Department of Environment
Environmental Protection Service
Pacific and Yukon Region

WEST COAST OIL SPILL COUNTERMEASURES STUDY
YEAR I

Regional Program Report: 79-28

by

Frederick G. Beech
David A. Betts
Robert L. Sherwood (Editor)

December, 1979

This report has been reviewed and approved for publication by Environment Canada. The conclusions reached reflect the collective judgement of the authors; approval does not necessarily infer endorsement as official government policy.

ABSTRACT

This report details the results of Year I of a two year program to study and improve marine oil spill countermeasures on the West Coast of Canada. The emphasis in the Year I report is on spill potential in relation to coastal oil products shipments rather than on major crude spills from offshore tankers. First described are oil spill legislation, contingency planning and action plans pertinent to government, industry and public organizations. The report then reviews containment and recovery cleanup equipment on the West Coast, discusses chemical countermeasures and derives a rating of equipment availability. The distribution of manpower in B.C. in relation to requirements for different spill situations also is described. Several risk parameters are analysed including historical slick incidents, significant spill events, vessel casualties, marine traffic densities and oil products annual frequencies of visits. One of these, slick incidents, is examined together with cleanup equipment availability to identify the critical oil spill areas of coastal British Columbia. Summary conclusions are included to suggest how West Coast oil spill countermeasures can be improved.

RÉSUMÉ

Ce rapport analyse, en détail, les résultats obtenus, au cours de la première année d'application d'un programme biennal, qui a été mis sur pied pour étudier et améliorer les mesures de lutte contre les déversements d'hydrocarbures, sur la côte ouest du Canada. En premier lieu, on trouve une description des lois, des plans et des mesures d'urgence adoptés par le gouvernement, l'industrie et les organismes publics en matière de déversements. Puis vient l'inventaire du matériel existant, y compris les moyens de lutte chimique, pour circonscrire et récupérer les produits déversés, et l'évaluation de son degré de disponibilité. La répartition en C.-B. des ressources disponibles en main-d'oeuvre est aussi analysée. Plusieurs éléments de risque sont examinés, notamment les accidents survenus dans le passé, la formation de nappes, les déversements de grande ampleur, la perte de navires, l'importance du trafic maritime et la fréquence annuelle du passage de produits pétroliers. Parmi ces facteurs, celui de la formation de nappes est examiné en fonction du matériel de nettoyage disponible, afin de délimiter les zones côtières particulièrement vulnérables. En conclusion, on propose divers moyens d'améliorer les mesures de lutte contre ces déversements, sur la côte ouest.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CONCLUSIONS

The conclusions which follow reflect the principal results of fieldwork and data analysis by the authors of this report during Year I of the West Coast Oil Spill Countermeasures Study. It is emphasized that the primary focus of Year I is on spill potential in relation to coastal oil products shipments rather than on major crude spills from offshore tankers. The conclusions are listed below in the same sequence as they appear in the main text.

1. On a regional basis, the availability of cleanup equipment is highest in the Vancouver area. Elsewhere it is significantly lower, with the southeast portion of Vancouver Island rating second to Vancouver.

2. The Vancouver/Victoria/Nanaimo triangle is the only part of the coast where manpower is readily available. Elsewhere, the availability of labour and access to the coast are limited to non-existent; severe logistics problems would be encountered in a large cleanup operation.

3. On the basis of historically significant spill event statistics, it is estimated that British Columbia experiences 25 important minor spills and one moderate spill annually. Major spill probabilites cannot be determined from the historical data as no major spill (over 100,000 Imperial gallons) has occurred on the West Coast.

4. Environmental Protection Service records suggest that there is a direct relationship between spill frequency and spill size. If that is so, and assuming that the history of coastal slicks and spills is a reliable indicator of oil spill probability, a major spill is most likely to occur in the Howe Sound/ Vancouver/ Fraser River/Boundary Bay area.

5. The Port Hardy/Alert Bay area is of significant concern in coastal B.C. owing to its limited availability of cleanup equipment and current frequency of spill incidents.

In addition to these major conclusions, a number of related issues were identified during the study. Several of these are listed below - their order of appearance is not intended to convey a ranking of importance.

1. A joint federal and provincial contingency plan should evolve as a result of the emerging Canada-British Columbia Understanding. Effective spill response will also require action plans for such industries as forestry and mining.

2. Outside of the large population centres on the Pacific Coast, companies tend to independently purchase cleanup equipment without knowledge of other equipment in their area. Methods of mitigating this difficulty include government and industry advice on equipment and manpower training and the formation of local cooperatives.

3. The low availability of equipment in the Port Hardy/Alert Bay area is not commensurate with its growing industrialization and current moderate frequency of spill incidents; a Canadian Coast Guard "Major A" or British Columbia Petroleum Association "A" package should be located in the area.

4. The Council of Marine Carriers has considered development of a barge-lightering system combined with high-speed containment and recovery capability. The feasibility of a cooperative financial arrangement should be discussed with such other agencies as the Canadian Coast Guard and the British Columbia Petroleum Association.

5. Few oil products vessels on the B.C. coast carry spill containment and recovery equipment. All marine oil products vessels and large receiving facilities should maintain spill packages similar to those recommended by PACE for oil tankers.

6. The National Emergency Equipment Locator System (NEELS) is primarily a listing of federal government and oil industry equipment. The participation of provincial and municipal governments and other industries should be encouraged.

7. The West Coast does not have the large offshore skimmers similar to those available in Arctic and Atlantic oil exploration areas. Industry and the Canadian Coast Guard should provide comparable capability on the West Coast against the possibility of a major spill.

8. Preventive measures could be improved significantly. For example, coastal logging operations in particular have a recurrent pattern of neglecting prevention and being unprepared for cleanup after a spill has occurred. Guidelines such as those being updated by the British Columbia Petroleum Association on bulk plant design and spill prevention should be encouraged for all industries and the appropriate federal and provincial agencies should address the need for on-going inspection programs.

1 INTRODUCTION

Prior to 1960, oil spills affecting the coastal waters of British Columbia were often completely ignored or indiscriminately treated with relatively toxic dispersants. As late as 1970 there was no specific agency responsible for cleanup coordination, although local remedial action was sometimes attempted. Two prominent examples of response efforts during that period, both in the eastern reaches of Burrard Inlet, included a 20 000 gallon bunker oil spill for which there was no cleanup and a 3000 gallon crude oil spill which, although treated with an equal amount of dispersant, resulted in a substantial fish kill.

With greater public concern over the environmental aspects of oil pollution in the 1960's, stimulated by such widely publicized incidents as the Torrey Canyon and Santa Barbara disasters, government agencies and private industry began acquiring oil spill recovery equipment and the expertise to use it. Advances in equipment design were encouraged through government assistance while research into dispersant application was increased. Nevertheless, several spills in the early 1970's demonstrated that preparations were still inadequate and that confusion was more the rule than the exception. As late as 1973, when the "Sun Diamond/Erawan" collision occurred in English Bay, the Canadian Coast Guard and Environment Canada had not resolved basic countermeasures strategies regarding the use of dispersants.

During this period, oil spill response became more important in the affairs of the petroleum industry, owing to its own initiatives, changes in legislation and the increased willingness of governments to prosecute firms negligent in the handling of oil products. Eventually some of the larger forest companies also began compiling action plans, purchasing equipment and training manpower, while the first private cleanup contractor, Clean Seas Canada Ltd., was organized.

Today, West Coast oil spill countermeasures capability has improved significantly, but is still inadequate for some situations. It is one of the principal aims of this report to document the present state of coastal oil spill cleanup response, its shortcomings and the alternatives for improvement. In recognition of continuing crude oil tanker traffic in contiguous Washington State waters and frequent oil products spills in British Columbia, the Environmental Protection Service of Environment Canada decided to initiate this study. It represents an overview of the present oil spill problem on the Canadian West Coast and evaluates current oil spill cleanup response capabilities.

The following sections of this chapter detail objectives, delineate scope and describe the principal data sources and methods utilized to meet the objectives.

1.1 Objectives

Anticipating the need for extensive data collection and the involvement of a multitude of agencies both public and private, the research group responsible for this study decided that a two-year time frame would be necessary. Year I concentrated on an overall review of B.C. coastal cleanup response capability in relation to vessel and tank farm oil products spill risk; Year II focuses on a more detailed examination of selected geographic areas.

This report constitutes the summary of research efforts of Year I objectives which were:

i) to describe and evaluate present cleanup response capability for different portions of the coast;
ii) to identify areas of high oil products spill risk;
iii) to determine the principal regions of concern based on a combination of response capability and spill risk; and,
iv) to recommend improvements to existing countermeasures capability.

It is emphasized that the approach used in this report is one of relative comparison between various segments of the B.C. coast. Owing to the large geographic area of the study, data insufficiencies and the dynamic complexities of oil spill situations, it was not possible to create any absolute indicator of risk for any single part of the coast. However, although this analysis is relative, it has value in terms of indicating coastal regions of comparatively greater concern with respect to spill risk and cleanup capability.

1.2 Scope

The geographical area of the study encompasses the mainland coast of British Columbia, all offshore islands and the seaward reaches of the Pacific Ocean to the 200 mile limit of the Canadian Fisheries Zone. Additional information has been included from sources in Alaska and Washington States in acknowledgement of the fact that international boundaries are no guarantee of immunity from another nation's spill.

The study was conducted between April, 1978, and April, 1979. Depending on availability, data were of the most recently documented year or five-year period. In some instances, early records were omitted because of inadequate data collection procedures at the time.

Amongst topics excluded from Year I investigations were oiled waste disposal sites, tank farm and marine vessel design factors and readily available cleanup equipment such as rakes and shovels. Problems associated with oil pollution from urban runoff and industrial processes also were excluded as were discussions of the characteristics of oil on water, the toxicity of various oil products and technical evaluations of oil spill equipment; many of these have been well described in Technology Development Reports published by the Environmental Protection Service as listed in the bibliography of this report. Unfortunately, data were not available on a sufficiently consistent basis to extract figures on annual amounts of products spilled or percentages recovered.

One of the major components of oil spill risk is that of the distribution of vulnerable biological, economic and social resources. After attempting to analyze the sensitivity of West Coast resources to oil spills, it was concluded that research methodologies and data availability were not sufficiently evolved to permit assessment. Therefore, this report makes the assumption that all of the B.C. coast is important in terms of the environment.

Of particular note was the exclusion of detailed oil spill prevention methods, frequently one of the most cost-effective means of dealing with oil spills. However, the Environmental Protection Service has developed expertise in prevention technology which it has made available to oil users on an advisory basis, especially where field investigations or accidental spills have revealed shortcomings. As enforcement of guidelines and regulations is frequently a provincial responsibility, the Pollution Control Branch is consulted when such action occurs.

Although the probability of a large crude oil spill from a supertanker enroute to a United States port through Juan de Fuca Strait may be relatively small, the consequences of such an accident for Canadian resources could be enormous. Similarly, a spill from the occasional crude oil tanker shipping out of Burrard Inlet could have significant environmental consequences. While recognizing such possibilities, it was the decision of the authors of this report to confine Year I research to the immediate problem of spills of oil products (gasolines, diesel, stove oil, bunker "C" and lube oils) based on the historical evidence of actual events. Substantial portions of Year II efforts are aimed at analyzing countermeasures capability with respect to large crude spills in greater detail for specific areas.

1.3 Data Sources

The main data source for the West Coast Oil Spill Countermeasures Study was information provided by industry and government in response to questionnaires. (Appendix I provides a listing of major study participants.) These questionnaires were initially sent in draft to business associations representing the forest and petroleum industries for their review, in accordance with the "Guidelines for Industrial Questionnaires" by the Planning, Policy and Analysis Branch of Environment Canada.

Finalized questionnaires were distributed to forestry and petroleum companies, accompanied by letters of introduction and an explanation of the study. A representative questionnaire sample is presented in Appendix II. Questions addressed oil products deliveries, storage and handling, oil spill prevention and cleanup measures. Of the ten forestry and five petroleum companies contacted, all replied with a high degree of attention to the details requested.

Additional questionnaires were sent to secondary industries, government oil users, mining companies and transportation firms. In several cases, representatives of smaller companies were interviewed by telephone. One hundred percent of those contacted provided useful information. The quality of responses was excellent and several organizations requested meetings to ensure that their replies met with the aims of the study. Advice was volunteered on matters that had been overlooked and several respondents suggested improved questionnaire formats.

Other information was obtained from the Government of British Columbia, several federal agencies, the Council of Forest Industries and the Council of Marine Carriers through written and telephone communications.

Another major data source was that of existing publications, documents and files on a wide range of topics and from diverse locations. A selected bibliography is included for convenient reference towards the end of this report.

Numerous visits were made to coastal oil facilities for a practical understanding of difficulties facing oil products users and to appreciate the conditions under which spills can occur. Most of these visits were made in the company of Regional Officers of the Fisheries and Marine Service who provided a great deal of insight into local conditions and problems. Appendix III summarizes field investigation information.

Three computer systems operated by the Government of Canada provided some of the more reliable research data: the National Analysis of Trends in Emergencies System (NATES) program supplied data on spill size, location and cause; the Marine Casualty System of Transport Canada gave details on the location and nature of shipping accidents; and the

National Emergency Equipment Locator System (NEELS) augmented the inventory of oil spill equipment that was identified through questionnaire returns.

Washington State sources provided much valuable information, particularly on contingency planning and risk analysis for conditions similar to those on British Columbia's coast.

Two research contracts were conducted by consultants to Environment Canada: Captain George Veres undertook a survey of shipping density along the main marine passages of B.C. and Ms. Eugenia Chan studied the feasibility of optimizing the acquisition and deployment of cleanup equipment in relation to spill risk and damage potential to marine resources.

1.4 General Study Methodology

The first major component of Year I research - cleanup response capability - was investigated through a review of present spill response systems including contingency plans, agency responsibilities, the location of existing spill equipment, and manpower availability and training. The main analytic tool developed in this component of the study was that of a cleanup equipment relative availability rating determined for Fisheries Statistical Areas along the whole coast. (Fisheries Statistical Area boundaries are illustrated in Figure 1.)

The other principal study component was oil products spill risk potential which was evaluated for each Fisheries Statistical Area by analysing such parameters as slick incidents, significant spill events, vessel casualties, marine traffic densities and oil products handling frequencies. Several of these factors were correlated with one another to select the one which could be isolated as a high risk indicator.

Final determination of critical areas was accomplished through tabular presentation of cleanup equipment relative availability ratings and oil spill risk ratings. Areas of poor cleanup response and high oil spill risk were identified and described.

The following chapters present the detailed results of this approach; more specifics on methodology are also included.

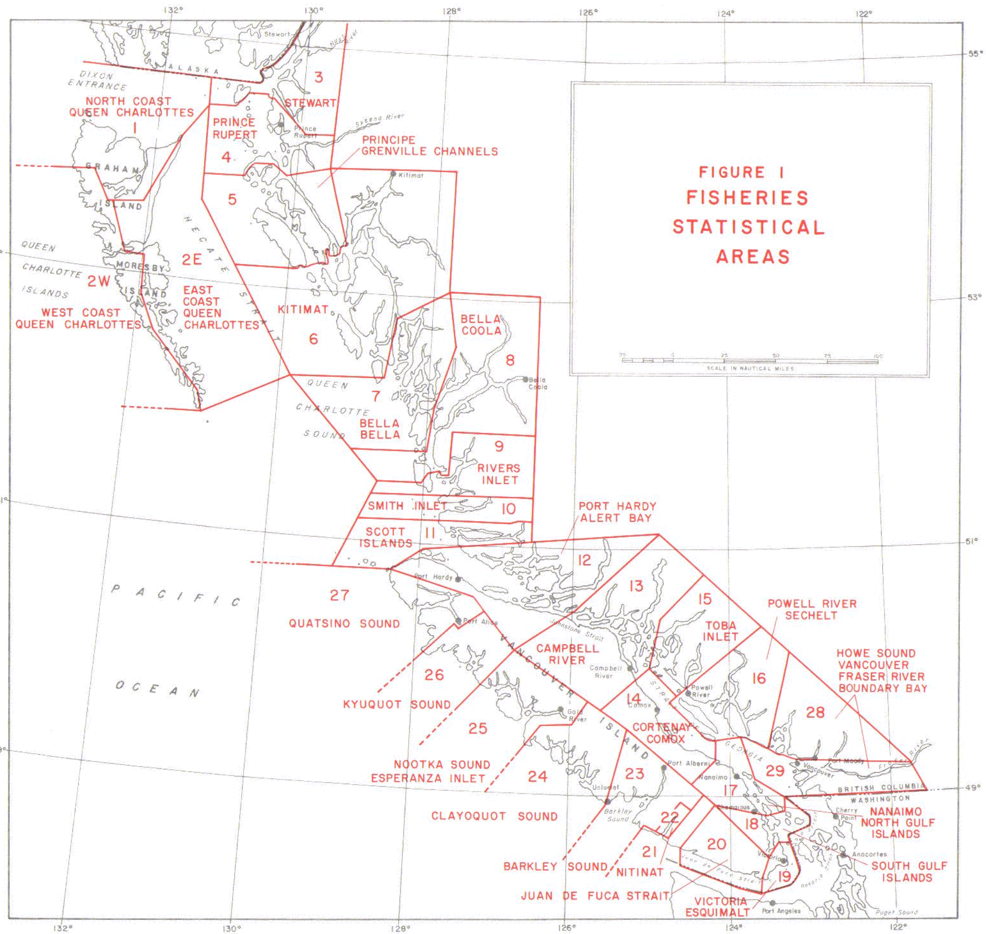

FIGURE I
FISHERIES
STATISTICAL
AREAS
SCALE IN NAUTICAL MILES
NORTH COAST QUEEN CHARLOTTES
1
2E
2W
EAST COAST QUEEN CHARLOTTES
WEST COAST QUEEN CHARLOTTES
3
STEWART
PRINCE RUPERT
4
5
PRINCIPE GRENVILLE CHANNELS
KITIMAT
6
7
BELLA BELLA
BELLA COOLA
8
9
RIVERS INLET
SMITH INLET
10
SCOTT ISLANDS
11
PORT HARDY ALERT BAY
12
13
15
TOBA INLET
14
CORTENAY COMOX
16
POWELL RIVER SECHELT
28
HOWE SOUND VANCOUVER FRASER RIVER BOUNDARY BAY
29
17
18
NANAIMO NORTH GULF ISLANDS
19
SOUTH GULF ISLANDS
20
VICTORIA ESQUIMALT
21
NITINAT
22
JUAN DE FUCA STRAIT
23
BARKLEY SOUND
24
CLAYOQUOT SOUND
25
NOOTKA SOUND ESPERANZA INLET
26
KYUQUOT SOUND
27
QUATSINO SOUND
CAMPBELL RIVER
PACIFIC
OCEAN
DIXON ENTRANCE
ALASKA
GRAHAM ISLAND
MORESBY ISLAND
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
VANCOUVER ISLAND
BRITISH COLUMBIA
WASHINGTON

2 OIL SPILL RESPONSE SYSTEMS

The intent of this chapter is to provide a descriptive overview of oil spill response systems in coastal British Columbia for readers not familiar with them; the chapter does not purport to be an analysis or interpretative evaluation of such systems.

The first section of the chapter outlines the legislation which applies to individuals and organizations responsible for oil spills into the marine environment. Subsequent sections examine contingency planning and other facets of oil spill response systems which have been developed by various government agencies, corporate cleanup contractors and cooperatives. National, international and voluntary assistance are also described.

2.1 Oil Spill Legislation

Federal legislation pertinent to the release of crude oil and oil products into the marine environment falls primarily under two statutes: the Fisheries Act, administered by the Minister of Fisheries and Oceans and the Minister of the Environment, and the Canada Shipping Act, administered by the Minister of Transport. They are intended to cover every source of oil pollution, whether from marine vessels, offshore drilling platforms or land-based facilities such as tank farms, pipelines or vehicles.

The Canada Shipping Act provides for penalties of up to $100 000 for oil spill incidents from vessels held responsible for contravention of the Oil Pollution Prevention Regulations. In addition, civil liability may be imposed against a polluter and costs of cleanup and damage may be levied against a carrier or owner of spilled oil products. Furthermore, the Canada Shipping Act requires the master of a vessel that is discharging or about to discharge a pollutant to report the situation to a designated Pollution Prevention Officer. Failure to do so can result in penalties of up to $100 000 for non-compliance.

The Fisheries Act is similar to the Canada Shipping Act with respect to cleanup and resource damage liability, reporting requirements and maximum penalites, although the maximum first offence fine is $50 000, rising to $100 000 on subsequent offences. It differs in application as it is oriented towards spills that occur in waters frequented by fish and generally is employed to prosecute those parties responsible for spills from land-based facilities. There is some degree of overlap between the two statutes in that the Fisheries Act can be applied to a shipping spill in an area frequented by fish, but this would only occur if the Department of Transport decided not to invoke the Oil Pollution Prevention Regulations and fish were affected.

The two aforementioned acts place the onus for cleanup directly on the party responsible for a spill. Neither federal agency initiates a cleanup unless it is obvious that it is needed and the spiller is unwilling or incapable of undertaking it. Should a federal agency intervene, an attempt is made to recover cleanup costs from the polluter, although liability for ships is limited to $75 per registered ton. If costs cannot be recovered from the polluter, Canada has established a Maritime Pollution Claims Fund which may be available if the polluter is a ship carrying more than 1 000 tons of oil in bulk. There have been very few instances of successful claims against this fund for a variety of reasons; the Department of Transport is considering changes to make it more accessible.

The Province of British Columbia has assumed an important role in emergency pollution response with a 1977 amendment to the Pollution Control Act which enables the provincial Minister of Environment to intervene in an environmental emergency. Section 26 of the Act states that where immediate action is required to prevent or control pollution, the Minister is authorized to take whatever steps are necessary to remedy the problem, including, if necessary, the requisition of labour and equipment. The amendment further empowers the Minister to recover cleanup costs and expenses from the person or agency responsible for polluting incidents from shore facilities.

Negotiations are currently in progress between provincial and federal environment ministers to clarify spill response as there are several areas, such as salmon streams, where present jurisdictions overlap. The draft Canada-British Columbia Understanding is intended to resolve such ambiguities. Both a joint contingency plan and action plan guidelines for industry are expected to evolve from the new understanding.

Other legislation that concerns the deposition of materials into marine waters includes the Migratory Birds Convention Act, the National Harbours Board Act, the Harbour Commissions Act and the Ocean Dumping Control Act, although these are seldom invoked in relation to oil spills. Apart from the Ocean Dumping Control Act, the penalties provided are generally much lower than those in the Canada Shipping or Fisheries Acts and are usually applied at the discretion of local authorities to deal with specific nuisances.

In spite of such federal and provincial legislation, oil spill cleanups on the West Coast have occasionally been delayed by concern over lengthy and uncertain cleanup cost recovery procedures. To prevent financial factors taking precedence over practical and rapid spill response, a readily accessible emergency fund should be considered by both levels of government.

2.2 Contingency Planning

Contingency planning is one of the more important aspects of an effective oil spill cleanup response system. However, even well-written plans incorporating all of the various criteria listed in Appendix IV (Contingency Planning) are of little value unless applied. Application includes acquisition and maintenance of equipment, training of personnel, and office and field practice emergency exercises. The omission of any one of these fundamentally reduces the possibility of a successful response system.

Contingency planning for oil spills in British Columbia is well advanced in the government sector and for some specific private industries. There are three main federal contingency plans which can be implemented depending on the source, spread and severity of a spill. Spills that occur from shipping accidents outside the jurisdiction of Harbour Boards or Harbour Commissions are the responsibility of

Transport Canada and would be dealt with through the Canadian Coast Guard, Western Region, Marine Contingency Plan. Spills into marine waters from land, mystery spills and those affecting inland waters under federal jurisdiction are the responsibility of Environment Canada and would be covered by the Pacific Region Environmental Emergency Contingency Plan. Response operations for spills that threaten boundary waters would be managed through the Joint Canada/United States Marine Pollution Contingency Plan with lead agency status accruing to the Coast Guard of the country in which the spill originated. Countermeasures for spills onto land and into freshwater streams are managed by the B.C. Provincial Emergency Program and/or the Pollution Control Branch.

Although these plans contain the framework for a well-organized response to a typical Pacific Coast spill, logistics (action plans) are not detailed in most of them. Under present policy, a polluter bears full responsibility for cleanup and it is up to him to have contingency plans that include the practical ways and means by which spilled oil can be recovered, although foreign flag vessels are sometimes deficient in this regard. To the degree that cleanup capability exists, government agencies leave cleanup in the hands of polluters.

The British Columbia petroleum industry has developed a high degree of response capability on the West Coast in relation to its potential for spills. Each oil company active in the coastal transport of petroleum products has developed contingency plans as a member of the British Columbia Petroleum Association. These plans have been reviewed as part of this study on the basis of the criteria detailed in Appendix IV. One oil company plan in particular is outstanding in its attention to the many specifics required for effective spill cleanup. Three others have been well-prepared and articulated, but are too general for application to varied situations, while one appears deficient in certain details considered essential to an effective emergency response plan.

The British Columbia forest industry is the largest single consumer of oil products on the Pacific Coast and its tank capacities range upwards to a maximum of 3.5 million gallons of bunker fuel.

Spills of oil products are fairly common in this industrial sector, but for the most part are comparatively small. In recognition of their need for oil spill response capability in areas remote from outside assistance, several of the larger firms have initiated programs of cleanup equipment acquisition and personnel training in oil spill countermeasures techniques. Prevention programs have been developed for many of the large fuel storage facilities, but there remains much to be done to improve storage in more remote logging camps. There is also considerable scope for the development of oil spill contingency plans and for the coordination of oil spill response capability on an industry-wide basis.

Forest company personnel have demonstrated their competence to handle oil spills on many occasions, particularly where past experience has alerted them to the negative consequences of poor preparedness. Most companies contacted were familiar with alerting procedures, contact personnel, local equipment supplies and spill control techniques. Only one had developed a compendium of such information for general distribution to outlying operations; however, it lacked site-specific details and was partially out of date.

The British Columbia Pollution Control Branch is encouraging development of contingency planning by industries involved in large scale oil products storage and handling. In 1978, the major petroleum distributors were requested to file contingency plans with the Branch; it is anticipated that forest companies developing their own spill control programs will also be asked for copies of their plans.

Other coastal oil users include mining operations, fish processing plants, chemical works, a cement factory, National Defence bases, transportation companies and B.C. Hydro and Power Authority. Contingency planning for many of these is rudimentary, although most have some degree of oil spill preparedness. B.C. Hydro and Power Authority, however, has developed very comprehensive and site-specific contingency plans for their coastal generating plants. At their largest facility in Chemainus, an informal cooperative has been created with neighbouring industries to provide material aid in the event of a spill. The Department of National Defence participates in emergency planning and has contingency plans for civil emergencies, although it has shown a lack of sufficient cleanup equipment and action plans for dealing with spills from its facilities at Holberg and Comox. Towboat companies that barge oil products have no specific contingency plans at present, but are planning to organize an industry-wide oil spill response system that would be structured somewhat similar to that of the petroleum industry.

2.3 Oil User Organized Response Systems

The organizations considered in this section include industries and government departments that store or transport significant volumes of oil products and have some capacity to respond effectively to oil spills from their own facilities or those of other groups. The petroleum industry has organized its response system as a cooperative venture, while other industries have either developed regional cooperative systems or have prepared themselves individually to cope with spills from their own operations. Although government oil users are not involved with structured cooperatives, individual departments tend to act in concert when confronted with a spill situation.

2.3.1 Petroleum Industry. The petroleum industry of British Columbia has organized its emergency oil spill response through the British Columbia Petroleum Association and the Vancouver-based Burrard Clean Oil Spill Cooperative.

Members of the association have purchased cleanup equipment and stationed it along the coast at various tank farms and terminals operated by member company representatives. The equipment is stored in "packages" which are designated "A", "B" or "C" according to content (Appendix V). An effort has been made to match package size with potential risk, such that the amount of equipment stored at any one location is related to the number of members in the area and the quantity of oil products stored. Each member has immediate and unqualified access to regional equipment and also may be assisted by other companies for cleanup assistance. Should the size of a spill be too great for local resources, members can request equipment stored at other coastal locations, and ultimately, from Burrard Clean.

The Burrard Clean Oil Spill Cooperative was formed in 1976 to provide for cleanup capability for oil spills resulting from its members' operations in Vancouver Harbour. The equipment owned by members of the cooperative consists of two modern recovery vessels, plus a wide range of auxiliary booms, pumps, sorbents and manual equipment. It is maintained and operated by a large tug and barge company and can be delivered to virtually any site on the B.C. coast, should the need arise. The location of the equipment in Vancouver Harbour is approriate owing to significant marine traffic and oil storage in the area and because the response to a large spill on the coast would likely be directed from Vancouver. It is estimated that Burrard Clean recovery equipment could be moved by tug or barge to the most remote locations on the coast within three days and to 90% of it in less than two days, while containment equipment could be air-freighted to a spill site in less than a day.

The equipment owned by members of the British Columbia Petroleum Association and the Burrard Clean Oil Spill Cooperative is specifically allocated for use by member companies and, as such, is an expression of the oil industry's desire to maintain control over its own spills. The industry also rents its equipment to other industries.

2.3.2 Forest Industry. Forestry constitutes the largest and most widespread industry on the West Coast. Its activities are heavily dependent on a wide range of fuels from heavy bunkers to light distillates. Oil product spills associated with forestry occur quite frequently, although generally in small quantities. The organization of emergency response in the industry varies from none to extensive, and roughly parallels the size and scale of each company's operations.

The pulp and paper sector uses bunker fuel as a power source, without exception. Most mills have acquired containment and recovery equipment along with the expertise to operate it. While only three companies have specific contingency plans, all are aware of nearby equipment depots and have the necessary contact numbers to initiate response. The largest forestry firm in British Columbia has developed a program dealing with the total oil spill issue, including contingency planning, equipment acquisition, training, prevention and facility upgrading.

The logging sector of the industry has a more varied spill risk and response capability owing to mobility and seasonal factors. Logging activities require mostly diesels, gasolines and lubricating oils that are difficult to recover once spilled. Quantities are usually in the range of 5000 to 30 000 Imperial gallons at each camp, although in some locations, storage capacity is as much as 250 000 Imperial gallons. Static prevention measures such as dykes and specialized shut-off valves vary with the permanence of individual camps. Contingency plans specific to oil spills are rare, but at least three companies have made efforts to outfit each of their camps with elementary cleanup equipment and contact lists. Logging firms are oriented to emergency response to forest fires and these response networks could serve in the event of a spill, particularly as they are the only viable source of labour, machines and communications equipment in remote areas of the coast. The majority of logging operations responding to questionnaires expressed knowledge of local contacts and equipment suppliers. Some personnel had been involved in training workshops, while others had participated in cleanup operations and could comment on the most common causes of spills from their own experience.

As the largest industry in British Columbia with numerous remote operations, forestry stands to gain much from a regional co-operative approach to spill prevention and cleanup. Moreover, excellent opportunities exist for equipment purchase and manpower training in association with other local industries and through the assistance of such agencies as the Environmental Protection Service and the Provincial Emergency Program.

2.3.3 British Columbia Hydro and Power Authority. B.C. Hydro and Power Authority maintains fuel storage depots at many locations on the coast. They range in capacity from diesel plants of approximately 20 000 Imperial gallons to a very large generating station at Chemainus of over 8 000 000 Imperial gallons of bunker and diesel. (The Burrard Inlet generating plant is no longer used for oil storage.)

During 1978, B.C. Hydro's pollution control department initiated a study of the company's facilities for the purpose of upgrading preventative and contingency measures specific to each site. These included action plans, contact numbers, equipment locations and maps describing the topography and marine waters most likely to be affected by escaped oil products.

The Georgia generating station at Chemainus is the one site owned by the company that stores significant amounts of containment and recovery equipment and has been instrumental in organizing an informal oil spill cooperative in the Nanaimo-Chemainus area. Members own compatible equipment and are prepared to assist each other in the event of a spill from any one of their operations.

2.3.4 Mining Industry. The two major coastal mine sites in B.C. are located in areas of low population and minimal logistical support. Westfrob Mine at Tasu on the west coast of Moresby Island, Queen Charlotte Islands, stores some equipment and has trained personnel for prevention and cleanup. Island Copper Mine, Vancouver Island, also has equipment but emphasizes that spill prevention is its primary goal. The company maintains contact with other groups in the region which can assist one another in cleanup.

Also included in this section is the B.C. Cement Company at Bamberton which uses bunker "C" as a power source. In 1974, the company acquired containment equipment and thoroughly revamped its oil storage system.

2.3.5 Marine Transportation. The marine transportation industry in British Columbia consists of tug and barge companies, oil company vessels, B.C. ferries and shipping firms associated with Canadian Pacific and White Pass and Yukon railways. The tug and barge companies are the principal carriers of oil products on the coast with one in particular, Seaspan International Ltd., almost completely dominating the market. Other tug and barge companies vary in their number of deliveries from the three destinations serviced by Rivtow Straits Ltd. to the multiple, low volume locations served by North Arm Transportation Ltd. and Shields Navigation Ltd. All of these firms have indicated that they employ standard procedures including checklists and radio communication when loading and offloading products to reduce the risk of accidental spillage. In some cases, such as at refineries, oil spill containment booms are deployed around vessels as an additional precaution.

With respect to cleanup response systems, the two largest tug and barge companies have developed contingency plans and maintain extensive equipment which is available for immediate dispatch to a spill site. Seaspan International, through acquisition of Gulf of Georgia Towing Co. Ltd., is owner of Clean Seas Canada Ltd., a company created in 1972 as a private cleanup contractor. (More details on this firm are provided in a later section of this chapter.) Rivtow Straits has developed a response capability as contractor to Burrard Clean Oil Spill Cooperative, described in an earlier section. The remaining tug and barge companies, although not equipped to deal with oil spills, have trained personnel experienced in transfer procedures and preventative measures.

Imperial Oil Ltd. employs two tankers to transport refined petroleum products to its coastal distributors. Both these ships are equipped with containment booms and spill recovery devices and the crews have been trained in their effective use.

The Council of Marine Carriers represents twenty-four shipping companies and acts as liaison with government, unions, associations and companies in other countries. Recently the Council has been investigating the development of an oil cleanup barge that could stand by at various coastal locations in British Columbia to serve as a major part of an emergency response system. It would combine lightering capacity along with equipment and manpower able to effect spill cleanup. The development of such a system would greatly enhance response capability on the West Coast through providing the high mobility necessary to rapidly begin oil spill containment and recovery.

2.4 Regulatory Agency Organized Response

Depending on the site or source of a spill, a variety of government agencies might be involved at the federal, provincial or municipal level. This section details the individual responsibilities of government response organizations.

2.4.1 Canadian Coast Guard. The Canadian Coast Guard maintains cleanup equipment at bases in Vancouver, Victoria and Prince Rupert; most is designed for transport by road, air or water with a minimum loss of mobilization time. Exercises at Boundary Bay and Burrard Inlet in 1978 tested this capability as well as the performance of equipment under realistic conditions.

The Coast Guard favours a concept of general planning because of the great variety of emergency situations that can occur. Unlike spills at storage depots where sources are fairly predictable, spills from ships may occur anywhere in B.C. waters. With a limited number of maritime bases, the Coast Guard must rely on readiness and high mobility to respond effectively to a spill; a strictly defined plan of action, in their estimation, would not be sufficiently flexible. They do, however, activate the Pacific Region Contingency Plan during exercises and real events.

Coast Guard bases are continuously manned, their ships are on regular patrol and, should the size of a spill warrant additional equipment, resources from other parts of Canada and the United States Coast Guard can be obtained by them.

2.4.2 Environment and Fisheries and Oceans. The federal departments of Environment and Fisheries and Oceans have expertise in a number of fields which are essential in effective oil spill response. (The Environmental Emergencies Branch of the Environmental Protection Service is the agency which coordinates Environment Canada response.)

The two departments' most frequent spill cleanup roles are as support agencies providing environmental information to an On-Scene Commander (OSC). This includes fisheries and wildlife information, spill movement predictions, weather data, advice on environmentally appropriate beach cleanup techniques, recommendations on environmentally safe disposal practices and guidance for bird rehabilition. Probably the Department of Environment's most important function is to advise the OSC on priorities for protection of marine mammals, fish and migratory birds, as well as such sensitive areas as river estuaries. Associated with this responsibility is the approval or non-approval of the use of oil dispersants as a cleanup technique in specific situations.

The Environmental Protection Service has ongoing programs in environmental emergency prevention, contingency planning and the research and development of oil spill countermeasures technology. They also manage the National Emergency Equipment Locator System, a program that provides rapid access to information on emergency equipment inventories throughout Canada. Further details on this system are provided in Appendix VI. In a broader context, the two departments have numerous programs of biological data collection and pollution research, all of which can be made available to assist in cleanup operations.

2.4.3 National Harbours Board and Harbour Commissions. There are five harbours on the Pacific coast supervised by either the National Harbours Board or independent harbour commissions. To date, only the Port of Vancouver, the Port of Nanaimo and Port Alberni harbour authorities have acquired oil spill cleanup equipment. The remaining harbour authorities, which share jurisdiction on the lower Fraser River, are not equipped to respond to oil spills in their respective areas.

2.4.4 Provincial Emergency Program and Municipal Organizations. Since 1974 the Province of British Columbia has taken increasing responsibility for oil spills on land and freshwater lakes and streams. Through the offices of the Provincial Emergency Program (PEP), the province now maintains a 24-hour emergency contact line, contingency plans and the nucleus of an equipment inventory that eventually will be expanded to provide spill response capability in all major PEP centres in B.C.

PEP plays an equally important role in coordinating the emergency preparedness of 125 municipalities through training programs, practice exercises and contingency planning. (As most municipalities maintain well-equipped works yards with employees available on a 24-hour basis, municipalities are frequently called out to assist in beach cleanup operations.)

Vancouver is taking the lead among civic governments in British Columbia in preparing for environmental emergencies such as oil spills. Other municipalities in the Greater Vancouver Regional District are similarly involved and have liaison with the Provincial Emergency Program. After expansion of PEP, it is likely that more coastal regional districts will develop improved oil spill response capabilities.

2.5 Other Assistance

Apart from government and industrial response systems, there are other sources of assistance that are available in spill emergencies. These include private cleanup contractors, national and international agencies and voluntary organizations.

2.5.1 Oil Spill Cleanup Contractors. There is currently no active private cleanup contractor on the Pacific Coast. Clean Seas Canada Limited, a subsidiary of Seaspan International, was involved over several years in some eighty spills. Owing to difficulties in recovering operational costs, the firm recently decided to limit its availability to its parent company. However, Clean Seas also has indicated that it will provide cleanup assistance to whoever negotiates a formal agreement which would include payment for services prior to their provision.

Clean Seas inventory is comprised of a comprehensive assortment of containment and recovery gear, storage containers, manual support and beach cleaning supplies. Equipment stores are organized for transport by barge or truck without losing time in transference from one mode to another. Their OSCAR skimmer was designed and built in collaboration with the Environmental Emergencies Branch of Environment Canada and has recovered oil in several spills.

2.5.2 National and International Assistance. A considerable inventory of cleanup equipment is available in the United States, much of it through private enterprise. Provided there is no requirement for their use in the U.S. at the time, essential government or privately-owned equipment and skilled operators can be readily imported. This in fact was done in 1973 to assist in the cleanup of Burrard Inlet after the Sun Diamond/Erawan collision.

In the case of moderate or major oil spills threatening U.S./Canada border areas, the CANUSPAC (Canada/U.S. - Pacific) Contingency Plan would be invoked by the regional head of the Coast Guard. The plan calls for formation of a Joint Response Team whose On-Scene Commander would come from the country where the spill originated. In such a case, the amount of equipment available to Canada from the U.S. would depend on the circumstances of the particular incident, as U.S. agencies are obliged by law to ensure protection of their own coasts first. Equipment surplus to their needs could be made available to Canada.

Specialized oil spill cleanup equipment exists throughout the world. No doubt a certain number of devices such as FRAMO skimmers from Europe could be transported by air to B.C., if required. Information on Canadian and global sources is available from the National Environmental Emergency Centre which maintains contact with industrial and major spill response organizations who have up-to-date information regarding the locations of such equipment and the contacts to procure them.

2.5.3 Volunteer Organizations. The main volunteer organizations associated with spill cleanup are those concerned with the well-being of birds and mammals. The Society for the Prevention of Cruelty to Animals is organized to handle bird collection, cleaning, medication and maintenance. The SPCA also has contact lists of volunteers trained in bird handling plus an assortment of equipment that can be moved to bird cleaning stations. Cleaning and handling of birds by the SPCA is in accordance with guidelines established by the Canadian Wildlife Service. Although the Stanley Park Zoo and Aquarium have an informal role to play in a spill emergency, they have expressed a willingness to care for animals affected by oil and have done so in the past. Their expertise in animal care would be an invaluable asset in an emergency situation.

Past cleanup operations have demonstrated that frequently numerous individual volunteers show up to assist in beach cleaning; this may have mixed blessings. Agencies in control of operations often prefer to hire labour that can be managed and protected from dangerous situations, rather than to rely on unorganized volunteers. However, it is certainly true that beach cleaning tends to be a labour-intensive activity. In this regard, Canada Manpower has made arrangements to absorb dedicated volunteers into an organization to provide management, workers compensation and financial remuneration for those who demonstrate a willingness to work for the duration of a cleanup.

3 OIL SPILL CLEANUP EQUIPMENT

One of the principal determinants of the effectiveness of oil spill cleanup operations is the equipment utilized. The emphasis in this chapter is on cleanup equipment specifically designed for oil spill control, rather than on such auxiliary items as clothing, beach cleaning tools, pumps, communications devices and lighting plants. The specialized equipment described in the following section by type, condition and quantity is later rated on the basis of its regional availability. More detailed information on such equipment is provided in the Environmental Protection Service publications listed in the bibliography to this report.

3.1 Equipment Types

Equipment designed specifically for oil spill cleanup includes containment and recovery devices, and chemicals. They are described below.

3.1.1 Containment Equipment. Containment devices presently used on the West Coast range from makeshift constructions of logs and belting to modern fabric offshore booms. The choice of boom type is dependent on economics, application and environmental conditions.

In calm harbours where permanent booms are used to protect transfer facilities, the best booms are those designed to withstand the effects of rough handling and prolonged exposure to weathering and stress. In British Columbia, booms of this sort are employed at the four major coastal oil refineries, some pulp mills and the B.C. Hydro & Power Authority generating plant on Vancouver Island. Belt and timber booms are quite effective in these applications, but are not as manageable as harbour booms specifically designed for the purpose.

Another type of boom is the emergency response variety, usually stored in a manner conducive to rapid mobilization. On the Pacific Coast, the most common is the 18 to 36 inch Bennett inshore boom, a device widely held by government departments and private industrial oil users for situations where currents and sea states are not excessive. It is fairly easy to transport and deploy, and has been a useful aid in many oil spill situations. A similar design in a large (72 inch) size is held by the Coast Guard for offshore applications.

The Vikoma Seapack, favoured by the Canadian Coast Guard, is a device that combines excellent containment qualities with a capability for rapid mobilization and deployment. Its main drawback is a total dependence for buoyancy on a diesel-operated air fan. Although currently the only proven offshore inflatable curtain boom, neither it nor the Bennett (72 inch) is effective in currents over 1.5 knots or in waves above 4 feet.

Two recent innovations, both from Vancouver, seem to have useful potential for B.C. waters. The ZOOOM Boom, manufactured by Versatile Environmental Products Co., is a lightweight, compact, self-inflating boom with fast deployment qualities and a fail-safe buoyancy construction. The other is a light, compact, disposable boom from Morris Industries. Its disposability is a real advantage considering the expensive task of cleaning an oiled boom and the relative infrequency of its use.

Another device stored on the coast is the absorbent boom for both containing and absorbing spilled oil. It is only effective where oil layers are thin because it has a shallow draught and the sorbent material is quickly saturated. Its principal application is for minor spills in low current waterways and ditches.

One factor in determining boom efficiency is that of its deployability. To date, B.C. does not have the planned capability for rapid deployment of boom by air transport, although private firms continue to research such a system.

3.1.2 Recovery Equipment. Recovery equipment ranges from organic and synthetic sorbents to mechanized devices such as skimmers and slurpers.

Virtually all oil spill equipment depots on the Pacific Coast store some variety of sorbent. The petroleum industry frequently uses "synthetic" types such as polyester foam, polystyrene and polyurethane in various configurations; other industries favour organic substances such as peat moss, wood waste, straw and hay. Neither type has much application in the cleanup of major spills, but both are invaluable for minor mopping-up operations. The essential differences between organic and inorganic sorbents are in their ability for reuse and for discrimination between oil and water. Inorganic sorbents are superior in both ways, but present disposal problems once their effective life is over.

Mechanical recovery devices range in size and capacity from large vessel-mounted skimmers operated by Burrard Clean, Clean Seas and the Canadian Coast Guard to small portable skimmers suitable for recovery of light oil products. The latter are especially popular with industrial oil users as an alternative to the expense and messiness of the common manual labour/sorbent method.

Mechanical skimmers have undergone considerable improvement during the last five years in their ability to discriminate between oil and water and to operate under fairly rough sea conditions (2-3 foot seas). The most promising models are those incorporating oleophilic-aquaphobic rotating discs for spills of light to medium viscosity oil products. Heavier oils are more effectively recovered by oleophilic belt skimmers or conveyer belt devices such as the original "slicklicker". Skimmers developed for offshore use have not yet been deployed on the West Coast; one such device is the FRAMO unit which has combatted spills in the North Sea and is currently included as part of the equipment held in the Canadian Arctic and Newfoundland.

3.1.3 Chemical Countermeasures. The use of dispersants, sinkants and herders continues to generate controversy as to their effectiveness and viability as options for On-Scene Commanders. Sinkants and herders are considered relatively inefficient, while dispersants in the past have had adverse effects on marine ecosystems to the extent that the Environmental Protection Service usually does not permit their use. In order to meet toxicity criteria as set down in such publications as "Guidelines on the Use and Acceptability of Oil Spill Dispersants" (Ruel et al, 1973), several companies have funded research efforts to develop a dispersant of low toxicity. Four formulations presently meet the criteria and one has been acquired in bulk by the Canadian Coast Guard as part of its emergency response system.

Dispersion of oil spills is a response method that can be attractive to an OSC, e.g. when hydrographic and climatic conditions prevent the deployment of conventional cleanup equipment, spilled oil can conceivably be dispersed almost immediately at source before it can contaminate shorelines or fishing grounds. New techniques in spraying make rapid and site-specific applications possible. The latest dispersants are virtually self-mixing, a property which eliminates the need for on-site mechanical agitation and makes aerial dispersant application feasible, as recently demonstrated by Conair Aviation Limited of British Columbia on the Ixtoc oil spill in the Bay of Campeche, Mexico.

Opponents of dispersants argue that they do not remove oil from water, but simply spread it throughout the water column by a process of breaking down oil to droplet size, with possible adverse consequences on subsurface organisms. As the droplets do not coalesce, effective skimming is circumvented. Therefore, the use of dispersants is dependent upon a careful analysis of biological considerations and other factors, not least of which is the expected effectiveness of the dispersant under the prevailing circumstances.

3.2 Equipment Maintenance and Condition

Field visits to equipment depots during the study indicated that much coastal equipment was new and unused. Where proper weather protection and capability testing had been provided, it usually was in excellent condition.

On the other hand, equipment that had been improperly cleaned, exposed to sunlight or left in the water was often deteriorated. In a few instances, there was too little attention to maintenance of equipment vehicles, e.g. trailers were found with flat tires and expired licence plates. Some motors were unserviced and several batteries powerless.

Spill equipment owners in the private sector occasionally seemed reluctant to replace worn out equipment. This was evident at several depots, suggesting that although a good deal of thought and energy had been originally expended in the development of equipment packages, there was a subsequent loss of concern and/or funding. On-going equipment maintenance and testing must be encouraged as an important part of spill response systems.

3.3 Equipment Quantities and Distribution

The British Columbia Petroleum Association has stationed oil spill equipment packages at a number of locations on the B.C. coast. These packages have been designated "A", "B" or "C" depending on the types and quantities of equipment in each. For descriptive purposes in this section of the report, other marine equipment depots (i.e., non-BCPA) have been identified by the same categorization except for the extensive inventories maintained by Burrard Clean, Clean Seas and the Canadian Coast Guard; these have been labelled as "major A" packages. A detailed, sample inventory of package types is presented in Appendix V.

A "major A" package contains virtually all types of cleanup equipment and supplies. These include containment and recovery devices, dispersants, hand tools, communication systems, land and water transport vehicles, lighting plants, safety gear, pumps and hoses, beach-cleaning equipment and other accessory items. Such a package requires regular maintenance to ensure fast mobilization and good performance, and thus requires a source of trained manpower to be effective.

"A" packages contain a similar assortment of spill equipment for dealing with most aspects of cleanup, but on a substantially smaller scale. They also may lack means of transport and high volume mechanical recovery equipment. Manpower is not specifically allocated, but trained operators are available locally, either amongst the staff of the facility holding the package or through contractors.

"B" packages are designed to provide a response capability for minor spills which might occur at storage facilities during transfer operations. Most are limited to manual equipment, sorbents, pumps and containment boom. Transport and manpower are often arranged with outside sources.

"C" packages are equipped for the cleanup of very small spills by manual means. Inventories are limited to hand tools, sorbents and wire fencing barriers. Lack of containment equipment limits the capability of these packages to land spills, except where some form of sorbent boom can be manufactured on site from available materials.

The distribution of oil spill equipment depots on the coast is presented in Figure 2 and Table 1. In the southern portion of the province, where the vast majority of equipment on the coast is located, "major A" packages are situated in Vancouver and Victoria. Other package sizes also occur in these two locations, as well as in Howe Sound, Nanaimo, Port Alberni, Powell River and Campbell River, particularly at pulp mills. The west and northwest coasts of Vancouver Island have relatively few packages - all are either smaller "B" or "C" types at major facilities such as oil company tank farms and pulp mills.

The central coast is virtually unequipped for an oil spill with the exception of Bella Coola, where a BCPA "B" package is located.

The north coast includes Kitimat, Prince Rupert and Stewart. Equipment is situated in all of these and includes one "major A" package equivalent to those in Vancouver and Victoria. Several smaller packages are found in the Queen Charlotte Islands.

It is significant to note that few oil products vessels carry their own cleanup equipment. This is a serious deficiency that warrants rectification through purchase of booms and skimmers for placement on vessels.

3.4 Equipment Relative Availability Ratings

To determine the relative response capabilities for different portions of the coast, a simplified equipment relative availability rating system was devised. (Concurrently, a feasibility study was undertaken by Ms. Eugenia Chan for Environment Canada to assess the

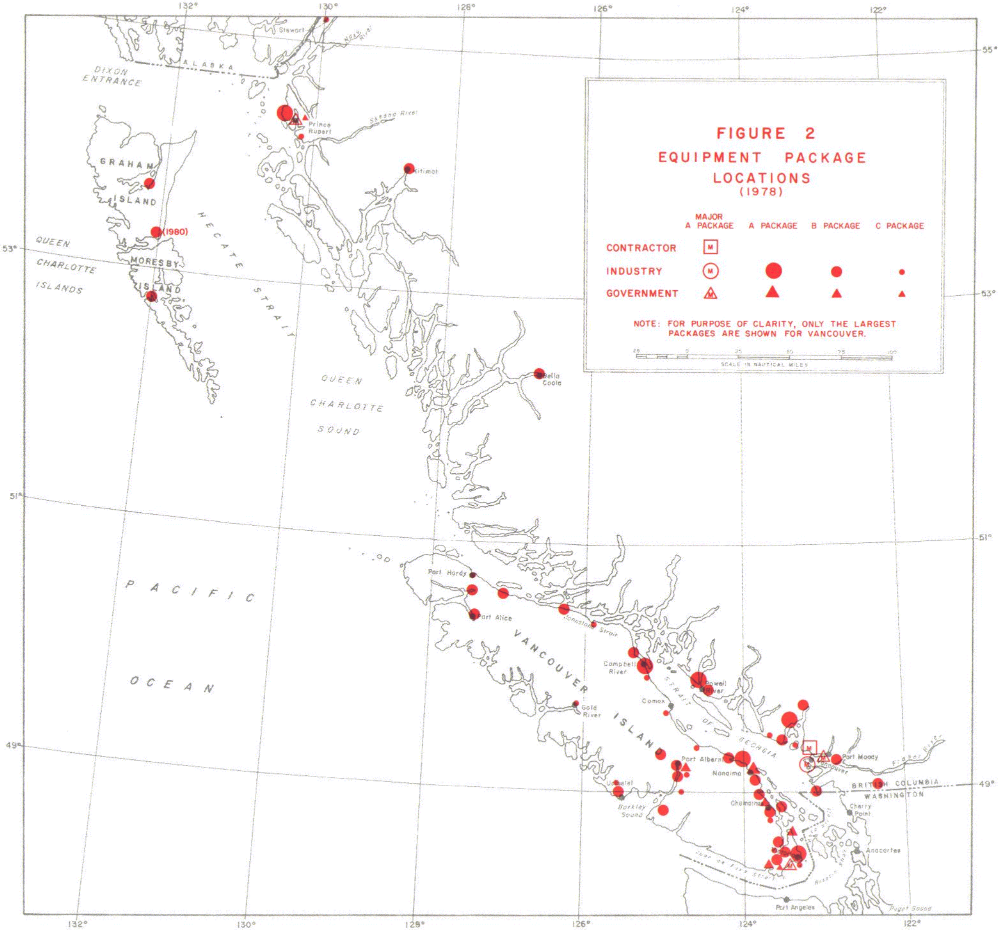
FIGURE 2
EQUIPMENT PACKAGE
LOCATIONS
(1978)
MAJOR A PACKAGE
A PACKAGE
B PACKAGE
C PACKAGE
CONTRACTOR
INDUSTRY
GOVERNMENT
NOTE: FOR PURPOSE OF CLARITY, ONLY THE LARGEST PACKAGES ARE SHOWN FOR VANCOUVER.
SCALE IN NAUTICAL MILES
DIXON ENTRANCE
ALASKA
Stewart
Prince Rupert
Skeena River
Kitimat
GRAHAM ISLAND
(1980)
MORESBY ISLAND
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
Bella Coola
PACIFIC OCEAN
Port Hardy
Port Alice
Johnstone Strait
VANCOUVER ISLAND
Campbell River
Powell River
Comox
STRAIT OF GEORGIA
Gold River
Port Alberni
Nanaimo
Ucluelet
Barkley Sound
Chemainus
Port Moody
Vancouver
Fraser River
BRITISH COLUMBIA
WASHINGTON
Cherry Point
Anacortes
Port Angeles
Puget Sound
132°
130°
128°
126°
124°
122°
55°
53°
51°
49°

TABLE 1 EQUIPMENT PACKAGE TYPES BY LOCATION

Fisheries Statistical Area	Location	Package Type	Package Holder	Fisheries Statistical Area	Location	Package Type	Package Holder
1	Port Clements	B	BC Petroleum Assoc.	23	Port Alberni	B	Harbour Commission
2 W	Tasu	B	Westfrob Mines		Port Alberni	B	MacMillan Bloedel
2 E	Queen Char. City	C	MacMillan Bloedel		Port Alberni	B	BC Petroleum Assoc.
3	Stewart	C	BC Petroleum Assoc.		Port Alberni	C	MacMillan Bloedel
4	Watson Island	C	Canadian Cellulose		Cameron	C	MacMillan Bloedel
	Prince Rupert	C	Provincial Emerg. Prog.		Ucluelet	B	BC Petroleum Assoc.
	Prince Rupert	Maj A	Canadian Coast Guard		Sproat Lake	B	MacMillan Bloedel
	Prince Rupert	A	BC Petroleum Assoc.		Kennedy Lake	C	MacMillan Bloedel
6	Kitimat	B	BC Petroleum Assoc.		Franklin River	C	MacMillan Bloedel
8	Bella Coola	B	BC Petroleum Assoc.		Estevan	B	MacMillan Bloedel
12	Port McNeil	B	BC Petroleum Assoc.	25	Gold River	C	BC Petroleum Assoc.
	Port Hardy	C	MacMillan Bloedel	27	Port Alice	B	Rayonier Limited
13	Elk Falls	B	Crown Zellerbach		Rupert Inlet	B	Utah Mines
	Eve River	B	MacMillan Bloedel	28/29	Port Mellon	A	Can. Forest Products
	Campbell River	A	BC Petroleum Assoc.		Woodfibre	B	Rayonier Limited
	Kelsey Bay	C	MacMillan Bloedel		Gibsons	B	BC Petroleum Assoc.
	Menzies Bay	C	MacMillan Bloedel		Bowen Island	C	Fire District
14	Royston	C	BC Petroleum Assoc.		New Westminster	B	MacMillan Bloedel
15	Powell River	A	MacMillan Bloedel		Vancouver	B	Gulf
16	Westview	B	BC Petroleum Assoc.		Vancouver	A	Imperial
	Stillwater	C	MacMillan Bloedel		Vancouver	Maj A	Clean Seas
17	Northwest Bay	B	MacMillan Bloedel		Vancouver	Maj A	Burrard Clean
	Harmac	B	MacMillan Bloedel		Vancouver	B	Ntl. Harbours Board
	Nanaimo	A	Harbour Commission		Vancouver	B	Gulf
	Nanaimo	A	BC Petroleum Assoc.		Vancouver	A	Shell
	Chemainus	B	B.C. Hydro		Vancouver	A	Standard
	Chemainus	B	MacMillan Bloedel		Vancouver	A	Imperial
	Crofton	B	BC Forest Products		Vancouver	A	Imperial
18	Bamberton	B	BC Cement		Vancouver	Maj A	Canadian Coast Guard
	Duncan	C	BC Petroleum Assoc.		Vancouver	C	Shell
	Ganges	B	BC Petroleum Assoc.		Vancouver	B	Gulf
19	Victoria	A	BC Petroleum Assoc.		Vancouver	B	Gulf
	Victoria	Maj A	Canadian Coast Guard		Abbotsford	B	Prov. Emerg. Prog.
	Victoria	B	National Defence				
	Victoria	B	Inst. of Ocean Sciences				
	Victoria	C	BC Petroleum Assoc.				
	Victoria	C	Provincial Emerg. Prog.				
	Victoria	C	BC Petroleum Assoc.				
	Victoria	B	BC Petroleum Assoc.				

possibility of developing a more explicit and comprehensive equipment response evaluation system for B.C.; a summary description of her analysis is provided in Appendix VII.) The equipment relative availability rating method used in this report was developed on a Fisheries Statistical Area basis for three classes of spill: minor (less than 10 000 Imperial gallons), moderate (10 000 to 100 000 Imperial gallons) and major (more than 100 000 Imperial gallons). Table 2 shows equipment relative availability values for the coast together with scaled to 100 ratings for the three classes of spills.

The procedure for deriving the ratings was first to assign a relative point value to each of the four spill package sizes based on estimates from personnel in the Environmental Protection Service, the Canadian Coast Guard and the BCPA. The relative values agreed upon were as follows: "Major A" package - 100; "A" package - 40; "B" package - 20; and "C" package - 4.

Secondly, these values were considered to decrease in relation to the distance each type of package had to be moved to a spill site: "Major A" packages - 10% per 50 nautical miles; "A" packages - 10% per 20 nautical miles; "B" packages - 10% per 10 nautical miles; and "C" packages - not worth moving.

In application of these factors to a minor spill, the total equipment rating for a particular area was calculated solely from values for that area under the assumption that a minor spill would dissipate before any distant equipment could be delivered. Moderate spill values were derived by summing all area response values to a particular area with a boosting of that area's own base value by a factor of three. (The boost factor took into account that, for a moderate spill, immediate deployment of equipment has a far greater effect in minimizing damages than does transported equipment.) Major spill values for each area were determined by summing all area response values relative to a particular area.

The results by Fisheries Statistical Area for the three classes of spill - minor, moderate and major - are presented in Table 2.

TABLE 2 CLEANUP EQUIPMENT RELATIVE AVAILABILITY RATINGS

	Fisheries Statistical Area	Minor Spill Values	Scaled to 100 Ratings	Moderate Spill Values	Scaled to 100 Ratings	Major Spill Values	Scaled to 100 Ratings
(1)	North Coast Queen Charlottes	20	3	168	7	128	12
(2W)	West Coast Queen Charlottes	20	3	126	5	86	8
(2E)	East Coast Queen Charlottes	4	1	130	5	122	12
(3)	Stewart	4	1	132	5	124	12
(4)	Prince Rupert	148	20	447	18	151	15
(5)	Principe/Grenville Channels	*	*	127	5	127	12
(6)	Kitimat	24	3	220	9	172	17
(7)	Bella Bella	*	*	173	7	173	17
(8)	Bella Coola	20	3	227	9	187	18
(9)	Rivers Inlet	*	*	224	9	224	22
(10)	Smith Inlet	*	*	244	10	244	24
(11)	Scott Islands	*	*	264	10	264	26
(12)	Port Hardy/Alert Bay	24	3	350	14	302	29
(13)	Campbell River	88	12	687	27	511	50
(14)	Courtenay/Comox	4	1	613	25	605	59
(15)	Toba Inlet	40	5	619	25	539	52
(16)	Powell River/Sechelt	24	3	843	34	795	77
(17)	Nanaimo/North Gulf Islands	180	24	1 346	54	986	96
(18)	South Gulf Islands	44	6	1 013	41	925	90
(19)	Victoria/Esquimalt	212	29	1 215	49	791	77
(20)	Juan de Fuca Strait	*	*	555	22	555	54
(21-22)	Nitinat	*	*	480	19	480	47
(23)	Barkley Sound	134	18	845	34	577	56
(24)	Clayoquot Sound	*	*	536	22	536	52
(25)	Nootka Sound/Esperanza Inlet	4	1	287	12	287	28
(26)	Kyuquot Sound	*	*	234	9	234	23
(27)	Quatsino Sound	80	11	436	17	276	27
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	732	100	2 492	100	1 028	100

* No designated cleanup equipment package.

The Vancouver area evidently has the highest equipment relative availability rating for response to any size of spill. Other areas have significantly lower relative ratings for minor spills. The southeast portion of Vancouver Island appears to be the area second-best equipped and situated to handle moderate and major spills. (It is essential to recognize that these ratings are relative; they in no way reflect any absolute level of cleanup effectiveness.)

4 MANPOWER

The cleanup of oil spills tends to be labour intensive, largely owing to the inability of mechanized equipment to operate under difficult, specialized conditions and because of potential environmental damage from heavy machinery. With labour costs usually constituting the major expense in cleanup operations, manpower training, efficiency and availability become important factors for consideration.

The object of this chapter is to review general manpower requirements for oil spills and to describe available manpower sources on the B.C. coast. No effort is made to statistically analyze either skilled or unskilled manpower regional availability.

4.1 Manpower Requirements at Oil Spills

With the majority of minor marine oil spills in B.C. having occurred in proximity to oil storage facilities, the limited cleanup manpower required usually has been provided by the agency or company responsible for the accident. However, on the basis of past cleanups of moderate spills, it is questionable whether sufficient trained or unskilled manpower has been available or properly utilized.

A review of regional and national records, including NATES, indicated that the data available were insufficient to explicitly determine appropriate numbers of individuals or man-days in relation to spill sizes. In an effort to obtain at least some indication of this relationship, United States Coast Guard records (Pollution Incident Reporting System - PIRS) were summarized for 1977, the most recent year on computer record. For that year, there was a wide range of manpower responses to marine oil spills, depending on area sensitivity and degree of cleanup; in some cases, no effort at all was expended, while in one extreme case, over 1300 man-days were incurred in the cleanup of only a minor event. However, in general, U.S.C.G. records averaged some 500 man-days for minor spills (less than 10,000 gallons), 1,000 man-days for moderate spills (10,000-100,000 gallons) and insufficient data for major spills (over 100,000 gallons).

A variety of international and national events also were reviewed, e.g. Amoco Cadiz, France: 6 500 people of which 5 000 were military; Mizushima, Japan: 200 000 workers of which about 8 000 were full-time; Nepco 140 barge, Ontario: 700 individuals; Kurdistan, East Coast Canada: 400 workers plus C.C.G. supervisory staff; Vanlene, B.C.: 120 people; and Irish Stardust, B.C.: 84 local persons plus Clean Seas crew and government personnel.

In summary, these historical figures along with U.S.C.G. data suggest 100 men or 500 man-days are common for minor spills; twice that for moderate spills; and some one hundred times that for major events. It is important to recognize that these figures can vary appreciably depending upon the material spilled, size and location of spill, weather and sea conditions, shoreline configuration, environmental factors, degree of cleanup desired and manpower availability.

On the basis of these numbers and in consideration of the manpower availability in B.C. as described in the following sections, it is evident that for minor spills, and in some cases for moderate ones, sufficient manpower exists on the West Coast, provided it is effectively coordinated. However, this is not the case for larger moderate or major spills, particularly in terms of trained personnel in remote areas.

4.2 Manpower Sources

Information on the training, availability and distribution of skilled manpower on the coast was obtained through questionnaires submitted to industry and government agencies. In addition, field visits to oil transfer and storage locations provided opportunities to interview those responsible for the care and operation of spill cleanup equipment.

Manpower requirements for spill containment and recovery can be categorized into two main types. The first is that of specifically trained or skilled personnel such as operators of specialized equipment (e.g., skimmers and dispersant applicators) and persons trained in the supervision of field operations. The second category is unskilled labour which includes operators of such standard equipment as heavy earth machines, pumps and boats.

4.2.1 Trained Manpower. In the private sector, the petroleum industry has developed a comprehensive program of training courses including the Petroleum Industry Training Service (PITS). Individual companies and the British Columbia Petroleum Association are involved in the training of members' agents, Burrard Clean contractor employees and refinery and distribution workers. Generally, these courses are also open to representatives of other industries and government agencies. Several forest companies have provided training opportunities to employees, particularly those at cleanup equipment storage locations. Although most activities are restricted to personnel at pulp mills, at least one firm has extended its program to logging areas.

The two largest tug and barge companies have trained personnel on their staffs as part of their involvement in oil spill cleanup contracting. In addition, crews of tugs engaged in towing oil products barges are familiar with cleanup procedures for minor spills that occur during fuel transfer. Other companies with trained personnel include B.C. Hydro and Power Authority, B.C. Ferry Corporation, B.C. Railway Company, several chemical firms and a mining operation.

With respect to government agencies, the Canadian Coast Guard has developed an experienced staff for response to oil spills from vessels. Skilled personnel range from operators of specialized recovery equipment to lead agency supervisors. Environment Canada complements the Coast Guard with individuals experienced in environmental protection and trained in organizing cleanup equipment placement for maximum protection of sensitive areas. These individuals also have the expertise for overall supervision of oil spill operations.

The Department of National Defence participates in contingency planning and has trained cleanup personnel for spills from some military bases and operations. In the event of a major spill, a large contingent of skilled and unskilled military manpower could be made available to the lead agency On-Scene-Commander.

The Provincial Emergency Program, with responsibility for coordinating municipal emergency response, has trained over 150 individuals from local governments in basic oil spill containment and recovery techniques and is in an excellent position to further encourage and extend such training.

The distribution of trained manpower in coastal B.C. largely corresponds to major equipment depots. Site visits by researchers of this report have indicated that personnel at some of the smaller facilities were poorly trained or inexperienced in the effective positioning of booms or the operating of skimmers.

4.2.2 Unskilled Manpower. Oil spill response on the B.C. coast invariably requires the services of machine operators and manual labourers. During past spills from industrial facilities, companies have demonstrated a willingness to divert as many employees as necessary from their regular duties to effect a cleanup. It is not uncommon on isolated parts of the coast for firms to volunteer manpower and equipment to other parties affected by a spill; in many areas this may be the only source of labour.

Canada Manpower has responsibility for organizing volunteer manpower. This includes providing wages, workers compensation, civil liability and administrative supervision for volunteers who express a willingness to work with cleanup crews.

Should further unskilled manpower be required, as in the event of a major spill, the Provincial Emergency Program Act provides the B.C. government with the authority to conscript necessary personnel for emergency cleanup. Similar authority exists for the Canadian Coast Guard. However, neither agency has thus far resorted to this alternative.

Availability of manpower in the unskilled labour and equipment operator category is mostly in accordance with the distribution of coastal population. On this basis, there are three main manpower regions: the Vancouver/Victoria/Nanaimo triangle; the inner coast north to Port Hardy; and, apart from such centres as Prince Rupert, remote areas of the north coast.

The Vancouver/Victoria/Nanaimo triangle is the only region where manpower is readily available without severe logistics problems.

North of this to Port Hardy, access to the the coast becomes increasingly more difficult, the local availability of labour is limited and logistics problems proportionately increase. From Port Hardy northwards to Prince Rupert, there is basically no large local manpower capability. Any major spill would require significant backup from other areas. The west coast of Vancouver Island is somewhat more self-sufficient with several large settlements.

5 OIL SPILL RELATIVE RISK POTENTIAL

For the purposes of this study, oil spill relative risk potential is defined as the possibility of future oil spills on a comparative geographic basis throughout the B.C. coast; it does not represent a mathematical probability figure. It was determined through analysis of historical accidents in West Coast waters in conjunction with marine traffic densities and oil products handling frequencies. Historical accidents were summarized using Department of Environment and Department of Transport data on slick incidents of all sizes, significant spill events and vessel casualties. Marine traffic densities covered every category of marine vessel including recreational craft, commercial fishing boats, freighters, tugs and barges. Oil products handling frequencies (i.e., annual frequencies of visits) were determined for product transfers at both terminals and ship bunkerings.

The following sections detail the specific methodology and data sources for each of these components. Included also are data summaries in cartographic and tabular form. The last section of the chapter discusses the interrelationships amongst the principal parameters and derives a final oil spill relative risk rating for each Fisheries Statistical Area.

5.1 Historical Accidents

As mentioned in the preceding, historical accidents were considered in terms of slick incidents of all sizes, significant spill events and vessel casualties.

5.1.1 Slick/Spill Incidents (1974-78). This report defines a slick as visible evidence of oil on water, regardless of extent or composition. Observations of such occurrences which have been reported to Environment Canada are termed "slick incidents". Data on the history of slick incidents on the West Coast were derived from Environmental Emergencies Branch, Environment Canada, Pacific Region, log books for 1974 - 1978 inclusive. These were on an incident basis only, without regard to slick size or type of oil product. Although data were carefully reviewed to avoid duplication, some of the reported incidents could have been false as field checks were not undertaken in every instance. From 1974 through 1977, the annual numbers of slicks reported were in the order of 200, but by 1978 the number had risen to 300 plus, in part owing to improved communications within the slick reporting network and with the general public.

Total incidents by location for the 1974 to 1978 period are shown in Figure 3, while Table 3 summarizes the number of incidents by Fisheries Statistical Area. Slick distribution on the map indicates that by far the greatest number of incidents have been reported in the Howe Sound/Vancouver/Fraser River/Boundary Bay area, suggesting both the high usage of those waters and a sizable reporting public. Victoria incidents can be viewed on a similar basis. Numerous slicks have been directly associated with industrial activities, particularly those of the pulp and paper industry at Powell River, Port Mellon, Woodfibre, Nanaimo, Crofton, Tahsis and Port Alberni. Many minor slicks of either gasoline or diesel have been reported for small boat facilities such as False Creek and Coal Harbour. Data for more northerly portions of the coast suggest both the absence of observers and a lower intensity of shipping and industrial activity. However, local concentrations of slick incidents are evident for Prince Rupert, Kitimat, Port Hardy, Alert Bay, Campbell River and Courtenay/Comox.

Environmental Emergencies Branch files were analyzed further for sources and causes of slick incidents. Although a number of the incidents from 1974 to 1978 were simply reports of slicks on water with no identifiable source or cause, the majority of "verifiable" incidents could be accurately categorized. The two most commonly identified sources, with similar frequencies of occurrence, were tank farms and marine vessels. The two dominant slick causes, again approximately equally apportioned, were oil products transfers (largely owing to human error) and bilge pumpings.

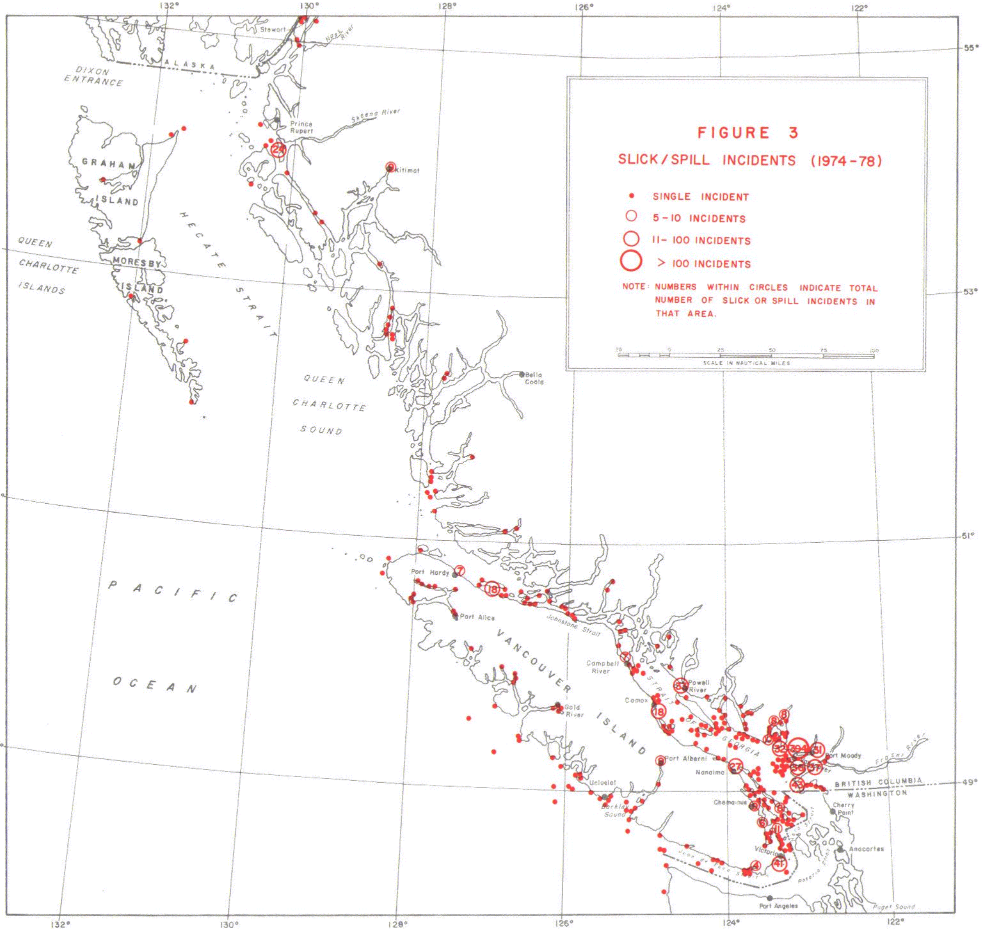

FIGURE 3
SLICK/SPILL INCIDENTS (1974-78)

TABLE 3 SLICK/SPILL INCIDENTS (1974-78)

Fisheries Statistical Area		Slick Incidents (1974-78)	Scaled to 100 Ratings
(1)	North Coast Queen Charlottes	2	1
(2W)	West Coast Queen Charlottes	2	1
(2E)	East Coast Queen Charlottes	3	1
(3)	Stewart	6	1
(4)	Prince Rupert	31	5
(5)	Principe/Grenville Channels	4	1
(6)	Kitimat	15	2
(7)	Bella Bella	2	1
(8)	Bella Coola	2	1
(9)	Rivers Inlet	4	1
(10)	Smith Inlet	4	1
(11)	Scott Islands	2	1
(12)	Port Hardy/Alert Bay	41	6
(13)	Campbell River	21	3
(14)	Courtenay/Comox	36	6
(15)	Toba Inlet	36	6
(16)	Powell River/Sechelt	24	4
(17)	Nanaimo/North Gulf Islands	55	9
(18)	South Gulf Islands	43	7
(19)	Victoria/Esquimalt	48	8
(20)	Juan de Fuca Strait	14	2
(21-22)	Nitinat	5	1
(23)	Barkley Sound	20	3
(24)	Clayoquot Sound	11	2
(25)	Nootka Sound/Esperanza Inlet	13	2
(26)	Kyuquot Sound	1	1
(27)	Quatsino Sound	11	2
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	637	100

5.1.2 Significant Spill Events (1973-78). The slick incidents identified in the previous section included reports of all incidents that have been relayed to the Environmental Protection Service by other agencies, industry or the public. They ranged in size and impact from unimportant slicks to oil spills with the potential for significant impact on the environment. This section selectively concentrates on the latter category, that is, where either the size of a spill or its effect on the marine environment denotes its significance. Generally, a spill that exceeds one metric tonne (about 250 Imperial gallons) is deemed to be significant wherever it occurs; smaller spills are considered significant only when posing a threat to an especially sensitive area, e.g. a bird sanctuary or an estuary. Data were extracted from a computer summary program known as the National Analysis of Trends in Emergencies System (NATES) for 1973 to 1978 inclusive. Records prior to 1973 were far too sparse and inconsistent to reliably interpret. Figure 4 portrays the distribution and sizes of significant spills on the West Coast for that period; Table 4 summarizes the information by Fisheries Statistical Area.

It is apparent from Figure 4 that the greatest concentration of such spills has been in the vicinity of Vancouver, including the Fraser River. Multiple significant events have also occurred near Victoria, Nanaimo, Port Alberni, Powell River, Port Hardy and Prince Rupert.

More detailed examination of NATES records suggested that the majority of significant events have been in proximity to terminal facilities from either a vessel or the facility itself. A very small portion of incidents has originated from vessels in open waters.

To approximate the potential sizes and numbers of future spills, the 1973 to 1978 significant spill events were divided into categories as follows:

Minor.......(less than 10 000 Imperial gallons)....143 occurrences
Moderate....(10 000 to 100 000 Imperial gallons).... 7 occurrences
Major.......(more than 100 000 Imperial gallons)... no occurrences
(The Canadian West Coast has never experienced a major oil spill.)

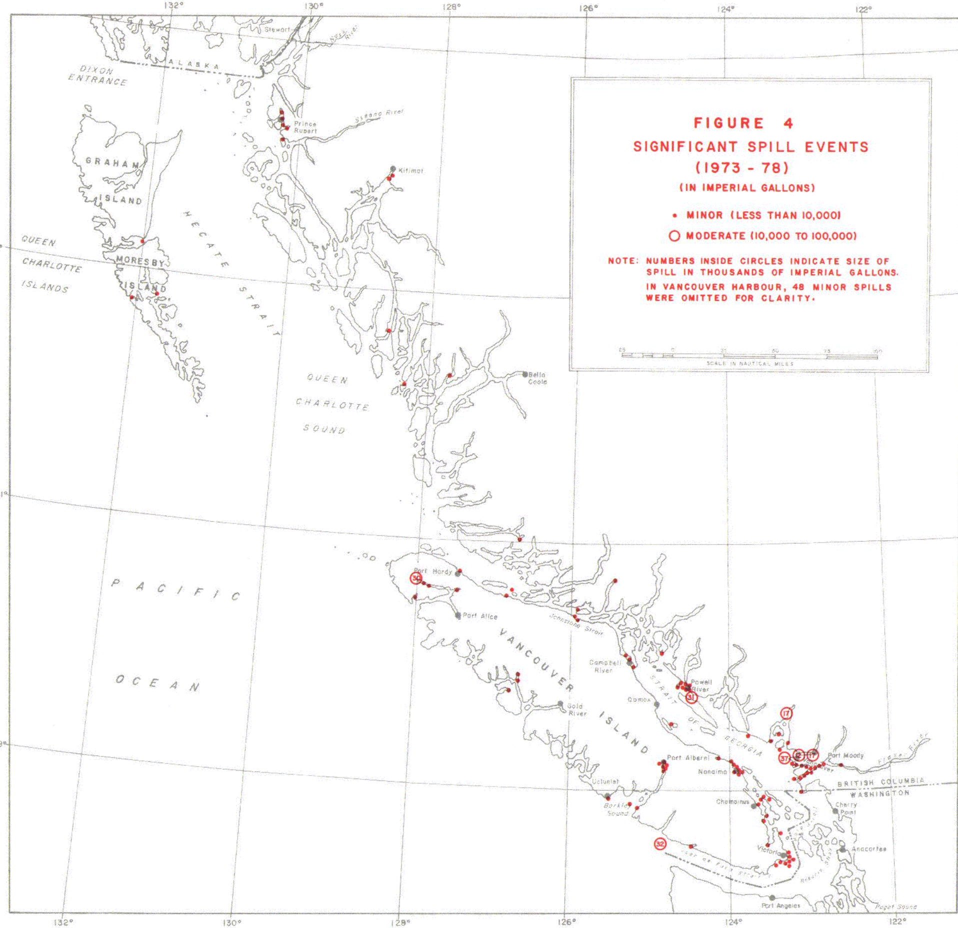

FIGURE 4
SIGNIFICANT SPILL EVENTS
(1973 - 78)
(IN IMPERIAL GALLONS)

- • MINOR (LESS THAN 10,000)
- ○ MODERATE (10,000 TO 100,000)

NOTE: NUMBERS INSIDE CIRCLES INDICATE SIZE OF SPILL IN THOUSANDS OF IMPERIAL GALLONS. IN VANCOUVER HARBOUR, 48 MINOR SPILLS WERE OMITTED FOR CLARITY.

TABLE 4 SIGNIFICANT SPILL EVENTS (1973-78)

	Fisheries Statistical Area	Significant Spill Events (1973-78)	Scaled to 100 Ratings
(1)	North Coast Queen Charlottes	0	0
(2W)	West Coast Queen Charlottes	1	1
(2E)	East Coast Queen Charlottes	2	3
(3)	Stewart	0	0
(4)	Prince Rupert	5	7
(5)	Principe/Grenville Channels	0	0
(6)	Kitimat	3	4
(7)	Bella Bella	1	1
(8)	Bella Coola	1	1
(9)	Rivers Inlet	0	0
(10)	Smith Inlet	0	0
(11)	Scott Islands	0	0
(12)	Port Hardy/Alert Bay	4	6
(13)	Campbell River	7	10
(14)	Courtenay/Comox	1	1
(15)	Toba Inlet	1	1
(16)	Powell River/Sechelt	10	14
(17)	Nanaimo/North Gulf Islands	12	17
(18)	South Gulf Islands	4	6
(19)	Victoria/Esquimalt	8	11
(20)	Juan de Fuca Strait	1	1
(21-22)	Nitinat	1	1
(23)	Barkley Sound	8	11
(24)	Clayoquot Sound	1	1
(25)	Nootka Sound/Esperanza Inlet	3	4
(26)	Kyuquot Sound	0	0
(27)	Quatsino Sound	5	7
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	71	100

Although there are inherent limitations in projecting probabilities from such a relatively limited historical data base (because of such variables as improved operating practices and increases in vessel transits), an approximate estimate for B.C. is 25 important minor spills and one moderate spill annually. (This does not take into account possible large spills from crude oil tankers in Puget Sound and Burrard Inlet or the numerous small slicks reported almost daily for Canadian West Coast waters.) In an attempt to ascertain where a spill of major size could happen on the coast, a compilation of maximum storage tank sizes and maximum ship or barge capacities was made by Fisheries Statistical Area. These (excluding crude oil tankers into U.S. ports and those out of Burrard Inlet) are portrayed in Table 5 which clearly indicates that a major spill is possible for any area on the coast (assuming the total loss of contents of a large tank or vessel). It should be recognized, however, that the probability of such an accident is statistically remote.

5.1.3 Vessel Casualties (1975-78). Vessel casualty information for British Columbian waters was compiled from Marine Casualty System data of the Department of Transport for 1975 to 1978. Accident locations are shown in Figure 5 by cause; Table 6 summarizes the number of casualties by Fisheries Statistical Area. This factor was included to assist in determining whether some portions of the coast display high casualty potential from navigational hazard, shipping density or human error, on the assumption that the potential for oil pollution in these high casualty areas is also higher.

The distribution of vessel casualty incidents follows the major north/south shipping routes. The greatest proportion of recorded accidents have been in Vancouver Harbour and the Fraser River where grounding was the dominant cause, although collision, fire/explosion, foundering/ sinking and striking also occurred. Grounding was again the major cause through the Gulf Islands, Clayoquot Sound, Johnstone Strait, north of Queen Sound and in the approaches to Prince Rupert. Barkley Sound has experienced a proportionately higher number of founderings/ sinkings and fire/explosions.

TABLE 5 MAXIMUM SPILL SIZE POSSIBILITIES*

	Fisheries Statistical Area	Storage Tank Maximum Sizes (000's Imp. gals.)	Ship/Barge Maximum Capacities (000's Imp. gals.)
(1)	North Coast Queen Charlottes	120	1400
(2W)	West Coast Queen Charlottes	700	310
(2E)	East Coast Queen Charlottes	40	1400
(3)	Stewart	2100	1400
(4)	Prince Rupert	2800	1400
(5)	Principe/Grenville Channels	10	1400
(6)	Kitimat	350	1400
(7)	Bella Bella	10	1400
(8)	Bella Coola	1300	1400
(9)	Rivers Inlet	220	1400
(10)	Smith Inlet	10	1400
(11)	Scott Islands	20	1400
(12)	Port Hardy/Alert Bay	160	1400
(13)	Campbell River	2100	1400
(14)	Courtenay/Comox	210	1400
(15)	Toba Inlet	30	1400
(16)	Powell River/Sechelt	2800	1400
(17)	Nanaimo/North Gulf Islands	2800	1400
(18)	South Gulf Islands	2800	1400
(19)	Victoria/Esquimalt	1400	1400
(20)	Juan de Fuca Strait	40	1400
(21-22)	Nitinat	10	1750
(23)	Barkley Sound	1400	1750
(24)	Clayoquot Sound	80	1400
(25)	Nootka Sound/Esperanza Inlet	3500	1400
(26)	Kyuquot Sound	10	1400
(27)	Quatsino Sound	3500	1400
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	4200	1400

* This table excludes consideration of crude oil supertankers bound for U.S. ports and the occasional crude oil tanker shipping out of Burrand Inlet.

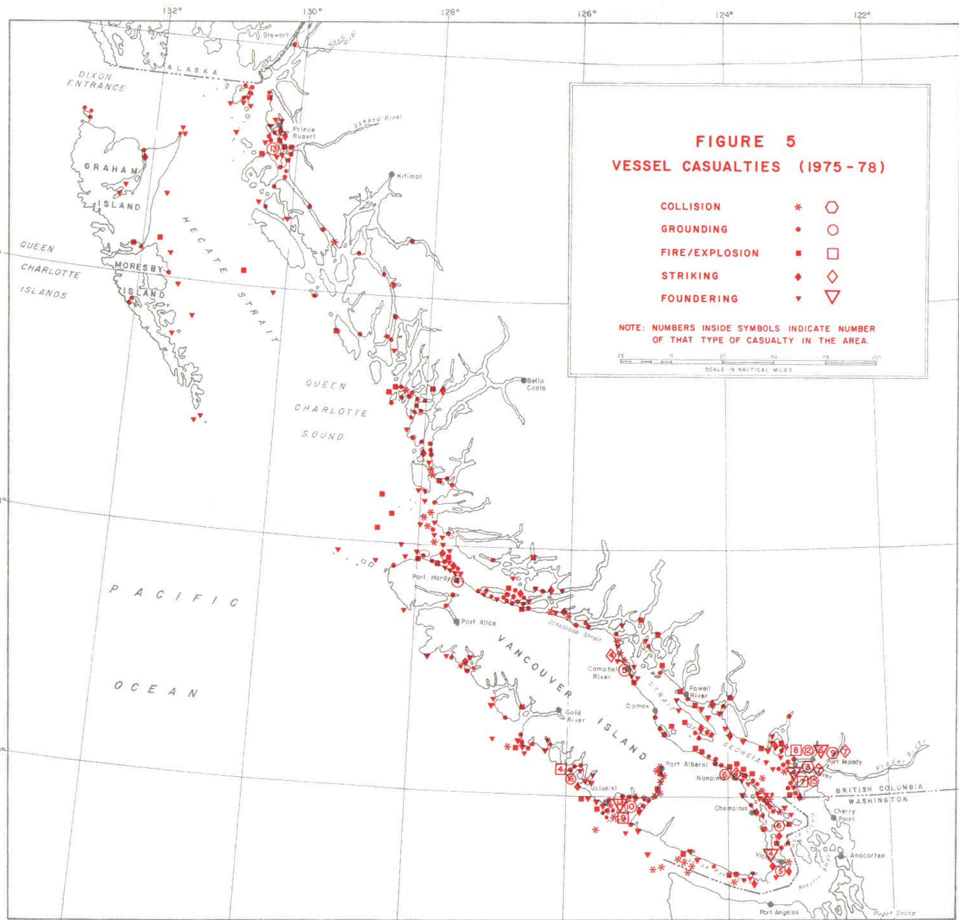
FIGURE 5
VESSEL CASUALTIES (1975-78)
COLLISION
GROUNDING
FIRE/EXPLOSION
STRIKING
FOUNDERING
NOTE: NUMBERS INSIDE SYMBOLS INDICATE NUMBER OF THAT TYPE OF CASUALTY IN THE AREA.
SCALE IN NAUTICAL MILES
DIXON ENTRANCE
ALASKA
Stewart
Prince Rupert
Kitimat
GRAHAM ISLAND
HECATE STRAIT
QUEEN CHARLOTTE ISLANDS
MORESBY ISLAND
QUEEN CHARLOTTE SOUND
Bella Coola
PACIFIC OCEAN
Port Hardy
Port Alice
Johnstone Strait
VANCOUVER ISLAND
Campbell River
Powell River
Comox
Gold River
STRAIT OF GEORGIA
Port Alberni
Ucluelet
Nanaimo
Chemainus
Port Moody
Fraser River
BRITISH COLUMBIA
WASHINGTON
Cherry Point
Anacortes
Port Angeles
Puget Sound

TABLE 6 VESSEL CASUALTIES (1975-78)

Fisheries Statistical Area		Total Vessel Casualties (1975-78)	Scaled to 100 Ratings
(1)	North Coast Queen Charlottes	9	9
(2W)	West Coast Queen Charlottes	2	2
(2E)	East Coast Queen Charlottes	10	10
(3)	Stewart	6	6
(4)	Prince Rupert	37	36
(5)	Principe/Grenville Channels	9	9
(6)	Kitimat	12	12
(7)	Bella Bella	20	19
(8)	Bella Coola	7	7
(9)	Rivers Inlet	6	6
(10)	Smith Inlet	7	7
(11)	Scott Islands	16	15
(12)	Port Hardy/Alert Bay	49	47
(13)	Campbell River	24	23
(14)	Courtenay/Comox	10	10
(15)	Toba Inlet	4	4
(16)	Powell River/Sechelt	15	14
(17)	Nanaimo/North Gulf Islands	35	34
(18)	South Gulf Islands	14	13
(19)	Victoria/Esquimalt	16	15
(20)	Juan de Fuca Strait	15	14
(21-22)	Nitinat	5	5
(23)	Barkley Sound	58	56
(24)	Clayoquot Sound	38	37
(25)	Nootka Sound/Esperanza Inlet	11	11
(26)	Kyuquot Sound	8	8
(27)	Quatsino Sound	3	3
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	104	100

Throughout the coast, the most common vessel type associated with accidents has been commercial fishing boats, although tug and barge incidents have not been uncommon in Alberni Inlet, Vancouver Harbour and the Fraser River. Freighter incidents have been few.

5.2 Marine Traffic Densities

There are three distinct groupings of marine traffic on the West Coast: large vessels (crude oil and oil products tankers, deepsea freighters, tugs/barges and ferries), commercial fishing boats and recreational craft. These contribute to oil spills through cargo loss, bunker fuel loss, bilge pumping and accidental or intentional deck spills. For the purposes of this report, values for each vessel category were extracted from independent sources on a Fisheries Statistical Area basis. Their combination into a composite marine traffic density rating was developed through assigned weightings and final summation of the weighted numbers, as detailed later in this section.

Large vessel traffic density was determined from a shipping density survey undertaken by Captain G. Veres for Environment Canada in 1978. His report compiled information from Statistics Canada, the States of Alaska and Washington, the National Harbours Board and Commissions, Canadian and U.S. Coast Guards, several ferry companies and a large assortment of marine carriers. The data were presented for 1977 traffic movements, particularly in eight high density areas. The more significant routes identified by the study are illustrated in Figure 6; Table 7 provides scaled ratings of the number of transits in each Fisheries Statistical Area. These ratings show clearly the high degree of use by large vessels of Vancouver and the Fraser River. Other more secondary zones include the Gulf Islands, where ferry traffic is extremely heavy, and Johnstone Strait, the main transit zone for Inside Passage vessels.

Data on the number of commercial fishing boats in each Fisheries Statistical Area were obtained from Small Craft Harbour Summary tables for 1976 that list the number of commercial vessels (with and without landings) registered by home port. These are summarized and

FIGURE 6

PRINCIPAL VESSEL TRAFFIC ROUTES (1977)

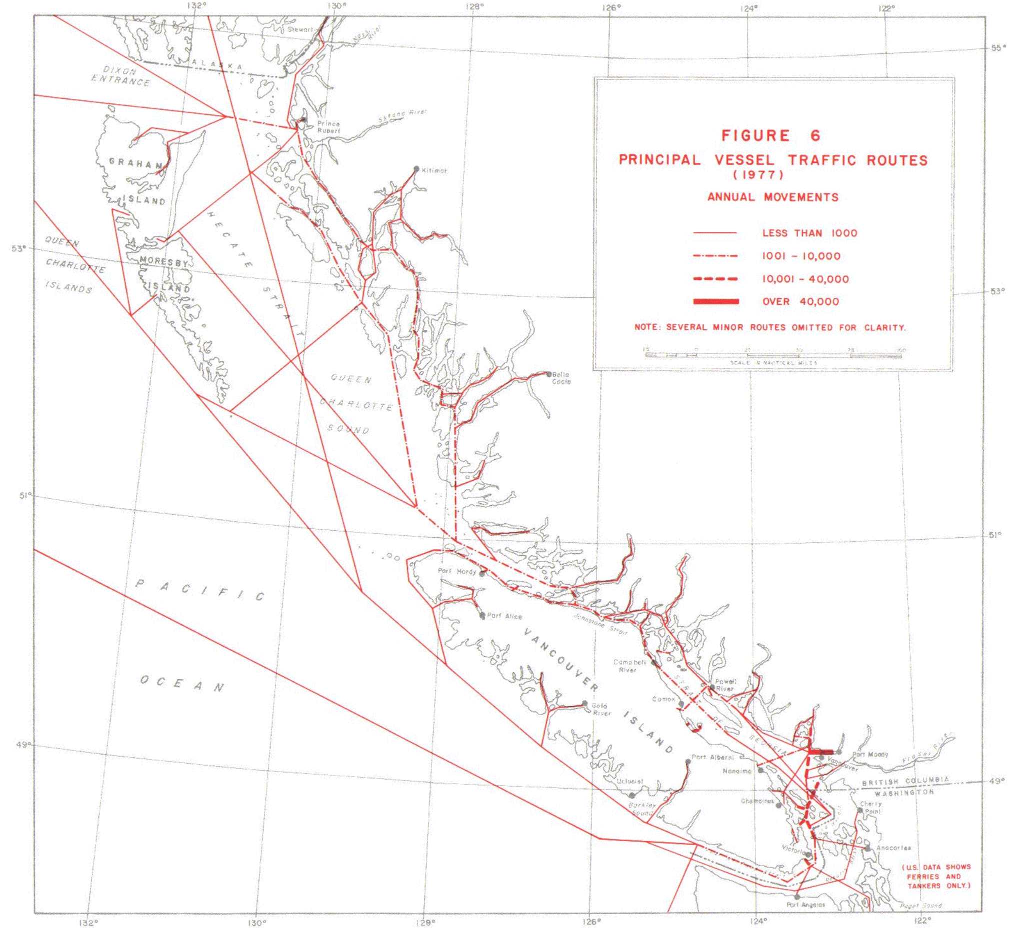

TABLE 7 MARINE TRAFFIC DENSITIES

	Fisheries Statistical Area	Large Vessel Transits (000's)	Scaled to 100	Registered Commercial Fishing Boats	Scaled to 100	Licensed Recreational Craft	Scaled to 100	Total Weighted Values Scaled to 100
(1)	North Coast Queen Charlottes	4	3	78	2	214	1	3
(2W)	West Coast Queen Charlottes	1	1	0	0	72	1	2
(2E)	East Coast Queen Charlottes	4	3	62	2	112	1	3
(3)	Stewart	2	2	88	3	360	1	3
(4)	Prince Rupert	6	5	675	21	1 486	2	11
(5)	Principe/Grenville Channels	6	5	28	1	235	1	4
(6)	Kitimat	8	7	49	1	1 207	2	6
(7)	Bella Bella	6	5	96	3	4	1	5
(8)	Bella Coola	7	6	134	4	219	1	6
(9)	Rivers Inlet	6	5	7	1	9	1	4
(10)	Smith Inlet	7	6	0	0	0	0	5
(11)	Scott Islands	8	7	0	0	0	0	6
(12)	Port Hardy/Alert Bay	14	12	272	8	844	1	11
(13)	Campbell River	29	24	337	10	2 479	4	19
(14)	Courtenay/Comox	35	29	272	8	3 854	6	21
(15)	Toba Inlet	1	1	58	2	0	0	2
(16)	Powell River/Sechelt	14	12	276	8	3 996	7	11
(17)	Nanaimo/North Gulf Islands	29	24	458	14	4 993	8	20
(18)	South Gulf Islands	49	41	144	4	3 626	6	28
(19)	Victoria/Esquimalt	20	17	448	14	12 480	21	16
(20)	Juan de Fuca Strait	20	17	91	3	386	1	13
(21-22)	Nitinat	2	2	5	1	0	0	3
(23)	Barkley Sound	4	3	327	10	3 465	6	6
(24)	Clayoquot Sound	3	3	138	4	121	1	4
(25)	Nootka Sound/Esperanza Inlet	1	1	22	1	516	1	2
(26)	Kyuquot Sound	1	1	19	1	0	0	2
(27)	Quatsino Sound	2	2	37	1	219	1	3
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	120	100	3 284	100	60 749	100	100

scaled to 100 in Table 7 which clearly indicates the overriding importance of Vancouver and the Fraser River. Much more secondary locales include Prince Rupert, Nanaimo/Gulf Islands and Victoria.

Data on the number of recreational boats in each Fisheries Statistical Area were extrapolated from studies of the Fisheries Management Service of the former Department of Fisheries and Environment for 1974 through 1976. Tabulation and scaling to 100 of these numbers are presented in Table 7 which shows the high significance of Howe Sound to Boundary Bay and the lesser importance of Victoria.

Through a concensus of researchers familiar with coastal traffic patterns and the significance of oil spills in relation to vessel classes, the three marine traffic density factors were weighted as follows: large vessels - 1.0, commercial fishing boats - 0.5, and recreational craft - 0.1. The weighted values for each of the three factors were added together, with the sum scaled to 100 for a summary marine traffic density rating as shown in the final column of Table 7.

5.3 Oil Products Annual Frequencies of Visits

Evidence from a variety of studies suggests that a significant percentage of oil spills are related to oil products handling at coastal storage locations and ship bunkerings. Because such information has never been previously determined for the whole B.C. coast, a major portion of the research effort in this study was directed to this risk component. Frequency numbers were compiled from responses to questionnaires sent out to representatives of federal and provincial government agencies and industry, including petroleum, forestry, fishing, mining and marine transport. As questionnaire returns were 100%, it was possible to crosscheck the responses for redundancies and omissions. For the purposes of this study, frequencies of visits included refinery loadings of oil products and bunkerings in Vancouver, plus unloadings at coastal storage locations.

Frequencies were tabulated from the returns for the most recently available year from each questionnaire respondent. They are shown by site in Figure 7 and in tabular form in Table 8 where scaled to

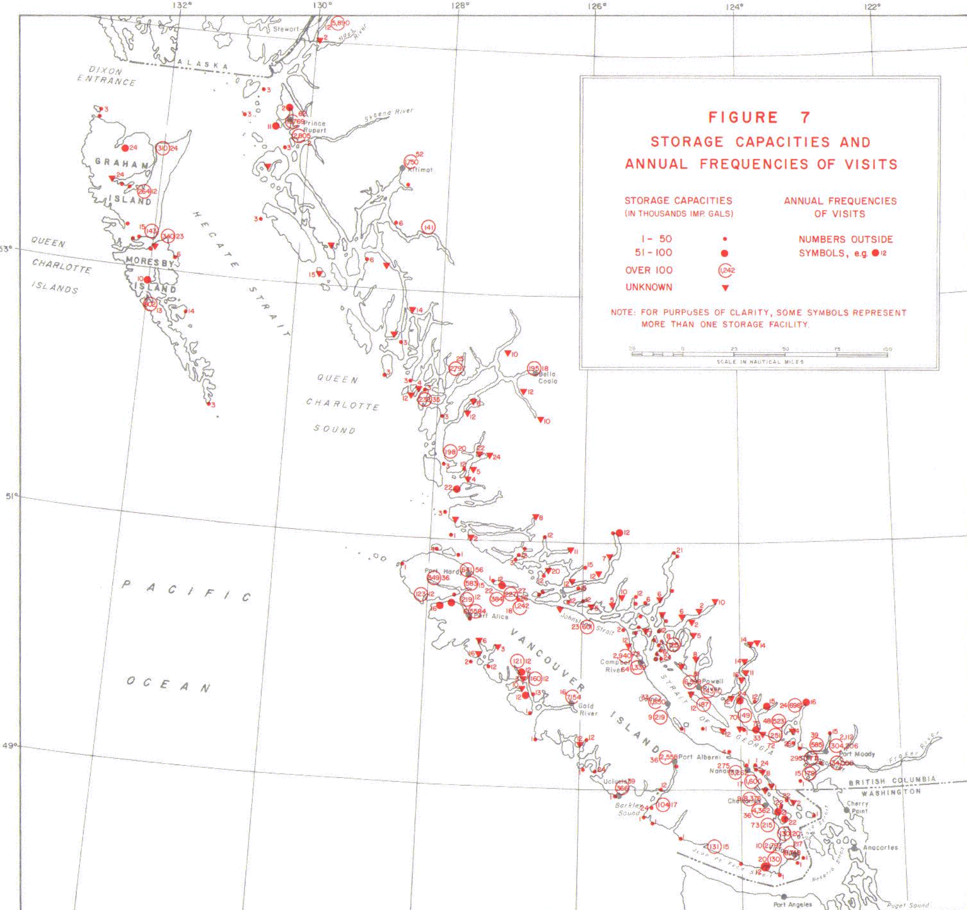
FIGURE 7
STORAGE CAPACITIES AND
ANNUAL FREQUENCIES OF VISITS
STORAGE CAPACITIES
(IN THOUSANDS IMP. GALS)
1 - 50
51 - 100
OVER 100
UNKNOWN
ANNUAL FREQUENCIES
OF VISITS
NUMBERS OUTSIDE
SYMBOLS, e.g. 12
NOTE: FOR PURPOSES OF CLARITY, SOME SYMBOLS REPRESENT
MORE THAN ONE STORAGE FACILITY.
SCALE IN NAUTICAL MILES
DIXON ENTRANCE
ALASKA
Stewart
Prince Rupert
Skeena River
Kitimat
GRAHAM ISLAND
MORESBY ISLAND
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
Bella Coola
Port Hardy
Port Alice
PACIFIC OCEAN
VANCOUVER ISLAND
Johnstone Strait
Campbell River
Gold River
Powell River
STRAIT OF GEORGIA
Port Alberni
Nanaimo
Ucluelet
Barkley Sound
Chemainus
Port Moody
Fraser River
BRITISH COLUMBIA
WASHINGTON
Cherry Point
Anacortes
Port Angeles
Puget Sound
Juan de Fuca Strait
Rosario Strait
132°
130°
128°
126°
124°
122°
55°
53°
51°
49°

TABLE 8 HANDLING FREQUENCIES/ANNUM

	Fisheries Statistical Area	Annual Frequencies of Visits	Scaled to 100 Ratings
(1)	North Coast Queen Charlottes	87	3
(2W)	West Coast Queen Charlottes	26	1
(2E)	East Coast Queen Charlottes	58	2
(3)	Stewart	14	1
(4)	Prince Rupert	86	3
(5)	Principe/Grenville Channels	3	1
(6)	Kitimat	79	3
(7)	Bella Bella	77	3
(8)	Bella Coola	121	5
(9)	Rivers Inlet	89	3
(10)	Smith Inlet	3	1
(11)	Scott Islands	11	1
(12)	Port Hardy/Alert Bay	349	14
(13)	Campbell River	268	11
(14)	Courtenay/Comox	44	2
(15)	Toba Inlet	146	6
(16)	Powell River/Sechelt	462	18
(17)	Nanaimo/North Gulf Islands	386	15
(18)	South Gulf Islands	173	7
(19)	Victoria/Esquimalt	220	9
(20)	Juan de Fuca Strait	57	2
(21-22)	Nitinat	2	1
(23)	Barkley Sound	129	5
(24)	Clayoquot Sound	51	2
(25)	Nootka Sound/Esperanza Inlet	91	4
(26)	Kyuquot Sound	39	2
(27)	Quatsino Sound	83	3
(28-29)	Howe Sound/Vancouver/Fraser River/ Boundary Bay	2548	100

100 ratings are also presented. Questionnaire returns indicated very little seasonal variation in the number of port visits throughout the coast. By far the greatest amount of oil products handling occurs in Vancouver as a result of vessel loadings at petroleum refining locations near Port Moody (the only coastal refinery locale in British Columbia) and bunkerings of deepsea vessels. Significantly less important, but still constituting about a once-daily handling of large volume oil products, are Powell River, the northern Gulf Islands including Nanaimo, and the northeast end of Vancouver Island. Campbell River and Victoria represent somewhat lower rates of products transfer. Much of the distribution on the coast (other than for Vancouver) is related to the forest industry, particularly logging camps and pulp mills.

Figure 7 also shows storage capacities for the reader's general interest. (Throughput figures were not readily available for reasons of confidentiality on the part of several respondents.) Owing to the complexity of determining spill risk associated with storage capacity (because of such difficult to quantify information as tank condition, design and size), this study did not statistically analyze this parameter. However, sufficient information was available to identify maximum storage tank sizes for every Fisheries Statistical Area; this was used as a basis for estimating maximum spill size as described in an earlier section.

5.4 Summary Interpretation of Oil Spill Relative Risk Factors

Earlier sections of this chapter developed ratings for certain parameters that presumably relate to oil spill relative risk. These parameters included slick incidents of all sizes, significant spill events, vessel casualties, marine traffic densities and oil products annual frequencies of visits. Each has been documented in the literature to have a statistically significant relationship with spill risk probability. In an effort to simplify final analysis and the identification of critical areas in this study, a number of linear correlations were computed for pairs of these parameters. On the assumption that the history of actual slick incidents is a reliable indicator of spill risk potential, each of the other four factors were correlated against it. The correlation coefficients which resulted were as follows:

slick incidents to significant spill events.........0.98
slick incidents to vessel casualties................0.78
slick incidents to marine traffic densities.........0.96
slick incidents to handling frequencies
(or annual frequencies of visits).................0.98

(A second set of correlations was also run which used parameter ratings factored by the nautical square miles within each Fisheries Statistical Area; the results of this second method were comparable to those obtained above.)

The results, apart from the correlation between slick incidents and vessel casualties, show a high statistical significance. (A more critical analysis of vessel casualty data suggested that a disproportionately high incidence of commercial fishing boat accidents in Barkley Sound did not involve fuel spillage; this anomaly sufficiently explained the lower correlation with slick incidents.) The remaining correlations appear to confirm the hypothesis that slick incident history can be used as the principal indicator of oil spill relative risk potential for the B.C. coast. Implied here is that the incidence of spills has historically occurred in close proximity to storage and transfer facilities and in association with marine traffic, confirming results of an earlier section of this chapter. Moreover, the correlation between slick incidents and significant spill events suggests that areas of frequent slicks on the coast are also those which have the higher frequencies of large spills.

In the following chapter, slick incident relative ratings therefore are used as the key risk-indicating parameter for the identification of critical areas.

6 IDENTIFICATION OF CRITICAL AREAS

A main objective of Year I of the West Coast Oil Spill Countermeasures Study was the identification of critical areas at risk from marine oil spills. Of the risk factors and countermeasures systems described earlier, two were selected as indicators of critical areas in this chapter. These are slick incident ratings (Chapter 5) and cleanup equipment relative availability ratings (Chapter 3) for all sizes of spills (minor, moderate and major). They are arrayed by Fisheries Statistical Area in Table 9; in each case the figures which are incorporated are the appropriately adjusted, weighted and scaled to 100 ratings from the earlier chapters. Contingency plans, action plans and manpower factors were not selected as indicators; it was assumed that they bear a close relationship to cleanup equipment relative availability.

Obviously any fully comprehensive study of marine oil spills should include evaluation of the natural resources which are at risk. In the early part of Year I of this study, an extensive effort was made to compile and analyse such environmental information but, owing to large data deficiencies and lack of a sufficiently sophisticated interpretative methodology, the effort had to be abandoned. As a result, this report emphasizes spill risk in terms of the historical evidence of spill occurrence and the relative availability of coastal cleanup equipment to respond to spill events.

Table 9, which itemizes these factors by Fisheries Statistical Area, shows that much of the B.C. coast has little history of slick incidents, but also a limited local ability for spill response. This is clearly the case for the Queen Charlotte Islands, the central and northern coast (apart from Prince Rupert) and the west coast of Vancouver Island.

However, with respect to areas with slick incident ratings from 4 to 9 (representing primarily the Strait of Georgia region), the equipment relative availability ratings for Port Hardy/Alert Bay in

TABLE 9 CRITICAL AREA IDENTIFICATION FACTORS

	Fisheries Statistical Area	Slick Incident Ratings	Cleanup Equipment Relative Availability Ratings: Minor Spill	Moderate Spill	Major Spill
(1)	North Coast Queen Charlottes	1	3	7	12
(2W)	West Coast Queen Charlottes	1	3	5	8
(2E)	East Coast Queen Charlottes	1	1	5	12
(3)	Stewart	1	1	5	12
(4)	Prince Rupert	5	20	18	15
(5)	Principe/Grenville Channels	1	*	5	12
(6)	Kitimat	2	3	9	17
(7)	Bella Bella	1	*	7	17
(8)	Bella Coola	1	3	9	18
(9)	Rivers Inlet	1	*	9	22
(10)	Smith Inlet	1	*	10	24
(11)	Scott Islands	1	*	10	26
(12)	Port Hardy/Alert Bay	6	3	14	29
(13)	Campbell River	3	12	27	50
(14)	Courtenay/Comox	6	1	25	59
(15)	Toba Inlet	6	5	25	52
(16)	Powell River/Sechelt	4	3	34	77
(17)	Nanaimo/North Gulf Islands	9	24	54	96
(18)	South Gulf Islands	7	6	41	90
(19)	Victoria/Esquimalt	8	29	49	77
(20)	Juan de Fuca Strait	2	*	22	54
(21-22)	Nitinat	1	*	19	47
(23)	Barkley Sound	3	18	34	56
(24)	Clayoquot Sound	2	*	22	52
(25)	Nootka Sound/Esperanza Inlet	2	1	12	28
(26)	Kyuquot Sound	1	*	9	23
(27)	Quatsino Sound	2	11	17	27
(28-29)	Howe Sound/Vancouver/Fraser River Boundary Bay	100	100	100	100

* No designated cleanup equipment package.

particular appear incongruous. Although that area has a moderate slick incident rating, its spill response capability is low as it is largely dependent upon outside sources of equipment. Moreover, the region is undergoing an industrial and population expansion with corresponding increases in oil products throughput and deliveries. One possible mitigative measure for this situation, as verified through a sensitivity check of equipment availability ratings, would be the placement of an "A" or "Major A" package at Port Hardy or Alert Bay.

The area encompassing Howe Sound/Vancouver/Fraser River/Boundary Bay has both the highest slick incident rating and the highest equipment relative availability rating. As these do not portray absolute values but rather the relative relationships within each category, it cannot be stated unequivocably that the Vancouver area is self-sufficient in cleanup equipment. In fact, based on historical cleanup records, it appears that Vancouver and environs are capable of handling only minor and some moderate spills; it follows that the region is ill-equipped for major events such as spillage from a U.S. crude oil tanker. Accordingly, this important issue has been identified as a primary Year II topic for detailed evaluation.

In summary, specific critical areas identified in this review include Howe Sound/Vancouver/Fraser River/Boundary Bay zone (for a major spill) and Port Hardy/Alert Bay (for moderate spills). Further consideration could be given to Prince Rupert as the only significant centre on the north coast for spill response. Several of these areas will be more comprehensively evaluated in Year II of the West Coast Oil Spill Countermeasures Study.

SELECTED BIBLIOGRAPHY

Barr, L., Oil Pollution: Potential, Prevention, Preparedness, discussion paper prepared for Islands Trust, Victoria, B.C. (1978).

Battelle Memorial Institute, Oil Spillage Study Literature Search and Critical Evaluation for Selection of Promising Techniques to Control and Prevent Damage, Richland, Wa. (1967).

Bawden, C. and D. Green, Alert Bay Oil Spill, An Interim Report on a Study of the Degradation of Bunker C Oil Left to Weather on a Semi-exposed Beach, Canada, Department of Environment, Marine Sciences Directorate, Victoria, B.C. (1973).

Beak Consultants et al, Field Evaluation of the Super Seahawk and Marco Class V Oil Skimmers, EPS 4-EC-78-2, prepared for Department of Environment, Environmental Emergency Branch, Ottawa, Ont. (1978).

British Columbia Railway, Dangerous Commodities, Emergency Response Information, Vancouver, B.C. (1975).

Burrard Clean Oil Spill Cooperative, Oil Spill Response Plan, Vancouver, B.C. (1979).

Canada, Department of Environment, Alert Bay Oil Spill, unpublished Interim Report, Environmental Protection Service, Vancouver, B.C. (1973).

Canada, Department of Environment, Departmental Contingency Plan, Environmental Protection Service, Environmental Emergency Branch, Ottawa, Ont. (1973).

Canada, Department of Environment, Guidelines for Industrial Questionnaires, Planning, Policy and Analysis Branch, Policy Analysis and Development Division, Ottawa, Ont. (1978).

Canada, Department of Environment, The Impact and Cleanup of Oil Spills on Canadian Shorelines: A Summary, EPS 6-EC-78-1, Environmental Protection Service, Ottawa, Ont. (1978).

Canada, Department of Environment, Oil Spill Countermeasures for Burrard Inlet, Centre of Spill Technology, Burlington, Ont., and Environmental Emergency Branch, Vancouver, B.C. (1974).

Canada, Department of Environment, Potential Pacific Coast Oil Ports: A Comparative Environmental Risk Analysis, Pacific and Yukon Region, Estuary Working Group, Vancouver, B.C. (1978).

Canada, Department of Environment, Selection Criteria and Laboratory Evaluation of Oil Spill Sorbents, EPS 4-EC-76-5, Environmental Protection Service, Ottawa, Ont. (1976).

Canada, Department of Fisheries and the Environment, Annual Summary of B.C. Catch Statistics, Fisheries and Marine Service, Pacific Region, Vancouver, B.C. (1972-1976).

Canada, Department of Fisheries and the Environment, Number of Commercial Vessels (With and Without Landings) by Statistical Area, unpublished table, Small Craft Harbours Branch, Vancouver, B.C. (1976).

Canada, Department of Fisheries and the Environment, Sailing Directions: British Columbia Coast, Vol. I, Southern Portion, Marine Sciences Directorate, Canadian Hydrographic Service, Ottawa, Ont. (1976).

Canada, Department of Fisheries and the Environment, Sailing Directions: British Columbia Coast, Vol. II, Northern Portion, Marine Sciences Directorate, Canadian Hydrographic Service, Ottawa, Ont. (1977).

Canada, Department of Transport, Marine Contingency Plan - Western Region, Canadian Coast Guard, Ottawa, Ont. (1978).

Canada, Department of Transport, Task Force - Operation Oil (Clean-up of the 'Arrow' Oil Spill in Chedabucto Bay) - Volume I, Information Canada, Ottawa, Ont. (1970).

Canada, Department of Transport, West Coast Fishing Vessels Casualties Inquiry - Executive Summary, Marine Investigations Branch, Ottawa, Ont. (1975).

Canada/United States Joint Working Group on Great Lakes Pollution, Joint Canada/United States Marine Pollution Contingency Plan for Spills of Oil and Other Noxious Substances, prepared for the International Joint Commission, Ottawa, Ont. (1978).

Canadian Permanent Committee on Geographic Names, Gazetteer of Canada, British Columbia, Ottawa, Ont. (1966).

Chan, E. Kam-Yung, Oil Spill Countermeasure Optimization Feasibility Study, prepared for Canada, Department of Environment, Environmental Protection Service, Vancouver, B.C. (1979).

Chevron Canada Limited, Oil Spill Contingency Plan, Vancouver, B.C. (1978).

Coupal, B., Use of Peat Moss in Controlled Combustion Technique, EPS 4-EE-72-1, prepared for Department of Environment, Environmental Emergency Branch, Ottawa, Ont. (1972).

De Leuw Cather, Canada Ltd., Arctic Oil Spill Countermeasures Logistics Study: Summary Report, EPS 3-EC-78-8, prepared for Department of Environment, Environmental Protection Service, Ottawa, Ont. (1978).

Dick, J.G. and A. Feldman, Efficiency and Retentivity Testing and Performance of Sinking Agents in the Removal of Oil Spills, EPS 3-EC-75-1, prepared for Department of Environment, Environmental Protection Service, Ottawa, Ont. (1975).

Dillingham Environmental Company, Systems Study of Oil Spill Cleanup Procedures: Volumes I and II, Industry Response Plan, prepared for Committee for Air and Water Conservation, American Petroleum Institute, Washington, D.C. (1970).

Envirogenics Company, A Feasibility Analysis of Incinerator Systems for Restoration of Oil Contaminated Beaches, prepared for Water Quality Office, Environmental Protection Agency, Washington, D.C. (1970).

Fiddy, K. et al, The Juan de Fuca Oil Spill Contingency Study, Canadian Local Initiatives Program, Vancouver, B.C. (1974).

Fingas, M.F. and C.W. Ross, An Oil Spill Bibliography, March 1975 to December 1976, EPS 3-EC-77-10, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1977).

Fingas, M.F. et al, The Basics of Oil Spill Cleanup, Canada, Department of Environment, Environmental Protection Service, Hull, Quebec (1979).

Fraser, J.P., Oil Spill Countermeasures - A Rational System for Selection and Sizing of Equipment, paper 184, 1979 Oil Spill Conference, Los Angeles, Ca. (1979).

Gulf Canada Ltd., Major Marine Oil Spill Contingency Plan, Calgary, Alberta (1977).

Harrison, M., Resident Boating on the West and Northeast Coast of Vancouver Island, Technical Report Series /PAC/T-75-13, Canada, Department of Environment, Fisheries and Marine Service, Pacific Region, Southern Operations Branch, Vancouver, B.C. (1975).

Hum, S. and D. Fletscher, Oil Spill Reporting and Cleanup Procedures in the Straits of Georgia and Juan de Fuca, Lower Fraser River and Burrard Inlet, unpublished MBA Executive Program Report, Simon Fraser University, Burnaby, B.C. (1978).

Hum, S. et al, Erawan Oil Spill, unpublished document, Canada, Department of Environment, Environmental Protection Service, Vancouver, B.C. (1974).

Hum, S. et al, Oil and Chemical Spill Countermeasures Map Series, Canada, Department of Environment, Environmental Protection Service, Vancouver, B.C. (1975).

Imperial Oil Limited, The Pacific Region Major Oil Spill Response Team, Vancouver, B.C. (1978).

Ince, J.G., Environmental Law: A Study of Legislation Affecting the Environment of British Columbia, University of British Columbia, Centre for Continuing Education, Vancouver, B.C. (1976).

Inter-Governmental Maritime Consultative Organization, Manual on Oil Pollution - Practical Information on Means of Dealing with Oil Spillages, London, England (1972).

Lem, W.J., Shoreline Protection and Restoration, Canada, Department of Environment, Environmental Protection Service, Centre of Spill Technology, Burlington, Ont. (1974).

Lloyd's Register of Shipping Trust Corporation, Register of Ships, Crawley, England (1974).

Logan, W.J. et al, Report on Mechanical Oil Recovery Equipment, Canada, Department of Environment, Environmental Emergency Branch, Ottawa, Ont. (1975).

McGuire, B., Environmental Atlas of Coastal Labrador, Canada, Department of Environment, Environmental Protection Service, Halifax, Nova Scotia (1978).

MacKay, D. and W. Harrison, Oil and the Canadian Environment, Proceedings of the Conference, 16 May, 1973, sponsored by the Institute of Environmental Sciences and Engineering, University of Toronto, Toronto, Ont. (1973).

MacKay, D. and P.J. Leinonen, Mathematical Model of the Behaviour of Oil Spills on Water with Natural and Chemical Dispersion, EPS 3-EC-77-19, prepared for Department of Environment, Environmental Emergency Branch, Toronto, Ont. (1977).

MacKay, D. and A. Wilks, A Statistical Analysis of Oil Spills in Canada, Research Report No. 50, Joint Program, University of Toronto and York University, Toronto, Ont. (1978).

MacMillan Bloedel Limited, Oil Containment Practices, Vancouver, B.C. (1974).

Mahr, D. et al, Oil Spill Surveillance System Study, EPA R2-73-215, prepared for Office of Research & Monitoring, U.S. Environmental Protection Agency, Washington, D.C. (1973).

Maine Port Authority, Testing and Evaluation of Oil Spill Recovery Equipment, prepared for Water Quality Office, Environmental Protection Agency, Washington, D.C. (1970).

Mallard, D. et al, Oil Problems Investigation, prepared for Canadian Scientific Pollution and Environment Control Society by students under the Canadian Opportunities for Youth Programme, Vancouver, B.C. (1971).

Marine Management Services, Guide for the Formation of Oil Spill Cooperatives, prepared for the Committee for Air and Water Conservation, American Petroleum Institute, Washington, D.C. (1972).

Mos, G. and M. Harrison, Resident Boating in Georgia Strait, Technical Report Series #PAC/T-74-5, Canada, Department of Environment, Fisheries and Marine Service, Pacific Region, Southern Operations Branch, Vancouver, B.C. (1974).

Mullen, R.M., Observations of High Seas Oil Containment (HSOC) Barrier Field Test, U.S. Coast Guard, R & D Center, Avery Point, Groton, Connecticut (1978).

Nicol, C.W., The Mizushima Oil Spill - A Tragedy for Japan and a Lesson for Canada, EPS 8-EC-76-2, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1976).

Oceanographic Institute of Washington, Risk Analysis of the Oil Transportation System, prepared for the Oceanographic Commission of Washington, Seattle, Washington (1972).

Owens, E.H., Coastal Environments of Canada: The Impact and Cleanup of Oil Spills, EPS 3-EC-77-13, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1977).

Owens, E.H., Coastal Environments, Oil Spills and Clean-up Programmes in the Bay of Fundy, EPS 3-EC-77-9, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1977).

Owens, E.H., The Restoration of Beaches Contaminated by Oil in Chedabucto Bay, Nova Scotia, Manuscript Series No. 19, Department of Energy, Mines and Resources, Ottawa, Ont. (1971).

Paish, Howard & Associates Limited, The West Coast Oil Threat in Perspective - An Assessment of the Natural Resource, Social and Economic Impacts of Marine Oil Transport in Southwest B.C. Coastal Waters, prepared for Canada, Department of Environment, Vancouver, B.C. (1972).

Petroleum Association for Conservation of the Canadian Environment, A Guide to Shoreline Protection, Cleanup and Restoration Following Oil Spills, prepared for Canada, Department of Fisheries and the Environment, Halifax, Nova Scotia (1977).

Petroleum Association for Conservation of the Canadian Environment, Offshore Marine Oil Spill Contingency Plan, Report No. 75-10, Ottawa, Ont. (1975).

Petroleum Association for Conservation of the Canadian Environment, Oil Tanker Operations Re Oil Spill Containment and Cleanup, Bulletin No. 11, Ottawa, Ont. (1979).

Petroleum Association for Conservation of the Canadian Environment, Report of the Bulk Plants Task Force, Ottawa, Ont. (1974).

Petroleum Industry Training Service, Oil Spill Containment and Recovery, Edmonton, Alberta (1977).

Purves, W.F., and L.B. Solsberg, Pumps for Oil Spill Cleanup, EPS 4-EC-78-3, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1978).

Quayle, D.B., The Vanlene Oil Spill, Manuscript Report Series No. 1289, Fisheries Research Board of Canada, Nanaimo, B.C. (1974).

Reif, G., Fact Book on West Coast Oil Transport Proposals, Telkwa Foundation, Telkwa, B.C. (1977).

Ross, S.L. and M. Fingas, Spill Technology Newsletter, EPS 3-EC-78-1, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1977).

Ruel, M. et al, Guidelines on the Use and Acceptability of Oil Spill Dispersants, EPS 1-EE-73-1, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1973).

Shell Canada Limited, Corporate Contingency Plan for a Major Spill, Vancouver, B.C. (1976).

Sittig, M., Oil Spill Prevention and Removal Handbook, Pollution Technology Review No. 11, Noyes Data Corporation, Park Ridge, New Jersey (1974).

Slaght, L.E. et al, M.V. Vanlene Oil Pollution Operation, unpublished document, Canada, Department of Transport, Canadian Coast Guard, Pacific Region, Victoria, B.C. (1972).

Smith, M.F., Planning, Equipment and Training for Oil Pollution Control, prepared for Slickbar Inc., Southport, Ct. (1975).

Solsberg, L.B. and G.D. Tidmarsh, Field Evaluation of Oil Mop and Preheat Unit, EPS 4-EC-77-12, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1977).

Solsberg, L.B. et al, Field Evaluation of Seven Oil Spill Recovery Devices, EPS 4-EC-76-3, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1976).

Texaco Canada Limited, Oil Spill Contingency Plan, Vancouver, B.C. (1978).

Thompson, A.R., West Coast Oil Ports Inquiry / Statement of Proceedings, Vancouver, B.C. (1978).

Thomson, K.P.B. et al, Remote Sensing of Oil Spills, EPS 3-EE-74-2, Canada, Department of Environment, Environmental Emergency Branch, Ottawa, Ont. (1974).

URS Research Company, Evaluation of Selected Earthmoving Equipment for the Restoration of Oil-Contaminated Beaches, prepared for the Federal Water Quality Administration, Department of the Interior, Washington, D.C. (1970).

Vanderkooy, N. et al, Evaluation of Oil Spill Barriers and Deployment Techniques for the St. Clair-Detroit River System, EPS 4-EC-76-4, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1976).

Vandermeulen, J.H., and C.W. Ross, Assessment of Cleanup Tests of an Oiled Salt Marsh - The Golden Robin Spill in Miguasha, Quebec, Part I, EPS 8-EC-77-1, Canada, Department of Environment, Environmental Protection Service, Ottawa, Ont. (1977).

van Gent, P.A., Oil Spill Control Manual, prepared for Shell International under direction of Interfunctional Working Group on Oilspill Control, London, England (1974).

Veres, G.A., Shipping Density Survey, Project 607-116, prepared for Department of Environment, Environmental Protection Service, Vancouver, B.C. (1978).

Warren Spring Laboratory, Oil Pollution of the Sea and Shore: A Study of Remedial Measures, prepared for the British Department of Trade and Industry, London, England (1972).

ACKNOWLEDGEMENTS

Completion of Year I of the West Coast Oil Spill Countermeasures Study required substantial professional, technical and clerical effort. The authors extend their gratitude for the enthusiastic assistance of the following individuals:

ENVIRONMENTAL PROTECTION SERVICE	Bob Beach, Deb Eakins, Keith Hebron, Suling Hum, Lance McLeod, Ken Meikle, John Millen, Steve Pond, Sy Ross, Laurie Solsberg
DEPARTMENT OF FISHERIES & OCEANS	Rick Harbo, Mary Harrison, Phil Meyer, Allison Rhodes
CANADIAN COAST GUARD	John Hopps, Eric Snow, Ian Young
PROVINCIAL EMERGENCY PROGRAM	Barney Lane
POLLUTION CONTROL BRANCH	Lanny Hubbard
B.C. PETROLEUM ASSOCIATION	Martyn Green
COUNCIL OF FOREST INDUSTRIES	Pat Hrushowy
COUNCIL OF MARINE CARRIERS	Pete Woodward
SEASPAN INTERNATIONAL	Des Sjoquist
CONSULTANTS	Eugenia Chan, George Veres
STUDENT ASSISTANTS	Elaine Horricks, Curt Millar, Bill Thompson
DRAFTING	Britt Lindstrom, Lillian Pearson
TYPING	Kim Arthan, Maggie Brown, Colleen Manness

APPENDIX I

LIST OF STUDY PARTICIPANTS

The following companies, industrial associations and government agencies gave generously of their time in providing data and guidance for Year I of the West Coast Oil Spill Countermeasures Study. In particular, Mr. Pat Hrushowy of the Council of Forest Industries, Mr. Martyn Green of the British Columbia Petroleum Association and Mr. Peter Woodward of the Council of Marine Carriers assisted considerably in coordinating data requests within their respective industries. It is largely owing to their efforts that a 100 percent return on questionnaires was realized.

APPENDIX I LIST OF STUDY PARTICIPANTS

Chevron Canada Limited
Gulf Canada Limited
Imperial Oil Limited
Shell Canada Limited
Texaco Canada Incorporated

British Columbia Forest Products Limited
Canadian Cellulose Company Limited
Canadian Forest Products Limited
Crown Zellerbach Canada Limited
Eurocan Pulp and Paper Company Limited
MacMillan Bloedel Limited
Ocean Falls Corporation
Rayonier Canada (B.C.) Limited
Tahsis Company Limited
Weldwood of Canada Limited

North Arm Transportation Limited
Rivtow Straits Limited
Seaspan International Company Limited
Shields Navigation Company Limited
White Pass and Yukon Corporation Limited

Aluminum Company of Canada Limited
British Columbia Cement Limited
Erco Industries Limited
FMC of Canada Limited
Hooker Chemicals Limited
Utah Mines Limited
Westfrob Mines Limited

British Columbia Hydro and Power Authority
British Columbia Packers Limited
British Columbia Railway Company

Burrard Clean Oil Spill Cooperative
Clean Seas Canada Limited
Morris Industries Limited
Versatile Environmental Products Company

British Columbia Petroleum Association
Council of Forest Industries
Council of Marine Carriers

Canadian Coast Guard
Canadian Wildlife Service
Department of Fisheries and Oceans
Department of National Defence
Emergency Planning Canada
Fraser River Harbour Commission
Nanaimo Harbour Commission
National Harbours Board
North Fraser Harbour Commission
Port Alberni Harbour Commission

British Columbia Pollution Control Branch
Provincial Emergency Program

City of Vancouver
Port of Vancouver

APPENDIX II

SAMPLE QUESTIONNAIRE

The following questionnaire is representative of those submitted to oil users on the B.C. coast. As a substantial amount of information was secured from other sources, questionnaire formats varied from industry to industry so as to minimize duplication.

APPENDIX II SAMPLE QUESTIONNAIRE

MARINE TRANSPORTATION, HANDLING AND STORAGE OF OIL PRODUCTS QUESTIONNAIRE

I Oil Products

A) What petroleum products do you ship and/or receive by marine water transport and in what volumes per annum?

B) Please state mode of transport, point of origin, and destination, with appropriate volumes per annum.

C) What is the frequency of delivery?

D) If your company forwards petroleum products to outlying operations by marine transportation, please list type of vessel used, quantity and point of origin and destination.

E) Please list location(s) of petroleum storage facilities and their capacity, if over 1000 gallons.

II Contingency Planning for Potential Marine Spills

A) Prevention

1) What preventative/safety features do you have at your operations and oil storage points; e.g. dykes, drains, overflow shutoffs or indicators?

2) Is access to your oil storage sites controlled or supervised?

3) Describe briefly the spill prevention procedures you employ while loading or unloading petroleum products from marine vessels.

B) Cleanup Procedures

1) Do you have emergency contact people available? If so, please list with contact telephone numbers.

2) Do you have trained personnel available for cleanup operations?

3) Do the number of available cleanup personnel vary by shift or season?

4) Are you involved in trial cleanup exercises? Please describe briefly.

5) Have you established locations and procedures for spilt product disposal? Please specify.

6) How do you dispose of waste oil products?

C) Equipment Inventory

1) Is cleanup equipment stored centrally or is it located at branch operations?

2) What cleanup equipment do you have available at your operations? Please indicate type, quantity, model number and location for each of the following categories:
   a) Spill prevention and removal equipment - (skimmers, pumps, oil containment boom, sorbents, etc.)

   b) Transportation vehicles - (marine, land, air)

   c) Communications equipment

   d) Human protection equipment

3) What is stored for emergencies and what is used daily?

4) Do you periodically test stored equipment? How often?

5) Is this equipment loaned or used by others off-site?

6) What are your procedures to obtain its use?

7) Are you a member of an equipment or cleanup co-op?

Past Oil Spills

1) What do you view as the most prominent cause of oil spills in your industry?

2) What equipment and procedures have you found most effective for spill cleanup?

APPENDIX III

FIELD INVESTIGATIONS

APPENDIX III FIELD INVESTIGATIONS

During the course of Year I of the West Coast Oil Spill Countermeasures Study, site visits were made to 32 coastal facilities (Table 10). The purposes of the visits were to:

1. Examine the location and condition of spill cleanup equipment;
2. Uncover previously unknown equipment sources;
3. Advise companies on spill potential and appropriate countermeasures.

Facilities were selected to represent every major type of industrial oil user on the B.C. coast. No company was singled out for specialized inspection; instead, emphasis was placed on an industry-by-industry overview. Site visits were carried out on the basis of several fundamental criteria previously originated by the study team. These included:

1. <u>Accessibility</u>
   Is the equipment always available?
   Is it loaded for shipment?
   Is it easily accessible?
   Are operators on 24-hour standby?

2. <u>Condition of Equipment</u>
   What is the condition of equipment?
   How modern is it?
   How often is equipment maintained?
   Is it protected from the elements?
   Is it field tested?

TABLE 10 FIELD INVESTIGATION FACILITY LOCATIONS

Facility	Location
British Columbia Cement Company Limited	Bamberton
Canadian Forest Products Limited	Beaver Cove
Department of National Defence	Comox
Nanaimo Harbour Commission	Nanaimo
Texaco Canada Limited	"
MacMillan Bloedel Limited	Port Alberni
Rayonier Canada (B.C.) Limited	Port Alice
Canadian Cellulose Company Limited	Port Edward
Imperial Oil Limited	Port Hardy
Chevron Canada Limited	"
Small Craft Harbour	"
Shell Canada Limited	Port McNeil
Canadian Forest Products Limited	Port Mellon
MacMillan Bloedel Limited	Powell River
Canadian Coast Guard	Prince Rupert
Imperial Oil Limited	"
Small Craft Harbour	"
Imperial Oil Limited	Royston
Utah Mines Limited	Rupert Inlet
Burrard Clean Oil Spill Cooperative	Vancouver
Clean Seas Canada Limited	"
Morris Industries Limited	"
Shell Canada Limited	"
Versatile Environmental Products Company	"
Canadian Coast Guard	"
Gulf Oil Limited	"
Imperial Oil Limited	"
Canadian Coast Guard	Victoria
Texaco Canada Limited	"
Burrard Yarrows Corporation	"
Imperial Oil Limited	Westview
Shell Canada Limited	"

3. <u>Infra-structure</u>

   What air, sea and land transportation facilities are locally available?

   Are communications adequate?

   Are food, lodging and services available?

4. <u>Contingency Planning</u>

   Do contingency plans exist?

   Are they up-to-date and complete?

   Are practice sessions held?

5. <u>Manpower</u>

   Are individuals trained in oil spill response?

   Is there a local source of backup labour?

   Does the workforce vary by shift or season?

   Is regular training available?

6. <u>General Knowledge</u>

   Is there awareness of other equipment in the area?

   Is there membership in an equipment co-op?

   Is there personal contact with other equipment managers?

   Have there been formal or informal agreements made for borrowing equipment from other industries in the area?

The majority of facilities visited were assessed as good to excellent by these criteria. Most equipment was in good condition, strategically located and prepared for immediate dispatch to spill sites. Virtually all locations had transportation facilities close by and often were equipped with boats or trucks specifically dedicated to spill response. Facility operators were aware of potential problems and, in most cases, had received training in the use of locally available equipment.

However, several problems were noted, such as:

1. inappropriate storage locations;
2. disorganized storage;
3. cluttered access to equipment;
4. poor access to equipment during non-working hours;
5. insufficient equipment with respect to potential spill size;
6. too little vehicular and cleanup equipment maintenance;
7. lack of cleanup equipment on oil products vessels.

In specific instances where difficulties could easily be rectified, means of doing so were suggested at the time to local operators. Where problem corrections required material resources greater than those locally available, alternative solutions were recommended to parent companies.

Facility Design and Operational Problems

Although site visits were aimed primarily at obtaining a realistic knowledge of spill equipment capability, many potential problems in oil storage and handling systems were observed. These included valves with no locks, rusted pipelines, inadequate dykes, fueling areas with no spill collection devices, oil in the water around docks, pipelines running through dykes, damaged storage tanks and sloppy hook-ups on oil transfer pipes. The potential for oil products spills from such situations was clearly pointed out to facility personnel; however, in many instances, companies were already in the process of upgrading their facilities, eliminating them, or researching ways of updating them.

Responses to questionnaires indicated that a large number of spills are caused by either equipment failure or human error, particularly at marginally operating sites. This suggests the need for development of a comprehensive prevention program to include facility guidelines and inspections by trained staff having the authority to recommend improvements. To date, there is no such program in operation in the province.

APPENDIX IV

CONTINGENCY PLANNING

APPENDIX IV CONTINGENCY PLANNING

The following is a brief itemization of significant aspects of contingency planning including action plans and environmental response concerns.

The essential components of an effective contingency plan are:

1) the organization of the spill response system;
2) the means for assessing spill situations;
3) notification procedures;
4) information on cleanup equipment location and availability;
5) guidelines on the control of spill sources;
6) information on containment, recovery and disposal of spill materials;
7) documentation and cost recovery procedures.

At the specific site/facility level, full implementation in terms of an action plan requires the following:

1) knowledge of local problems and environmental conditions;
2) clear designation of individuals' respective roles and duties for appropriate personnel;
3) precise descriptions of locations, capabilities and limitations of containment and recovery equipment;
4) prearranged use of equipment owned by others in the vicinity;
5) detailed response options and strategies;
6) provision for training programs, field tests and exercises;
7) specifics on local communications;
8) outline of safety procedures to be followed.

For the environmental protection of an area from a spill, plans must:

1) identify high risk areas;
2) describe the behaviour of spilt products with respect to tides, currents and winds;

3) identify and priorize critical environments for protection or write-off;
4) detail means of minimizing damages to resources;
5) set standards for effective cleanup;
6) consider the variety of weather conditions affecting cleanup operations.

APPENDIX V

EQUIPMENT PACKAGES - SAMPLE CONTENTS

APPENDIX V EQUIPMENT PACKAGES - SAMPLE CONTENTS

TYPICAL "MAJOR A" PACKAGE

Mobile operations centre
Transportation-trailers and trucks
Boats, working platforms
Lightering capacity - barges and port-a-tanks
Portable and vessel-mounted skimmers
Oil spill booms, anchors, buoys
Generators, lighting clusters, extensions
Communications equipment - VHF and "walkie-talkies"
Sorbent materials
Dispersants
Beach cleaning equipment
Apparel includes: rubber boots, breast-high waders, jacket and pant sets, gloves, life jackets, goggles, hard hats
Miscellaneous equipment: See separate listing
Accommodation and cooking facilities
Fire extinguishers
Bullhorns
First aid supplies

TYPICAL "A" PACKAGE

Oil spill boom, anchors, buoys
Generator, lighting cluster, extensions
Floating oil skimmer, pump, hose
Communications equipment - "walkie-talkies"
Sorbent materials
Apparel includes: rubber boots, breast-high waders, jacket and pant sets, gloves, life jackets, goggles, hard hats
Miscellaneous equipment: See separate listing
Fire extinguisher
Port-a-tank
Bull horn
First aid kit

TYPICAL "B" PACKAGE

Oil spill boom, anchors, buoys
Sorbent materials
Apparel includes: rubber boots, breast-high waders, jacket and pant sets, gloves, life jackets, goggles, hard hats
Miscellaneous equipment: See separate listing
Fire extinguisher
Port-a-tank
Bull horn
First aid kit

TYPICAL "C" PACKAGE

Sorbent materials
Apparel includes: rubber boots, breast-high waders, jacket and pant sets, gloves, life jackets, goggles, hard hats
Miscellaneous equipment: See separate listing
Fire extinguisher
Port-a-tank
Bull horn
First aid kit

Typical Miscellaneous Equipment

Shovels
Forks
Rakes
Pick
Mattock
Sledge hammer
Axe
Carpenters wrecking bar
Crowbar
Hammers
Flashlights
Broom
Rope
Pliers/cutter
Screwdrivers
Wrenches
Tool box
Hand drill
Wire mesh
Stakes
Tie wire
Explosimeter
Respirator
Chain saw
Rags
Spray pump
Gas cans
Trash hand pump - 20' suction hose, 50' discharge hose

Note: Miscellaneous items are normally packaged in aluminum containers with corner lifting rings, suitable for air, land or water transport.

APPENDIX VI

NATIONAL EMERGENCY EQUIPMENT LOCATOR SYSTEM

APPENDIX VI NATIONAL EMERGENCY EQUIPMENT LOCATOR SYSTEM

The National Emergency Equipment Locator System (NEELS) was set up by Environment Canada for computer inventory of spill cleanup equipment throughout Canada. It was designed for simplicity of information access and storage, to cover a variety of emergency equipment categories, to provide free membership to program participants and to enable a variety of quantitative and geographical analyses to be run. Environment Canada is presently involved with several system changes intended to expand the field selection and clarify listings.

On the West Coast, the Canadian Coast Guard and the B.C. Petroleum Association are two of the larger and more significant members of NEELS. The Council of Forest Industries and the Provincial Emergency Program have been in the process of considering their own memberships, while recent contacts by Environmental Protection Service staff have encouraged the City of Vancouver and B.C. Hydro and Power Authority to investigate the potential of the program for their needs. To date, there have been disappointingly few new members.

One of the important discoveries in Year I of the West Coast Oil Spill Countermeasures Study was that only 45% of coastal spill packages were located on NEELS. Moreover, many of the inventories had not been updated regularly and the available data were frequently sketchy or incorrect. Such problems likely result from the fact that NEELS is a cooperative effort with minimal government supervision and one that is dependent upon the committed involvement of individual organizations. As it is the only nation-wide equipment information coordination system, it appears that if membership is not completely desirable, then at least companies might make the effort to input their inventories as a regional and national courtesy. At the same time, government individuals responsible for program management must consider stricter control over input, membership and updating.

APPENDIX VII

OPTIMIZATION OF SPILL RESPONSE PLANNING

APPENDIX VII OPTIMIZATION OF SPILL RESPONSE PLANNING

Much time and effort can be wasted in attempts to locate and transport cleanup equipment from distant and diverse sites which results in delayed response and more costly cleanups. It is also difficult to estimate and justify equipment allocations without a coastal understanding of countermeasures capabilities.

In acknowledgement of these difficulties and in an effort to more pragmatically comprehend the problem, the Environmental Protection Service contracted with Ms. Eugenia Chan to determine the feasibility of optimizing West Coast countermeasures activities. The objectives of her study were:

- to assess the potential for the application of operational research techniques for improving effectiveness of B.C. oil spill countermeasures;
- to present an implementation outline for two computer models, both based on the relevant techniques and applicable data gathered by staff of the Environmental Protection Service;
- to identify improvement programs and investment schemes for equipment purchasing and allocation, depot locating, manpower and training, etc.;
- to identify the data requirements and data collection methods of an effective countermeasures study.

Ms. Chan's report entitled "Oil Spill Countermeasure Optimization Feasibility Study" presented an outline for using both simulation and linear programming techniques. The allocation of equipment in an optimal fashion on the coast was considered in particular. A direct cost-benefit analysis would not be necessary as the emphasis would be placed on identifying the best ways of managing countermeasures capabilities on the coast through a total cost comparison. The study proposed the building of a pilot model for a specific locality to examine the significance of the information available and to determine the needs for additional data.