may be delayed for a number of years primarily because of sublethal effects (e.g. tainting).

Crustaceans

The crab resources of the north coast districts are not well documented. Important crab fisheries in MacIntyre Bay, Hecate

Strait and Naden Harbour were not documented in the Termpol Submission.

It is recommended that if an alternate route is considered along the coast of the Queen Charlotte Islands, Tasu and Rennell Sounds in particular, should be examined for the distribution and abundance of crustaceans (T. Butler, personal communication). Alaska king crabs are also recorded from Long Arm and Skidegate Inlets.

The Termpol Submission does point out that crabs have suffered heavy mortality following some oil spills (e.g. Tampico Maru spill, North et al, 1964). There are abundant shrimp communities along the proposed tanker route but they are not adequately documented. "The potential effects of oil on these shrimp communities are not known", as is stated in the Termpol Submission. Hence there is a need to document these resources along proposed and alternate oil transportation routes.

Other Invertebrates

There are many incidental fisheries or potential fisheries for which there is little information. These would include, for example, the harvesting of sea urchins, squid, and sea cucumbers. Consideration of the fishery potential for other resources has not been made in the Termpol Submission. A faunistic survey done by Bernard and Quayle (1973) has fulfilled some of the data gaps.

4.1.2 Fishes. The proposed tanker route passes through major fishing areas for salmon, groundfish, herring and other fishes. Accordingly there are major concerns relating to the damage which could be caused to these highly valuable resources, in the event of oil contamination.

(a) Salmon: The salmonid resources of both the Kitimat and Skeena systems were underestimated in the Termpol Submission, especially the latter which was given little emphasis. For example, the annual escapements to the streams of Douglas Channel, Wright, Lewis, Squally, Whale and Campania Channels including the Kitimat system average: 2,500 sockeye, 22,000 coho, 29,000 chum, 4,100 chinook and 475,000 pink salmon.

Escapement records for the Queen Charlotte Islands Statistical Areas 2W and 2E, Figure 5) are available from the Fisheries and Marine Service spawning files. Summarized records since 1947 are now in a draft form and should be available as published spawning catalogues in the near future. Data are not available on the coastal movements of juvenile salmon from stocks from the Queen Charlotte Islands. The known biology of the four salmon species in these areas indicates that coastal and near-shore rearing occurs between April and November. In regard to adult coastal migration, only chum and sockeye have been tagged on the west coast of the Queen Charlotte Islands, and only in small numbers in 1974 and 1975. These data have not yet been analyzed, but recoveries of tagged fish were made both on the east coast of the Queen Charlotte Islands and off Vancouver Island, suggesting that the west coast of the Queen Charlotte Islands is part of a major migration route for B.C. salmon stocks (F. Dickson, personal communication).

(b) Groundfish: The full potential of a groundfish fishery in Hecate Strait and Dixon Entrance is not known and very little information is known for the

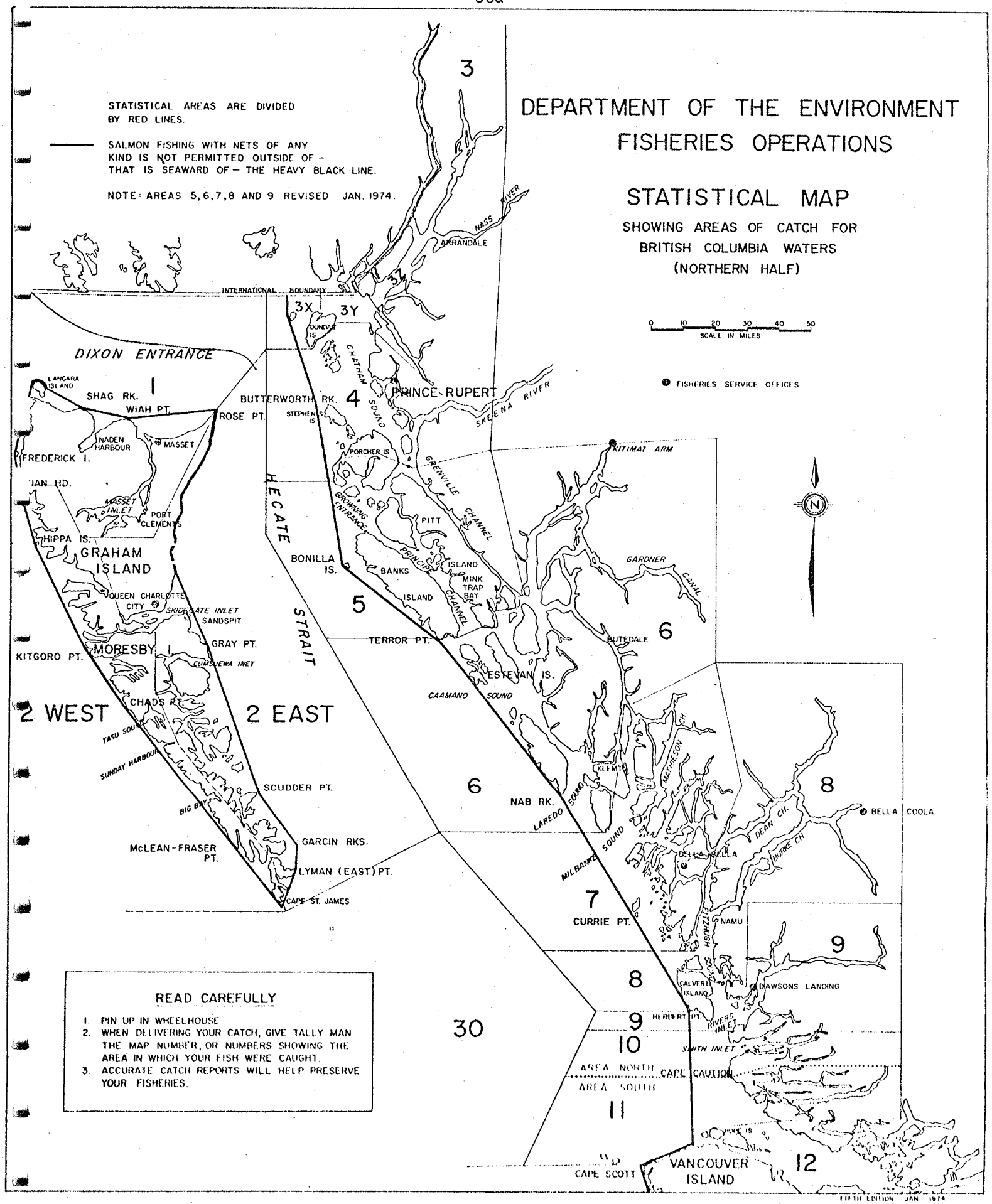


Figure 5 Statistical Map Showing Areas of Catch

west coast of Queen Charlotte Islands or Douglas Channel. There is very little information on groundfish migration routes, spawning grounds, food, and growth. There is also a lack of knowledge on the aquatic physical-chemical conditions necessary for this fishery. Within the Termpol Submission the resiliency of groundfish stocks was attributed in general to their fecundity. This is misleading for many groundfish have pelagic larval forms and need to produce large numbers of eggs and juveniles to overcome the problems of natural survival, especially in the pelagic phase. Additional stresses, due to pollutants (for example, oil) on the pelagic larvae and eggs would seriously affect groundfish stocks, and recovery may take more than one year.

(c) Herring: Fishing areas for the capture of herring for food were not shown in the Termpol Submission. Commercial net fishing for herring in Kitkatla Inlet was not shown.

Herring stocks were not emphasized in the document, and statements were made to indicate that major herring stocks are not to be found along the proposed tanker route. This is an incorrect assessment. Major herring spawning occurs in the Prince Rupert and Kitkatla areas. There is also localized herring spawn opposite Hartley Bay, extending from Money Point to Kiskosh Inlet in Douglas Channel. While this herring stock is not commercially exploited, it is used by the Hartley Bay Native Indians for food. Recent information on herring appears to have been ignored in the literature review.

Landings of herring roe, spawning grounds, and amounts of spawn can be obtained from the annual reports of Humphreys and Webb (1970 to 1973) or Webb (1974 to 1976). Several earlier reports have been published in the Fisheries and Marine Service Technical Report Series (nos. 296, 613). Catches from Area 2W (West of the Queen Charlotte Islands) generally account for only 500 tons of the total from the Queen Charlotte Islands.

It is know that juvenile herring generally rear in shallow near-shore waters of the western coast of the Queen Charlotte Islands from early spring until fall, but details are not available for other stocks.

(d) Other Fishes: There are minor commercial and recreational fisheries for other fish species that must be considered in relation to the Termpol Submission. However, these minor fisheries are not well documented.

Eulachon stocks are utilized by Native Indians for food and oil.

The marine eulachon distributions are virtually unknown except for the occasional report of offshore catches by foreign fleets.

There is a minor recreational fishery for surf smelts that was not documented in the Termpol Submission.

White sturgeon are sparsely distributed in inshore waters and there is a minor commercial freshwater fishery.

Rainbow trout (steelhead) have not been adequately studied in regard to their marine rearing. The best assumption that can be made at present is that their distribution would be similar to that of juvenile salmon.

Albacore tuna are occasionally fished by trollers off the west coast of Moresby Island. The performance of the fishery is unpredicatable, in that fish distribution is dependent on the northward extension of water of 15-16 C in summer. Also, the degree of participation by B.C. fishermen depends upon weather and the sale prices, both for albacore and salmon. Certain Fisheries and Marine Services Technical Reports contain details on the annual B.C. albacore fishery (Nos. 1973-3, T-74-3, T-75-10). In general, albacore are found in a broad band, seaward of coastal upwelling (i.e., 20 - 50 miles offshore), and at relatively shallow depths. Tuna often are "trapped" in shallow pockets of warm water at their northern limits, which could make them more vulnerable to an oil spill. Depending on routing, fishery-tanker conflict may occur.

4.1.3 Plankton.

(a) Zooplankton: There is very little information on zooplankton and the study carried out for the Termpol Submision was totally inadequate. There was a distinct lack of site-specific information. The dependence of many organisms on this component of the food chain emphasizes the need for more information relating to zooplankton.

(b) Phytoplankton: There was also an absence of site-specific information regarding phytoplankton for the particular areas of concern, hence, it is difficult to understand statements within the Termpol Submission that recovery of the phytoplankton following oil spillage would be over a short term. Without detailed knowledge of the specific phytoplankton populations, such a prediction is hypothetical and hence misleading.

4.1.4 Marine Plants. Many areas of littoral benthic algae and plants are used by fish for habitat, rearing areas and/or for the deposition of eggs (e.g. herring). Some of these plant communities were identified in the Termpol Submission; oil spills could seriously affect these plants and hence their associated biological communities. Several seaweed inventories (internal reports, FMS, North Coast Branch) have been carried out for the Queen Charlotte Islands and would assist in evaluating the proposed tanker routes.

4.1.5 Marine Mammals. The Termpol Submission covers most of the available data and recognizes the deficiencies of our present knowledge. Most of the surveys completed by the proponent verified existing knowledge and, consequently, many questions still remain unanswered. The available data are most exclusively directed toward the Hecate Strait and associated shorelines. Offshore and intertidal areas off the west coast of the Queen Charlotte Islands have not received adequate attention and data are lacking. Data on migration routes, timing feeding, breeding and rearing areas for most of the marine mammals are scarce. In general, the available data for most marine mammals are inadequate regarding their abundance, distribution, and life history for all areas of the north coast of British Columbia.

4.1.6 Food Chain Relationships. There was little appreciation of the effects of an oil spill on the relationships between the various components of the food chains. While many organisms are facultative in their environmental requirements, others may not be and in consequence could be highly susceptible to oil spills. A major breakdown of important populations at one or more levels in the food chain could have serious ramifications for those populations at other levels. In addition, the accumulative effect of hydrocarbons via the food chain could be a serious concern even if only "low-level" pollution occurred.

4.1.7 Proposed Enhancement of the Marine Resources

Within the Termpol Submission, enhancement of salmon stocks was viewed as a means to overcome the effects of oil spillage. This is a major presumption and enhancement of the salmonid stocks should not be viewed in this context. The proposed enhancement of the biological resources is designed to benefit fisheries and aquatic ecosystems in general, not to overcome the effects of any oil spillage. The enhancement plans serve to stress the importance of the north coast aquatic communities and the need for their protection.

At present, enhancement plans have only been formulated for salmon. Plans have been developed for certain non-salmonid species, and it is likely that enhancement of a wide range of species could occur in the future. There are many options available to develop fisheries on species which are not utilized at present. For example, fish farming (aguaculture) techniques have not been used in the north but could develop in the future. In addition, harvesting of organisms such as sea urchins, kelps, sea cucumbers, mussels, clams, plankton, dogfish, and certain species of groundfish could develop into major viable fisheries.

(a) Enhancement Along the Proposed Tanker Route: Currently there is not a commercial fishery in Douglas Channel but Fisheries and Marine Service has plans for major enhancement facilities on the Kitimat River. Once these facilities are operational, there is every likelihood that there would be a commercial fishery in Douglas Channel.

Extensive salmon enhancement plans have been developed for aquatic systems along the proposed tanker route. Along the north end of the Queen Charlotte Islands, bordering Dixon Entrance, there are plans for enhancement facilities on: the Yakoun River to produce 140,000 coho and 400,000 pinks, and on rivers in Naden and Masset Inlets to produce 130,000 chum.

Along the east coast of the Queen Charlotte Islands, bordering Hecate Strait, enhancement facilities are planned, for example on the Copper River, Skedans Creek and Skidegate Inlet Creeks to produce 225,000 pink salmon. Pallant Creek, Mathers Creek, Lagoon Creek, Juan Perez area, Skincuttle Inlet, Selwyn Inlet and Skidegate Inlet are also sites for proposed enhancement of the salmon populations. An additional 560,000 chum salmon is expected from these aquatic systems and an additional 140,000 coho from the Tlell and Copper Rivers.

On the mainland side of the proposed tanker route, enhancement facilities are planned for the Nass River-Portland Inlet area, such as facilities on Cranberry River, Observatory Inlet, Alliance River, Khutzemateen Inlet, Toon River, Quinimass River, Work Channel, and the Meziadan system. These facilities would be expected to produce an additional 80,000 sockeye, 60,000 chinook, 300,000 pinks, 280,000 chum and 150,000 coho.

Enhancement facilities planned for the Skenna River are on Ecstall, Kalum, Babine, Morice, Kispiox, Kitwanga, Lakelse, Morrison Rivers and Pinkut Creek. An additional 160,000 sockeye, 190,000 chinook, 800,000 pink, 410,000 coho, and 140,000 chum salmon are expected from these areas.

Facilities planned for the Grenville-Principe area are on Lowe Lake, and a number of small streams in the general area. Production from this area is expected to be 140,000 sockeye, 70,000 chum, and 50,000 coho.

Facilities planned for the Douglas and Gardner Channel area and on the Kemano and Quaal Rivers. These facilities are expected to produce 100,000 coho, 600,000 chum, 450,000 pink, and 25,000 chinook.

Aside from the facilities alredy mentioned, there are many more planned which are located further south. It is possible that in the event of an oil spill, some of these facilities and their production could be affected.

To summarize, the expected production from facilities along the proposed tanker route would be: 990,000 coho, 380,000 sockeye, 2,175,000 pink, 1,780,000 chum, and 275,000 chinook salmon.

(b) Enhancement Along Alternate Routes (West Coast of the Queen Charlotte Islands): The facilities planned on the west coast of the Queen Charlotte Islands are located at Tasu Inlet and Rennel Sound. These facilities are expected to produce 110,000 chum and 75,000 pink salmon.

The total production expected from enchancement facilities along this possible route is: 100,000 coho, 710,000 chum, 525,000 pink, and 25,000 chinook salmon.

(c) Enhancement in the Vicinity of the Terminal: The only enhancement plans that would be within the vicinity of the terminal are on the Kitimat River, where a hatchery facility is planned to produce 200,000 coho and 75,000 chinook, and spawning channels to produce 350,000 pink and 250,000 chum salmon.

In summary, the total number of salmon that are expected to be produced from systems bordering the proposed tanker route is 6,475,000. This production being comprised of 1,190,000 coho, 350,000 chinook, 380,000 sockeye, 2,525,000 pink, and 2,030,000 chum salmon.

The total number of salmon expected to be produced from systems bordering the alternative route (west coast of Queen Charlotte Islands) is 2,235,000, comprised of 300,000 coho, 100,000 chinook, 875,000 pink, and 960,000 chum salmon.

4.1.8 Recommended Studies for Resource Documentation. More detailed resource information is required along the proposed tanker route and any alternate routes prior to commencement of operation.

The resource inventory should be conducted over all seasons for one year or more.

The study should be carried out:

(a) In the littoral areas along the proposed tanker route(s) and terminal site to identify the critical regions for all major components of the aquatic biological resources. For example, abalone, clams, sea urchins, herring spawning areas, marine plants, crabs, marine mammals, possible rearing areas of juvenile salmon (and other fishes) and important salmon migration routes and spawning creeks.

(b) In the Kitimat River estuary and other estuaries in Douglas Channel to provide more up-to-date statistics on the numbers and distribution of salmon, herring, eulachon, and other fishes.

A portion of the study would be to summarize existing data by conducting a thorough search of existing records, and interviewing knowledgeable fishermen and Fisheries and Marine Service personnel. However, the major thrust of this study should be field surveys along the proposed tanker route(s).

A systematic survey of the west coast, with the use of aerial photography and in-situ sampling procedures, could be undertaken to document marine plants.

Further study of nearshore rearing distributions of major herring stocks of the Queen Charlotte Islands would be required.

Further study requirements for salmon are:

1. Analysis of fish taking data.

2. Field examination of adult migration routes and staging areas on the east and west coast of the Queen Charlotte Islands.

3. Field examination of coastal and nearshore rearing Areas 2W and 2E.

Additional information on other fish species should be gained during field studies that have been suggested.

4.1.9 Review of the Supplemental Information. A request was made to the proponent for an examination and comparison of alternate marine approach routes to Kitimat (Question 31). Information was given regarding navigational feasibility in the answer to Question 23 but environmental implications and relative probabilities of accidents that may result in damage to the environment were not adequately documented.

Additional information was requested on fishery resources along the proposed tanker route and at the proposed dock site.

Preparation and analysis of additional resource information is being undertaken by the Applicant. However, short term studies recently undertaken by the Applicant are not adequate and more detailed resource documentation is required along the proposed tanker route.

However, this additional information would not alter our assessment that the proposed tanker route (through Dixon Entrance, etc.) has an extremely high potential for major adverse impact on the fishery resoures in the vicinity of the route. If this project were to proceed further such information would be required.

4.1.10 References.

Bernard, F.R. and Quayle, D.B. 1973. British Columbia faunistic survey, a summary of dredging activities 1970 - 1972. FRBC, Man. Rep. 1240, 11 pp.

Borque, S.C. 1974. Status of the 1973 British Columbia Albacore Fishery. FMS, Tech. Rep. #PAC/T-74-3. 61 pp.

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Hourston, A.S. and D.N. Outram. 1972. Millions of eggs and millions of spawn in British Columbia herring spawning, 1951-1970. FRB, Tech. Rep. 296, 155 pp.

Humphreys, R.D. AND C.W. Halgete. 1976. An evaluation of herring spawn survey techniques used in British Columbia waters. Fish. Mar. Ser. Tech. Rep. 613, 142 pp.

Humphreys, R.D. and L.A. Webb. 1970. The abundance of herring sapwn in the coastal waters of British Columbia. DFE. Tech. Rep. 1970-9.

Humphreys, R.D. and L.A. Webb. 1971. FMS Tech. Rep. 1971-11.

Humphreys, R.D. AND L.A. Webb. 1973. FMS Tech. Rep. T-73-10.

North, W.J. et al. 1964. Successive biological changes observed in a marine cove exposed to a large spillage of mineral oil. Conn. Int. Explor. Ser. Med. Symp. Pollut. Mar. Microorgan, Prod. Petrol. Monaco pp 335-354.

4.2 Marine Birds. Marine birds are among the most vunerable species to oil spills. During review of the Termpol Submission, it was concluded that the knowledge of the seasonal distribution of marine birds along approach routes is generally inadequate. As a result, this was one of the deficiencies documented and, hence a request was made for the provision of information with regards to marine bird populations. It was felt that comprehensive information was required on the seabird distribution and congregations by season, for the various species, along the proposed and alternate approach routes to the terminal. Terms of reference which were considered necessary were outlined and provided to the proponent together with the deficiency statement. It is emphasized that the bird resources along the Pacific Coast have not been studied in sufficient detail to provide adequate description of their biology, movements, and distribution.

With respect to the value of the marine bird resources, it should perhaps be noted that the Canadian Government is responsible for the preservation and conservation of migratory birds, seabirds, inclusive, under the Migratory Birds Convention Act, which ratifies the agreement reached between Canada and the United States in 1916. To discharge this responsibility the Canadian Wildlife Service was created. The duties of the Canadian Wildlife Service include the maintenance of viable populations of migratory birds in perpetuity. The value of migratory birds cannot and should not be expressed in monetary terms; their significance is identified in international treaties and in Canadian laws. The general public's appreciation of the migratory bird resource over the years has further manifested itself in the form of general environmental concerns and legislative pronouncements: Canada's National Wildlife Policy and Program 1966, and Canada Wildlife Act 1973.

Seabirds serve us in their roles as indicators of the quality of the marine environment. Effects of oil spillage on populations of other marine organisms are difficult to assess because of their submerged nature. Seabird populations, however, constitute a "litmus paper" with which the health of Canada's coastal zones can be measured. To use them as such is now an urgent matter of practical and national interest. Our immediate neighbours already relalize this. Investigations along the U.S. West Coast and in Alaska on seabirds alone, over the last two years, have cost several millions of dollars.

The magnitude of the risk to marine birds is related to the likelihood of accidents. One single oil spill could conceivably eliminate major seabird populations. It is of significance that the Queen Charlotte Islands have been identified on the basis of preliminary data to be highly important for seabirds. Hundreds of thousands of Auks are nesting in these regions but the exact magnitude of population is unknown. One large concentration of staging Auks has been encountered just off Dixon Entrance during aerial surveys of the outer B.C. coast (Robertson, 1974). Location and distribution of other such concentrations are not known.

5 ENVIRONMENTAL IMPACT CONSIDERATIONS

5.1 Construction Phase. This aspect of the proposal is considered to be of subsidiary environmental importance to the overall concerns associated with the transport of oil into Kitimat. However, certain restrictions must be imposed upon the construction of any facilities (e.g. terminal and tank farm) in order to minimize their impact on the surrounding environment.

Of major importance is the timing of construction. Construction should be carried out with due regard to ecological matters. In this context, construction must not conflict with the migration of salmonids and other important aquatic organisms. Blasting in or near water will be of particular concern and must be strictly controlled.

During the construction of any facilities on lands adjacent to water courses every effort must be made to prevent the disruption of the water courses and their biological components. Land runoff from the construction site must be contained by the judicious use of interceptor ditches and settling ponds to prevent the release of deleterious materials (e.g. silt) into the water courses. Such settling ponds should allow settlement of the solids even under maximum rainfall conditions. In addition any in-stream activities must be subject to stringent timing restrictions to safeguard freshwater, estuarine and marine resources. Effluent from the construction sites must receive adequate treatment or be disposed in a manner which will not degrade the integrity of the receiving environment.

5.2 Terminal and Tanker Traffic Operations. In considering the terminal and tanker operations, it is necessary to consider two levels of concerns. The first level relates to the impacts which may result from the normal operations and during average operating conditions. The second level of con-

cern relates to the impacts which result from abnormal operations or accidents. An example of the latter is the occurrence of an oil spill during tanker transit or during the off-loading operations.

The review must consider both levels of concerns; these have accordingly incorporated into the sections which follow.

5.3 Oil spills

5.3.1 Introduction

As long as crude oil and its refined products are transported and used, oil spills are inevitable. Malfunction of equipment, and human error have frequently been the primary causes for the majority of oil spill incidents. Thus, while oil spills may be controlled, they cannot be eliminated entirely.

Oil spills of massive proportion may result from loaded tankers inbound for Kitimat through groundings, collisions, or other accidents. Oil pollution may result from tanker operations of ballasting, tank cleaning and bilge pumping at sea. Problems may also occur while the tanker is offloading, or is on her outward journey.

The Applicant has acknowledged the inevitability of an oil spill, and has developed a contingency plan to deal with this eventuality. However, the contingency plan as submitted by the proponent is considered to be inadequate in its present form. A number of pertinent details and considerations are required. The effect of oil spills on biological resources and socio-economic concerns as well as their protection under a variety of hydrographic and atmospheric conditions has yet to be directly addressed by the proponent. Spill risk analysis exercises should have been undertaken. The single spill scenario presented is unsatisfactory, being inconclusive, incomplete and non-specific in

nature. Again no attempt was made to link biological resources and socio-economic factors with the spill countermeasures.

5.3.2 Acute and Chronic Effects of Oil Pollution on Marine and Estuarine Organisms

The proponent carried out an extensive literature search in the Termpol submission. However, the effects of an oil spill on the marine environment will depend upon many factors, for example, the volume of oil, its type, the time of year, prevailing environmental conditions, location, and clean up methods. The Termpol submission tended to oversimplify the problems of oil spillage and the consequent effects on the biological resource. The Submission did not address the potential problem of impacts which could result from multiple oil spills.

In order to assess the effects of oil spillage and clean up on marine and estuarine organisms residing or passing through the proposed or alternate tanker routes, it is necessary to have information on the short term (acute) and long term (chronic) effects of the oil. Specific information is required, and only gross comparisons may be made by drawing upon the current information on this topic for other marine and estuarine species. Organisms differ in their degree of sensitivity to oil even between successive stages in their life cycle and accordingly one may find differentail responses to oil pollution between the components of particular habitats.

The potential acute and chronic effects of oil pollution on the various components of the aquatic environment (birds, mammals, fish, invertebrates, and plants) are of considerable concern. Degradation of these resources could be of major significance due to acute effects. However, chronic effects may also be of significance particularly to resources which are harvested. Tainting of organisms due to oil pollution would make them undesirable for sale. Acute, lethal

effects on these resources would be detrimental to the maintainance of populations and contrary to the opinions given in the Termpol Submission that receovery of marine resources from oil pollution may be of short duration.

Certain statements made in the Termpol Submission were considered to be misleading and oversimplified:

a) that even if a salmon year class was eliminated by an oil spill, salmonid populations would recover within a decade. It is possible that some salmon populations could recover within a decade. However, many factors contribute in the maintenance of populations (rearing conditions, food resources, fishing pressure, etc.) and it is conceivable that their total recovery from an oil spill which eliminated a year class may may take more than a decade.

b) that a salmon population that lost a year class could be stocked by "strays" or "jacks". Stocking a salmon resource with "strays" would not be a good management technique, and the use of "jacks" (water) for the same purpose, impractical.

c) that the impact of an oil spill on zooplankton would be of short duration if adequate contingency plans were implemented. In reality, contingency plans may not be adequate to contain a major oil spill. Hence the affects of the oil on zooplankton could be over a prolonged period.

If an oil spill occurred in an estuary when adult salmon were migrating or juveniles migrating and/or rearing, the impact could be more severe than outlined in the Submission. More than one year class of salmon will occur in the estuaries at any one time, and hence, a major oil spill could be disastrous to more than one species, or stage in the life cycle.

The effects of an oil spill on invertebrates were considered to be of short duration by

the proponent. This could be the case for minor oil spillage, but major and/or repeated oil spillage are a probability could have major adverse consequences. Recovery of marine resources from serious oil pollution could be over a prolonged period due to acute and chronic effects. Some populations may, of course, not recover.

Certain populations of marine ogranisms would be more susceptible than others, and in this regard concentrations of seabirds would be most vulnerable. Three major colonies along the coast of British Columbia are the Langara Region, the southeast coast of the Queen Charlotte Islands, and the Scott Islands. Alcids and Storm Petrels are the most numerous seabirds along the British Columbia coast. Alcids are among the birds most vulnerable to oil pollution whereas Storm Petrels are less threatened by spills than Alcids because they spend more time in the air and only dive occasionally. Waterfowl, especially diving ducks, will be vulnerble to spills during the winter as they concentrate in large numbers in estuaries and inlets along the British Columbia coast. Migrants, because of their concentration in large numbers, may be very temporarily but critically vulnerable to oil pollution. The birds most likely to be directly affected by spills are breeding populations of Alcids and wintering diving ducks, whereas ducks, geese, and shorebirds, which feed in the intertidal zone, may be hardest hit indirectly through destruction of the feeding habitat. Seaducks are most vulnerable of all ducks as they rely most on the marine habitat for feeding purposes.

5.3.3 Effects of Clean-up Operations on Marine Resources

The methods of oil spill containment, clean-up and recovery operations have not advanced to a point where all oil can be corralled and salvaged in every location or climatic condition with 100% success. While some fine pieces of spill countermeasures equipment have been developed, simple manual labour involving absorbents, pitchfork and shovel is still a very vital part of oil spill clean-up operations.

1. Physical Methods

From an environmental protection point of view, physical methods for oil spill containment and clean-up necessitating the use of booms and skimmers or absorbents are considerd to be the least damaging.

On shore, however, special attention must be given to techniques involving the removal of oil contaminated beach material by heavy equipment, cloaking or sealing of oil contaminated areas of beach, hosing with high pressured water jets, burning and steam cleaning. All of the methods have detrimental effects on beach and cliff dwelling organisms.

2. Sinkants

Non-toxic, oleophilic solids such as treated sand and stearated chalks have been used to sink oil to the sea bed. Subsequently, the oil may be incorporated into the organisms living on the sea bed (if not already smothered by the mixture), in addition to fouling fishing gear and tainting fish catches. In time, it may be possible for some of the oil/sinkant mixture to work its way along the ocean floor, eventually to appear on shore.

3. Seeding

The seeding of oil spills with microbial cultures and/or fertilizing with nutrients to facilitate biodegredation requires more research. At the present time, this method for oil spill clean-up has not been shown to be effective in open waters and on beaches.

4. Dispersants

The use of dispersants is currently a topic of considerable controversy.

Dispersants used in early major oil spills were exceedingly toxic compounds compared to several products commercially available today. Nevertheless, it must be noted that the use of a dispersant creates a mixture which is more toxic than the dispersant or oil. Also, the breaking up of oil into smaller particles permits its greater availability to the biota in the water column and sediments.

Most of the organisms which will be affected by dispersants and dispersant-oil mixtures will be sedentary, or capable only of limited movement and avoidance, such as the planktonic forms. Marine organisms which filter the water, such as clams, mussels, oysters, barnacles, etc., will ingest small oil droplets and be subject to acute or chronic toxicity. It is known that certain bacterial strains may store hydrocarbons in their vacuoles. Since some marine organisms feed on the bacteria, this then becomes one possible route for oil into the food chain. It is also of interest to note that considerable quantities of oil have been observed in the guts of copepods and barnacle larvae, and in their fecal pellets. The oil passes unchanged into the fecal material, which is then consumed by other members of the food chain.

No known literature exists on the effects of dispersants on birds. it is generally assumed that if dispersants remove the oil from the water surface, the birds benefit. Effects on the birds' food sources and ingestion of oil from the water column however, should also be considered, and bird relocation techniques be attempted as a first choice protection technique.

Controversy will continue on the pros and cons for dispersant use. It is generally acknowledge, however, that considerable field research is needed to establish the conditions and circumstances under which dispersants can be used effectively and safely. Meanwhile, it is highly desirable that every effort be directed toward the physical removal of oil. Dispersants should be used only as a last resort to protect important and sensitive areas, or to prevent or reduce hazards to human life or substantial hazards of fire to property.

5. Natural Degradation

Under some circumstances, natural degradation of oil spills through the slow natural processes of bacterial and physical action is an acceptable clean-up technique. This method, however, is often undesirable when dealing with areas of biological significance, or areas being used for commercial or recreational purposes.

Oils are themselves toxic. But, the effects of their spillage into the environment may be compounded by the cleaning methods employed. it is incumbent upon the applicant to ensure that all spill countermeasures planning and operations be co-ordinated with due regard to all environmental concerns such that a more hazardous situation is not created due to ignorance of the effects.

5.3.4 Oil Spill Risk Analysis

The initial stage in the preparation of an adequate oil spill contingency plan is the preparation of an oil spill risk analysis. The spill risk analysis must examine the proposed and alternate marine routes, and the oil terminal with a view to systematically determining "most likely" cases and "worst possible" cases for singular and multiple spill incidents of both major and minor proportions. It must also explore the risk of a tanker fire or explosion situation.

The need for risk analysis was identified as a deficiency, however, the Applicant has not yet responded to this deficiency.

5.3.5 Oil Spill Scenarios

Oil spill scenarios should be used to determine contingency requirements, rather than as the proponent put it "to demonstrate the...protection ...provided by the oil spill contingency operations". Such scenarios provide excellent opportunities to detail, and to fully analyse, on paper, all eventualities, consequences of decision making and viable alternatives in the face of a given spill incident, known prevailing physical and environmental conditions, and the limitations associated with the availability and deployment of manpower and equipment. Ideally, if followed through, a scenario will be of considerable assistance in defining, anticipating and preparing for potential problems. Fully developed oil spill scenarios for "most likely" and "worst possible" cases for major, minor and multiple spills occurring in the proposed and alternate marine routes and at the terminal are, therefore, essential. In the development of the scenarios, details on human and natural resources a risk, area of spill influence under a variety of meteorological tide and current conditions, feasibility of countermeasures activities, and precise spill contingency action and required countermeasures services and equipment must be documented. Spill scenarios are not considered to be complete unless they continue to the last decision which has to be made, and acted upon.

In a first attempt at gaining some preliminary awareness as to the potential area of influence of an oil spill of some magnitude in the area, A. Ages of Ocean and Aquatic Sciences, Department of Fisheries and the Environment chose two "most likely"

locations for an accident to happen: Grenville Rock and Ness Rock were arbitrarily chosen. Grenville Rock would be a potential hazard for tankers trying to negotiate the Northern entrance of Hecate Strait. Ness Rock would be a navigational risk for tankers entering Caamano sound after rounding Cape St. James. An estimate for an oil spill of 10,000 tons of oil was taken and one-day and four-day areas of contamination were developed for December 25-28, 1977, for each location. The probability of this size of spill was not determined as this was the subject of another Working Group. The solid portion of Figure 6 denotes the area of oil spill contamination after one day, assuming continuous spillage from an accident on Grenville Rock and a termination of this spill at the end of a 24-hour period. The shaded portion depicts the area of contamination after four days. Both areas shown do not represent a solid sheet of oil, only the general boundaries of oil streaks and patches being moved by the wind and waves. Similarly, Figure 7 depicts the area of spill contamination from an accident on Ness Rock. While these scenarios, for purposes of this exercise, are intentionally sketchy, they do show that scenarios can be derived given existing meteorological and hydrographic information, and common sense. The plugging in of known human and natural resources affected, the determination of type, adequacy and availability of countermeasures services and equipment required, and an examination of the feasibility and extent of spill containment and clean-up procedures would then follow. Similar scenarios can be developed for spills at the terminal.

5.3.6 Contingency Plans

When the scenarios are developed, it should be possible to determine the feasibility and extent of containment and clean-up activities for spills under hydrographic, meteorological and topographic

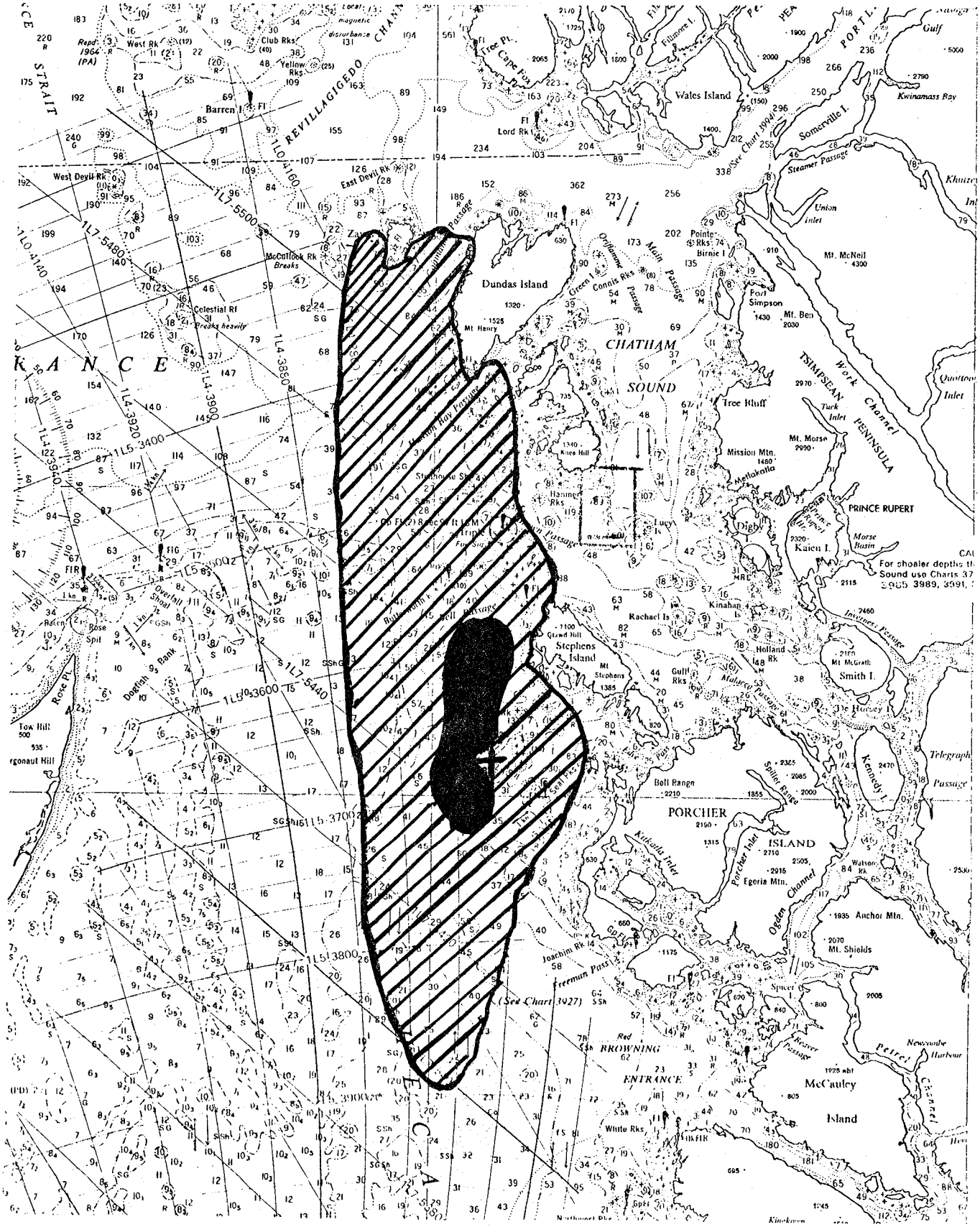


Figure 6 Oil Spill Scenario - Grenville Rock

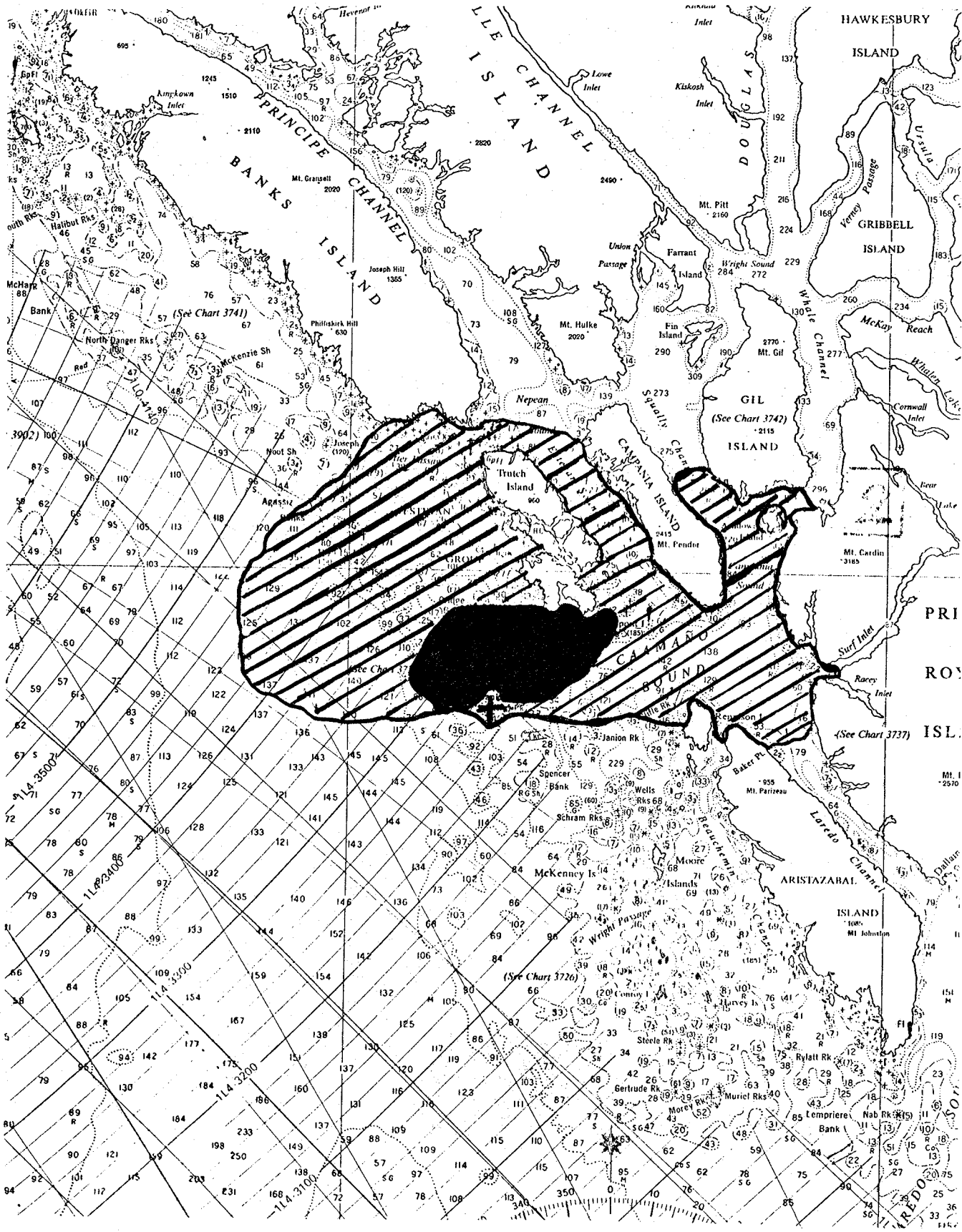


Figure 7 Oil Spill Scenario - Ness Rock

conditions. It should also be possible to develop comprehensive, firm oil spill contingency plans detailing logistics, as well as specifying in considerable detail, all appropriate spill countermeasures services, equipment, communications systems, and supporting scientific services required for purchase and retainership. Overall and sub costs associated with purchasing, retaining, renting etc. are important considerations in developing a viable and realistic contingency plans for the proposed terminal construction/operation at hand. The proponent has yet to do this.

In view of the proponent's marine resources information inadequacies, the resoure sensitivity maps produced by the proponent should be reviewed before further reliance is placed on them, as is their indicated intent (see Volume V, Appendix XII of Kitimat Pipe Line Ltd. Termpol Submission).

Oil spill booms should be strictly dedicated for use in certain pre-designated areas of high biological sensitivity such as Minette Bay. It is not acceptable that booms "will be available" from somewhere, for instance from tugs, support barge, catamaran storage building (see response to question 30, page 9).

The proponent might give consideration to dispersal equipment and chemical availability should the use of dispersants be necessary (response to question 30, page 13).

The Department of Fisheries and Environment (DFE) does allow for conditions under which dispersant use may be considered. These conditions are specifically outlined in the DFE 1973 publication "Guidelines on the Use and Acceptability of Oil Spill Dispersants". Should authorization be granted, several of the new dispersants which are on the market now, are considered to be of relatively low toxicity, and to be effective on crude oils. When planning for dispersants, however, it should be remembered that depending on the extent and location of the spill, the cost (in terms of dollars and space for adequate suply)

may be prohibitively high, and that immediate availability of stock dispersant may be limited. It should be noted that their use interferes with the mechanics of physical recovery of oil. And finally, oceanographic, topographic and meteorological conditions may adversely influence their application by sea. Aerial application of dispersant is innefficient.

Initiative should be taken by the proponent in involving appropriate governmental officials early on in spill contingency planning discussions. During a major incident, particularly as marine resources and socio-economic concerns will be affected, federal DFE officials will undoubtedly play a major role. This role should also be reflected in the contingency plan.

The contingency plan should address the possibility of "something going wrong", and identify several viable alternative actions. For instance in the proponent's supplementary submission (see response to question 30), how essential are the pieces of countermeasures equipment from Prince Rupert and from Vancouver for initial/immediate spill reaction? What if the Prince Rupert-Terrace Highway is closed by avalanches, or airports in Vancouver, Terrace and Prince Rupert are fog bound?

Performance of all marine spill countermeasures containment and recovery equipment is severely affected by the presence of wind, waves and current. Even under ideal conditions, conventional equipment is far from being 100% effective. In spill equipment tests conducted by DFE, satisfactory results were obtained for some pieces of equipment in sea states of up to Beaufort 3-4. For seas running higher, consideration for open water spill countermeasures would be foolhardy, and attention instead should be directed to shoreline protection and clean-up. It is acknowledge that total shoreline clean-up is impossible. This should be reflected in the scenarios and contingency plan by the proponent.

The contingency plan as submitted by the proponent is considered to be inadequate in its present form.

As the Contingency Planning Working Group will be examining the contingency plan in greater detail reference should be made to the appropriate chapter for further information.

5.3.7 Discharge of Bilge and Ballast Water at Sea

The concern associated with this problem will differ according to the make up of the oil tanker fleet. It is felt that the American fleet should present no problem as facilities do exist at Valdez, Alaska for the acceptance, treatment and disposal of all oily wastes. No assurances however, have been given regarding the offshore fleet.

Canadian marine regulations legislate against the occurrence of oily water discharge into Canadian waters, but cannot deal with discharges occurring in waters outside.

5.3.8 Recommendations

1. Oil spill risk analysis must be prepared for the proposed and alternate marine routes, and the oil terminal. It is essential that "most likely" cases and "worst possible" cases for major and minor spills be determined. Multiple spills potential must also be examined.

2. Complete oil spill scenarios using existing physical biological and socio-economic data for the "most likely" cases and "worst possible" cases as determined above are required. Reference to oil spill countermeasures activity and equipment must addresss biological resources protection and socio-economic concerns.

3. Based on the above scenarios, detailed contingency plans are requested. Spill countermeasures services requirements and equipment lists must be specific. It must be assured that all goods and services identified can be purchased or produced when required.

4. The question of possible discharge into the sea of ballast water or water from tank cleaning operations (particularly if multi-purpose carriers are used) should be addressed by the proponent.

5.4 Continuous Oil and Other Effluent Discharges

Additional sources of water pollution in the Kitimat Arm which may arise from the terminal operations include:

(a) Oil/water separator which treats oily water flowing from the curbed area on the dock.
(b) Effluent from treatment system which treats all drainage from the tank farm, and is presumed to discharge to the Kitimat River Estuary.
(c) Sewage effluent from tankers and from tugs and facilities provided for the dock operating crew.

Treatment systems for land based sources of sewage effluent will have to comply with municipal/provincial government requirements. Regulations for vessel sewage wastes have not yet been promulgated for the West Coast, however are expected to be issued in the near future under the Canada Shipping Act.

Surface currents in the Kitimat Arm will generally carry any effluents which may be discharged in the vicinity of the dock south along the west shore of the Kitimat Arm. The sewage treatment equipment must be maintained and operated correctly to minimize possible hazardous effects upon the aquatic resources.

The proponent has not considered the procedures to be used in the event that a spill of oil on the dock occurs in excess of the limited capacity of the oil water storage tank. The excess oil will almost certainly spill into the sea.

5.5 Marine Resource Utilization

5.5.1 Commercial Fishery

The coastal waters of northern British Columbia are divided into statistical areas by the Department of Fisheries and the Environment, Fisheries Service (Figure 5). The importance of the north coast

commercial fishery is emphasized by statistics which show that in the period 1970 to 1975, 27.1% of all personal commercial fishing licences were sold in the northern coast districts, and approximately 43% of the total salmon catch, and 54% of the non salmonid catch, in British Columbia was landed from the north coast districts. Almost all the fishery resource information is related to statistical areas only and there is a general lack of site specific information within any area.

Statistics regarding the type of gear employed, the species and tonnage of fish, shellfish or others caught are compiled from sales slips. In any particular area, the specific locations where commercial boats have fished are not known.

According to fishery regulations, the sales slips are supposed to represent the location of fish catch. However, fishermen often report the landing area rather than the catch area.

In addition, since the statistical analyses are based upon sales slips returned to the Statistics Branch, there will not be a record of a vessel fishing in the area which does not catch fish. Hence, the number of vessels in the area may be more than reported.

There is active participation by Native Indians in the commercial fishery and associated industries (such as fish processing plants) in the north coast region. There have been some estimates made of the populations of Indian Bands involved in the commercial fishery (McKay 1977) by geographic regions.

A comprehensive study of the socio-economic implications of the proposed terminal to native fisheries is addressed by the Socio-Economic Working Group. However, pertinent aspects are given here.

Native Food Fishery

Socio-economic aspects concerning the transport of oil were over-simplified and incompletely considered in the Termpol Submission. Of particular importance is the utilization of

the marine resources by Native Indians. The Native Indian people of the northcoast region rely on a wide variety of marine resources for food, including kelps, herring spawn, salmon, abalone, sea urchins, clams and crabs. For instance, along the proposed tanker route, Indians at Kitkatla Bay, Hartley Bay, and other villages depend significantly upon these marine resources for food. The potential impacts of an oil spill upon their lifestyle merits considerable attention and needs to be recognized and well documented.

Fishing areas for the capture of herring for food are not shown on resource maps in the Termpol Submission; herring net fishing Kitkatla Inlet is not shown.

There is some documentation of the British Columbia Indian salmon food fishery, but only for a few specific areas such as the Fraser River system (Bennett, 1973). A socio-economic analysis by W. McKay, of Native Indian participation in the B.C. salmon fishery, is in preparation by the Fisheries and Marine Service, Department of Fisheries and the Environment.

In general, information on the number of salmon captured and the number of boats and people participating in the food fishey is inaccurate, primarily due to an absence of systematic data collection. Consequently data on catch and effort are believed to be considerably underestimated (McKay, 1977).

There is little documentation of other marine resources which are utilized is the native food fishery.

Recreational Fishery

The values of the marine resources for recreational purposes should receive more attention than that given in the Submission, particularly regarding the impact of an oil spill.

The high resident utilization of the environment's resources will certainly be affected by an oil spill. Depending upon the proximity of the spill, a large number of beaches will become contaminated, affecting marine recreational activities. Available data on recreational activities are limited to an on-site study of the Kitimat River

(Sinclair 1975), area sports catches for the Queen Charlotte Islands and for other statistical areas, and some angler information from Provincial sources. Although the information is brief and not site specific, the surveys suggest a high participation in outdoor activities, for example, 40% of all households in Kitimat participate in some outdoor recreation (Sinclair 1975). Therefore, although the population is low, the usage is very high and should receive more attention, particularly regarding the impact of an oil spill. The Submission also does not ly cover addequateaspects such as tanker shoreline ards to wash, hazsmall crafts, native travel, usage and shorelineaesthetic vales.

5.5.2 The Impacts Upon Fisheries Resulting from Minor and Major Single or Multiple Oil Spills

Oil spills and the associated acute and chonic effects may impair fishery values in many ways, for example, through prevention of harvests, tainting of catches, mortality of the harvested species (directly and through sublethal effects) and through short and long term damage to suporting ecosystems.

Assumptions considered misleading area made in the Termpol Submission regarding the operations of fishing fleets in the event of a major oil spill. Such operations as the changing or gear to take part in another fishery or the utilization of alternate fishing grounds are highly unlikely as most boats have specific types of gear, and are restricted to areas without fishing closures, and where concentrations of their potential catch are to be found.

5.5.3 Conflicts of Normal Operations with the Fishing Fleet

A number of specific comments can be made with respect to the details presented in the Termpol Submission. These details are itemized as follows:

(a) Fisheries Operations Map

(i) The gillnetting areas shown are reasonably accurate for most of the areas except for Wright Sound, Whale Channel, and Lewis Channel, where gillnetters use the entire area. They are not concentrated in groups

as indicated on the map but tend to be dispersed. Thus, the tanker movement could pose considerable conflict with seine and gillnet fleets in these areas.

(ii) Trollers cover a much broader area than was shown in the Termpol Submission.

(b) Fishing Vessel Operations Survey

(i) This survey was reasonably accurately documented in the Termpol Submission.

(ii) Table 3 of this survey is misleading as the type of gear used may fluctuate widely from year-to-year and month-to-month.

(iii) (Page 23) It is highly improbable that "tanker delay due to fishing operations will be rare". There are concentrations of gillnetters and seiners in Browning Entrance, Principe Channel, Squally Channel, and Wright Sound that will have the potential to cause delays in tanker movement.

(iv) The statement that the tanker route avoids the areas of greatest fishing vessel density is not necessarily true. A route down the west coast of Queen Charlotte Islands then across Hecate Strait would avoid more fishing vessels. However, vessels in Squally Channel, Wright Sound and Douglas Channel could not be avoided.

Experience in Juan de Fuca Straits suggests that commercial traffic moving through concentrations of fishing vessels under poor visibility creates a major risk for the smaller vessels.

There are no provisions in the document for expediting the remuneration to fishermen in the event of collision or loss of gear. A faster process to indemnify fishermen who lose gear should be specified.

5.5.4 Benefits to the Fishing Fleet

In view of the complexity of operations associated with the proposal to bring oil into Kitimat, improvements would be made which would benefit

the fishing fleets. These would include such items as improved hydrographic charts, communication systems, weather forecastings and navigational aids.

5.5.5 Recommend Studies

Some major deficiencies in the Termpol Submission might be remedied by a program which would involve an integrated analysis of the risk to, and socio-economic implications for, the coastal ara of Northern B.C. Such a study would include the north and east coasts of the Queen Charlotte Islands and the mainland coastal area within the probable zone of influence of an oil spill. Such a study would involve detailed assessment of:

(a) The potential socio-economic impact on residents, including:

  (i) Impact of tanker traffic and wake on floating and shore facilities and shore utilization.

  (ii) Losses in aesthetic and recreational values.

(b) The cultural, social and economic impacts on Native Indians.

(c) Impacts upon the commercial fishing industry, including closure times, gear losses, vessel insurance, and direct fishing losses.

The study would utilize information on routing, anchorage sites, vessel frequencies and speeds, operational impact, and spill impacts.

A probability model with respect to these relationships would need to be developed.

Fishing Operation

More accurate information information is required on the movement of fishing vessels along the proposed tanker route(s). This may require intensive aerial observation and photography during the fishing season.

Documentation of the fishing grounds along the proposed tanker route(s) which may be in conflict with tanker traffic is required as are details of the alternate fishing grounds that could be utilized. The procedure to be followed when there is a large concentration of gillnetters or seiners operating along the proposed tanker route(s) was outlined by the proponent in supplementary information provided.

5.5.6 Review of Supplemented Information (Vol.VII Termpol Submission)

A request was made to the proponent for additional information regarding fishery activities on the proposed tanker route (Question (39).

In response the proponent has started a review of field reports from Fisheries and Marine Service patrol boats, to provide more detailed information on fishing vessels operating on the proposed tanker route. As stated in the proponent's response to Question 39, unlike other ships or tug and barge tows, tankers would not have the option to choose unspecified alternate passages to avoid a fishing area.

The proponent is also relying on improved communications in the area of the tanker route and is advising the Fisheries and Marine Service to report more site specific details on th location of the fishing fleet that may require additional patrol boats and personnel. The proponent adviss that tanker will almost always be able to negotiate her way through a large concentration of fishing vessels without disruption of fishing activities or damage of fishing gear. The problem of facilitating compensation for collisions or loss of fishing gear is still not addressed.

An assessment of the socio-economic implications of the operation and possible oil spills for Native people, residents, and those utilizing fishery resources along the tanker route and in the terminal area was requested (Question 45). This information has not yet been provided.

5.5.7 References

Bennett, M.G. 1973. Indian fishing and its cultural importance in the Fraser River System. Published jointly by Fisheries Service,

Pacific Region, Department of the Environment and the Union of British Columbia Indian Chiefs, April 1973. 44 p

McKay, W. 1977. A socio-economic analysis of Native Indian participation in the British Columbia salmon fishery. Report in preparation.

Salmon Sport Fishing Catch Statistics for British Columbia Tidal Waters. 1976. Department of Environment, Fisheries and Marine Service.

Sinclair W.F. 1975. The Kitimat River: Its use and importance to residents of the Kitimat District. Environment Canada. Fisheries and Marine Service Technical Report Series No. PAC/T-75-20 NOB/ECON9-75

5.6 Air Quality/General

Oil tankers are proposed to be unloaded at Kitimat using their own pumps. Under these conditions, the stack emmissions would constitute a source of gaseous pollutants. It should be noted that, under certain circumstance, these emissions together with those from the tank farm would raise the level of gaseous pollutants already present from other industry in the Kitimat area.

The proponent was requested to provide estimates of the maximum emission rate, duration and total emissions of hydro-carbons, nitrous oxcides, sulfur dioxcide and particulates expected from vessels off-loading and ballasting at the terminal. He was further requested to evaluate the effects of these emissions in typical and adverse conditions of dispersal in the area, to discuss the effects of these additional emissions confirmed with the expected emissions from the tank farm, and to discuss the effects on vegetation, wildlife, human health and aesthetics. A response has not yet been provided by the proponent.

Meteorological Factors

Dispersion of gaseous pollutants is dependent on wind direction and speed, and an atmospheric stability. Pollutants may be "washed-out" by precipitation. Smog can be induced photo-chemically by sunlight.

The proposed Kitimat Oil Port is at the head of the Kitimat Arm of Douglas Channel which together with the Kitimat River form a north-south valley flanked by mountains in excess of 3000 Feet elevation. Winds are constrained by this valley to blow in generally north or south directions.

Figures 8 and 9 are analyses of winds at Kitimat Townsite and Kitimat Smelter. They clearly demonstrate the dominance of southerly and northerly winds at both sites. Southerly winds predominate in spring, summer and fall while northerly or northwesterly winds predominate in winter. Mean wind speeds (mph) are light but strongest with winter outflow winds. Calm winds are infrequent.

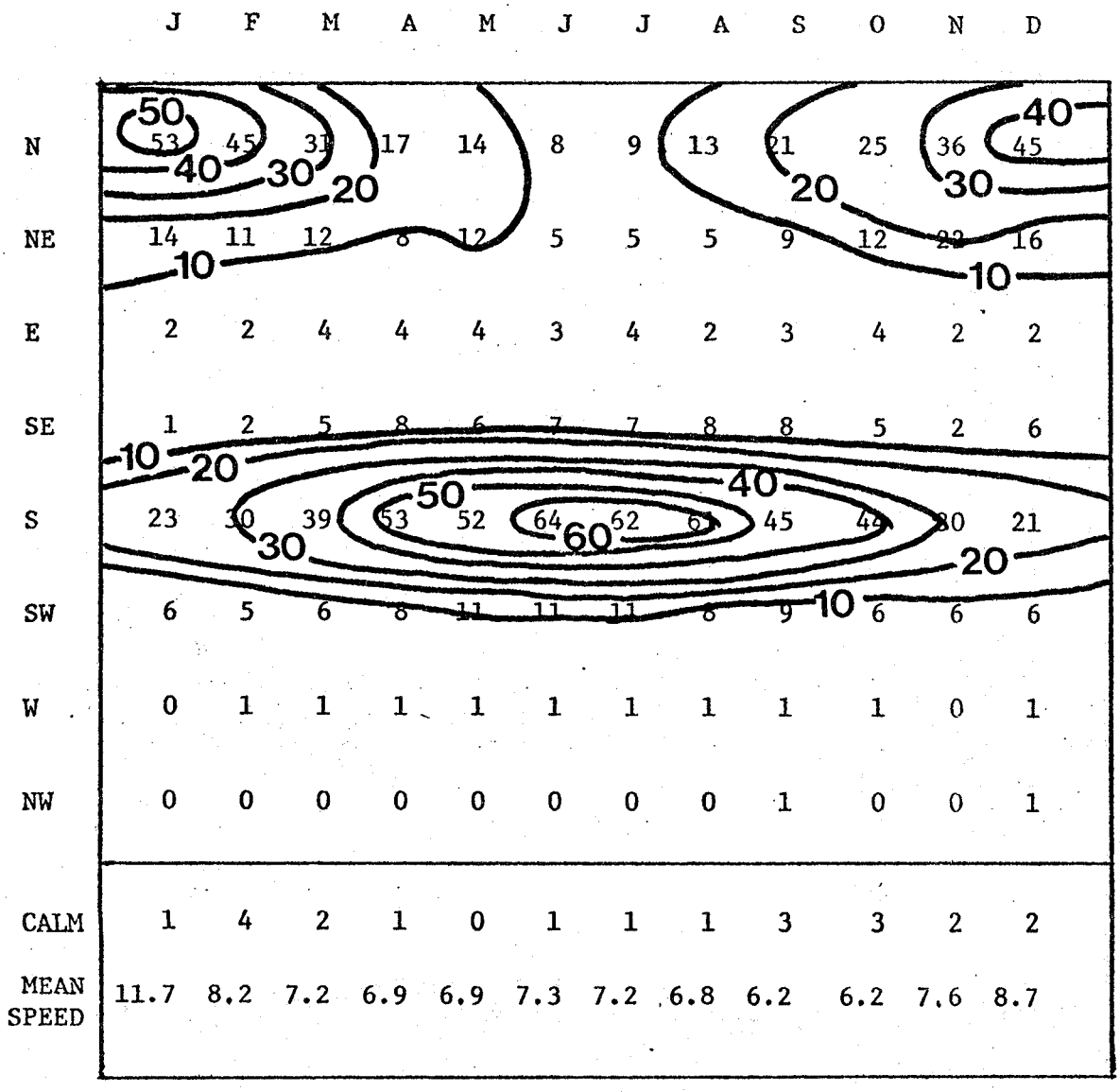
Surface-based inversions are frequent. In spring and summer these are due to milder Pacific air over-running the surface air layers which are cooled by contact with the sea surface. In winter, they are due to outflow of cold surface based Arctic air in the valley bottom. The estimated percentage frequency or occurrance of surface-based inversions is as follows:

	Winter	Spring	Summer	Fall
Late Afternoon	40	55	50	40
Early Morning	65	67	62	57

Mean precipitation summaries for Kitimat Townsite and Kitimat (Smelter) are given in Table I. Measurable precipitation is recorded on an average of 195 days per year and ranges from 11 days in July to 22 in December.

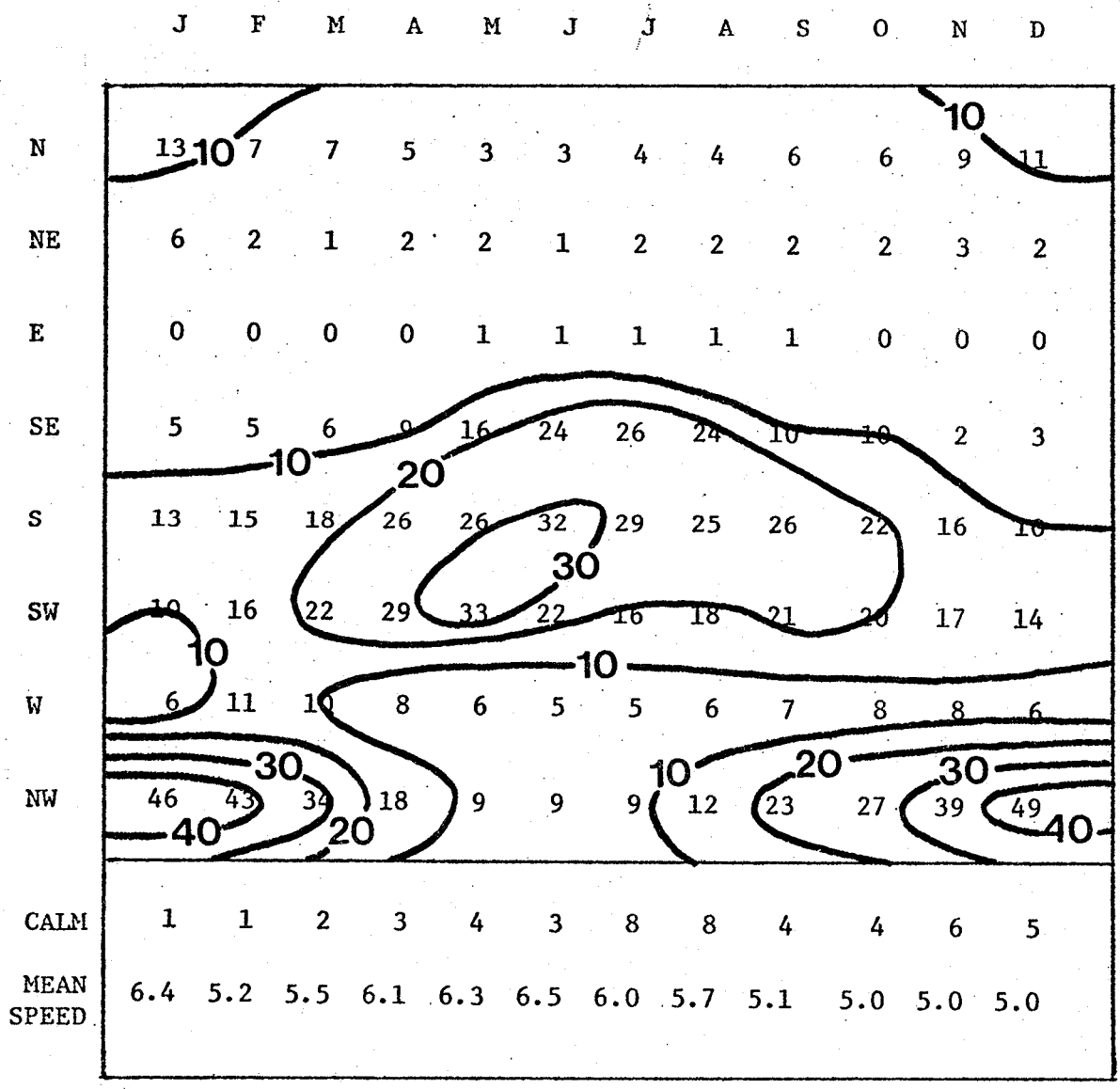
On the average, Kitimat Townsite receives 1417 hours of bright sunlight annually; this value is some of lowest of any site in B.C. Because of the latitude, the intensity of the solar radiation is much lower than it is in California, for example.

Because of the high frequency of inversions and the prevailing southerly winds, there will be periods, particularly in summer, when concentrations of pollutants in the Kitimat Valley including Kitimat Townsite, will be increased by emissions from the unloading ships and from the tank farm. "Wash-out" from the frequent and rather heavy precipitation will mitigate this somewhat. It is considered unlikely that photo-chemical smog could become a serious problem.



Kitimat (Townsite), B.C. - Percentage Frequency Wind Direction (and Calms) and Mean Wind Speed by Months (Nov. 1967 - Aug. 1975)

Figure 8



Kitimat (Smelter), B.C. - Percentage Frequency Wind Direction (and Calms) and Mean Wind Speed by Months (February 1966 - October 1975)

Figure 9

Table I Mean Precipitation Amounts (inches)

(From Temperature and Precipitation, 1941-1970, British Columbia published by Atmospheric Environment Service, Department of the Environment, Canada)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
KITIMAT													
Mean Rainfall	8.33	8.22	6.91	7.44	3.09	3.02	3.05	3.78	8.88	17.85	12.61	11.28	94.46
Mean Snowfall	56.4	24.2	17.1	4.0	0.0	0.0	0.0	0.0	0.0	2.5	24.0	39.6	167.8
Total Precipitation	13.97	10.64	8.62	7.84	3.09	3.02	3.05	3.78	8.88	18.10	15.01	15.24	111.24
No. of Days with Measurable Precipitation	19	16	17	15	12	13	11	12	14	23	21	22	195
KITIMAT TOWNSITE													
Mean Rainfall	6.19	6.60	5.70	5.05	2.94	2.29	2.08	3.20	7.67	13.59	9.56	7.56	72.43
Mean Snowfall	70.4	39.6	17.7	5.0	0.0	0.0	0.0	0.0	0.0	2.9	23.2	52.6	211.4
Total Precipitation	13.23	10.56	7.47	5.55	2.94	2.29	2.08	3.20	7.67	13.88	11.88	12.82	93.57
No. of Days with Measurable Precipitation	20	17	16	14	12	10	12	15	15	22	20	22	195

It is recommended that the proponent be again requested to provide the information previously requested. Further, it is recommended that the proponent be required to ensure that a program of air-quality monitoring be continued to ensure that the objectives of the Clean Air Act are met. Smoke emissions would have to comply with the Air Pollution Regulations of the Canada Shipping Act.

5.7 Aesthetic and Heritage Resources

The proponent has commented on the possible impact of the project on ecologically special areas, its archeological and historic resources. Taken together these resources include the special qualities of scenic grandeur and isolation and comprise an important part of the attraction of the area to the visitor, and to the residents.

The Submission identifies the existence of the tangible resources such as provincially dedicated ecological reserves and map reserves and the recorded and suspected existence of a large number of archelogical sites. However, the Submission is considered to substantially underrates the intangible values present, such as scenic and wilderness qualities.

The Submission concludes that there will be no impact on this category of resources from normal operations of the tanker operation and terminal system. On the contrary, taking into account the intangible qualities mentioned above, there would almost certainly be some effect on the scenic and wilderness qualities from the normal operation.

The Submission identified the potential impact of shore based clean-up operations, in the event of an oil spill, on archeological and historic sites "if care is not taken to avoid identified sensitive areas" (Volume III, page 5-56). However, the Submission notes that both archeological and historic sites are poorly surveyed in some of the areas along the proposed route (Volume III, ages 4-21, 4-22). The surveys and mapping of sensitive areas proposed as part of the contingency planning does not include the completion of archeological and historic sites surveys, which would provide some assurance that these sensitive areas would indeed be identified and avoided.

5.8 Land and Vegetation

Some reference has already been made to land and vegetation in Section 8.5.7. There are further land and vegetation considerations which have not been mentioned, and which relate more to the construction and operation of the proposed terminal and marine systems. While, the emphasis has been placed on marine aspects, there will undoubtedly be some impact on the land and vegetation of the areas affected. In particular, there will be potential for impact at the marine terminal site and at other sites which may be utilized for other purposes such as for the storage of oil spill containment equipment, or the disposal of wastes arising from the clean-up of a major oil spill.

First on-the-ground activities will be the control and location surveys. These operations will be carried out by small work crews and will take place in advance of the main clearing and construction. The principal environmental concerns which arise from survey activities relate to slope stability and erosion, fire hazard, and possible siltation.

Following the location surveys there will be test drilling and clearing, ground preparation and finally construction. Some potential for impact is possible from these activities; for example, terrain and aesthetic disturbance, erosion and siltation, spillage of fuels, and disturbance of birds by noise, and others.

The terminal and its access road and pipeline are located on a steep hillside which slopes directly into Kitimat Arm. Considerable terrain disturbance in the immediate ara and removal of vegetation, will be required to establish the facility. The hillside scar will be prominent as viewed from the water and the Eastern shore of the Arm, but less noticeable from the direction of the Kitimat Townsite.

It should be noted that these possible impacts were not reviewed in any great depth, as it was felt that these were minor relative to the impacts predicted with respect to terminal and marine aspects as outlined in other sections.

6 Conclusions and Recommendations

An environmental assessment review of the Termpol Submission was conducted. This review included the idetification of deficiencies in the Submission, a careful assessment of the details, and a preliminary review of the proponent's supplementary information. The review did not have the benefit of the proponent's complete responses to the request for supplementary information, some of which could only be provided if long-term studies are conducted.

Port site and route selection are considered to be among the most significant considerations with respect to oil port development. Details of site selection need appropriate consideration. Given that Kitimat is the selected site, three possible routes need to be fully assessed. It was concluded that the proponent has not adequately assessed the port site and the route alternatives. It is recommended, therefore, that port site and marine route alternatives be more comprehensively assessed in terms of environmental implications.

Further hydrographic information is required in the relevant seaward approaches to Kitimat to meet modern navigational safety requirements of deep draft vessels. Hydrographic surveys should be conducted in Principle Channel, Dixon Entrance and Hecate Strait. Depending upon the outcome of surveys to be carried out in 1977 by the Canadian Hydrographic Service, further survey activity might be necessary. As well, more comprehensive investigations of Anger Anchorage should be carried out to determine its suitability as an anchorage.

Tidal current surveys should be carried out in the same areas as hydrographic surveys. A three year oceanographic program should be undertaken covering Douglas Channel and East Hecate Strait. Such a program should include field observations of oceanographic parameters and the development of vertically integrated numerical models.

Tidal current information is grossly lacking to support the development of oil spill scenaries. There is a paucity of physical and chemical oceanographic information for northern B.C. waters. This information is required in the assessment of possible impacts upon marine environment quality.

The proponent's submission is considered deficient in providing a comprehensive discussion of the meteorology of the B.C. north coast and of the meteorological services required. It was concluded that:

(1) Adverse weather conditions would, at times, introduce the problem of difficult navigation conditions and the risk of serious oil pollution, and could hamper clen-up operations in the event of an oil spill. However, the lack of meteorological data, particularly for critical sections of the route such as Wright Sound, makes it impossible to estimate the risk in quantitative terms. It was recommended that this deficiency be overcome.

(2) It was also considered essential that for any proposed operation, the operational meteorological limits be clearly defined and that measures be taken to improve the meteorological services in support of the operation.

There is no doubt that there are significant fishery resources in the north coast region. Further documentation and studies of the fishery resource will not alter our assessment that the proposed tanker route (through Dixon Entrance, etc) has an extremely high potential for major adverse impact on the fishery resources in the vicinity of the route.

If the project were to proceed, then further documentation and studies of fishery resources would be required. Field studies should be carried out for all seasons, for one or more years. Short term studies as previously undertaken by the proponent are considered to be inadequate. It is necessary to document fishery resources along alternate tanker routes to better evaluate the associated risks to the environment of any proposed oil transport. Enhancement of salmonid stocks will increase the fishery potential of the north coast. This program should not be viewed as a means to overcome the effects of oil spillage.

An oil spill could decimate major seabird populations. The Canadian Government has an obligation for the preservation and conservation of seabirds under the Migratory Birds Convention Act, the Canada Wildlife Act 1973 and Canada's

National Wildlife Policy and Program 1966. Information provided to permit assessment of the route least detrimental to seabird preservation and conservation was considered to be inadequate. It was recommended that field investigations of at least one year's duration be conducted to provide comprehensive information on seabird populations, their distribution and congregation by season and for vartious species along the proposed and alternate routes to the terminal. This information would enable the identification of the optimum route from the marine bird point of view.

It is generally accepted that oil spills are inevitable as a result of the proposed oil terminal operation. The effect of such spills to the biological resources, and the socio-economic effects, could be serious. It was concluded that concerns relating to the state of preparedness, the level of effectiveness of oil spill countermeasures and related socio-economic matters were not adequately addressed by the proponent.

Oil spill risk analysis, comprehensive oil spill scenarios, and viable, realistic contingency plans for "most likely" and for "worst possible" cases of minor and major oil spills (single and multiple) are required for the proposed and alternate marine routes, and oil terminal. Risk to, and protection of biological resources and socio-economic concerns as a result of an oil spill and its spill countermeasures must be specifically addressed.

The north coast commercial fishery is important to the economy of British Columbia. However, there is a general lack of site specific information on fisheries resource utilization. There is active participation by Native Indians in the commercial fishery an associated industries. Additionally, many native Indians depend significantly upon various marine resources for food.

Some major deficiencies in the Termpol submission should be remedied by the recommended studies relating to fishery operations and socio-economic impacts.

The utilization of the marine resources for recreational purposes should receive more attention than that given in the Termpol Submission, particularly with respect to the possible impact of an oil spill on this resource.

Oil spills and the associated acute and chronic effects may impair Fisheries through prevention of harvests, tainting of catches, mortality of the harvestable species and through long and short term damage to supporting ecosystems. In the event that a fishery resource is affected by a an oil spill such operations as the changing of fishing gear to take part in another fishery or the utilization of alternate fishing grounds are highly unlikely in most cases. It was considered that tanker movement could result in considerable conflict with fishing fleets. The possibilities of facilitating compensation to fishermen in the event of collision or loss of gear is not addressed by the proponent.

Associated with the project are improvements which would benefit the fishing fleets including improved hydrographic charts, communication systems, weather services and navigational aids.

It was concluded that there may be some increase in the level of atmospheric pollution in the Kitimat Area as a result of emissions from the off-loading tankers and the tank farm. However, the types, rates and impact of these emissions have not been established. It was recommended that the proponent provide this information during the planning stage of the operation, and further that if necessary the proponent ensure that a program of air quality monitoring be maintained to ensure that the objectives of the Clean Air Act will be met.

The scenic and wilderness qualities of the northern B.C. coastal area contribute to the values of the area's aesthetic and heritage resources. The highly sensitive and vulnerable areas, however, are not defined to the degree considered essential for their protection or preservation. It was recommended, therefore, that pre-operational surveys should include completion of reconnaissance surveys for historic and archeological sites along all shorelines which might be affected by oil spill countermeasures.

Possible adverse impacts to land and vegetation include slope failures, erosion, fire, siltation, fuel spillage, disturbance to wildlife and others. While these may be considered minor relative to impacts predicted to result from terminal and marine aspects, they should, nevertheless, be minimized to the extent readily possible. It was

recommended therefore, that appropriate measures with respect to timing, erosion control, blasting and control of deleterious materials must be developed for the construction of land-based facilities so as to minimize the possible adverse environmental impacts during the construction stage of proposed project development.