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Federal Environmental  
Assessment Review Office

## Sea Island Fuel Barge Facility

Report of the  
Environmental  
Assessment Panel

March, 1989

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# Sea Island Fuel Barge Facility

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March, 1989



**Sea Island Jet Fuel Barge Facility  
Environmental Assessment Panel**

The Honourable Lucien Bouchard  
Minister of the Environment  
House of Commons  
Ottawa, Ontario

The Honourable Benoit Bouchard  
Minister of Transport  
House of Commons  
Ottawa, Ontario

Dear Ministers:

In accordance with the terms of reference issued on February 9, 1988, the Environmental Assessment Panel has completed its review of the jet fuel barge terminal facility on Sea Island that has been proposed to service airlines at Vancouver International Airport. We are pleased to submit this report for your consideration.

Yours sincerely

David W. I. Marshall

Chairman

Sea Island Jet Fuel Barge Facility  
Environmental Assessment Panel

**Canada**

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## EXECUTIVE SUMMARY

In February, 1988, the Minister of the Environment established a three member Environmental Assessment Panel to conduct a comprehensive public review of a proposal by the Vancouver Airport Fuel Facilities Corporation to construct and operate a jet fuel barge terminal on Sea Island in the North Arm of the Fraser River. The proposed facility was to be sited on federal lands under the administration of the North Fraser Harbour Commission. The Panel's terms of reference included a range of issues that went beyond the purely environmental effects of the proposal. In particular, the Panel examined the need for the project, its socio-economic effects, and its economic justification. Alternative arrangements for transporting jet fuel to Vancouver International Airport that could meet current and future aviation jet fuel requirements were also reviewed.

This Panel report is the final stage of the 12 month public review of the proposal. During the course of the review, the Panel gathered information on the environmental, social and economic effects of the proposed project and held two public forums. Following receipt of statements from interested parties, a two-day issues scoping workshop was held in April, 1988 to identify and prioritize important issues. Written submissions addressing these issues were received from the proponent, federal and provincial regulatory agencies, local municipalities, public interest groups, native organizations, concerned citizens and corporate intervenors. Four days of public hearings were held in November, 1988 to allow a full discussion of public concerns about the proposal.

The lower Fraser River and its estuary represent a biologically productive ecosystem of national and international significance. The estuary provides important habitat for a diversity of fish and wildlife species, including some 34 species of marine and freshwater fish. The North Arm of the Fraser River, which is the site of the proposed facility, is used by all five species of Pacific Salmon during their inland spawning and seaward migration cycles. The Fraser River estuary is also the largest and most important area for migratory birds in British Columbia. Extensive marshland habitat, important to both salmon and waterfowl, is located close to the site of the proposed facility.

The Fraser River, including the North Arm, supports a commercial salmon fishery of major economic significance. In addition, the estuary supports important native and sports fishing activities. The resources of the Fraser River are the foundation of the livelihood and culture of the Musqueam Band, whose reserves include land immediately downstream of the proposed facility. In response to the recreational and aesthetic values of the river, land use along the river is now being directed away from industrial uses to include park, recreational, residential and commercial uses. Public access to the water has also increased considerably in recent years and this trend is expected to continue.

During the course of the review, participants raised a variety of concerns about the potential environmental, social and economic effects of the proposed project. Two major concerns raised were:

- the effects of a major spill of jet fuel during transportation to the terminal and/or of chronic spills associated with off-loading of barges at the terminal; and
- the need for the proposed project, given the existing capability to deliver jet fuel to Vancouver International Airport by pipeline from local refineries and the Westridge marine terminal in Burrard Inlet.

Other significant concerns and issues raised included:

- socio-economic effects on the area's residents and resource users;
- adequacy of the techniques and data used by the proponent to assess spill risks and potential consequences;
- emergency response capability, in terms of containment, clean-up and fire-fighting of fuel spills;
- effects associated with the construction and routine operation of the proposed facility; and
- compensation programs for losses and damages resulting from a major spill of jet fuel.

**The Panel concludes that there is a need for additional jet fuel delivery capability to Vancouver International Airport, but there is not a demonstrated regional economic benefit associated with the Vancouver Airport Fuel Facility Corporation's proposal. The barging of jet fuel to the facility would pose unacceptably high risks of damage to valuable fish and wildlife resources in the Fraser River estuary. The potential consequences of a fuel spill are made more severe by the fact that an adequate spill response capability does not now exist in the lower Fraser River and is unlikely to be developed in the foreseeable future.**

**The Panel, therefore, recommends that the Minister of Transport unconditionally reject the proposal submitted to the North Fraser Harbour Commission to construct and operate a jet fuel barge terminal on Sea Island.**

The foregoing major conclusion is reflected in the detailed recommendations in the Panel report. These recommendations include steps to resolve outstanding commercial issues between the Vancouver Airport Fuel Facilities Corporation and Trans Mountain Enterprises Ltd., the operator of the jet fuel pipeline serving Vancouver International Airport. Also included in the Panel report is a recommendation to expand the mandate of the Fraser River Estuary Management Program in order to ensure broader, more effective resource management and planning on an estuary-wide basis.



## 1. INTRODUCTION

### PANEL APPOINTMENT

In accordance with the federal Environmental Assessment and Review Process (EARP), federal departments and agencies must consider and assess the environmental effects of projects and activities for which they have a decision-making role. When a project is judged to have potentially significant effects or engenders major public concerns, an Environmental Assessment Panel is established to conduct an independent public review of the project and its effects.

In conformity with the provisions of the EARP, the North Fraser Harbour Commission (NFHC) through the Minister of Transport, requested a Panel review of the proposal of the Vancouver Airport Fuel Facilities Corporation (VAFFC) for the construction and operation of a jet fuel barge terminal to service airlines at Vancouver International Airport. The North Fraser Harbour Commission, as owner of the proposed site for the fuel barge terminal, has the main decision-making role for the proposal. The Panel review was also endorsed by the Management Committee of the Fraser River Estuary Management Program (FREMP).

The Panel was appointed in February, 1988, by the Minister of the Environment. The Panel members are Mr. David Marshall (Chairman), Dr. Tom Northcote and Dr. Allister Brown. Panel member biographies are found in Appendix A. The Panel was assisted in its review by its Executive Secretary, Mr. Paul Scott and by Dr. Sarah Groves.

### PANEL MANDATE

The Panel's Terms of Reference, reproduced in Appendix B, direct it to publicly review and assess the environmental and socio-economic effects associated with the proposed fuel barge terminal and to report on the acceptability of the proposal. The Panel was also asked to give consideration to the need for the proposal and alternatives to it.

### REVIEW PROCESS

On February 9, 1988, the federal Minister of the Environment formally announced the appointment of the Panel. Shortly after its appointment, the Panel arranged for copies of an August, 1986 Environmental Impact Assessment, prepared by Acres International Limited on behalf of the Vancouver Airport Fuel Facilities Corporation, to be circulated to all groups and agencies expected to play a major role in the review. Copies of the document were also placed in local libraries. An Addendum to this report was prepared and circulated in March, 1988.

Review participants, including the project proponent, government agencies, public groups and industrial corporations, were then invited to assist the Panel in the identification of key issues and concerns that should receive the greatest attention during the review and to assist in the identification of requirements for additional information that had to be gathered prior





to the scheduling of the public hearings. This input was obtained through two mechanisms:

1. Review participants were asked to state their key issues or concerns and suggested information requirements in writing.
2. A two day issues "scoping" workshop was held on April 21 - 22, 1988. The workshop was open to anyone wishing to attend, however, individuals representing groups and agencies expected to have significant roles to play in the review were specifically invited. Appendix C lists all individuals who participated in the workshop.

The issues scoping workshop was very successful. Workshop participants and the Panel members were most satisfied with the conduct and outcome of the workshop. The Panel recognizes that using issues scoping workshops as a forum for identifying and prioritizing issues is a relatively new and untried technique in the context of Panel reviews. However, the Panel found the technique to be very efficient and effective and supports the use of scoping workshops in future Panel reviews.

The results of the issues scoping workshop, along with the written submissions received, provided the Panel with a solid basis for preparing its requests for additional information. These requests were finalized in May, 1988 and were directed to the Vancouver Airport Fuel Facilities Corporation, Trans Mountain Pipe Line Company Limited and government agencies.

Responses to the Panel's requests for additional information were finalized in August, 1988. They were circulated to all major review participants and placed in local libraries. Following a seven week period of review of these documents, the Panel announced its plans for public hearings.

The final public stage in the Panel's review process was the public hearings. The hearings were held on November 17, 22, 23 and 24, 1988. The purpose of the hearings was to allow for a full examination in public of all information and submissions received by the Panel and to allow for a full discussion of public concerns related to the environmental and socio-economic effects associated with the proposed fuel barge terminal. The hearings were preceded by a request for written submissions on the proposal and its effects. A list of all participants in the hearings is presented in Appendix D and a list of all written submissions received by the Panel is presented in Appendix E.

The Panel was assisted in its review by three technical specialists whose roles were to provide independent information on and analysis of complex technical issues that were raised during the course of the review. The technical specialists provided input to the review both prior to and during the public hearings. The three technical specialists and their areas of expertise were:

Mr. Jack Cawdery — Project Need and Economic Justification

Mr. Laurence Solsberg — Spill Control, Contingency Planning and Response Capability

Dr. Peter Larkin — Fish Resources and Effects on Fish Resources

The final step in the Panel review process is the submission of this report to the Minister of the Environment and the Minister of Transport. The Panel report contains the Panel's findings, conclusions and recommendations.

*"We suggest that if we cannot tolerate the worst case scenario then the risks are too great and we should not submit the river to this hazard."*

*Adrienne Peacock, Civic New Democrats*

*"The department has consistently communicated for 14 years, a strong concern for the Fraser River ecosystem, and has repeatedly stated that the transshipment of hazardous liquid commodities along the Fraser River poses an unacceptable threat to the high ecological values of the estuary."*

*Mac Clark, Department of the Environment*

*"The potential environmental damage that could result to Vancouver parks along the river warrants a position of no support for a jet fuel barge off-loading facility. The Vancouver Board of Parks and Recreation is formally on record by unanimous vote of the seven Commissioners as opposing this proposal, and we urge you to recommend this unacceptable risk not be approved."*

*Malcolm Ashford, Vancouver Board of Parks and Recreation*

*"We are reaching a point where we should be asking what is the carrying capacity of the estuary, and particularly, the North Arm. Along the North Arm we have ferry terminal proposals, residential development that is surreptitiously whittling away our foreshore and marshes ..."*

*Evelyn Feller, Fraser River Coalition*

## 2. PROJECT DESCRIPTION

### EXISTING FUEL SUPPLY AT VANCOUVER INTERNATIONAL AIRPORT

Jet fuel (jet fuel A) is currently supplied to Vancouver International Airport by pipeline and, in limited volumes, by tanker truck. The pipeline system is owned and operated by Trans Mountain Enterprises of British Columbia Limited (TME), a subsidiary of Trans Mountain Pipe Line Company Ltd. (TMPL). The major component of the existing delivery system is a dedicated 16.8 cm (6 5/8 inch) outside diameter pipeline running between the four local refineries located on Burrard Inlet (Chevron, Shell, Esso and Petro-Canada), the Westridge marine terminal, and the TME tank farm on the north side of Sea Island (Figure 1).

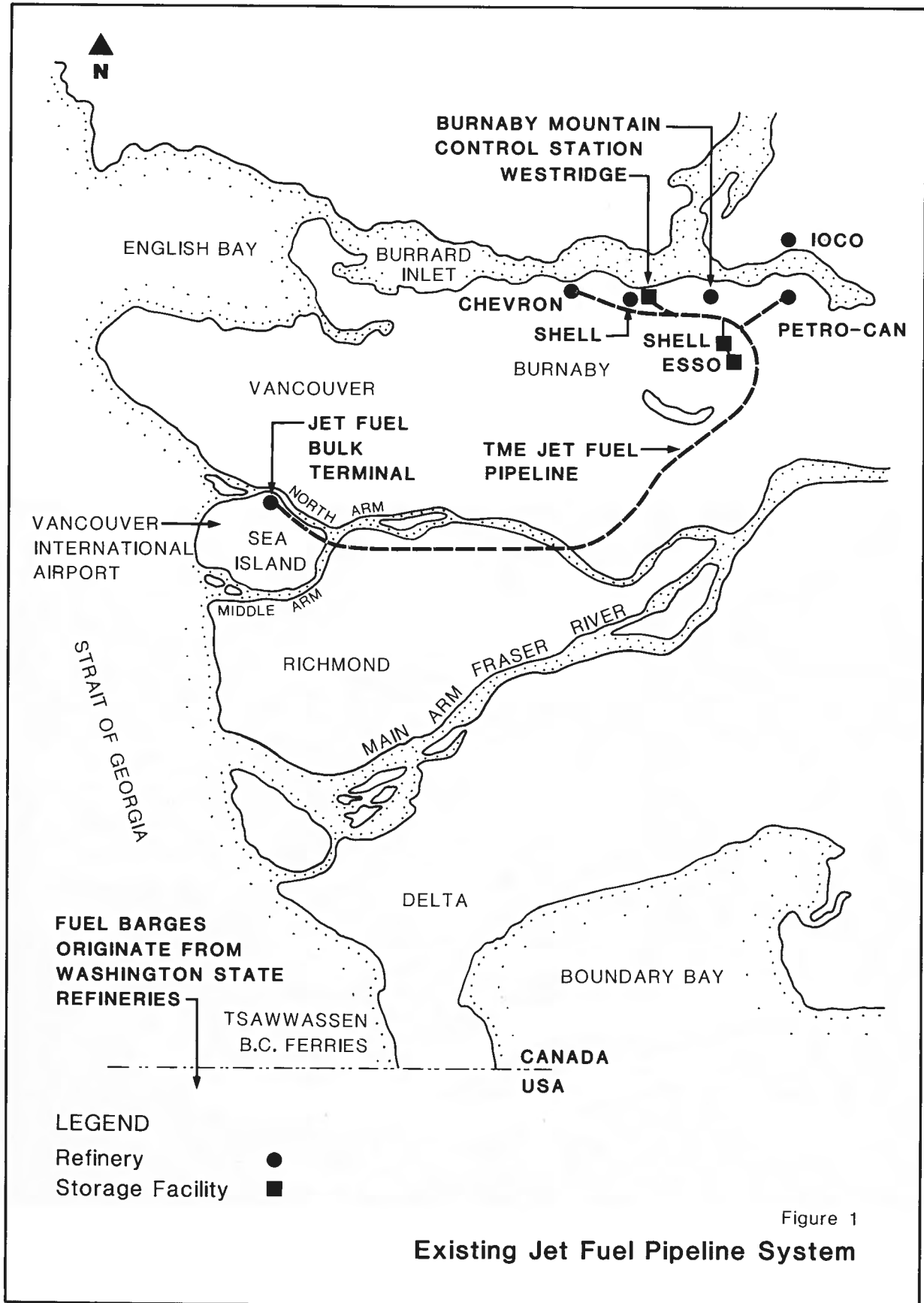
The TME pipeline is a unidirectional, dedicated line with a present sustainable delivery capacity of 2.4 million L/d. The main pipeline is 27.9 kilometres in length. The pipeline route crosses over the Brunette River and travels underground through Burnaby. The pipeline goes under the North Arm of

the Fraser River to Richmond and then passes underground through Richmond to the Middle Arm of the Fraser River. The pipeline makes a second river crossing under the Middle Arm and travels across Sea Island to the TME tank farm. The pipeline has provided uninterrupted service since it was constructed in 1970. To date, more than 8 billion L of jet fuel have been delivered through the pipeline system.

#### Westridge Terminal

The Westridge terminal (Figure 1), consisting of dock facilities and two 130,000 barrel storage tanks (one of which is connected to the jet fuel pipeline) is owned and operated by TME. Canadian Airlines International leases one of the Westridge terminal tanks from TME and uses the tank to handle jet fuel which is purchased from United States refineries, transported by barge to Westridge, offloaded into the







Westridge tank, and shipped via the jet fuel pipeline to Sea Island. In order to meet Canadian specifications, jet fuel obtained from United States refineries is treated with an anti-static additive at Westridge before it is pumped into the pipeline for transfer to Sea Island.

### Jet Fuel Specifications

Jet fuel is a kerosene product very similar to diesel fuel or home heating oil. Specifications for jet fuel are set by the Canadian General Standards Board (CGSB) to meet the particular requirements of operating aircraft for extended periods at very low air temperatures. Canadian specifications require that an anti-static additive be added to jet fuel to prevent the build-up of static charge. United States specifications for jet fuel do not require this additive. Thus jet fuel purchased from refineries in the United States must have the additive mixed into it before the fuel can be used in Canada.



Two properties of jet fuel, conductivity and water separation, change as a consequence of mixing anti-static additive with jet fuel or transporting fuel through a pipeline. Conductivity, a measure of the tendency for fuel to dissipate static charge, increases when anti-static additive is mixed with fuel and decreases when fuel is transported through a pipeline. Water separation, the tendency for jet fuel and water to separate, is measured by the water index separation method or WISM. Fuel with a high WISM has high separation of water and fuel and therefore, a high heat of combustion. A low WISM indicates low separation of water and, thus, a lower heat of combustion. The mixing of anti-static additive with jet fuel lowers the WISM and may put fuel off-specification. WISM is generally not affected by transport through a pipeline.

A standard practice for ensuring that jet fuel transported through a pipeline remains on-specification is to require fuel to have sufficient "freeboard" (i.e., the additional conductivity required to allow fuel to be shipped and received within specified conductivity limits) before it is accepted into a pipeline. TME has a standard requirement for freeboard which must be met before jet fuel will be accepted into the jet fuel pipeline.

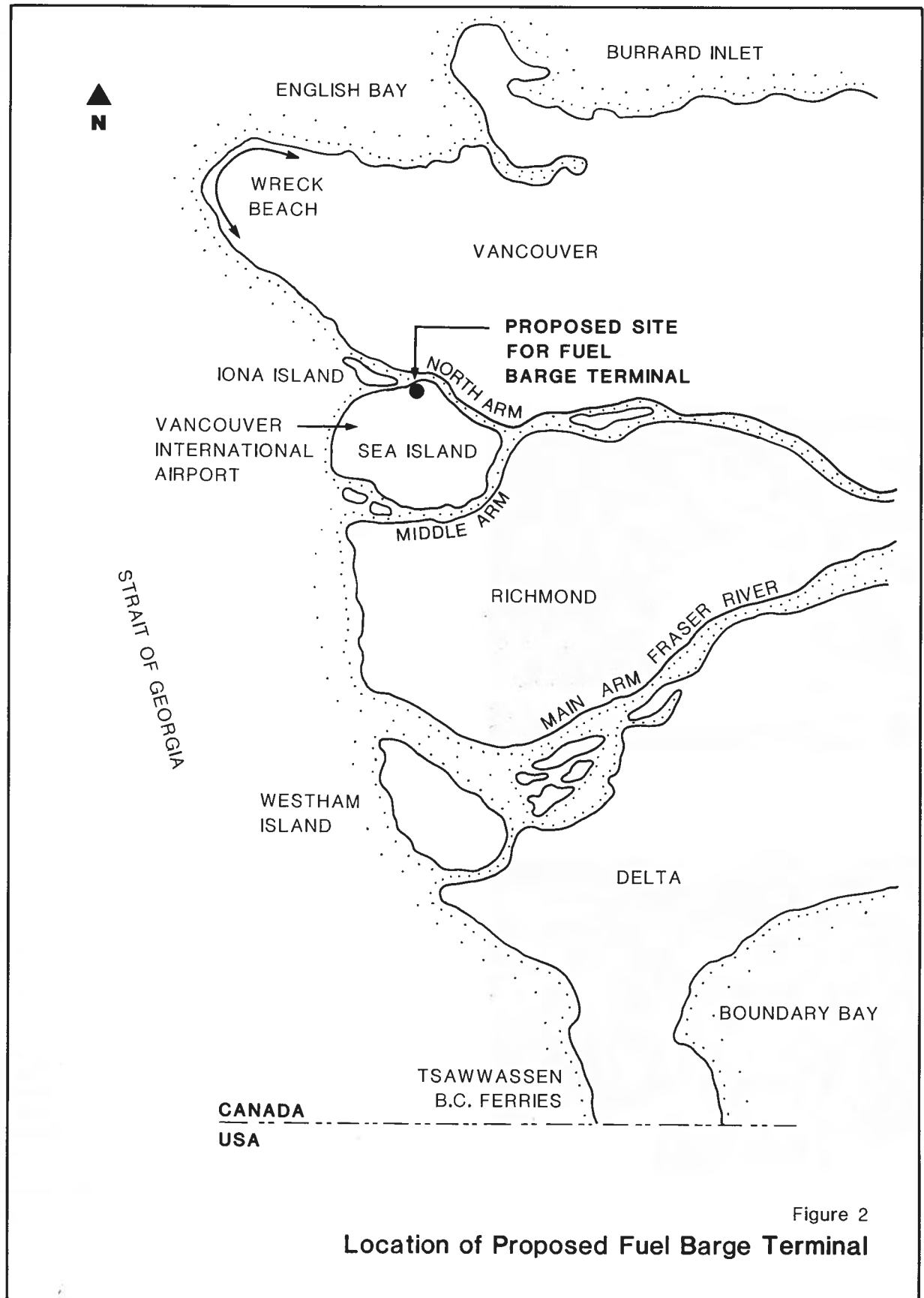
### PROPOSED PROJECT

The Vancouver Airport Fuel Facilities Corporation (VAFFC), a consortium of 14 airline companies, proposes to build a fuel barge terminal in the North Arm of the Fraser River on the north side of Sea Island (Figure 2) at a site presently used for dredge spoil storage. The terminal would be used for delivering jet fuel from United States refineries to Vancouver International Airport. Fuel would be offloaded from barges into a pipeline that would transport fuel to the existing fuel storage facility owned by VAFFC on Sea Island (Figure 3). Imported jet fuel would be delivered to the airport using the existing system of pumps and hydrants.

### Barge Operations

Jet fuel would be delivered by barge to the proposed fuel barge terminal from refineries in the Anacortes area of Washington State. Barges would be towed north through the Strait of Georgia and into the North Arm of the Fraser River. Sea-going tug boats would be used to tow barges to the mouth of the North Arm. At the mouth, barges might be towed to the barge berth by the sea-going tug or they might be handed over to river tug boats for towing into the North Arm.

Tanker barges from the Seaspan International fleet would be used to transport fuel from refineries in the United States to the proposed fuel barge terminal. The proposed barges, the Seaspan 822 and Seaspan 824, are steel-hulled barges which carry approximately four to five million L (25,000 to 30,000 barrels) of refined hydrocarbon products. These tanker barges consist of watertight compartments for product storage and sealed void spaces for buoyancy. Each compartment is vented and connected to piping for transferring product to and from the barge. Spill rails on the barge decks are designed to contain up to 375,000 L of spilled product.



The Seaspan tanker barges are operated under Canada Coast Guard and United States Coast Guard (USCG) regulations. The Canada Coast Guard Ship Safety has powers under the Canada Shipping Act to conduct spot inspections of unmanned barges carrying oil cargoes. These barges are also required to carry USCG certificates of inspection which allow the barges to operate in United States waters. Certificates are renewable every two years, subject to inspection by the USCG.

### Terminal Description

The fuel barge terminal would consist of a berth for fuel barges, a dock and associated pumps, hoses, pipeline and electrical and mechanical infrastructure. The berth for the fuel barge would be a basin approximately 72 x 18 x 5 m excavated into the river bank (Figure 4). The north side of the basin would be constructed of a sheet pile wall stiffened with buttress piles and protected by rip-rap. The slope of the shore side of the basin would be protected by rip-rap. The entrance to the barge basin would be equipped with a boom curtain which would be used to close the entrance to the basin during fuel off-loading operations.

The dock would consist of mooring and breasting dolphins and a sheet pile wall. A timber-pile walkway would provide pedestrian access to the dock from the shore. The walkway would support a fuel pipeline which would be connected by hose to the barge for off-loading jet fuel. Pumping equipment and a small building for tool storage and shelter for personnel would be built on a platform at the end of the walkway. The walkway and platform would have impervious concrete surfaces. A curb around their perimeters would contain small amounts of accidentally spilled fuel.

### Terminal Construction

Construction of the barge terminal would take six to nine months and cost an estimated \$3.5 million. Excavation of the stockpiled dredge spoil on the site to the natural level of the river bank would be the first step in terminal construction.



Steel sheet piles would then be installed, and the dock area would be excavated, initially from land and then by cutter suction dredge. Upon completion of excavation, timber piles would be installed for the berthing area, dock and access walkway. Rip-rap protection would be placed on the bank slopes. Finally, construction of the access walkway would be completed, mechanical and electrical equipment would be installed, and the pipeline to the existing VAFFC storage facility would be constructed.

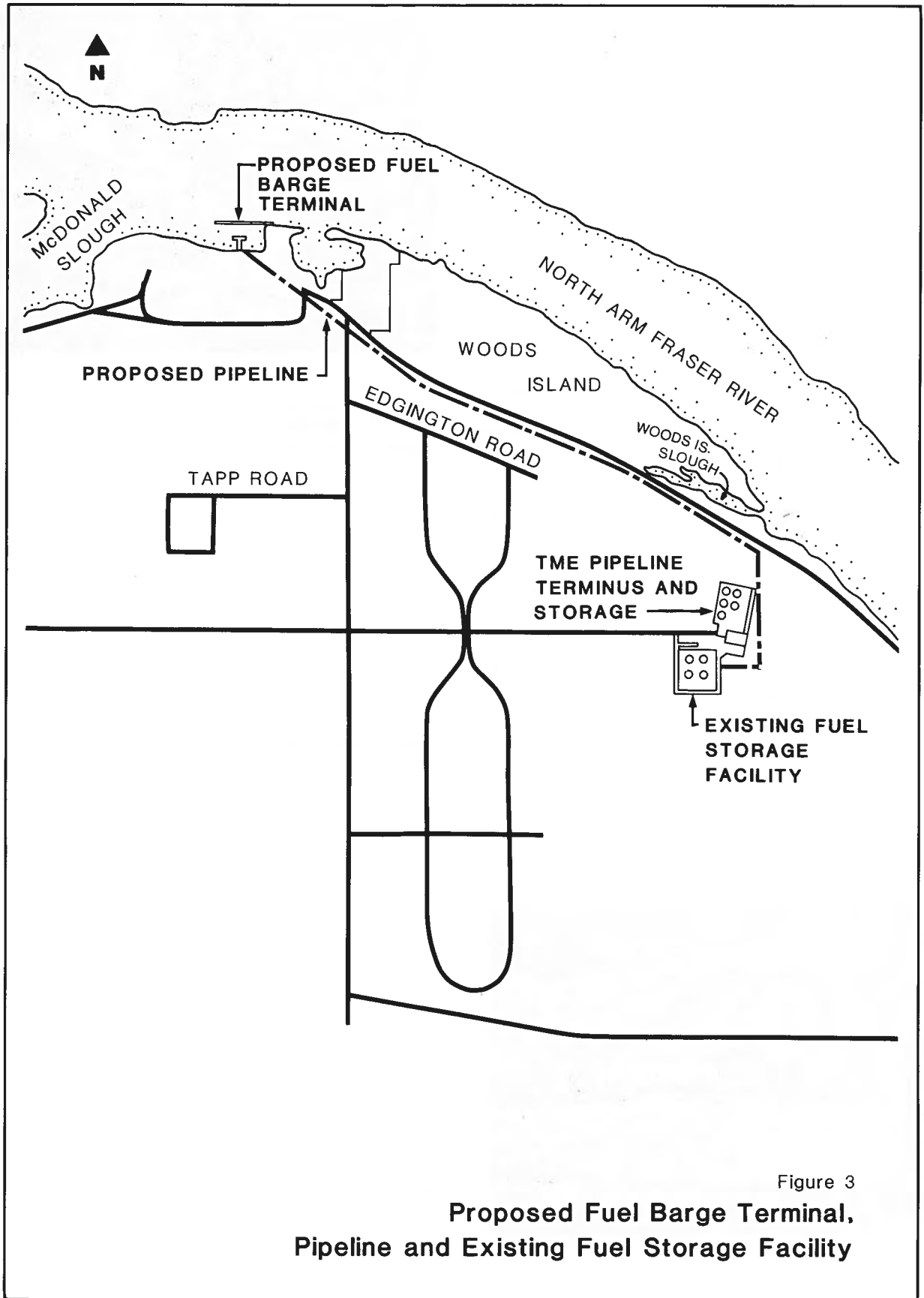
Construction activities in the river would be timed to avoid environmentally sensitive periods as much as possible. All construction activities would be undertaken in accordance with applicable federal, provincial and municipal regulations and guidelines.

### Terminal Operation

Initially, between one and six fuel barges per month would be handled at the fuel barge terminal. Each barge would deliver approximately four million L of jet fuel. Barge arrival would be timed to coincide with high slack tide. Prior to the arrival of a barge in the North Arm, a diversionary boom would be deployed across the mouth of McDonald Slough in an attempt to protect it during fuel transfer operations. The barge would then be maneuvered into the barge basin, and a fireboom would be positioned across the mouth of the barge basin to contain chronic spills that may occur during fuel transfer operations.

Off-loading of fuel from barges would occur only during daylight hours. During the short days of winter, more than one day could be required to complete off-loading operations. Fuel would be transferred directly from the barge by pipeline to the existing storage facility. From the storage facility, the fuel would enter the existing fuel delivery system and be handled according to present operating procedures. Dock and barge personnel involved in fuel transfer operations would be fully trained in fuel transfer and emergency response procedures. Emergency fuel spill response and fire fighting equipment would be located at the fuel barge terminal.





## PROJECT RATIONALE

The VAFFC proposes to construct and operate the fuel barge terminal at Sea Island to meet several objectives:

- to provide greater security of supply of jet fuel at Vancouver International Airport;
- to increase the capacity of the existing fuel delivery system;
- to encourage competitive pricing of jet fuel by providing access to alternative suppliers; and
- to provide a convenient means of returning off-specification fuel to refineries.

*"....the uses made of the river and its associated lands are of tremendous value to the people of the Lower Mainland, but the river is something more than the foundation of economic activity. It is a feature of the physical, biological environment that is of immense psychological importance to the people of the Lower Fraser, to the man fishing from the bar, to the person watching waterfowl in the marshes, to the child paddling in the pool, the river adds a richness to life that is difficult to measure. It is a link that people have with the complex ecological system of which they are a part, and along with the mountains and the sea, it is the essence of this region of British Columbia, and it is part of what people mean when they call it home."*

*Adrienne Peacock, Civic New Democrats*

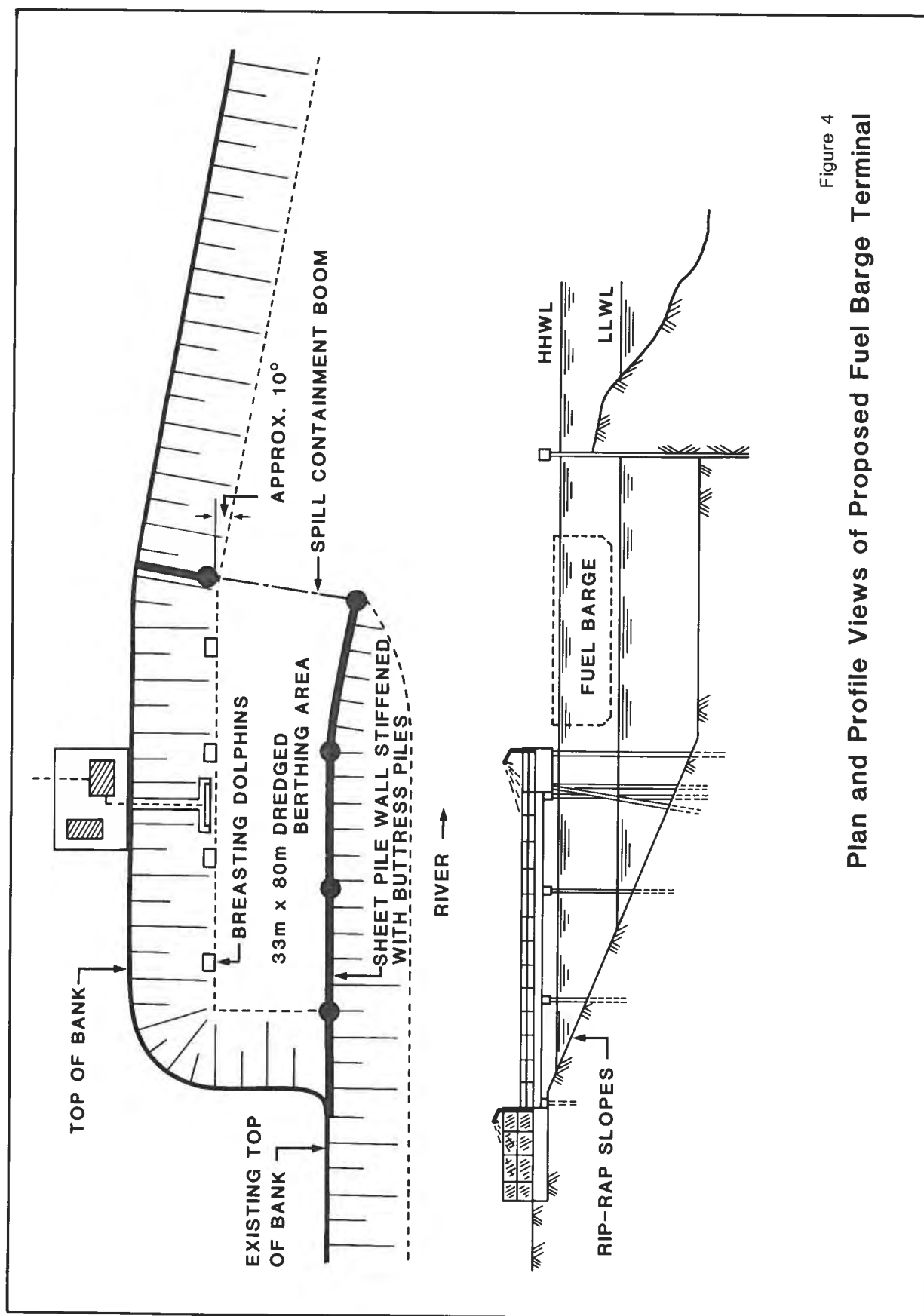


Figure 4  
Plan and Profile Views of Proposed Fuel Barge Terminal

### 3. MAJOR RECOMMENDATIONS

In fulfilling its mandate from the Minister of the Environment, the Sea Island Fuel Barge Facility Environmental Assessment Panel was faced with the challenge of evaluating the environmental, social and economic impacts of a project which would satisfy the need to supply additional jet fuel to Vancouver International Airport in an extremely sensitive environment. In evaluating this project, the Panel considered alternative means of meeting the increased fuel supply requirements.

The Panel recognizes and concurs with the proponent that there is a need to deliver larger volumes of fuel to Vancouver International Airport during periods of peak demand. The Panel also recognizes the cost savings which would accrue to Vancouver Airport Fuel Facilities Corporation (VAFFC) if fuel from United States refineries was readily available at Vancouver International Airport. Consequently, there are strong financial arguments in favour of the project. However, when evaluated in a regional economic context, the VAFFC proposal does not provide substantial economic benefit compared to the alternative of increasing existing pipeline capacity in conjunction with using existing facilities at Westridge terminal for fuel importation.

The lower Fraser River and its estuary provide important ecological, cultural, social, economic, aesthetic and recreational values to British Columbians, Canadians, and visitors from around the world. The Panel fully understands the genuine, deep-rooted concern for the value of the estuary and its resources expressed by the majority of intervenors during the review. This concern is indicative of a growing general awareness of environmental issues and values. As a result of increased awareness and much hard work by public interest groups and government agencies and the creation of the Fraser River Estuary Management Program, extensive regeneration of environmental quality in the North Arm of the Fraser River has occurred over the past decade.

Valuable resources would be at risk from the operation of the proposed fuel barge terminal. The effects of chronic spills of fuel in day-to-day operations and/or the effects of a major spill cannot be satisfactorily mitigated, nor are there adequate facilities or technologies to protect the environment from these events. Information presented at the hearings provided evidence that adequate spill response capability does not currently exist in the Fraser River estuary. There is also little likelihood of developing the capability in the foreseeable future to respond adequately to a major spill. In the event of a major fuel spill, there are no satisfactory means of ensuring that immediate and satisfactory compensation can or will be made at the most critical times.

**The Panel concludes that there is a need for additional jet fuel delivery capability at Vancouver International Airport at certain times of the year, but that there is not a demonstrated regional economic benefit associated with the VAFFC proposal.**

**The Panel concludes that the VAFFC proposal poses risks with unacceptable consequences to resources in the Fraser River estuary, particularly in the North Arm.**

**The Panel recommends that the Minister of Transport unconditionally reject the proposal by Vancouver Airport Fuel Facilities Corporation to construct and operate a jet fuel barge terminal on Sea Island.**



It is unfortunate that an environmental review process has become the forum for resolving what appears to be primarily a commercial issue involving the Vancouver Airport Fuel Facilities Corporation and Trans Mountain Enterprises. Consequently, the resources of the Fraser River estuary have become innocent bystanders to difficult commercial negotiations. The Panel, however, recognizes that the fuel barge terminal proposal progressed to the stage of an independent public review largely because of the VAFFC's dissatisfaction with the present commercial arrangements for delivery of fuel to the airport. With the rejection of the proposal and the strong potential for increased demand for jet fuel at Vancouver International Airport, measures should be taken to resolve the commercial issues that appear to be at the heart of the problem.

**The Panel recommends that the Minister of Transport and the Minister of the Environment jointly appoint an individual to facilitate a process which would involve the British Columbia Utilities Commission and appropriate federal and provincial agencies to:**

- resolve the commercial issues between the Vancouver Airport Fuel Facilities Corporation and Trans Mountain Enterprises; and
- ensure that an equitable arrangement is reached for delivery of fuel to Vancouver International Airport.

Many review participants raised questions about the carrying capacity of the Fraser River estuary and the role of integrated planning in guiding development in the estuary. All future development proposals for the estuary should be evaluated in a manner that better assesses both their environmental and economic costs and benefits. Assessment of any future proposals for handling bulk liquids in the Fraser River estuary should include a detailed project-specific review of contingency planning and emergency response capability, spill behaviour, potential spill effects, and project economics.

All future development proposals for the lower Fraser River and estuary should be designed to include features that provide direct improvement of habitat with demonstrable net benefits to all users of the river and estuary. Although programs for the mitigation and compensation of habitat loss and the "no-net loss" policy which guides habitat management in the estuary presently exist, there is a need for a broader policy framework for addressing attributable and non-attributable resource losses in the Fraser River estuary.

The Panel commends the Fraser River Estuary Management Program for the important role it plays in facilitating the coordinated project review process and encouraging an estuary-wide approach to resource management. FREMP's initiatives have fostered a new spirit of cooperation among

various users of the river and estuary. Defined goals and objectives for specific activities that occur in the estuary have been developed as a direct result of FREMP initiatives. The Panel, however, believes that it would be appropriate and timely to significantly expand FREMP's role.

**The Panel recommends that the Minister of the Environment in conjunction with his colleague, the British Columbia Minister of Environment, expand FREMP's mandate:**

- to include a broader, more active role in resource management and planning on an estuary-wide basis;
- to incorporate a mechanism for direct public involvement in the planning activities undertaken by FREMP;
- to emphasize the development of policy guidelines for the redistribution of the benefits of development in the estuary among the various resource users; and
- to establish means such as environmental enhancement levies, performance bonds and revolving funds for compensation of development related attributable and non-attributable losses of resources.

*"...but I don't see a real concerted effort to be part of a real public process, which requires rolling up your sleeves and getting right into the community level. And I don't think FREMP's got the funds to do that nor the staff."*

Wendy Turner, Community Forum on Airport Development

*"...it's always the question of finances that I find quite interesting. I can appreciate it if you can get the fuel cheaper, I mean the rationale is it makes it cheaper for everybody. But always in the cost-benefit, I never see where it actually is, the accounting of the cost to the environment, the cost to the residents, etcetera."*

Wendy Turner, Community Forum on Airport Development

*"It would open the marketplace to supplies outside of the immediate Vancouver area, and will ensure that honest pricing on the west coast prevails. The local marketplace, we believe, does not have the surplus capacity to create a fully competitive market. Roughly 25 per cent of the cost of the airline operation is related to fuel."*

Vic Rivers, Vancouver Airport Fuel Facilities Corporation

*"There is no factual evidence to support the suggestion that there is a question on pipeline safety and integrity, and there is no factual evidence to support the suggestion that there is inadequate reliability of continuous supply over the long term by using a pipeline supply system to the airport."*

Tom Doyle, Trans Mountain Pipe Line Company Limited

*"We had a relocation that took place this past summer and that required us to cut into the pipe to move it, and we found that both internally and externally, the pipe was in almost new condition. So the condition of the pipeline, as it presently stands is very good."*

Bob Virgette, Trans Mountain Pipe Line Company Limited

## 4. ISSUES

### INTRODUCTION

The Panel review was organized around nine major issue categories. Panel members, the proponent and intervenors from government agencies, industry and concerned citizens' groups participated in the discussion of issues related to the proposed project. In this chapter, the discussion of each issue is summarized, and the Panel's conclusions or recommendations concerning that issue are stated. The issue categories are:

- project need and economic justification;
- project alternatives;
- resources at risk;
- risk assessment;
- fuel spill scenarios;
- spill contingency plans;
- construction activities;
- routine operations; and
- compensation.

### PROJECT NEED AND ECONOMIC JUSTIFICATION

The need and economic justification for the proposed Sea Island fuel barge terminal were discussed at length during the Panel hearings. Many intervenors questioned the need for the project and discussed possible alternatives to the proposed project. Discussion of project need and economic justification focussed on:

- adequacy of existing jet fuel delivery capacity;
- capability of the existing jet fuel pipeline system to deliver fuel to the airport that meets Canadian specifications;
- reliability and integrity of the existing jet fuel pipeline system; and
- magnitude of the economic benefits that would result from the ability to import jet fuel through the proposed terminal on Sea Island.



### Adequacy of Existing Jet Fuel Delivery Capacity

The volume of air traffic at Vancouver International Airport has increased substantially since 1984, and jet fuel requirements have increased accordingly. Jet fuel consumption increased from 425 million L in 1984 to approximately 700 million L in 1988. In periods of peak demand during July and August, 1988, fuel requirements reached an average of 2.4 million L/d, the sustainable pipeline delivery capacity. On several occasions in August, 1988, daily jet fuel demand exceeded the pipeline delivery capacity and fuel inventories at the airport were seriously depleted.

Intervenors at the hearings agreed that at the current pumping capacity, the capability of the pipeline to meet peak jet fuel requirements at the airport is severely strained. TME indicated that it plans to increase the sustainable maximum delivery capacity of the pipeline from 2.4 million L/d to 2.7 million L/d by June, 1989. Additional pumping capacity will be added to achieve this increased delivery capability, and the operating pressure will be increased from 350 psi to 750 psi. TME indicated that through further addition of pumping capacity and operation up to the maximum licenced operating pressure of 1440 psi, pipeline delivery capability can be expanded, as required, to 6 million L/d. Twinning of the pipeline would increase delivery capability even further.

**The Panel concludes that the delivery capacity of the existing jet fuel pipeline can be upgraded as required to accommodate increased fuel demand at Vancouver International Airport for the foreseeable future.**



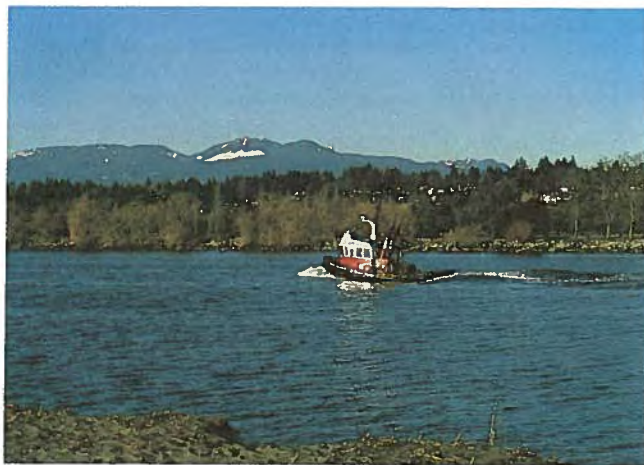
### Capability of Existing Pipeline System to Deliver Specification Jet Fuel

Handling procedures and technical difficulties involved in keeping jet fuel on-specification were discussed in depth at the hearings. Jet fuel is tested before it is accepted into the TME pipeline and again when it is received at the TME tank farm on Sea Island to ensure that it is on-specification. Testing includes measurement of conductivity and WISM. Results of the first test are used to determine whether or not the fuel has adequate freeboard to allow for loss of conductivity in the pipeline and still deliver on-specification fuel to the airport.

TME reported that there were 33 incidents of off-specification fuel being delivered to the airport by pipeline between mid-1978 and the end of 1987. When off-specification fuel has been received at the airport, it has generally been possible to bring the fuel back on specification by allowing it to settle, by the addition of additives, by filtration or by blending off with on-specification fuel. On only one occasion since the pipeline began operation in 1970 has it been necessary to remove a batch of off-specification fuel from the airport by truck and return it to the refinery. The techniques used to handle off-specification fuel are also used at other airports receiving jet fuel by pipeline in Canada and the United States.

Canadian Airlines International (CAI) has experienced recurring difficulties at Westridge with shipments of jet fuel that have insufficient freeboard to accommodate the anti-static additive required to meet Canadian specifications and to meet minimum standards for acceptance into the jet fuel pipeline. Because of the difference between United States and Canadian specifications, jet fuel purchased from refineries in Washington does not meet the Canadian conductivity standard, and an anti-static additive must be mixed with the jet fuel during off-loading at Westridge. On two occasions, most recently in August, 1988, the addition of the required anti-static additive reduced the freeboard to a level which made the jet fuel unacceptable to TME for shipment via pipeline to the airport. Because of the lack of facilities for treating off-specification fuel at Westridge, CAI sold one batch of off-specification fuel to an offshore refinery for re-refining and trucked part of the second batch to the Shell refinery for treatment. The balance of the second batch is being stored in the tank at Westridge. Significantly, both batches of fuel that caused problems with fuel specification at Westridge were purchased by CAI from the Arco refinery at Cherry Point, Washington.

It is unclear exactly what procedures would be followed to mix the anti-static additive required to meet Canadian specifications with jet fuel to be handled at the proposed Sea Island



terminal. Concern was raised by some intervenors that off-specification problems, similar to those experienced at Westridge, might occur in fuel off-loaded at the proposed Sea Island fuel barge terminal, thereby posing a risk of tying up valuable airport storage facilities. The VAFFC suggested that the proposed fuel barge terminal would enhance the airport's ability to handle off-specification fuel without tying up valuable fuel storage tanks by providing speedy removal of off-specification fuel from the airport should this be required.

The current procedures for handling jet fuel and delivering it by pipeline to Vancouver International Airport are adequate to ensure that fuel meets Canadian specifications. The Panel believes that VAFFC and TME should cooperate in investigating methods for ensuring that jet fuel from Westridge will have adequate freeboard to be accepted for shipment through the pipeline.

### Reliability and Integrity of Existing Jet Fuel Pipeline

The Panel and many intervenors were interested in the reliability and integrity of the existing jet fuel pipeline, the primary source of jet fuel supply at Vancouver International Airport. TME indicated that the pipeline, built in 1970, is relatively young and appears to be in good condition based on a recent visual inspection. The pipeline is constructed so that it is well-protected against external and internal damage. The entire length of the pipeline is coated with coal tar and fiberglass wrap, and the pipeline is under cathodic protection against corrosion. Where the pipeline crosses under the Fraser





River the pipe wall thickness is approximately double the normal wall thickness, the pipe is double wrapped, and the pipe is encased in a 2.5 cm thick reinforced concrete coating to protect against scour. Underwater inspections of these crossings were planned for February, 1989.

The pipeline has a record of reliable service with only five operational upsets during nearly 20 years of operation. The interruptions averaged four hours, with a maximum interruption of twelve hours. The routing of the pipeline allows good access by vehicle for repairs, maintenance and close inspection, as required, for all parts of the pipeline except the two river crossings.

Several intervenors questioned TME on their environmental protection program for the jet fuel pipeline and tank farm at the airport. TME routinely patrols the pipeline twice each week, once by helicopter and once by road. Staff who conduct these patrols look for evidence of leaks or activities that could damage the pipeline. TME is in the process of finalizing a contingency plan for the jet fuel pipeline.

A variety of valves and gauges installed on the TME pipeline and tanks play a role in the detection and control of spills. Block valves on each of the two Fraser River crossings can be used to shut down the pipeline in the event of a break in a river crossing. Presently, these valves are manually operated, but TME plans to automate them when the pipeline is upgraded. At the airport, high level gauges on the fuel tanks set off alarms when the tank is at risk of overflowing.

TME plans a program of modifications and additions to the jet fuel pipeline system and will submit the program to the British Columbia Ministry of Transportation and Highways for approval early in 1989. The planned improvements would upgrade the system's reliability and integrity and strengthen TME's ability to handle potential environmental problems related to the pipeline. TME proposes to begin running electronic monitoring devices on the pipeline to determine the location of any internal or external corrosion, dents or defects in the line. The upgrades scheduled for 1989 will further enhance the security of supply, and these upgrades should be implemented as soon as possible. In addition, the testing and

monitoring systems that will be installed will make a significant contribution to ensuring that the pipeline is environmentally safe.

**The Panel concludes that the existing pipeline with proposed upgrades and sophisticated electronic testing, monitoring and shut-down capability will reliably supply Vancouver International Airport with jet fuel for the present and foreseeable future in an environmentally acceptable way.**

### **Magnitude of Economic Benefits Resulting from Further Diversification of Jet Fuel Supplies at Vancouver International Airport**

Approximately 700 million L of jet fuel were dispensed at Vancouver International Airport during 1988. Given these large volumes, small cost savings per litre of jet fuel translate into large savings in total fuel costs for the airlines using the airport. VAFFC indicated that the capability to barge jet fuel from United States refineries, by increasing the competitiveness of the jet fuel market in Vancouver, could result in average fuel cost savings of about two cents per litre.

To reduce fuel costs, CAI (which accounts currently for about one-half of total fuel requirements at the airport) already imports about 20 percent of its requirements from United States refineries using the Westridge marine terminal. CAI uses Westridge under a lease arrangement negotiated with TMPL in 1986. This lease currently extends to 1996.

The proposed Sea Island fuel barge terminal would give other member airlines of the VAFFC, who do not currently have an agreement to use the Westridge terminal, access by barge to United States suppliers. Analysis presented by CAI indicates that barge access to United States suppliers by the VAFFC could result in fuel cost savings of between \$18.0 and \$63.5 million over a 20-year period depending on specific assumptions adopted about future jet fuel pricing and requirements at Vancouver International Airport.

Hearings participants questioned whether the proposed Sea Island terminal would be required in order to achieve the fuel cost savings sought by the VAFFC. Discussion focused on the feasibility of using the Westridge terminal for increased imports of jet fuel by barge. TME indicated that there is a presently unused storage tank at Westridge with a rated capacity of 19.9 million L (130,000 barrels) which could be readily converted to jet fuel service (an identical tank was previously converted for use by CAI under the 1986 lease agreement).

VAFFC expressed concern about logistical difficulties encountered by CAI in coordinating jet fuel off-loading with the arrival and departure of large crude oil tankers at Westridge. TME indicated that the current utilization of the crude oil dock is only about six days per month. TME further stated its willingness to dedicate a currently unused second dock at Westridge to jet fuel off-loading, if scheduling at the main dock became a problem with increased movement of jet fuel through the terminal.

*"We who live in this part of the city, know the Fraser River better probably, than most other Vancouverites. It's part of our daily lives and certainly supplies a large part of our recreational needs: walking, horseback riding, jogging, cycling, absorbing nature, just contemplating."*

June Binkert, Southlands Citizens Planning Committee and Fraser River Coalition

*"First, risk consists of two components; the probability of an accident and the consequences of that accident. The proponent has elected to emphasize probability, while Environment Canada has focused on consequences."*

Robert Sherwood, Department of the Environment

*"Every household on our reserve relies on salmon; some without an outside income rely exclusively on this catch of fish and other sea foods from the river."*

Wendy Grant, Musqueam Band

*"The only statistic that has any meaning is that accidents happen and we consider that no chances should be taken. The risks are just too great for a small benefit to a very few people. We would also argue that as years go by, the risk will become greater."*

June Binkert, Southlands Citizens Planning Committee and Fraser River Coalition

*"...the dynamic nature of a riverine environment such as that of the Fraser, renders effective containment or diversion of a hydrocarbon spill impossible in the majority of cases."*

Mac Clark, Department of the Environment

*"The annual average number of salmon juveniles which migrates seaward through the Fraser River and estuary, can exceed 800 million. Juvenile salmon are present throughout most of the year, with peak concentrations in the lower Fraser River occurring between March and July."*

Mike Nassichuk, Department of Fisheries and Oceans

*"Cost recovery for government agencies, municipalities, that take it upon themselves to clean up spills from polluters, is time consuming and uncertain. This sometimes results in delayed response, inter-agency arguments, poorly handled clean-ups, unnecessary environmental impacts."*

Fred Beech, Department of the Environment

*"However, it should be remembered that the North Arm of the Fraser is presently used to transport fuels, explosives and many other products up and down that river. The barging of jet fuel in the Gulf of Georgia goes on all the time between Burrard Inlet and places such as Whidbey Island, Anacortes, Ferndale, and a multitude of hydrocarbons flow daily to Vancouver Island across Georgia Strait as part of our everyday life. In other words, barging goes on all of the time around us both here in the Vancouver area, in Holland, in the Gulf of Mexico, around New York and in Japan."*

Vic Rivers, Vancouver Airport Fuel Facilities Corporation

**The Panel concludes that the facilities required to allow the VAFFC to gain access by barge to United States suppliers of jet fuel are essentially already in place at Westridge.**

## PROJECT ALTERNATIVES

The Panel and intervenors at the hearings were interested in alternatives to the proposed fuel barge terminal. Alternatives were discussed in some detail in conjunction with project need and economic justification. Many intervenors and TME expressed the opinion that the existing jet fuel pipeline and the upgrades to the system that are planned for 1989 can continue to adequately meet requirements for jet fuel at the airport for the foreseeable future.

Trucking is not a viable alternative as the primary mode of fuel supply at the airport due to the large number of tank trucks that would be required to meet daily fuel demand. However, eight refineries, four at Burnaby Mountain and four in north-

western Washington, are within trucking distance of the airport. Trucking of jet fuel from these refineries could be used to supply fuel to the airport in the unlikely event of a major disruption in pipeline service.

Rail transportation of jet fuel to the airport was an option considered by the proponent. However, the existing railway system does not extend onto Sea Island. Thus, rail transportation of jet fuel would require either the construction of the necessary railway infrastructure on Sea Island or transfer of fuel from rail tanker cars to trucks to deliver fuel to storage facilities at the airport. This option was rejected because it was neither practical nor cost effective.

Barges are used regularly to bring fuel from United States refineries through the Strait of Georgia to Burrard Inlet. An alternative for increasing the supply of jet fuel is expanded use of the terminal facilities at Westridge by fuel barges from United States refineries and increased use of the existing jet fuel pipeline.

**The Panel concludes that the existing jet fuel pipeline with planned upgrades is an acceptable alternative to the proposed project.**



## RESOURCES AT RISK

The Panel recognizes the ecological, cultural, social, recreational, economic and aesthetic values of the resources of the Fraser River and estuary to the people of British Columbia. Although all of these values cannot be readily measured in monetary terms, their importance was emphasized by many participants throughout the review. Many of these resources and the user groups dependent upon them would be seriously threatened by chronic or major fuel spills.

**The Panel concludes that resources in the estuary are already exposed to a variety of risks and is concerned that the operation of the proposed fuel barge terminal would expose the estuary and its resources to additional unwarranted risk.**

Technical specialists and intervenors from government agencies, citizens' groups and the Musqueam Band expressed a wide range of concerns for resources at risk in the estuary. These concerns for resources and the various user groups are discussed under the following topics:

- habitat;
- fish;
- birds;
- commercial, native and sports fisheries;
- Musqueam Band;
- recreational opportunities and aesthetic values; and
- commercial activities.

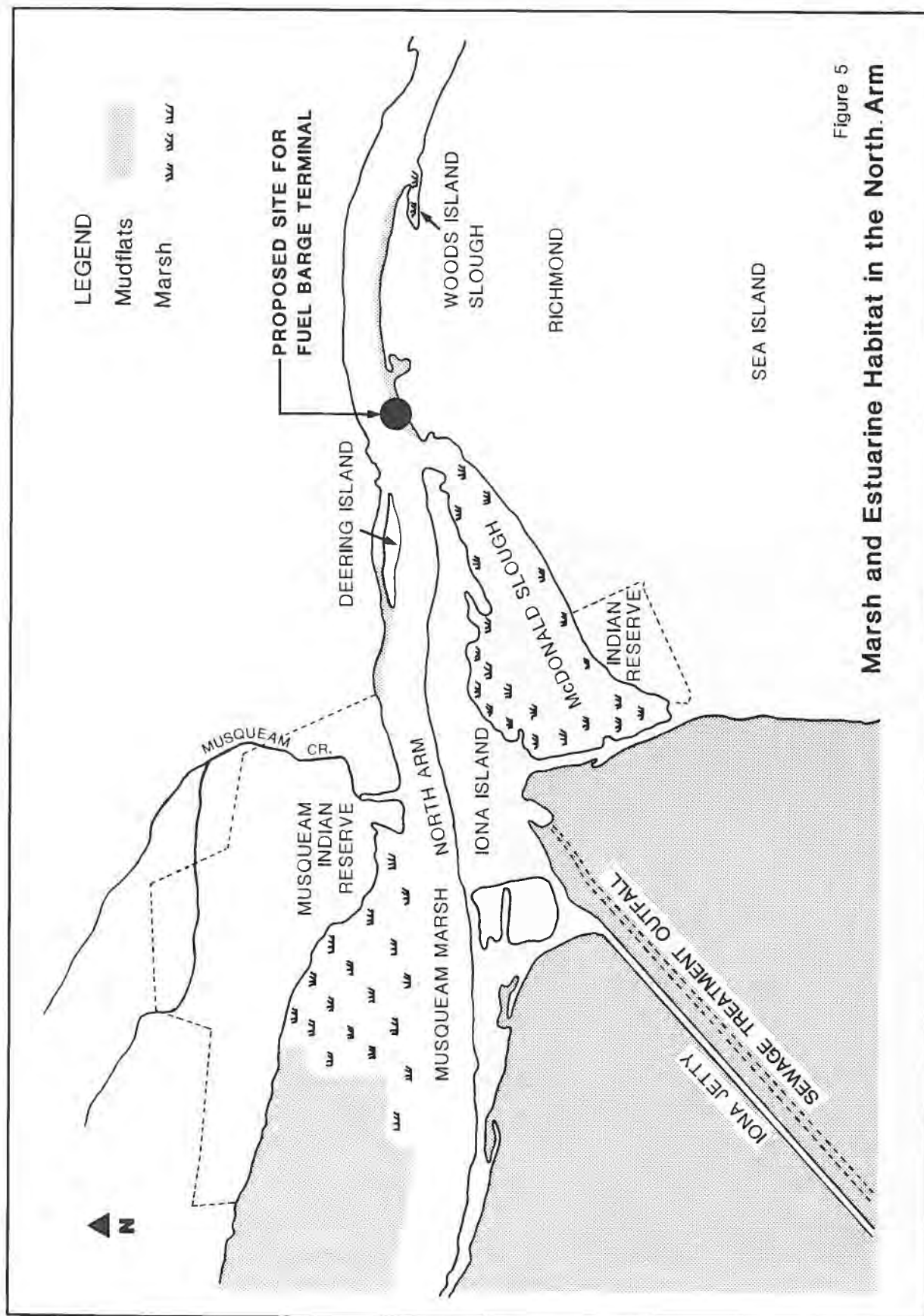


Figure 5  
Marsh and Estuarine Habitat in the North Arm

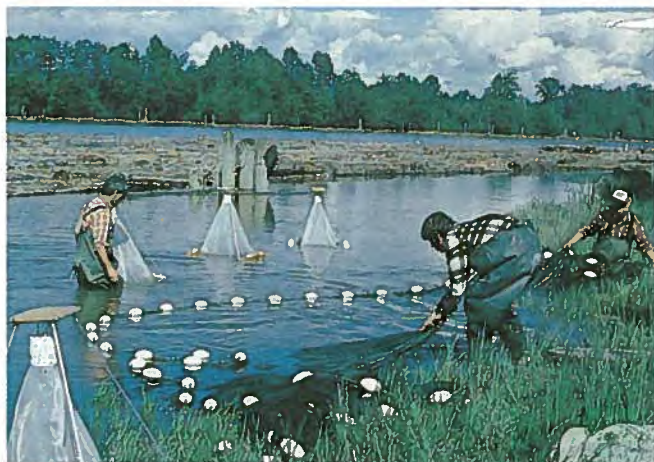


## Habitat

The biologically productive, estuarine ecosystem of the lower Fraser River is important habitat which provides food and shelter for a diversity of fish and wildlife species. The estuary has been extensively altered for industrial, agricultural, commercial and residential purposes resulting in the loss of an estimated 70-80% of historic wetland and estuarine habitats. The remaining estuarine habitat is critically important to the maintenance of healthy fish and wildlife populations. The value of this habitat and various measures being undertaken to protect and enhance the habitat were the subjects of considerable discussion at the hearings.

The total area of marsh and estuarine habitat remaining in the North Arm is 187 hectares. Some of the highest quality habitat in the North Arm occurs downstream of the Oak Street Bridge. Approximately 80% of this habitat is in the Sea Island area and includes McDonald Slough immediately downstream of the proposed terminal, Wood's Island Slough immediately upstream of the proposed terminal, and a large marsh on the Musqueam Reserve on the north shore of the North Arm (Figure 5). The Department of Fisheries and Oceans and the Department of the Environment discussed the importance of these areas as prime producers of food for fish and waterfowl and stressed the importance of protecting these areas from development and possible exposure to chronic or major fuel spills.

Projects to protect, enhance and re-establish productive estuarine habitat are underway or planned in various parts of the Fraser River estuary. A habitat enhancement program has been completed along the shore of Fraser Park; a habitat development program is planned for Iona Island; and habitat protection and salmon enhancement activities are being undertaken by the Musqueam Band. All of these projects are consistent with the Department of Fisheries and Oceans' 1986 policy on the management of fish habitat. The policy has a long term objective of net gain of productive capacity of fish habitat through conservation, restoration and development of new habitat.



## Fish

Some 34 species of freshwater and marine fish including all 5 species of Pacific salmon occur in the lower Fraser River and estuary. These fish and their habitats would be at risk in the event of chronic or major spills of jet fuel. Hydrocarbons such as jet fuel are toxic to fish. Toxic effects of jet fuel on fish include mortality of juveniles, erratic swimming behaviour which increases fish vulnerability to predation, sublethal effects and tainting.

Salmon are the most extensively studied and managed of the fish species in the Fraser River system, and thus discussion at the hearings focused on Pacific salmon. The North Arm of the Fraser River is used by all species of juvenile salmonids during their seaward migration and by adult salmonids during their upstream spawning migration. Information presented at the hearings by the Department of Fisheries and Oceans indicates that utilization of the North Arm by both juvenile and adult salmonids is higher than previously understood.

The distribution of juvenile salmonids moving seaward in the various arms of the lower Fraser River is postulated to depend largely on their swimming ability. Passive swimmers such as chum and pink salmon fry are apparently distributed throughout the river in proportion to river flow. Therefore, approximately 15% of these fry would travel downstream through the North Arm as about 15% of the river flow goes through the North Arm. Actively swimming fry such as chinook salmon apparently select and follow shorelines during their downstream migration. Thus disproportionate numbers (much greater than 15%) of Harrison Lake and Pitt River salmon fry probably travel downstream through the North Arm. Juvenile salmonids including Harrison Lake chinooks and probably sockeye may remain in the marshes of the North Arm and lower Fraser River for up to several months before entering the Strait of Georgia.

Adult pink and sockeye salmon have been studied by the International Pacific Salmon Commission during their upstream spawning migration. Up to 20% of these adults may reside for short periods of time in the North Arm.

**The Panel concludes that the North Arm of the Fraser River is considerably more important to all species of Pacific salmon than previously understood.**

**The Panel recommends that the Department of Fisheries and Oceans continue its studies of juvenile and adult salmon in the North Arm and the rest of the estuary in order to increase the accuracy of data on salmon utilization of the Fraser River.**

## Birds

The Fraser River estuary is the largest and most important area for migratory birds in British Columbia and is a candidate site for designation as a wetland of international significance under an United Nations agreement. Intervenor in the hearings expressed concerns that this valuable habitat and the birds it supports would be threatened by the risk of spills at the proposed fuel barge terminal.

The Fraser River estuary provides feeding, breeding and overwintering habitat for hundreds of thousands of birds including migratory and breeding waterfowl, shorebirds, loons, grebes, cormorants and gulls. McDonald Slough, Iona Island, Musqueam Marsh and adjacent water represent some of the most valuable habitat for waterbirds in the vicinity of the proposed terminal. The Department of the Environment, the agency responsible for migratory birds, stated that abating further habitat loss is the most important step that can be taken in the conservation of migratory birds. Because estuaries are rare along the coast of British Columbia, the conservation and protection of the Fraser River estuary is of particular importance.

The proposed project could have adverse effects on waterbirds, and some of these effects could have severe consequences. Waterbirds would be likely to encounter jet fuel spilled in the Fraser River, and such hydrocarbons are known to be toxic to birds. Light weight hydrocarbons such as jet fuel penetrate to the feather shafts of birds and are ingested by birds as they attempt to remove the material by preening. Hydrocarbons are also toxic to benthic organisms eaten by waterbirds, and thus the possibility exists that spilled jet fuel could suppress food populations upon which birds rely.

### **Commercial, Native and Sports Fisheries**

The Fraser River including the North Arm supports commercial, native and sports fisheries of major economic, cultural and social significance. Pacific salmon are the major target of these fisheries. The average annual escapement of Fraser River salmon is six million adult spawners. The Department of Fisheries and Oceans' stock management plan for Fraser River sockeye has the objective of increasing escapement to 12 million or more over a period of years. The estimated average annual gross wholesale value of the salmon fishery is \$148 million. The cultural and social value of the fishery cannot be measured in monetary terms. Government agencies, citizens' groups and the Musqueam Band expressed strong concerns about the potential effects of chronic and major fuel spills on Fraser River fisheries.

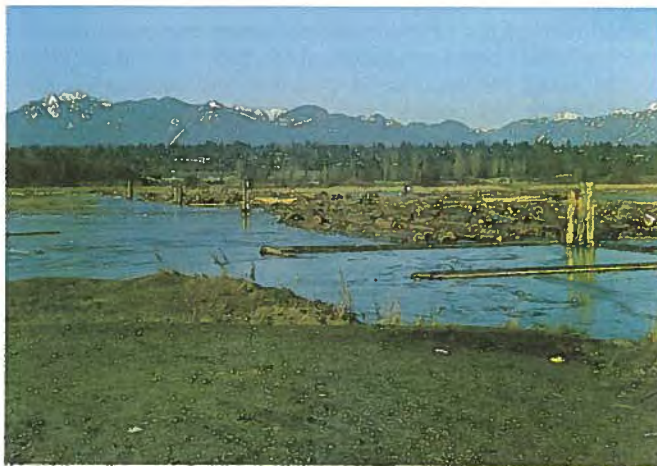
The level of fishing activity in the North Arm appears to be relatively low, but fishing effort is not a reliable indicator of fish abundance. Navigational activities in the North Arm make it difficult to set drift nets and gill nets, so fishing effort by the commercial and native fisheries is concentrated in other parts of the river. Sports fishing occurs in the North Arm, and McDonald Beach Park is a popular fishing location and boat launching area for sports fishermen.

### **Musqueam Band**

The watershed of the lower Fraser River and its resources have been the foundation of Musqueam society and culture for at least 8,000 years. The Musqueam reserves include land on the north shore of the North Arm just downstream from the proposed fuel barge terminal and the marshes along McDonald Slough. The Musqueam Band stated that their lifestyle and fishing, hunting, salmon enhancement and economic development activities would be at risk from the proposed fuel barge terminal.

Over 700 people live on the Musqueam reserve, and this number will increase by 42 percent with the return of newly recognized status Indians. Every household on the reserve relies on the Fraser River as a source of salmon and other foods. Band members also hunt along the river and on the reserves for waterfowl, pheasant and grouse.

The Musqueam people participate in the commercial and native food fisheries. The commercial fishery on the Fraser River provides a livelihood for over 20 commercial fishing vessels owned by Band members as well as additional jobs in fish processing. In 1988, 143 Indian Food Fish licenses were held by members of the Musqueam Band, and by late November, 1988, almost 34,000 salmon had been taken. The Musqueam native food fishery includes the North Arm downstream of the Knight Street bridge but is concentrated in the Canoe Pass area of Ladner due to heavy navigational use of the North Arm.



Salmon enhancement and economic development initiatives are being undertaken by the Musqueam Band to ensure an independent and self-sufficient lifestyle for Band members. The Band has been careful to protect important habitat for juvenile salmonids in Musqueam Marsh from the effects of development, and a salmon enhancement project is underway in the lower reaches of Musqueam Creek, the only creek in the City of Vancouver that supports a wild salmon stock. The Band hopes to release ten to fifteen million fry per year at the creek mouth and use the returning spawners for commercial purposes and for restocking the creek.

The Musqueam Band recently purchased eight acres of land directly across from the proposed fuel barge terminal. This waterfront property constitutes the Musqueam shipyard, an economic development initiative that will provide an employment base for Band members as well as facilities for Musqueam commercial fishing vessels.

## Recreational Opportunities and Aesthetic Values

The Fraser River and estuary are of recreational and aesthetic value to residents of the lower mainland and visitors from around the world. Bird-watching, boating, fishing, picnicking, walking, sunbathing and swimming are some of the activities that attract residents and non-residents to the river and estuary. Representatives of municipalities, provincial and federal agencies, citizens' groups, and residents of the estuary described the values which the river represents to them.

Parks and recreational properties located on both shores of the North Arm are used by residents and visitors throughout the year. These properties include golf courses, marinas, street end parks, green spaces, municipal parks in Vancouver and Richmond, and regional parks on Iona Island and Point Grey. The largest property is the newly created University Endowment Lands Regional Park. This park includes Wreck Beach which extends around Point Grey from the Musqueam Reserve to Spanish Banks.

Public access to the water along the North Arm has increased considerably over the past decade. Land uses along the river are changing from industrial to a mix of uses including park, recreation, residential, and commercial. Significant increases in waterfront access are expected over the next ten to twenty years as municipalities work to maintain and create green spaces and recreational areas along the river. The proposed fuel barge terminal would pose risks to the expanding recreational opportunities and aesthetic values of the North Arm. Many intervenors expressed concerns that the risks to the community and the environment would exceed the regional economic benefits to be realized from the proposed terminal.

## Commercial Activities

The Fraser River plays an important role in the economy of British Columbia as a major transportation corridor and the location of a variety of commercial activities including log-handling and storage, marinas, forest product businesses, industrial operations and fish processing. Many of these operations have docks or other facilities located on the water which would be at risk to damage caused by chronic or major spills of fuel.

## RISK ASSESSMENT

A risk assessment of the proposed fuel barge terminal was undertaken by the proponent to evaluate the likelihood of a jet fuel spill. Considerable discussion at the hearings was focused on the risk assessment and the interpretation of the results of this analysis. Intervenors questioned the risk assessment methodology, the data used in the analysis and the scope of the assessment.

### Risk Assessment Methodology

The proponent equated the risk associated with a fuel spill to the probability of a barge rupture resulting from a broadside collision in the North Arm. The probabilities, in turn, were derived from the frequency of collision involving two vessels on

the Fraser River. The reported spill frequencies per kilometre for various modes of fuel transport (truck, train, barge, pipeline) were compared. Many intervenors questioned this approach. Specifically, concern was expressed that risk expressed solely in terms of transit distance did not accurately reflect the true risk to the environment.

Risk is the probability that a defined hazard will occur. The only event considered by the proponent was collision of two vessels. The proponent stated that the risk assessment undertaken did not relate to the design and operation of the terminal facility. The proponent further stated that the risk assessment methodology did not follow the established procedures for fault tree analysis.

Determination of the consequence of a defined system failure or incident is referred to as consequence analysis. The proponent's consequence analysis was focused on the fate of a major spill using numerical modelling of Fraser River discharges.

### Risk Assessment Data

The proponent selected data for use in the risk assessment which were from actual incidents involving barge movements in the North Arm. The restrictive nature of the data base and the ambiguity in the definition of a "barge movement" were questioned by several intervenors. The Department of the Environment commented that reporting procedures and requirements for fuel spill incidents are entirely different from procedures required for incidents involving other commodities. The Department of the Environment stated, with the concurrence of the proponent, that most fuel spills occur during transfer operations, not during transport. Several data bases of actual spill reports for British Columbia, Canada and the United States were identified as being more appropriate for the risk assessment. These data would have given a more realistic estimate of fuel spill probability.

### Scope of Risk Assessment

The risk assessment focused on fuel spills occurring in the North Arm during transportation of fuel by barge to the proposed fuel barge terminal. The proponent stated that risk assessment was undertaken to illustrate that the chance of an incident in the channel was extremely low. Several intervenors indicated that the scope of the risk assessment was too narrow. In particular, concerns were expressed that the risk assessment addressed only transportation spills associated with broadside collision. The intervenors questioned the methods and data used to calculate the probability of a major spill. Concerns were expressed relating to the measurement of errors and reliability of probabilities calculated by the proponent.

The proponent did not undertake risk assessment for the terminal and associated facilities. Risk assessment is a technique which enables designers and engineers to analyze designs, search for failure pathways and identify potential common cause events leading to major consequence accidents. This type of analysis is used to assist in solving complex engineering design problems by comparing design alternatives



and identifying failsafe engineering solutions. The proponent stated that risk assessment was not used for such purposes for the proposed fuel barge terminal.

**The Panel concludes that the proponent's risk assessment is limited in methodology, data and scope and, consequently, underestimates the real risks associated with the proposed fuel barge terminal.**

## FUEL SPILL SCENARIOS AND SPILL EFFECTS

Considerable discussion at the hearings focused on the fuel spill scenarios and assessment of potential spill effects that were prepared for the proposed fuel barge terminal. Many intervenors requested clarification on the fuel spill scenarios and asked for information on impacts that might be associated with the scenarios.

### Fuel Spill Scenarios

Fuel spill scenarios presented by the proponent were based on a simplified, one-dimensional model of the Fraser River which required input data from a generalized Fraser River model developed by the Institute of Ocean Sciences. The model did not account for factors such as movement of the salt wedge, eddy currents, river bank configuration, winds and fluctuations in barometric pressure. Although the model can be used for spills of any size, only major spills were modelled.

The fuel spill model was used to estimate how long spilled fuel would remain in the river and how far upstream the fuel would travel under various scenarios. The high slack tide conditions selected for the scenarios maximized the flushing of spilled fuel into the Strait of Georgia. Differences of opinion between the proponent and several intervenors were expressed over the duration of time a spill might remain in the river and the geographical area that could be affected by a spill.

Some review participants questioned how spilled fuel would behave as it moved up and down the river and what its fate would be after it passed out of the North Arm and into the Strait of Georgia. Concern was expressed about the potential, which had not been addressed, for spilled fuel to become trapped or stranded in sloughs, eddies, marshes, log booms and debris along the river banks. Local fire departments were concerned about the lack of conclusive information on the ignition potential of spilled jet fuel.

The spill modelling results obtained by the proponent differed significantly from those obtained by the Institute of Ocean Sciences using a similar, but more sophisticated numerical model. The choice of boundary conditions made a significant contribution to the physical accuracy of the models. The level of detail provided on spill scenarios and discrepancies in modelling approaches made it difficult to fully comprehend how a "worst-case" spill might affect the Fraser River, the estuary, the Strait of Georgia, and resources at risk.

**Considering the importance of the resources at risk and due to the potential for other activities in the estuary to result in spills of hazardous materials, the**

**Panel recommends that the Department of Fisheries and Oceans accelerate its work on the development of spill scenarios for use as planning tools in developing countermeasures planning and response capability in the estuary.**

### Spill Effects

Many intervenors were interested in understanding in some detail the types of spill effects that might be associated with the fuel spill scenarios presented. The disagreements over the fuel spill scenarios resulted in many intervenors questioning the completeness and accuracy of the analysis of spill effects. Questions were posed about specific environmental concerns including:

- the potential for spilled fuel to be retained in marshes, sloughs and other low-energy environments where pollution levels are already higher than the main channel of the Fraser River;
- the difficulty of removing spilled fuel from marshes and beaches and the environmental effects associated with clean-up activities in these areas;
- the acute toxic and sublethal effects of jet fuel on fish, birds, invertebrates and vegetation;
- complete recovery time for marshes, sloughs and beaches impacted by spilled fuel;
- the potential for a fuel spill to result in a fire; and
- the possibility that spill effects could extend beyond the mouth of the North Arm and affect Point Grey, Burrard Inlet and the Strait of Georgia.

Concerns were expressed about spill effects on recreational opportunities and aesthetic values. The possibility of a fuel spill forcing the closure of Wreck Beach to swimming during the summer when as many as 12,000 people/day could be using the beach was identified as a major concern. The odour and fouling effects of a spill would adversely affect aesthetic appreciation of parks, green spaces, and recreational pursuits along the North Arm.

The environmental effects of chronic small spills were not specifically addressed. Wherever fuel is transferred, it is always present in the water column no matter how carefully it is handled. Burrard Inlet and New Westminster were cited as examples where routine handling of fuel has resulted in detectable levels of fuel in the water. Concern exists for the cumulative effects of minor, chronic spills which would inevitably occur at the proposed fuel barge terminal.

**The Panel recommends that the Department of Fisheries and Oceans and the Department of the Environment undertake more intensive research programs to better understand environmental effects of hazardous product spills and the application of research findings to the reestablishment of productive environmental conditions.**

## SPILL CONTINGENCY PLANS AND COUNTER-MEASURES

General information on spill contingency plans and spill countermeasures that could be used at the proposed fuel barge terminal was discussed at the hearings, but the proponent indicated that complete operational contingency plans would only be developed upon approval of the proposal. Technical specialists and many intervenors expressed serious reservations about the capability of existing spill response teams and countermeasures technologies to respond adequately to a major fuel spill in the lower Fraser River.

Among the concerns expressed about spill contingency plans and countermeasures in the lower Fraser River were:

- the lack of active spill prevention measures incorporated into the engineering design of the terminal;
- the lack of a clearly defined chain-of-command for responding from land or water to a spill or fire;
- apparent confusion among various authorities over who would have primary responsibility for responding to a major spill or fire;
- the limitations of available countermeasures and spill containment equipment in riverine situations;
- the difficulty of responding to a fire associated with a fuel spill and the current lack of a fire boat to fight a fire in the lower Fraser River;
- the lack of suitable equipment in the lower mainland for controlling spills on the Fraser River;
- the lack of a designated disposal site for fuel-soaked debris; and
- the lack of a formal agreement between the VAFFC and Burrard Clean Oil Spill Cooperative and the time that would be required to move the cooperative's equipment from Burrard Inlet to the site of a spill in the North Arm.

The Panel believes that development of operational contingency plans for spills, fires and other accidental occurrences should be an integral part of the environmental planning and assessment process for specific projects. The technological limitations of spill countermeasures and equipment for containing riverine spills raise grave concerns about the feasibility of controlling a major fuel spill at the proposed fuel barge terminal. The present lack of capability to fight a river fire from the waterside is also of serious concern.

**The Panel recommends that the North Fraser River Harbour Commission work with FREMP and other agencies to develop an estuary-wide response plan which includes a clearly defined chain-of-command for responding to accidents such as spills, fires, and other incidents.**

## CONSTRUCTION ACTIVITIES

Many technical issues related to construction of the proposed fuel barge terminal were discussed by technical specialists and intervenors at the hearings. The potential effects of dredging were the most extensively discussed. Most intervenors agreed that the potential effects of dredging and other construction activities could be avoided or mitigated through seasonal timing of operations, good engineering design and practice, and good environmental practices.

The site of the proposed fuel barge terminal is presently used for dredgespoil storage. Construction activities occurring on this site would probably not have serious effects on aquatic and terrestrial habitat or organisms. However, construction activities could potentially affect adjacent areas such as McDonald Slough through sedimentation and disturbance of wildlife. Construction activities would also have adverse effects on recreational opportunities and aesthetic values in the area. These activities should be planned and managed in consultation with regulatory agencies so that these activities would be conducted in an environmentally acceptable manner.

## ROUTINE OPERATIONS

Routine operations would occur for the operational life of the proposed fuel barge terminal. The discussion at the hearings focused on environmental management procedures, timing and scale of operations, maintenance dredging, and river traffic and navigational hazards.

## Environmental Management Procedures

Although the proponent indicated that an environmental management plan would be prepared upon project approval, a comprehensive plan outlining the environmental management procedures that would apply to all aspects of the proposed fuel barge terminal was not available for public review at the hearings. The proponent indicated that an environmental officer responsible for environmental monitoring and training would be employed. A system of boom curtains was proposed to contain chronic spills.

Two boom curtains, one installed across the entrance of the barge berth and one positioned across the mouth of McDonald Slough, were proposed by the proponent for the containment of chronic and accidental spills that could occur during transfer operations. The boom curtain across McDonald Slough could block the mouth of the slough for up to 48 hours each time a barge entered the North Arm for off-loading of jet fuel. The potential for the boom curtain to restrict movement of juvenile salmonids to and from the slough and possibly exacerbate seasonal problems with depressed oxygen levels in the slough is of concern.

Environmental monitoring programs for the proposed fuel barge terminal would be required to establish background data on features such as water quality, fish and benthic invertebrate populations, and habitat and to evaluate environmental effects of terminal operation. Appropriate monitoring programs have not been developed nor have discussions to

define monitoring requirements been initiated with regulatory authorities. However, the proponent indicated willingness to work closely with regulatory authorities to develop monitoring programs should the project be approved.

The Panel believes that an environmental management plan should be an integral part of the project planning and assessment process. A well-developed environmental management plan would have enabled the Panel to more completely understand potential effects of routine operations and the strategies proposed to mitigate these effects.

### Timing and Scale of Operations

Intervenors were concerned over the timing and scale of operations at the proposed fuel barge terminal. The timing of fuel off-loading operations was questioned by several intervenors who expressed doubts over whether or not operations would be confined to daylight hours during all months of the year.

The future scale and nature of operations at the terminal was questioned. Concern was expressed over the number of barges that might be handled per month as fuel requirements at Vancouver International Airport increase over time. Questions were posed about possible origins, including United States refineries and refineries in Burrard Inlet, of increased barge traffic. Concerns over the possible development of additional infrastructure for handling jet fuel or other commodities at the proposed terminal were also voiced.

The Panel is concerned about the scale and nature of operations at the proposed fuel barge terminal for its operational life. Over the long term, operations at the proposed terminal could be increased above the level of one to six barges per month as fuel demand increased at Vancouver International Airport. Therefore, the Panel is concerned about possible effects related to increased levels of operation or possible future expansion of the terminal.

### Maintenance Dredging

Information on maintenance dredging requirements including frequency, volume and dredge disposal plans was sought. The Department of Fisheries and Oceans indicated that potential effects related to dredging could be dealt with through planning and cooperation. The Department of the Environment presented information indicating that unacceptably contaminated sediments were unlikely to be found at the site as industrial facilities had not previously been located there.

**The Panel concludes that with proper planning and consultation with regulatory authorities maintenance dredging could be conducted in an environmentally acceptable manner.**

### River Traffic and Navigational Hazards

Traffic management in the North Arm of the Fraser River, particularly the scheduling of the movements of the fuel barge in and out of the North Arm, was of concern to many intervenors. Scepticism was expressed about whether or not there would be sufficient coordination among river users to ensure that the fuel barge would always move into the North Arm under optimal slack tide conditions. It was suggested that the North Fraser Harbour Commission traffic management system might require upgrading to make it better able to manage vessel traffic in the North Arm. The need for a better understanding of existing movements of liquid petrochemicals in the North Arm was pointed out on several occasions.

**The Panel recommends that the North Fraser Harbour Commission review its traffic management system and upgrade it as necessary.**

### COMPENSATION

Intervenors participated in a discussion on compensation for lost habitat and ways of achieving no-net loss of habitat in accordance with Department of Fisheries and Oceans policy. The proponent was under the impression that by selecting an area zoned "green" for industrial development in the North Fraser Harbour Commission's habitat management plan the habitat compensation problem had been addressed. However, no discussions on habitat compensation or habitat management had been undertaken with the Department of Fisheries and Oceans.

The discussion of compensation for spill related damages included both financial compensation for damages and rehabilitation of damaged resources. Concern was expressed that prolonged legal battles are often required before final agreements on financial compensation for spill damages are reached. The posting of a bond was identified as one way of alleviating this problem. Compensation for foregone loss of resources as the result of a spill was also identified as a serious concern that could potentially be addressed by the posting of a bond. The Panel believes that potential environmental and economic losses related to a major fuel spill in the lower Fraser River could be difficult, and in some cases impossible, to compensate. The Panel is particularly concerned about compensation for foregone losses of food, commercial, and sports fisheries resources, recreational opportunities and aesthetic values.

**The Panel recommends that FREMP explore compensation mechanisms for attributable and non-attributable losses through means such as compensation funds, environmental levies, and revolving funds.**

**SEA ISLAND FUEL BARGE FACILITY  
ENVIRONMENTAL ASSESSMENT PANEL**

A handwritten signature in black ink, appearing to read 'D. Marshall', written over a horizontal line.

David Marshall (Chairman)

A handwritten signature in black ink, appearing to read 'JB Northcote', written over a horizontal line.

Tom Northcote

A handwritten signature in black ink, appearing to read 'Allister A Brown', written over a horizontal line.

Allister Brown

## **APPENDIX A — PANEL MEMBER BIOGRAPHIES**

### **Mr. David Marshall (Chairman)**

Mr. Marshall is the Vancouver based Director of the Pacific, Western and Northern Region of the Federal Environmental Assessment Review Office (FEARO). He graduated from Queen's University in 1971 with a degree in chemical engineering. Before joining FEARO in 1980, he was head of the Environmental Impact Assessment and Design Division and head of the Policy, Co-ordination and Development Division of Environment Canada's Environmental Protection Service. Mr. Marshall has had extensive experience in environmental assessment activities and Environmental Assessment Panel reviews.

### **Dr. Allister Brown**

Dr. Brown is a Vancouver consultant specializing in hazardous materials management, risk assessment, spill containment and clean-up, transportation of dangerous chemicals and air and water pollution control. He received his B.Sc. in chemistry and

mathematics in 1964 from the University of British Columbia and his Ph.D. in chemistry in 1970 from the University of Toronto. Prior to forming his own consulting company (Technology Resource Inc.) in 1982, Dr. Brown was Vice President of C.D. Schultz and Co. Limited and taught as an Assistant Professor at the University of Kansas Medical School.

### **Dr. Tom Northcote**

Dr. Northcote is a Professor at the University of British Columbia (U.B.C.) with the faculties of Forestry, Graduate Studies and Science. He is also associated with the Westwater Research Centre and Resource Ecology, at U.B.C. He received his B.A. in 1950 and his Ph.D. in 1960, both from U.B.C., and took postgraduate work at Cambridge, England. Dr. Northcote has taught at U.B.C. since 1958. His main area of research has been associated with freshwater fishes and ecology.

## APPENDIX B — PANEL TERMS OF REFERENCE

### INTRODUCTION

At the request of the federal Minister of Transport, an Environmental Assessment Panel has been established by the federal Minister of the Environment to conduct a public review of a proposal to construct and operate a jet fuel barge offloading facility on Federal Crown Land on Sea Island, Richmond, B.C. The site of the proposed facility is under the administrative control of the North Fraser Harbour Commission. The project proponent is the Vancouver Airport Fuel Facilities Corporation.

### MANDATE OF THE PANEL

The mandate of the Panel is to publicly review and assess the environmental and socio-economic effects associated with the construction and operation of the jet fuel barge offloading facility. The Panel shall consider and report on the environmental and socio-economic acceptability of the project. The Panel shall include in its review some consideration of the need for the project and alternatives to it. In considering project alternatives, account shall be taken of the environmental and socio-economic effects of these alternatives. If the Panel concludes that the project is acceptable, it may recommend terms and conditions under which the project could proceed, including arrangements for monitoring the implementation of the project and subsequent environmental effects. If the Panel concludes that the project is unacceptable, it shall provide its rationale for this recommendation. In fulfilling its mandate, the Panel shall provide adequate opportunities for public review and input.

### SCOPE OF THE REVIEW

The Panel review shall include consideration of the following:

- (1) Project definition and need.
- (2) Alternatives to the project, including siting and transportation mode alternatives.
- (3) Environmental setting of the project.
- (4) Potential environmental and socio-economic impacts of the project.
- (5) Environmental and socio-economic impact mitigation and compensation possibilities in connection with the project.
- (6) Environmental and public risk factors associated with the project, including those related to navigational safety

within the Fraser River Estuary Management Program area.

- (7) Contingency planning and countermeasures effectiveness.
- (8) Liability and compensation.

### PROCEDURES

Detailed written procedures for the conduct of the review shall be established by the Panel and made available to the public.

### PANEL REVIEW STEPS

The main steps in the Panel review process shall be as follows:

1. Review of existing project documentation, in particular the Environment Impact Assessment report prepared by Acres International Limited. This review should focus on identifying key issues of concern and information gaps in the present documentation and shall include opportunities for public input.
2. Panel preparation of requests for additional information to be directed to the project proponent through the North Fraser Harbour Commission.
3. Response to the Panel's request for additional information prepared by the project proponent, submitted to the Panel and made publicly available by the Panel.
4. Public review of the Acres Environmental Impact Assessment report and proponent's response to the Panel's request for additional information.
5. Public hearings held by the Panel.
6. Panel preparation of its final report.

### REPORT AND RECOMMENDATIONS

The Panel shall submit its findings and recommendations to the federal Ministers of the Environment and Transport in the form of a written report. All reasonable efforts should be made to have this report completed by November 30, 1988.

## APPENDIX C — ISSUES SCOPING WORKSHOP PARTICIPANTS

NAME	AFFILIATION		
Larry Bachelder	Trans Mountain Pipe Line Co. Ltd.	David Marshall	Panel Chairman
Joe Becker	Musqueam Indian Band	Michael Matthews	Transport Canada —
June Binkert	West Southlands Ratepayer's Association and Southlands Citizens Planning Committee	Mike McPhee	Vancouver International Airport
Mel Blaney	City of Vancouver —	Terry Mulder	Fraser River Estuary
Roland Bolton	Emergency Planning	Tom Nichols	Management Program
Dave Bremner	City of Vancouver — Fire Department	Tom Northcote	City of Vancouver
Allister Brown	Canadian Coast Guard	Jim Pipe	Sierra Club
Marissa Byrne	Panel Member	Barbara Pringle	Panel Member
Gus Cammaert	Fisheries and Oceans Canada	Wendy Quinn	Trans Mountain Pipe Line Company Limited
Debra Campbell	Acres International Limited	Laszlo Retfalvi	Panel Secretariat
George Colquhoun	Musqueam Indian Band	Vic Rivers	Fraser River Coalition
Anthony Dorcey	North Fraser Harbour Commission	Ray Robinson	Environment Canada
Evelyn Feller	Westwater Research Centre — U.B.C.	Craig Runyan	Vancouver Airport Fuel
Mike Flynn	Fraser River Coalition	Paul Scott	Facilities Corporation
Julie Gardner	Fisheries and Oceans Canada	Bob Sherwood	FEARO — Ottawa
Allan Graham	Westwater Research Centre — U.B.C.	Terry Stewart	Municipality of Richmond
Sarah Groves	Wardair Canada Inc.	Mary Sutherland	Panel Executive Secretary —
Ken Hall	Panel Secretariat	Peter Trask	FEARO
Scott Hanna	Westwater Research Centre — U.B.C.	Wendy Turner	Environment Canada
Alex Jamieson	Acres International Limited	Gary Williams	Transport Canada —
Keith Keller	Township of Richmond	Judy Williams	Vancouver International Airport
Otto Langer	Fisheries and Oceans Canada		Vancouver Sun
Paul Levelton	Acres International Limited		Fraser River Coalition
Ken Lien	Trans Mountain Pipe Line Co. Limited		Vancouver Natural History Society
			Wreck Beach Preservation Society and Fraser River coalition



## APPENDIX D — HEARINGS PARTICIPANTS

NAME	AFFILIATION		
Al Ages	Fisheries and Oceans Canada	Colin Levings	Fisheries and Oceans Canada
Malcolm Ashford	Vancouver Board of Parks and Recreation	Paul Levelton	Acres International Limited
Fred Beech	Environment Canada	Mike McPhee	Fraser River Estuary Management Program
Vivian Bevis	West Southlands Ratepayers Association	Garry Miller	Trans Mountain Pipe Line Company Limited
June Binkert	Southlands Citizens Planning Committee and Fraser River Coalition	Pat Miller	Acres International Limited
Roland Bolton	Vancouver Fire Department	Mike Nassichuk	Fisheries and Oceans Canada
Hal Blake	Seaspan International Limited	Adrienne Peacock	Civic New Democrats
Gus Cammaert	Acres International Limited	Wally Raeppe	Acres International Limited
Jack Cawdery	Technical Specialist	Vic Rivers	Vancouver Airport Fuel Facilities Corporation
Mac Clark	Environment Canada	Craig Runyan	Township of Richmond
Tom Doyle	Trans Mountain Pipeline Company Limited	Lloyd Ryan	Seaspan International Limited
Evelyn Feller	Fraser River Coalition	Bob Sherwood	Environment Canada
Merv Fingas	Environment Canada	Laurie Solsberg	Technical Specialist
Mike Flynn	Fisheries and Oceans Canada	Rick Steen	Richmond Fire Department
Bob Gardiner	Hay and Company	Mickey Tanner	Total Naval Technology Inc.
Allan Graham	Wardair	Robin Taylor	Acres International Limited
Wendy Grant	Musqueam Indian Band	Arnie Thomlinson	United Fishermen and Allied Workers Union
Scott Hanna	Acres International Limited	Wendy Turner	Community Forum on Airport Development
Don Hehn	Fraser River Estuary Management Program	Bob Virgette	Trans Mountain Pipe Line Company Limited
Colin Hendry	Canadian Coast Guard	Mike West	Vancouver Shipyards Company Limited
Alex Jamieson	Township of Richmond	Judy Williams	Wreck Beach Preservation Society
Otto Langer	Fisheries and Oceans Canada		
Peter Larkin	Technical Specialist		

## **APPENDIX E — INFORMATION RECEIVED BY THE PANEL**

### **A. Documents/Reports**

1. Environmental Impact Assessment report dated August, 1986 and prepared by Acres International Limited on behalf of the Vancouver Airport Fuel Facilities Corporation.
2. Addendum to the Environmental Impact Assessment report dated March, 1988 and prepared by Acres International Limited on behalf of the Vancouver Airport Fuel Facilities Corporation.
3. Compendium of Responses to the Panel's Request for Additional Information. This Compendium which was circulated in early September, 1988 contains responses from Acres International Limited on behalf of the Vancouver Airport Fuel Facilities Corporation, Trans Mountain Pipe Line Company Limited, the North Fraser Harbour Commission, Mr. Laurence Solsberg, Mr. Jack Cawdery, Fisheries and Oceans Canada, Environment Canada, the B.C. Ministry of Environment, the Vancouver, Richmond and University Endowment Lands Fire Departments, the Canadian Coast Guard and the Panel Secretariat.

### **B. Written Submissions in Response to the Panel's Request for Identification of Key Issues and Additional Information Requirements**

1. Comments received from the Corporation of the Township of Richmond dated April 20, 1988 and resubmission of March 1987 staff report as endorsed by Richmond Council.
2. Letter from the Musqueam Indian Band dated April 22, 1988.
3. Submission from the Fraser River Coalition dated April 5, 1988.
4. Letter from Dr. Ken Hall.
5. Submission from the Wreck Beach Preservation Society dated April 7, 1988.
6. Letter from Trans Mountain Pipe Line Company Limited dated April 8, 1988.
7. Submission from the Fraser River Estuary Management Program dated April 12, 1988.
8. Joint submission from Fisheries and Oceans Canada and Environment Canada dated April 14, 1988.
9. Letter from the City of Vancouver dated April 8, 1988 with attached summary of concerns raised by the Vancouver Fire Department.

### **C. Formal Written Submissions Received by the Panel Prior to and During the Public Hearings**

1. Submission from the Corporation of the Township of Richmond dated October 17, 1988.
2. Submission from the British Columbia Aviation Council dated October 31, 1988.
3. Letter from T.N.T. Total Naval Technology Inc. dated November 4, 1988.
4. Submission from Environment Canada dated November 4, 1988.
5. Submission from the Management Committee of the Fraser River Estuary Management Program dated November 7, 1988.
6. Submission from the Vancouver Board of Parks and Recreation dated November 8, 1988.
7. Submission from Fisheries and Oceans Canada dated November 9, 1988.
8. Letter from Trans Mountain Pipe Line Company Limited dated November 9, 1988.
9. City of Vancouver Position Paper on the Jet Fuel Barge Facility.
10. Letter from Mr. Ernest Starling dated November 10, 1988.
11. Letter from Greenpeace dated November 14, 1988.
12. Brief to the Panel from Ms. Adrienne Peacock on behalf of the Civic New Democrats dated November 17, 1988.
13. Written Brief to the Panel from Duane Robert Burnett dated November 19, 1988.
14. Southlands Citizens' Planning Committee Brief to the Panel dated November 23, 1988.
15. Submission of the Fraser River Coalition to the Panel.
16. Addendum to the Fisheries and Oceans Canada submission to the Panel dated November 24, 1988.
17. Submission to the Panel from the Musqueam Indian Band dated November 24, 1988.
18. Presentation of Opposing Petition and Brief from the Wreck Beach Preservation Society dated November 24, 1988.
- \* 19. Letter from the Green Party of Canada.
- \* 20. Letter from the Sierra Club of Western Canada dated November 28, 1988.
- \* 21. Letter from Dr. Barry Leach, Chairman of the Fraser Wetlands Habitat Committee of the Fraser River Conference dated November 16, 1988.

\*22. Letter from the Wildlife Rescue Association of British Columbia dated November 22, 1988.

\*23. Letter from CRAB Create a Real Available Beach dated November 17, 1988.

\*24. Letter from the Federation of Canadian Naturalists dated November 4, 1988.

\*25. Letter from the Naturist Society dated November 21, 1988.

\* These letters were all appended to the Wreck Beach Preservation Society Brief.