ORDER NO. 636
DATE: January 27, 1982

BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of the Application of NORTHERN TIER PIPELINE COMPANY A Delaware corporation	Application No. 76-2 FINDINGS OF FACT, CONCLUSIONS OF LAW, ORDER AND RECOMMENDATION

This matter came on regularly for hearing on January 3, 1980, in Tumwater, Washington, before Chairman Nicholas D. Lewis and the Energy Facility Site Evaluation Council of the State of Washington. Ancillary hearings have been conducted beginning September 2, 1976, in Port Angeles, Washington. Hearings have also been conducted in Port Townsend, Shelton, Olympia, Lacey, Tacoma, Enumclaw, Seattle, Spokane, Coupeville, Oak Harbor and Everett, Washington. Hearings have been conducted by Keith Sherman, Claude Lakewold, Tom Stacer, and John von Reis.

The following parties appeared:

NORTHERN TIER PIPELINE COMPANY (Applicant)

CITY OF PORT ANGELES

DEPARTMENT OF FISHERIES

DEPARTMENT OF TRANSPORTATION

DEPARTMENT OF NATURAL RESOURCES

COUNSEL FOR THE ENVIRONMENT

CLALLAM COUNTY

DEPARTMENT OF ECOLOGY

DEPARTMENT OF GAME

DEPARTMENT OF SOCIAL AND HEALTH SERVICES

OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION

JEFFERSON COUNTY

ISLAND COUNTY

SNOHOMISH COUNTY

KING COUNTY

KITTITAS COUNTY

GRANT COUNTY

SPOKANE COUNTY

SAN JUAN COUNTY

CITY OF SEATTLE

PORT OF PORT ANGELES

FIRE DISTRICT NO. 3
(Clallam County)

MAKAH TRIBE

TULALIP TRIBES

SAVE THE RESOURCES COMMITTEE

NO OIL PORT!

CITIZENS' TASK FORCE

ITT-RAYONIER CORPORATION

CROWN ZELLERBACH CORPORATION

ATLANTIC RICHFIELD CORPORATION

COALITION AGAINST OIL POLLUTION

These additional parties and organizations participated before the Energy Facility Site Evaluation Council since the filing of the original application:

MASON COUNTY

SKAGIT COUNTY

THURSTON COUNTY

QUINCY IRRIGATION DISTRICT

PIERCE COUNTY

EAST COLUMBIA IRRIGATION DISTRICT

CITY OF TACOMA

ADAMS COUNTY

CITY OF BUCKLEY

LINCOLN COUNTY

Opportunity for members of the public to testify was provided in the previously mentioned hearing locations.

Having considered the record in the matter, the Council proposes the following findings of fact and conclusions of law:

FINDINGS OF FACT

I. A. HISTORY OF PROCEEDINGS

1. On July 6, 1976, the Northern Tier Pipeline Company, hereinafter "Northern Tier," "company," "applicant," or "NTPC," then a Montana corporation, filed an application with the Energy Facility Site Evaluation Council for authority to construct and operate an energy facility consisting of a crude oil receiving port, a crude oil transmission pipeline, and associated storage and other facilities. The company sought certification of its receiving port site at a location on the south shore of Ediz Hook at Port Angeles, Washington. The company sought certification of a proposed tank farm site at Green Point, a geographical feature several miles east of Port Angeles. The company proposed to construct and operate a receiving and transmission facility capable of moving crude oil from Port Angeles to points east as far as Clearbrook, Minnesota. In the state of Washington, the company sought certification of a route from Port Angeles through Clallam, Jefferson, Mason, Thurston, Pierce, King, Kittitas, Grant, Lincoln and Spokane counties to the Idaho border.

2. On July 26, 1976, EFSEC determined that Northern Tier's July 6, 1976 application should not be accorded official

status, but, on July 28, 1976, the Council, on its own motion, reconsidered and accorded official status to the application, contingent on receipt of additional information. Certain additional information was received in August and November, 1976.

3. On February 28, 1977, the Council found the Northern Tier proposal to be consistent and in compliance with county and regional land use plans and zoning ordinances, except that the proposed tank farm site was determined inconsistent with the Clallam County Comprehensive Plan and not in compliance with the Clallam County Interim Zoning Map. Council Order No. 529 is incorporated herein by this reference.

4. Northern Tier made route amendments in 1978 in King, Kittitas and Spokane counties, largely to diminish potential threats to the water supplies of three large communities, and also changed some 16 miles of its route from Lincoln County to Adams County at the request of Adams County. On December 11, 1978, the Council found the changed portions of the route consistent and in compliance with county and regional land use plans and zoning ordinances. Council Order No. 550 is incorporated herein by this reference.

5. In June, 1979, the company completed an amendment containing substantial modification of its Clallam, Jefferson, and King county sites, added site portions in Island

and Snohomish counties, and abandoned site portions in Mason, Thurston and Pierce counties. The 1979 amendment altered berth and submarine unloading line configurations. It also changed the route to run under Admiralty Inlet and Saratoga Passage rather than around Puget Sound, and to cross the land masses of Whidbey and Camano islands, and the land and waters of Snohomish County. On November 26, 1979, the Council found the amended portions of the site inconsistent, and not in compliance, with various Clallam County and City of Port Angeles land use plans and zoning ordinances; with particular provisions of the Snohomish County zoning code, namely forestry and recreation, mineral conservation, and flood hazard zones; and with the zoning ordinance of the Town of Arlington, but otherwise consistent and in compliance with county and regional land use plans and zoning ordinances. Council Order No. 579 is included herein by this reference.

I. B. CORPORATE DESCRIPTION OF APPLICANT

1. The Northern Tier Pipeline Company (hereinafter "Northern Tier," "NTPC," "the applicant" or "the company") is a consortium first incorporated in 1975 in Montana. In 1979, the company changed its state of incorporation to Delaware.

2. The company was formed for the purpose of, and still has as its specific purpose, obtaining those federal and state licenses, approvals, and certifications prerequisite to construction of a common carrier crude oil receiving superport in the harbor of Port Angeles, Washington; a nearby tank farm; associated facilities; and also a crude oil pipeline capable of moving oil from Port Angeles to points east as far as Clearbrook, Minnesota.

3. Equity ownership of Northern Tier has changed since the company was first formed. Present equity ownership is as follows:

Participant	Ownership Percentage
Butler Associates, Inc.	2.52%
Curran Oil Company	4.73%
Glacier Park Company (subsidiary of Burlington Northern Inc.)	21.21%
MAPCO, Inc.	1.94%

Western Crude Oil, Inc. (subsidiary of) Getty Oil, Inc.)	26.10%
MNT, Inc. (subsidiary of Chicago, Milwaukee, St. Paul and Pacific Railroad Company)	1.88%
U. S. Steel Corporation	26.10%
Westinghouse, Inc.	9.59%
CENEX	5.93%

4. Equity ownership and perhaps control of the company could change at any time.

5. Butler Associates, Inc., has entered into a joint venture which would provide construction design, construction engineering and construction management should the project be built. Northern Tier has contracted to purchase necessary pipe from U.S. Steel. Burlington Northern, Inc., is in a position to supply right-of-way and Westinghouse may be specified to supply pumps.

I.C. DEMAND FOR FACILITY LOCATION AND OPERATION

RCW 80.50.010, the Council's policy statute provides:

> The legislature finds that the present and predicted growth in energy demands in the state of Washington requires the development of a procedure for the selection and utilization of sites for energy facilities and the identification of a state position with respect to each proposed site. The legislature recognizes that the selection of sites will have a significant impact upon the welfare of the population, the location and growth of industry and the use of the natural resources of the state.
>
> It is the policy of the state of Washington to recognize the pressing need for increased energy facilities, and to ensure through available and reasonable methods, that the location and operation of such facilities will produce minimal adverse effects on the environment, ecology of the land and its wildlife, and the ecology of state waters and their aquatic life.
>
> It is the intent to seek courses of action that will balance the increasing demands for energy facility location and operation in conjunction with the broad interests of the public. Such action will be based on these premises:
>
> (1) To assure Washington state citizens that, where applicable, operational safeguards are at least as stringent as the criteria established by the federal government and are technically sufficient for their welfare and protection.
>
> (2) To preserve and protect the quality of the environment; to enhance the public's opportunity to enjoy the esthetic and recreational benefits of the air, water and land resources; to promote air cleanliness; and to pursue beneficial changes in the environment.
>
> (3) To provide abundant energy at reasonable cost.

It is apparent from the language of this provision that the legislature intended the Council to consider the issue of demand for the facility not as an issue apart from substantive concerns but only insofar as a balance need be struck between a project's ability to satisfy the generalized demand for energy facilities on the one hand and, on the other, public interests which might be affected by the proposal.

1. Northern Tier proposes to construct an energy facility capable of receiving more than an average of 50,000 barrels of crude petroleum per day, transmission pipelines larger than six inches minimum inside diameter between valves, and with a total length for transmission of these products of more than 15 miles.

2. Identification and quantification of the particular increasing demand for the Northern Tier proposal over the years since the project's inception are not readily ascertainable.

3. The project was originally conceived as a response to a number of factors. One factor was a determination by the Canadian government to allocate Canadian petroleum supplies to domestic Canadian needs which resulted in a largely realized cutoff of Canadian crude petroleum supplies to refineries located in the upper Midwestern U.S. except on an exchange basis. Another factor was an anticipated inability of U.S. West Coast crude purchasers to absorb the output of the Prudhoe Bay petroleum fields. This anticipated inability created an expectation that a massive means of moving Prudhoe Bay petroleum to U.S. secondary markets would have to be created. A third factor significant for decisionmakers in the mid 1970's was the expectation that demand for crude petroleum and its products in the upper Midwestern states and the United States as a whole would steadily increase over time.

4. The Public Utility Regulatory Policies Act (PURPA), Public Law 95-617, established federal processes for selecting delivery systems to transport Alaskan and other crude oil to inland states; for resolving both the West Coast crude oil surplus and the crude oil surplus problems in the northern tier states; for expediting procedures for acting on pipeline applications for all federal permits, licenses, and approvals required for construction and operation; and for coordination to the maximum extent practicable of federal and state decisions. The President of the United States entered findings which accorded expedited federal processing to Northern Tier, and, if Northern Tier were not successful, to the Trans Mountain Pipe Line Company. Congress turned the determination of need for this project over to the President and the President turned the decision over to the financial community. No specific determination of national need for the Northern Tier project resulted from the PURPA process.

5. In the course of processing this application, the Council made a direct request of the federal government for an assessment of demand for the project. Federal and other witnesses testified in the Council's proceedings on the issue of demand. Witnesses who testified did not establish a national need for the project.

6. Much has happened to the petroleum market and to the supply of, and demand for, petroleum products since early July, 1976. The benchmark price for an average barrel of crude petroleum, both in terms of constant and inflated dollars, has risen sufficiently to diminish the ability to predict markets. Evidence presented before this Council does not correspond to the anticipation of several years ago that demand for petroleum in the upper Midwestern U.S. and in the United States as a whole would steadily increase over time.

7. Prudhoe Bay production is expected to begin a long term decline no later than 1986. No large new Alaskan fields have been discovered, defined, or made ready for production. Should a comparable field be found in a recoverable area, it would have to be proved, scheduled and brought on line (a process requiring 6 to 8 years under normal circumstances), before commercial crude could be produced. Substantial new fields have been discovered and proved in Montana, Wyoming, and North Dakota. Prudhoe Bay production not absorbed on the West Coast is moving readily to secondary markets by existing means.

8. The federal government has deregulated the price of crude oil, which increases the incentive for markets for domestic crudes to develop in regions closest to points of production.

9. Since 1976, West Coast refineries have increased their capacity to process Alaskan crude oil. Retrofitting and changes in purchasing practices have resulted in more Alaskan crude oil being used on the West Coast than was anticipated in 1975 and 1976. The ability of West Coast refineries to process Alaskan petroleum continues to increase.

10. Since 1976, new pipeline systems such as the Koch-Williams Bros. Line intended to serve the Koch refinery in Minnesota have been constructed. (The Koch refinery is the largest in Minnesota.) Space available for shipping petroleum to the upper Midwest from the Gulf of Mexico on existing components of the mid-continent system has increased.

11. Northern Tier did not produce testimony of any witness who indicated a willingness to ship or receive crude petroleum on the company's proposed facility. Northern Tier produced no contracts or other written agreements for use of its proposed facility.

12. Factors such as emphasis on national energy independence and a desire to purchase from secure sources of supply have created a steady market for domestically produced crude oil. To the extent that overall demand decreases, foreign crude rather than domestic crude will likely be displaced from U.S. markets.

13. To the extent that Northern Tier would be able to offer a competitive tariff for transportation charges, monetary benefits realized from transportation price savings would flow largely to producers of petroleum rather than to consumers of petroleum products. Producers normally charge a delivered price for petroleum sold and retain the balance of that price, after subtraction of transportation and other expenses.

14. West Coast surplus is a concept describing petroleum originating in Alaska (or the far East) and moving past the first sizable U.S. market to other more easterly U.S. markets. Most petroleum moving past the West Coast is shipped through the Panama Canal. The greatest part of it is moved by Sohio, which has no West Coast refineries. The West Coast surplus exists only to the same extent that there is a Valdez, Alaska surplus or a Persian Gulf surplus. The real issue is maintaining an efficient transportation system flexible enough to move crude to any second market, if and when the first market is satiated.

15. Northern Tier has not filed a proposed competitive tariff nor demonstrated that it could. Such a filing is not mandated by EFSEC.

16. The Northern Tier proposal would move oil along a particular fixed route. If future West Coast discoveries

created a greater demand for a west-to-east crude oil pipeline, a different configuration than that proposed by Northern Tier could well prove more advantageous. Granting a permit to Northern Tier would tend to foreclose other options.

17. The operation of a port and pipeline on the scale proposed by Northern Tier is, in fact, a limited entry business. Organizations capable of building and operating such projects are few. Licenses to operate such projects are rarely issued and demand for a multiplicity of similar projects is not anticipated.

18. No need for a port large enough to accommodate 327,000 DWT vessels has been shown. Other port sites in the state of Washington have sufficient depth to accommodate vessels carrying all Alaska North Slope crude.

19. The Council is strongly aware of the vital importance of availability of petroleum products to the eastern Washington economy. No supply-induced shortages of petroleum in eastern Washington have been shown, though marketing reorganization activities may have caused some eastern Washington consumer difficulty and more product could be moved to eastern Washington from West Coast refineries through rail, truck, barge and potential pipeline facilities than is presently moved.

20. The economy of eastern Washington is largely agricultural; an adequate supply of petroleum product for uses such as fertilizer, cultivation and transportation is vital to the functioning of that economy. The challenge of providing geographically dispersed communities in eastern Washington with sufficient amounts of petroleum product has been met up to now by means including the Chevron pipeline from Salt Lake City delivering product to Pasco and Spokane; the Yellowstone pipeline from Billings, Montana, providing product to Spokane and Moses Lake; barges traveling the Columbia River to Pasco; and tank trains and trucks hauling product in from western Washington.

Should supply shortages arise in eastern Washington, demand can be met by increasing the deliveries from western Washington. A product line connecting the western and eastern parts of the state is a potentially feasible and realistic solution for further easing potential supply problems in eastern Washington.

I.D. PROJECT FINANCING AND LIABILITY

1. Northern Tier estimates that its project will have a construction cost of $1.9 billion. (March 1981 dollars). Northern Tier's cost estimate excludes several significant elements. Examples include working capital, interest during construction, and the cost of linefill. Project financing has not been established.

2. The present sponsors of the project are possibly capable of financing the project but have not committed to do so.

3. Should operation or construction of the project bring about liability claims or other events requiring state participation, the State will bear the attendant financial burdens to the extent that the project is not adequately insured or bonded.

4. Findings as to the financial responsibility of regulated industries are regularly made by state licensing agencies, including the Washington Utilities and Transportation Commission.

II. A. 1. MARINE TERMINAL FACILITIES

Choice of Site

1. When the Northern Tier project was initially conceived in 1975, Northern Tier considered Cherry Point the best location for a major oil terminal. Later in 1975 or early in 1976, Northern Tier elected to apply to the state for permission to site its port at Port Angeles Harbor. This change was made before the Washington Coastal Zone Management Plan included a policy statement supporting the siting of a major crude oil handling facility only at or west of Port Angeles.

2. Northern Tier applied to the Department of Ecology to site its marine terminal in Port Angeles in March 1976.

3. Northern Tier concluded that fixed berths in Port Angeles Harbor would result in the least environmental risk. The principal considerations were that Port Angeles was already an industrialized area and that operational oil spills could be more readily contained and cleaned up within the harbor than at some location in the Strait of Juan de Fuca.

4. Swan Wooster Engineering, Inc., was engaged by Northern Tier in the spring of 1976 to perform an engineering study, investigating alternative deepwater port sites in the vicinity of Port Angeles, assuming a Port Angeles site, for suitability as a supertanker terminal. Swan Wooster was also charged with recommending the most feasible type of berthing facilities and preparing preliminary engineering designs and construction cost estimates. Before Swan Wooster was retained, the Northern Tier board of directors had selected Port Angeles as the port site.

5. Swan Wooster submitted a review draft to Butler Associates in late April or May 1976, recommending location at Port Angeles.

6. The criteria developed by Swan Wooster were: ease of navigation to the site; depths of water in the berthing and approach areas; foundation conditions; and the establishment of a possible relationship between a berthing site and a site within reasonable distance which could be developed as a storage site. The criteria were applied to the Grays Harbor area and to generalized portions of coastline along the Strait of Juan de Fuca. Also included as primary evaluation criteria were: wind, waves, ocean current data, potential foundation problems, and a very general assessment of what Swan Wooster considered to be the ecological and socioeconomic factors at each site.

7. The primary reasons for Swan Wooster's conclusion that Port Angeles was indeed the most suitable site were operational factors, such as the comparative ease of servicing vessels at a fixed berth instead of a single point mooring, and the ease of controlling minor operational spills within an enclosed harbor area. As to a particular location within the Ediz Hook site, the berths were initially placed farther east on the Hook to allow possible construction of a salt terminal and continued, if reduced, use of log booming and rafting areas. The initial site was abandoned for the present one when Swan Wooster learned that the harbor leases in the present location were to expire soon.

8. The preliminary port concept prepared by Swan Wooster for its 1976 study formed a basis for the project description as it related to design, construction and operation of the physical structures of the tanker unloading berths.

9. At the time these findings and recommendations were made, no consideration was given to problems of air quality at the various alternative port locations. No analysis was made of fiscal impacts on local governments in the vicinity of these sites. No consideration was given to risks associated with fires and explosions.

10. The analysis that was performed by Swan Wooster is accurately characterized as strictly an engineering study of various port locations.

11. The Swan Wooster report was attached to the original application submitted to EFSEC on July 6, 1976.

12. In 1978, Swan Wooster examined six specific sites along the Strait in addition to the harbor at Port Angeles: Pillar Point, Low Point, Freshwater Bay, Green Point, Clallam Bay and Neah Bay. Nothing in the record indicates that Northern Tier gave serious consideration to any alternative site other than Port Angeles.

Overall Description of Marine Terminal Facilities

13. The proposed marine terminal facilities consist of the tanker unloading system, which includes the tanker berths and the unloading pipelines; and the onshore storage facilities. The berths will be located along the south shore of Ediz Hook approximately midway between the base and the east end of the Hook. The unloading pipelines will be located onshore from the berthing area to the east end of the Hook. They will be laid underwater to the onshore storage facilities near Green Point, approximately six miles east of the city of Port Angeles.

Vessel Unloading System

14. As proposed by Northern Tier, the two tanker berths at Ediz Hook would extend out from the Hook as far as 600 feet. Combined, they would measure approximately 3400 feet from end to end. The construction zone on the southern shore of the Hook adjacent to the berths would occupy about 2300 feet of shoreline and roughly one-half of the width of the Hook. (Ex. 19) The two unloading pipelines into which tankers would discharge their cargo would come onshore from the booster pump platform and run east about 1.25 miles, paralleling the Coast Guard runway before entering the water off the southeastern end of the Hook.

15. The unloading facilities consist of two fixed tanker berths, a berth for a bunker fuel barge, pipeline systems for the transfer of bunker fuel, roadway and pipeway trestles connecting the berths with Ediz Hook, booster pumps to assist the ships' pumps, two unloading pipelines for moving the crude oil to the storage tanks onshore, and crude oil and bunker fuel metering systems and support facilities.

16. The berths will stand approximately 600 feet from the shore in 100 feet of water. They will be designed to accommodate tankers ranging in size from 18,000 to 327,000 DWT (dead weight tons).

17. Each berth will include breasting and mooring dolphins, a roadway and pipeway trestle, a service platform for placement of the crude oil unloading and bunker fuel loading/unloading arms and piping, a ship's access tower, personnel offices and support facilities. Each berth will also have two additional breasting dolphins installed to enable the berthing of tankers as small as 18,000 DWT. Walkways will be provided between all dolphins.

18. A small dock in the vicinity of the tanker berths will be used for mooring an oil spill recovery vessel and line handling launches that will be necessary to assist in the berthing of tankers. Northern Tier initially proposed that a fireboat be moored at this dock as well. Later testimony from one of the applicant's witnesses indicated that the fireboat should be moored elsewhere in the harbor away from the terminal facility. (TR 4411).

19. The service platform decks will be constructed of precast concrete panels with a cast-in-place topping. The decks will be supported by heavy steel pipe trusses connected to pipe piling and will have continuous perimeter curbing. Deck surfaces will be sloped to allow runoff and waste water to be collected by a tank beneath the deck. Deck surfaces will be designed to permit access by trucks up to fifteen tons and to accommodate a crane with a lifting capacity of approximately

ten tons. Each of the platform structures will be protected by a row of small dolphins since the platforms will not be designed to accept any berthing or mooring line forces.

20. A steel-framed tower will be situated on each platform and will have floors at 20, 40 and 60 feet above the deck surface. The platform will provide landing stages for a ship's gangplank and will contain stairs and railings around each deck but will not be roofed or enclosed.

21. Each service platform will be equipped with crude oil unloading arms, bunker fuel loading/unloading arms, potable water connections, crude oil piping, a runoff and waste water holding tank, an oil-water separator, cargo sampling equipment, a ship's access tower, a personnel office and stevedores' facilities.

22. The service platform for the bunker fuel barge will be located onshore between the easterly two mooring dolphins of Tanker Berth No. 2.

23. Although land storage of the bunker fuel facilities would be preferable to barge storage on the basis of economic factors, Northern Tier's proposed barge system would be as safe as storing bunker fuel on land. The permanently moored

barge will have a capacity of 150,000 barrels. (TR 2260-61, 2995-6, 4665, 4695).

24. As with the tanker berth service platforms, steel pipe piling will support a concrete deck sloped to an under-deck tank to collect runoff and waste water. The deck will also have concrete perimeter curbs.

25. Associated equipment and facilities on the platform will include meters; marine arms or hoses; an oil-water separator; bunker fuel receiving and loading pipeline system terminations and manifolding; electric power supply connections for operating six 200-hp unloading pumps (which is the typical arrangement for a bunker fuel barge); and terminations of the small insulated pipelines connecting the shore-based therm-oil heating plant to the heating coils in the barge compartments. The heating plant will be situated onshore immediately east of the parking lot and roadway trestle entrance to Tanker Berth No. 2.

26. Each service platform will be equipped with four 16-inch marine unloading arms that will be able to provide a maximum unloading rate of 100,000 barrels per hour. All four arms would be used during unloading operations for larger ships, and in some instances, for smaller vessels as well.

27. The unloading arms will be connected to the main pipeline running from the berth to the booster pump platform.

28. Two 12-inch arms will also be provided for loading bunker fuels onto the crude oil tankers. These arms will be attached to two separate fuel oil pipeline systems joining the tanker berth platforms to the barge berth platform. The design will allow both lines to be used simultaneously.

29. Northern Tier also intends to make low-sulfur diesel fuel available to vessels requiring it via a small line (approximately 2½ inches).

30. The control systems for the crude oil unloading arms and the bunker fuel arms will be located in the platform tower in a control cubicle adjacent to the arms.

31. The arm ends will be equipped with hydraulic-actuated couplers that can rapidly disconnect the arms from the ship's flanges under any emergency condition that requires immediate removal of the vessel from its berth.

32. Steel pipe piling and concrete caps will be used for the construction of breasting and mooring dolphins.

33. The exterior surfaces of all steel pipe piling will be cathodically protected and will be coordinated with the protection system designed for other steel marine structures and the unloading pipelines.

34. A two-stage rubber fender system will be fitted on the primary breasting dolphins; secondary dolphins for berthing smaller ships will be equipped similarly.

35. Fenders will be installed on the easterly two mooring dolphins of Tanker Berth No. 2 to allow breasting against the shoreward side of the dolphins of the permanently moored bunker fuel barge. These dolphins will be able to accept both the mooring loadings of tankers at berth and the breasting loadings of the fuel barge.

36. Mooring lines will be hauled in by powered capstans and attached to mooring dolphins. All mooring points will be provided with quick release hooks.

37. Both breasting and mooring dolphins will be accessible from the service platforms via pedestrian walkways supported by steel pipe piling.

38. Each service platform will be connected to the Hook by a trestle with a two-lane roadway and curbs with rail-

ings on each side. The trestle will be designed to accommodate trucks up to fifteen tons.

39. The platform for the booster pumps will be located near the fixed berths and will consist of a concrete deck supported by steel pipe piling. Continuous curbing around the deck will be provided to direct runoff and oily wastes to a holding tank inlet. The platform will be equipped with the two booster pumps, a control center, a holding tank for runoff and oily waste, an oil-water separator, a crude oil surge relief tank, incoming line strainers, crude oil piping and associated valves, and a crude oil metering installation with a prover to verify the quantities of oil measured by the meters.

40. Concrete walls will enclose the surge relief tank and will be capable of retaining a volume of oil equivalent to the tank volume.

41. The booster pumps will be horizontal, split-case, single-stage, double-suction pumps equipped with mechanical seals and operated by electric motor prime movers, totaling 10,000 horsepower on each 48-inch unloading line.

42. These pumps will require that a new power line extend out to the end of Ediz Hook in buried concrete conduits.

43. The design of the pump piping will allow either pump to be used on either of the two unloading pipelines.

44. The metering facilities located on the booster pump platform will have a minicomputer to control meter-proving runs and adjust readout quantities automatically. The numbers of barrels of crude oil offloaded by the tankers will be indicated by counters; both counters and printers will be located at the meter installation on the booster pump platform. Remote counters and printers will be in the main control center at the onshore storage facilities. A permanent printed record of the amounts will be provided by printers.

45. The bunker fuel barge platform will also be equipped with a metering system.

46. The crude oil surge relief system will consist of relief valves and a tank located on the booster pump platform for receiving oil diverted through the relief valves. The system is designed to protect the installations from high transient pressures which may result from unanticipated shutdown of either the ship's pumps or the booster pumps, or from improper operation of the facilities. The valves will be set to relieve at pressures slightly greater than normal operating pressures, and the tank will be able to contain an amount equivalent to six minutes of ship discharge at the rate of 100,000 barrels

per hour (10,000 barrels). This tank would collect pumpings only from the ship. Although the applicant's witness could not imagine a situation in which the tank volume would be too small to contain discharge from the vessel, he did acknowledge that the ship's pumps must be shut down manually on board by the officer in charge. (TR 2258-59, 2651-52).

Low Sulfur Fuel-Uses and Storage

47. Northern Tier is committed to requiring steam turbine tankers calling at its terminal to burn low sulfur residual fuel during unloading and at-berth activities. This fuel will be made available at each berth by Northern Tier. (TR 18971). Diesel powered ("motor") tankers will be required to burn low sulfur diesel or low sulfur residual fuel for all at-berth operations and while entering and departing Port Angeles Harbor. (TR 18972).

48. Supplies of the appropriate fuels will be maintained in a storage barge permanently moored at the barge berth.

49. Tankers bringing the low sulfur bunker fuels will berth and unload at the tanker berths by means of the bunker fuel marine arms and pipeline systems. Crude oil tankers will be able to unload their cargoes while simultaneously taking on bunker fuel.

50. A bunker fuel tanker will also be able to off-load at one tanker berth, while a crude oil tanker is receiving bunker fuel and unloading crude oil at the other berth.

Fire Protection, Water and Waste Control - Unloading System

51. The marine terminal facilities will be equipped with a fire protection system having both seawater and foam capability. The system will include two diesel engine-driven fire pumps installed on a platform, fire mains along the roadway and pipeway trestles, and fire hydrants located on the berth and booster pump platforms and access trestles.

52. The platforms and roadway trestles will be equipped with foam monitors. Portable dry chemical units will be located on the platforms to fight electrical fires.

53. A fireboat will be in service at all times during tanker unloading and bunkering operations. The vessel will be equipped with seawater fire pumps, a foam chemical system and portable firefighting and first aid equipment.

54. All buildings will be provided with smoke and heat detectors. Fire reporting stations will be located on the berthing and booster pump platforms and at the shore ends of the roadway trestles. These stations will sound a general alarm

at Ediz Hook and activate a warning signal at the Green Point control center.

55. Each tanker berth platform will be provided with a potable water system for servicing the stevedores' facilities and for delivery to ships' tanks.

56. Northern Tier anticipates using the City of Port Angeles' 8-inch water main which is presently used to service the Coast Guard station at the end of Ediz Hook.

57. This fresh water drawn from the City's water system would not be used for firefighting beyond very minor incidents. The system dedicated for fighting fires would be completely separate from the water supplied for ships' uses.

58. Northern Tier estimates that the average tanker demand may be approximately 60,000 gallons of fresh water per ship with a maximum of 120,000 gallons per vessel.

59. Two vessels taking on water simultaneously will create a peak demand estimated at 6000 gallons per hour.

60. Northern Tier's personnel facilities should require about 3500 gallons of fresh water per day.

61. The holding tanks situated at each of the terminal platforms to collect and hold stormwater runoff and oily wastes will have a capacity sufficient to contain small operational spills as well as runoff from the maximum 24-hour rainfall recorded in the Port Angeles area. Tank contents will be processed through oil-water separators that will discharge effluent into the harbor below the mean lower low water line (mllw). Oily residue will be returned to the crude oil unloading lines and transferred to the storage facilities at Green Point.

62. A daily composite sample of effluent from the separator will be taken for laboratory analysis.

63. Separate holding tanks will collect sanitary sewage generated at the berth and booster pump platforms. This waste will be disposed of by commercial septic tank pumpers and haulers. No facilities will be necessary for handling sewage from the vessels calling at the terminal. U.S. Coast Guard regulations require that all vessels operating in or entering U.S. territorial waters have marine sanitation devices. This requirement will preclude the need for sewage handling facilities. (TR 4611-12).

64. Floating oil booms between ship and shore will be installed in front of the mooring dolphins and under the berth service platforms and will extend between the extreme

mooring dolphins. Retractable booms will be extended around tankers at berth and will be connected to the fixed boom, thereby enclosing each tanker. Additional shorter booms will be deployed between the ships' hulls and the fixed boom, in the area below the ships' manifolds, to provide local enclosure in that area.

65. The bunker fuel barge will also be enclosed by a similar configuration of oil booms that will be anchored at various points to prevent them from floating up against the barge.

66. A floating oil skimmer will recover the oil contained within the boom systems.

67. The oil collected will be pumped into the holding tank on the berth service platform and returned to the main cargo unloading pipeline.

68. An oil spill recovery vessel will be used to collect more dispersed operational spills. The oil collected by this boat will be stored on board for later processing in the oily waste handling system at the tanker unloading facilities.

69. Northern Tier has committed to apply for membership in the Clean Sound Cooperative, a regional organization of oil and oil transportation companies whose purpose is to mitigate the effect of oil spills regardless of who caused them. In the event that Northern Tier is accepted, the services, equipment and expertise of the Clean Sound Cooperative would be employed to clean up oil spills larger than those that can be processed by Northern Tier's own equipment.

Unloading Pipelines

70. The onshore segments of the 48-inch diameter unloading pipeline will be situated almost entirely on Ediz Hook. They will extend from the booster pump platform via short trestles to Ediz Hook and then along the Hook to its eastern tip (a distance of approximately 1.25 miles) where they will connect to the submarine portion of the unloading pipelines. The unloading pipelines will be equipped with block valves on Ediz Hook so that the underwater segment can be isolated from the terminal facility. (TR 2317).

71. The transition from the submarine unloading lines to the onshore storage facilities piping systems will be achieved by pipeline risers that Northern Tier proposes to install in a narrow, nearly vertical slot excavated into the face of the shoreline bluff at Green Point. The risers will be an-

chored at their bases at several points in the face of the bluff slot, and on the bluff along the first horizontal section of piping connecting to the storage facilities. Backfill in the slot will be set back from the normal face of the bluff to allow for bluff regression. Riprap will be used over the trenches at the base of the bluff to prevent erosion of the beach area. Northern Tier has calculated the rate of regression of the bluffs at Green Point to be eight inches per year. (TR 8589). The soil cement covering the pipelines in the notched riser at Green Point would be designed to erode at this same rate; if erosion to the soil cement occurred at a different rate, material could be added or removed as necessary. (TR 8591).

Onshore Storage Facilities

Choice of Site

72. Criteria used by Northern Tier in the selection of a site for the tank farm included:

A) Availability of sufficient land (200 to 300 acres) not more than 7 to 10 miles from Port Angeles Harbor.

B) Acceptable topographic, soil, and drainage conditions, as well as access during construction and operation.

C) Proximity to transmission lines to supply electrical power requirements.

D) Acceptability of the site with regard to local zoning ordinances and land use plans.

73. In 1976, Northern Tier considered four potential sites for location of its tank farm to serve its terminal at Port Angeles. Two of these sites were in the area west of the Fairchild International Airport. These sites were rejected due to difficulties anticipated with routing unloading pipelines from the tanker berths along Ediz Hook, through the industrial area at the base of the Hook, and then through the urban area to the sites.

74. In the early design stages, Northern Tier considered locating the unloading pipelines from the tanker berths to the storage tanks at Green Point entirely onshore. This concept was rejected in favor of the submarine route across the harbor because it was felt that construction of the pipelines at the base of the Hook would be too difficult in the congested area there. It was believed that routing pipelines off the Hook through the city was not prudent.

75. No cost comparison or construction analysis was made to compare an all-land route to the submarine route

for the unloading pipelines. No comparison was made in terms of environmental impact or risk of rupture of an all-land pipeline from Ediz Hook to Green Point as opposed to a crossing of Port Angeles Harbor.

76. The area designated by Northern Tier as Site 3, located on Bagley Creek approximately two miles southwest of Green Point, was Northern Tier's first choice for the location of a tank farm. Title reports were obtained for all parcels of property comprising Site 3 and property owners were contacted. When these contacts failed, Northern Tier began searching for another site.

77. The presently proposed location for the onshore facilities is referred to as Site 4 and is located in the vicinity of Green Point. Options for the property acquisition were obtained from July to September 1976. Site 4 was designated the proposed site for the tank farm and Site 3 as the primary alternative.

78. The ability to acquire property ownership determined the selection of the site of the tank farm.

79. The Northern Tier tank farm will be sited near Green Point, approximately six miles east of Port Angeles. This will be the location for the storage tanks and appurtenances,

piping systems, oil-water separators, oil measurement equipment, the main control center for the terminal facilities, and the initial pump station.

Onshore Facilities Description

80. Included at the onshore storage facilities site at Green Point will be the main control center for the tanker unloading facilities. The control system will include the following features: The work area at each berth will be monitored by closed circuit television. A mimic panel will display the valves and piping of the tanker and bunker barge berths and the booster pumps, indicating whether the valves are open or closed. A panel controlling the booster pumps will be equipped with start-stop controls and indicators for monitoring the primary operating variables. Additional control and monitoring panels will be provided for the berth and booster pump platform oil-water separators and the bunkering fuel loading pump. Counters and printers for measuring and recording amounts of crude oil and bunker fuel will be included in the Green Point control center. These will be actuated by the meters installed on the booster pump and barge berth platforms.

81. Other features at the main control center will include a computer for operation-related information and a system for detecting leaks throughout the pipeline.

82. The start-stop functions of the booster pumps and the fuel barge loading pumps will be under the remote control of the marine terminal dispatcher at the Green Point control center. The dispatcher will be able to extend local control of these functions to the berth service platforms by activating permissive control circuits.

83. Local control will be possible for the loading/unloading arms, berth piping valves, the booster pumps and auxiliary equipment.

84. Critical berth and booster pump platform installations, control circuits and protective devices will automatically be powered by an emergency generator in the event of a power failure at the berth and booster pump platforms.

85. The communication systems between the main control center and Ediz Hook will include high frequency marine radio, direct telephone circuits, as well as conventional telephone and UHF radio communication to the fireboat, oil spill recovery vessel, berth and booster pump platforms.

86. Spare equipment will be installed to provide redundancy for all radio circuits.

87. An emergency generator at the pump station at Green Point will provide power for terminal control and communications, should a power failure occur.

Storage Tanks

88. The storage capacity of the tank farm will be equivalent to seven to ten days of average daily pipeline throughput.

89. Construction of the tanks will be done in phases; initially, eleven 545,000 barrel tanks will be constructed to provide 6 million barrels of storage. Seven additional 545,000 barrel tanks will be constructed as terminal and pipeline system volumes increase. The additional tanks will provide 3.8 million barrels to create a total storage capacity of 9.8 million barrels for the projected terminal capacity of 933,000 barrels per day.

90. Each storage tank will have a diameter of 285 feet and a shell height of 56 feet. Floating roofs with primary and secondary perimeter seals will be installed to reduce vapor emissions and fire potential in the tank seal area.

91. Shell nozzles will be installed to connect the tanks to the main suction and fill line and to provide for the

installation of electric motor-driven tank mixers designed to prevent stratification of the tank contents and to minimize deposits of bottom sediments.

92. Other tank connections and appurtenances include water draw-off connections, roof drains, gauging platforms, spiral shell stairs, roof ladders, shell wind girders, manholes, clean-out doors, automatic tank gauges, fire protection systems and suction tubs with vortex breakers.

93. The tank shells will be supported on reinforced concrete ring foundations. The area beneath the tanks will be graded, compacted and surfaced with a sand-gravel and asphalt mix.

94. Tank exteriors will be painted with a coating system to protect against atmospheric corrosion. A cathodic protection system will be applied to the exterior bottom surfaces; interior bottom surfaces will receive a corrosion-resistant coating.

95. The piping systems at Green Point will include the main filling and suction systems, a water draw-off system and a drain system for the floating roofs. The filling lines and manifolds will be designed to handle the maximum tanker unloading rate of 100,000 barrels per hour. The suction line and

manifolds will be designed for a system capacity of 933,000 barrels per day. Anti-corrosion external coatings and a cathodic protection system will be applied to the main filling and suction pipelines. The main filling and suction lines will be buried.

96. Each group of storage tanks will be serviced by two filling pipelines, each of which will be connected to an incoming unloading pipeline. A suction line will connect the tanks to the initial pump station booster pump suction manifold. Every tank will be connected to the filling and suction pipelines by a tank line and a valve manifold.

97. The drainage systems of the floating tank roofs will be designed to drain the runoff resulting from the maximum 24-hour rainfall in the Port Angeles area. The runoff will be piped directly to the holding basin within the main holding basin and processed as in the case of bottom water. External portions of the drainage systems will be coated and protected cathodically against corrosion and buried.

98. Water collecting inside the tank bottoms will be drawn off by a system consisting of a number of connections with valves around the bottoms of the tank shells. The water will be drawn off at these connections by automatic devices that will allow the water (and some oil) to flow by gravity

through a piping system to a holding basin located within the main holding basin. Most of the oil arriving in the holding basin with the water will be recovered by a skimmer and returned to storage. The main oil-water separator will process the effluent.

99. Storm water runoff and oil spills from the storage tanks will be contained by low dikes surrounding the groups of tanks and remote holding basins.

100. A large and small basin will be provided for each group of tanks. The larger basin is to be sufficiently large to contain an amount equivalent to the capacity of one tank plus an allowance for storm water. The smaller basin will be capable of receiving storm water drawn off the tank roofs and water drained from the interior tank bottoms.

101. A common dike approximately six feet high will enclose on three sides the area occupied by the eleven tanks constructed for Phase I of the pipeline system. The fourth side of the storage tank area will be left open to permit drainage to the larger holding basin. The area will be sloped at least 1% for a minimum of fifty feet away from the tanks and exposed piping and toward the holding basin.

102. Northern Tier has estimated the volume of run-off from the initial group of eleven tanks and related facilities will be approximately 112,000 barrels, consisting of 34,500 barrels from the tank roofs and 77,500 barrels from other areas. The design volumes for the small and large basins will be approximately 55,000 and 725,000 barrels, respectively.

103. The diking and holding basin arrangement for the Phase II group of storage tanks will be similar to the Phase I configuration. The storm water allowance will be approximately 66,000 barrels of which 22,000 barrels will come from the tank roofs and 44,000 barrels from the other areas. The small and large holding basins will have design volumes of 45,000 and 685,000 barrels, respectively.

104. Northern Tier's maximum design rainfall figure is 3.3 inches in a 24-hour period and was derived from National Oceanic and Atmospheric Administration (NOAA) records for the Port Angeles station published in 1965 for the period from 1931 to 1960. Northern Tier asserts that this figure corresponds closely to the 100-year storm maximum published by the Department of Commerce in 1955.

105. The dikes surrounding the storage tank areas will be constructed with an impermeable core for impounding water or oil.

Fire Protection, Water and Waste Control-Onshore Facilities

106. A 55,000 barrel tank will store a sufficient volume of water to supply the fire protection system with the design flow rate for about four hours.

107. Northern Tier prefers that water for personnel and fire protection on Green Point be supplied by the local water district servicing area. If this does not prove to be feasible, on-site water wells will be developed.

108. The tank farm facilities at Green Point will be operated by approximately fifteen people.

109. An oil-water separator will be installed adjacent to each of the large holding basins. Oil recovered by the separator will be collected in a compartment and transferred back to a storage tank. The separators will be designed to process an amount of surface runoff equivalent to the maximum 24-hour recorded rainfall (3.3 inches) in not more than seven days.

110. An on-site diked area will be used for the disposal of sediments removed periodically from the oil-water separators. The area will be provided with drainage to a holding basin.

111. Sanitary wastes will be disposed of by septic tank systems. Should the soils at Green Point not be compatible with such systems, holding tanks will be installed and serviced by commercial septic tank pumpers and haulers.

Construction and Post-Construction Activities

112. Construction of the Phase I group of tanks and related facilities will involve 400,000 cubic yards of excavation and 355,000 cubic yards of embankment. The corresponding amounts for the Phase II group of tanks are 190,000 and 175,000 cubic yards, respectively. Two hundred people will work on construction of the tank farm over approximately an 18 month period.

113. Upon completion, each tank will temporarily be filled with water for hydrostatic testing. This filling will also provide a preloading and test of the foundation as well as the tank shell. After testing, the tanks will receive three coats of protective paint.

114. X-ray or gamma ray inspections will be made of all onshore piping system welds before a corrosion preventative coating is applied to the weld joint areas.

115. Post construction procedures will include the removal from the site of surplus materials and debris. Northern

Tier will attempt to preserve and restore original site contours or, alternatively, will grade the altered areas to produce contours that will blend with those of undisturbed areas. Original drainage patterns will either be preserved and restored or compatible new patterns will be created to satisfy the surface drainage requirements of the site and adjoining properties. Erosion control devices such as ditch checks and ditch linings will be constructed where necessary. The landscaping of the areas around the control office and warehouse buildings will be compatible with the existing vegetation on adjoining properties.

Overall Power Requirements - Marine Terminal

116. The marine terminal facilities will require electric power to run the booster pump motors, berthing facilities and booster pump platform auxiliaries, as well as for lighting platform work areas, roadway trestles, personnel trestles, mooring dolphins, bunker fuel loading pumps, the unloading arms, the cathodic protection system, communications systems, control systems, oil-water separator and other support facilities.

117. Northern Tier estimates that in its initial design capacity (two berths and 709,000 barrels per day), the

marine terminal will have an electrical requirement of approximately 3,400,000 kwh per month (40,800,000 kwh annually).

118. In addition to the emergency power generator at the onshore storage facilities, an emergency diesel-driven generator will be installed on a platform at Ediz Hook and will be able to supply power automatically to the unloading arm positioning controls, the manifold valves, area lighting, building lighting and utilities, communications equipment, system controls, booster pump motor-operated valves and the electric powered capstans.

II. A. 2. PIPELINE FACILITIES DESCRIPTION

1. Northern Tier proposes to move oil from its Green Point tank farm site east to and beyond the Idaho border through a 42 inch external diameter steel pipe. Seven pump stations will propel the oil through the pipe between the tank farm and the Idaho border. One pressure reducing station will lower the pressure head created by the descent into the Columbia Basin from the Cascade Mountains and Colockum Hills. The company proposes to place block and check valves at selected locations along the route.

2. Northern Tier proposes to lay somewhat more than 367 miles of 42 inch diameter pipe in the state of Washington. The pipe will have a 65,000 psi yield strength and will meet American Petroleum Institute (API) high test pipe specifications and fracture toughness. Fracture toughness, not a normal feature of liquid carrying steel pipelines, lessens the likelihood of pipe failure from small flaws and is a limiting factor on the length of rupture from outside pressures. Northern Tier's specifications on chemical composition and tolerances for diameter out of roundness and for straightness exceed applicable API standards.

3. Fracture toughness is the property of steel to withstand fracture in the presence of a very sharp flaw or de-

fect. In pipes such as that specified by Northern Tier, it is operative up to cracks of critical size, normally in the neighborhood of four or five inches. A force against the pipe sufficient to create a crack in excess of this critical size would not be dampened and the spread of any such crack would not be diminished by fracture toughness. Fracture toughness is a factor which mitigates against the translation of pipeline flaws into leaks.

4. Northern Tier proposes to place its pipeline in a seven foot trench at all terrestrial and an eight foot trench at all submarine points. The depth may be exceeded if local conditions, such as those negotiated with farmers concerned about agricultural practices, so indicate. Applicant proposed to backfill the trench in all terrestrial areas and in the shore approaches of submarine areas. Applicant will rely on natural backfill in the deeper submarine areas. The cover provides protection and insulation for the pipeline and also meets current federal requirements. Northern Tier would seek a shallower cover if federal requirements were eased and no other requirements applied.

5. To lay the pipeline in Washington State, Northern Tier will operate three separate construction sections, each having responsibility for work within a significant geographical area of the state. The pipeline construction period is ten

months. The pump station construction period is expected to be approximately 16 months.

6. Northern Tier's construction program is intended to result in a system capable of delivering up to 933,000 barrels per day. Northern Tier anticipates reaching this capacity during the fifth year of its operations. To function at 933,000 barrels per day, the system will require approximately seven additional tanks at the Green Point tank farm and additional pumping equipment at the proposed Washington pump stations. Construction of the additional tanks will take approximately 19 months. Expansion of the pumping system in the state will take 4 to 6 months to complete.

7. The length of time during which the proposed project would operate is unknown. Operating life depends on factors such as the long-term supply of and demand for crude petroleum in the service area; mechanical soundness of the equipment; financial soundness of the company; the availability over time of needed materials, labor force and energy; and other factors. Length of time of operation of the line is not limited by the length of time required to retire any indebtedness incurred in construction of the line.

8. During its operational phase, the proposed project would employ approximately 110 people in the state of

Washington. Approximately 40 people would work in the company's proposed Port Angeles headquarters.

9. Northern Tier proposes to ship a variety of crude oils through its line. Northern Tier expects to ship more Alaskan North Slope (ANS) and Persian Gulf crudes than any other types, although the company does expect to ship certain crudes from Indonesia and other producing regions. ANS crude is a sulfurous, highly viscous crude with an approximately .9 specific gravity at the 50-55°F design temperature anticipated for Washington operations. Saudi No. 2 light, the most representative Persian Gulf crude, is less viscous and has a significantly lower specific gravity. The specific gravity and viscosity of other crudes vary.

10. Northern Tier does not propose a project capable of shipping all crude types now produced or for that matter now received in the Puget Sound region. For example, the system will not be capable of transporting high viscosity California "heavy" crudes and similarly will not be able to move high paraffin, high pour point* crudes such as Minas crude from Indonesia. Both types are used substantially by North Sound refineries. Northern Tier has committed to transporting only crude oil with its project, though the line will be capable of shipping refined petroleum products.

*Crudes which attain a liquid state only if heated

11. Northern Tier's design capacity of 933,000 barrels per day is a yearly average figure which takes into consideration the likelihood that the system would be shut down for repair, maintenance or other reasons approximately 5% of any year. Similarly the figures are stated for design days which for Western Washington assume temperatures in the 50-55°F range and 40-45°F in Montana. The design figures are also limited by the consideration that the most highly viscous and therefore slowest moving batch of crude in the line will determine the overall flow rate within the line. The design capacities assume the presence of batches of ANS crude in the line. On a day (with design day temperatures and ANS crude in the line) during which there were no shutdowns, the pipeline could transport an average 982,105 barrels per day. On a warm clear day in July with a temperature in the surrounding environment of approximately 80° and a line fill not including any ANS crude, the capacity of the line to transport crude oils would increase. A rough approximation of the increase under those conditions may be ascertained by dividing the 982,105 barrel per day figure by .95.

12. Any common carrier line crudes are shipped in relatively discreet batches as a common practice and are not shipped in blends or mixes. The type of crude shipped at any time depends on the arrangements made by customers.

13. The pipeline dispatcher operating out of the main control center at Green Point will oversee pipeline system operations. The various crudes to be shipped will be segregated and stored in different tanks at the tank farm. The dispatcher will control the system in accordance with a predetermined schedule intended to move the ordered (by customers) amount of the proper crude out of the tank farm through the pump stations and pipeline and to the designated delivery point at agreed times.

14. The line flow will be metered at the tank farm and at each delivery point.

15. Northern Tier intends to control the functioning of the various pump stations and delivery facilities as well as the pressure reducing station from the Green Point tank farm. Northern Tier does not intend to staff these remotely-controlled facilities. The dispatchers will have computer assistance in controlling the remote facilities and the facilities can be operated on site if necessary. The controllers will have a broad capability to manipulate the system to achieve necessary flow rates. When functioning properly, the leak detection system will detect leaks in excess of 0.5% (5000 barrels $\pm$) of line flow.

16. Northern Tier has not designed its system to shut down automatically in emergency circumstances. Should such circumstances, such as power loss at a pump station, line break, or unauthorized valve closure occur; the computer network, which surveys the entire system six times each minute, would normally inform the dispatcher of the circumstance in no more than 10 seconds. The dispatcher then has the responsibility to assess the accuracy of the information and the scope of the emergency. If the dispatcher concludes that circumstances so warrant, he or she can shut down the system with a single command. On receiving that command, the computer would shut down the various pumps in whatever sequence it concluded would create the least hydraulic surge. An optimum shutdown time for the system is approximately ten minutes.

17. Northern Tier's proposal does not contain a backup computer system; however, a critical station shutdown or other significant emergency event would cause line pressure changes at adjoining stations, triggering automatic shutdown at each station in turn.

18. Each station will have the capacity to adjust valves, suction pressure, discharge pressure and other variables to accommodate system flow. The high discharge pressure switch, set to shut down the pump station should discharge pressure exceed appropriate limits, offers protection against over-

pressure. Northern Tier proposes pump station alarm systems intended to detect pressure, temperature and vibration variations; excess flow through seal leaks; overload; and other factors.

19. Northern Tier intends to operate its system as a packed line to reduce mixing between different crude oil batches and to better ascertain the beginning and end points of adjacent batches.

20. System problems which cannot be solved by remote equipment located at the pump stations or by the controls available to the pipeline dispatcher, are anticipated to be dealt with by personnel sent into the field.

21. Northern Tier proposes a pipeline maintenance office at Spokane as well as at three eastward points on the line. The Spokane facility and the others will handle routine valve meter pipeline and pump station maintenance. In accordance with federal requirements, the line will be overflown every two weeks. For large maintenance projects and emergency repairs or other matters, Northern Tier will employ private contractors.

22. Northern Tier may choose to abandon this proposed facility (terminal facility, tank farm, pipeline and pump stations) on a permanent or temporary basis before or after

completion of construction. Economic reasons such as supply deficiencies, decreases in consumer demand within the company's service area, operating or maintenance costs as compared to profitability or other difficulties, might cause permanent abandonment. Were Northern Tier or another company purchasing Northern Tier to alter the purpose, function, and use of the system, temporary abandonment in the nature of a transition period could occur. Economic difficulties could also cause temporary abandonment. In such an instance, the system might be disconnected from power sources, secured, and the pipeline filled with water and a rust inhibitor.

23. If permanent abandonment occurs, oil should be removed from the line by displacement through the injection of water. Northern Tier has not committed to salvaging pipe in the event of permanent abandonment, but such salvaging would have to be preceded by the removal of water. In the event of salvaging, line sections under waterway, river and road crossings might prove difficult to remove. Sealing and burial is an alternative for such sections. Pump stations should be dismantled and their components put to other uses.

II. A. 2.a. SUBMARINE PIPELINE PORTIONS

(Cross-Sound and Harbor)

II.A.2.a.(1) Cross-Sound Submarine Pipeline

Route History and Description

1. Applicant, upon abandoning plans for Cherry Point, selected Ediz Hook as its oilport site. That proposal calls for submarine unloading lines from Ediz Hook to a tank farm at Green Point, a distance of approximately five miles. (See Section II.A.2.a.(2)) Although applicant had then planned to route the line entirely on land from Green Point around Puget Sound, that was dropped in favor of a submarine crossing of the Sound in two stages, underneath Admiralty Inlet and underneath Saratoga Passage.

2. Given most serious consideration for the Admiralty Inlet crossing were two routes between Port Williams (near Sequim) and Point Partridge, at the westernmost reach of Whidbey Island. A proposed "Northern Route", of about seventeen miles would have run directly between the two points. That route was rejected by applicant for several reasons, including the existence of significant areas of potential liquefaction and undesirable bottom slopes. Then, a proposed "Southern Route" of about eighteen miles was considered. It was to run east from Port Williams to a point midway between Protection Island

and the mouth of Discovery Bay, then generally northeast directly to Partridge Point. This route, though deeper, was deemed to have much improved soils and to be in an area of less severe surface tidal currents. (TR 7676)

3. The "Southern Route" was incorporated in Revision 2 (June 1979) of NTPC's application. Due to depths, soil conditions and anticipated bottom currents, it was originally proposed that certain portions of the Admiralty Inlet pipe might be reduced to a 36 inch diameter, rather than the 42 inches making up the remainder of the submerged (as well as the terrestrial) portion. (TR 7676)

4. For the Saratoga Passage crossing, two routes were considered. The first, of about three miles from Strawberry Point on Whidbey Island to Brown Point on Camano Island, was rejected because of an upland development along the route near Strawberry Point. It was decided to make the crossing from Polnell Point (a relatively undeveloped area) on Whidbey Island to Brown Point, approximately four miles in length. The bottom conditions on the two routes were stated to be not significantly different. It is noted however that about one-half (1½ miles) of the Strawberry Point route was in a "potentially liquefiable area" whereas only one-quarter (1 mile) of the Polnell Point route was so classified by applicant. A communications cable

must be cut and re-spliced on the Polnell to Brown Point route. (TR 7677) (Ex. 282) (Ex. 289) (Ex. 84, Fig. 11)

5. Applicant's geotechnical and current studies underlying the selection of the "Southern Route" across Admiralty Inlet and the Polnell Point to Brown Point route across Saratoga Passage consisted of surveys conducted in January of 1979. The survey was conducted by Shannon & Wilson, Inc., geotechnical consultants, of Seattle, Washington and monitored by R. J. Brown and Associates, an international engineering/consulting firm specializing in design and construction management of submarine pipelines and related facilities. In addition to a review of NOAA current data, the survey involved subbottom profiling, bathymetry, sidescan sonar, magnetometer surveys, and 61 bottom soil samples. Twenty-two of these samples were on the approximately eighteen-mile "Southern Route" and six on the four-mile Polnell to Brown Point route. (TR 7677, Ex. 281, Ex. 282)

6. A Council order of August 19, 1980, was issued as a result of motions brought by several intervenors contending that applicant had failed to adequately inform the Council as to depth criteria, pipe size, velocity and direction of currents, bottom sediments, trenching methods or trench depths. The order noted, in part, that:

"Northern Tier has not complied with Council rules requiring identification of a specific site for location of its submarine and terrestrial pipeline accompanied by adequate descriptions of physical, geological, geographic and hydrological information concerning the identified site and accompanied also by design and construction proposals intended to accommodate the proposal to the site and its defined characteristics."

The order took special note of the sparsity of vibracore samples, the uncertainty as to a safe maximum pipe laying depth in the attendant currents and submerged weights, and the lack of satisfactory current data and other related factors.

7. After performing certain current studies and also additional bathymetry, side-scan sonar, and subbottom acoustic profiling studies (but taking no new soil samples or magnetometer surveys) as a result of the Council's order of August 19, 1980, applicant made its most recent proposal, a "Revised Southern Route" (henceforth revised route). This revised route would skirt the greatest depths (about 450 feet three miles northeast of Protection Island). Applicant also discarded the 36 inch alternative pipe proposal in favor of an all 42 inch diameter pipe. (Ex. 281)

8. The revised route would descend a 65- to 70-foot bluff at Port Williams and enter the Strait of Juan de Fuca approximately one and one half miles north of the mouth of Sequim Bay. (At depth the pipe would initially be laid on the sea floor; later it would be settled in an eight foot deep trench.) The line would continue eastward from Port Williams for approximately six miles, roughly paralleling the north shore of the Miller Peninsula at a distance of one mile or greater. At a position midway between Diamond Point (mouth of Discovery Bay) and Protection Island, the pipeline would curve left approximately 70 degrees and take up a northeasterly heading (with three minor deviations) to a landfall 4,000 feet north of Partridge Point on Whidbey Island. There it would ascend a notch in a steep 100-foot bluff. (Ex. 281, Ex. 81, Photo 2A, TR 7714, 7726)

9. In the curve area, the line comes to within one mile of Protection Island and reaches its deepest point, approximately 380 feet. Additionally, three miles of the route in this area have been identified as a "potentially liquefiable zone" by NTPC consultants. Three miles northeast of the curve, the line skirts a hole approximately 450 feet deep (such was the main reason for the revision of the "Southern Route"), and reaches its second deepest point, approximately 330 feet. This is an area where relatively high tidal currents are anticipated. The route then encounters one and one-half miles of what has

been described as "sand waves" or "barchan-shaped sand waves." These waves measure up to twenty feet in height. Other geotechnic factors of interest include evidence of submarine slides or slumping adjacent to the line in the vicinity of the Miller Peninsula, near Cape George, and at approximately mid-point between Protection Island and Point Partridge. There is also evidence of possible seismic fault lines running through Admiralty Inlet and near Protection Island. (See Part III.A. for a discussion of seismic considerations.) (Ex. 298, Ex. 288, Ex. 279, TR 38625, Ex. 291)

10. The Saratoga Passage crossing would depart Polnell Point on a gentle gradient and run in a straight line for four miles, crossing Utsaladdy Bay, to Brown Point on Camano Island, where it will ascend a steep bluff of approximately 70 feet. The maximum depth along this route would be 72 feet. Currents are anticipated to be relatively low in this area. A one mile stretch of the most easterly portion of this route has been identified as a "potentially liquefiable zone" by NTPC consultants. (TR 7728, Ex. 282, Ex. 289)

11. Summary of Route History and Description. Applicant's most recently proposed route would cross 18 miles of Admiralty Inlet at depths to 380 feet and four miles of Saratoga Passage at depths to 72 feet. Twenty-two soil samples were taken on the Admiralty crossing and six on the Saratoga crossing.

portions of each crossing pass through soils which are potentially liquefiable. The Admiralty route also crosses a one and one-half mile long sand wave field and passes through an area of high tidal currents. There is evidence of submarine landslides and slumping and of possible seismic fault lines on or adjacent to the Admiralty route.

Horizontal Design Current for Submarine Pipeline

12. The presence of relatively high bottom currents is significant, in part because the pipe will lie on the sea floor for an indeterminate time, perhaps several months, prior to trenching. The faster the current flows over the top of the pipe, the more likely the pipe is to rise and flutter, possibly to the point of rupturing. This hydrodynamic occurrence is known as vortex shedding (the von Karmen effect). To counter this, the weight of the pipe, including its concrete coating, should be relatively heavy. However, in potentially liquefiable zones (see Findings 32 and 33), such as exist along the proposed routes, the pipe weight should be only slightly more than that of the surrounding soil in a liquefied state; in such areas it should be relatively light (as compared to weight in a high current area). Accordingly, high bottom currents in a potentially liquefiable zone could approach a critical point where it is not possible to weight the pipe for both current protection and liquefaction protection. An increase in design

current has a geometric effect on the submerged weight requirement. The submerged weight increases with the square of the current velocity. (TR 22127)

13. Submarine pipeline design requires a knowledge of the environmental conditions the pipeline would be exposed to during installation as well as operation. The magnitude and direction of bottom currents are necessary input for the pipeline hydrodynamic stability analysis. A pipeline design is highly influenced by bottom currents. (R. J. Brown Report, Ex. 81, pp. 3-4,5.) Bottom currents are not constant but vary even along a particular route due to changes in water depth, bottom profile and route direction. The meaningful current field data can only be obtained by taking current measurements along the proposed pipeline route. (R. J. Brown Report, Ex. 81, pp. 3-4,5.)

14. Northern Tier's 1979 application for the submarine crossings of Admiralty Inlet and Saratoga Passage was made without a detailed survey being conducted of the currents. The R. J. Brown design currents used for the 1979 application were derived from measurements made several years prior by NOAA and the University of Washington. These measurements, however, had to be used with caution because: first, the currents were measured by meters not near the bottom, but some 50 feet above the bottom; and second, most of the measuring locations were

not situated along the pipeline route. (R. J. Brown Report, Ex. 81, pp. 3-4,5.)

15. The highest design current R. J. Brown recommended in 1979 was 5.0 feet per second, occurring within what was described at that time as Section 5 of the old southern route. (Ex. 81, Table 3.3 and 3.4.) Lower design currents were recommended for other sections.

16. In its 1979 report (Ex. 81, p. 1-9), R. J. Brown recommended additional current analysis, to include 16 meters across Admiralty Inlet and six across Saratoga Passage for the purpose of verifying and/or finalizing pipeline submerged weight requirements and lay barge station keeping ability.

17. Following the Council's August 19, 1980 determination of the insufficiency of Northern Tier's submarine pipeline application and presentation, Northern Tier hired R. J. Brown to do further design studies, including current measurements. A current meter survey was made under R. J. Brown's supervision between September 8 and October 11, 1980. R. J. Brown disclaimed its earlier recommendation for 16 meters in Admiralty Inlet, stating it had been based on a proposal of a subcontractor and had been proposed without review. (TR 22019.) Seven meters were placed at five stations across the Strait in the vicinity of the proposed pipeline route. The highest cur-

rent velocities were recorded during the spring tide of September 25-27 and reached near-bottom values of 5.74 feet per second. (Timmermans, TR 21859.) As a result of this 1980 work, R. J. Brown recommended an increase of the design current to 6.0 feet per second (fps) in the area of maximum tidal flow. (Timmermans, TR 21860.) No meters were placed in Saratoga Passage. The design current is intended to represent the maximum possible current which the pipeline would experience during installation and its operational lifetime. (Ex. 81, Par. 3.2.2 and 3.4.1.) R. J. Brown did not arrange for metering of the western 9½ miles of the crossing.

18. A one-month metering program is not sufficiently long to include seasonal variations of tides, the effects of storms, and the current variations associated with the estuarian circulation. (Winter, TR 38186; Holbrook, TR 38210.) The highest velocity tides and currents in the Strait are typically experienced during the months of November, December and April through June. (Winter, TR 38186; Holbrook, TR 38210.) In order to measure the highest currents in the vicinity of the proposed submarine pipeline crossing of Admiralty Sill, the metering program must include these months. (Winter, TR 38186; Holbrook, TR 38210.) The extrapolation process used by applicant from one month's data is unreliable.

19. A metering program of six months duration was recommended by oceanographers for the Admiralty Inlet crossing in order to take into account nontidal current variations. (Winter, TR 38186; Holbrook, TR 38210.) Longer metering programs have been employed for other pipeline projects, such as for the offloading deepwater port facility proposed for Kitimat Inlet, British Columbia, where DeBrocky-Seatech carried out a metering program of 12 months duration, with five cruises and up to 14 meters deployed on each cruise. (Winter, TR 38595, 38598.)

20. In order to determine the highest velocity currents which would be experienced at any point along the proposed pipeline crossing of the Admiralty Sill, it would be necessary to have meters at more locations along the length of the pipeline than were employed by R. J. Brown & Associates. The highest velocity currents affecting the proposed pipeline would probably occur in the stretch between the north latitude of Protection Island and the landfall on Whidbey Island. The spacing of the R. J. Brown meters and the manner in which it was done could have missed the point of strongest currents. In addition, it would be important to have several meters located within one to four meters of the bottom at several points along the pipeline route in order to develop a more accurate relationship between the near-bottom current and the lowest measuring meter. (Winter, TR 38186-87; Holbrook, TR 38210-11, 38486.)

Northern Tier deployed meters at more than one depth only at Station No. 3.

21. Applicant's methodology in determining the design current involved several steps. The 5.74 fps reading from the near bottom meter at Station 3 (ten feet off bottom) was first converted to a pipeline perpendicular component of 5.4 fps. That was multiplied by a derived extrapolation factor of 1.265 to obtain an estimate of the high current expected for the year. (That factor was an average obtained by reference to NOAA surface current tables and tidal range tables.) That figure was then reduced by 17 percent to account for an anticipated drop in speed from ten feet off the bottom to three feet, where the pipe would lay. The result was 5.67, which was rounded up to 6.0 fps. (Ex. 300; Timmermans Pre-filed, p. 20; Timmermans, TR 22348-22354, 22371.)

22. The metering work undertaken by R. J. Brown does not justify the use of a 17 percent reduction factor for the Admiralty crossing. The depth of the bottom boundary layer and the bottom roughness are unknown at the locations of the meters. Without accurate knowledge of these parameters, a realistic estimate of the near-bottom current distribution cannot be made. Measurements in other parts of Puget Sound have shown that the tidal currents within two feet of the bottom can be comparable with currents at the surface and intermediate depths

at some stages of the tidal cycle. (Holbrook, TR 38211-12 and 38487; Winter, TR 38188-89.)

23. Applicant's extrapolation technique does not include non-tidal currents. (Holbrook, TR 38639-41.) The NOAA tidal current tables give surface data and are designed for assisting the mariner in navigating passages and should not be substituted for site-specific measurements of current for purposes of designing a pipeline. (Holbrook, TR 38642.)

24. The currents in the Admiralty Inlet region are very complex and the maximum measured current speeds could be encountered in a direction perpendicular to the pipeline short distances away from the actual current meter sites used by R. J. Brown. (Holbrook, TR 38212-13.) The direction of the current observed 10-15 feet above the bottom does not necessarily reflect the direction of the current in the zone 0 to 4 feet from the bottom. (Winter, TR 38189.) The jetting effect of water across Admiralty sill is generally perpendicular to the pipeline. (Holbrook, TR 38647-48.)

25. Large-scale storm systems off the Pacific Coast can cause the influx of coastal water into the Strait which results in an easterly moving current. These currents, called "current reversals," could influence current velocities in the eastern Strait of Juan de Fuca at the site of the proposed

Admiralty Sill crossing. These currents are irregular in strength and occurrence and could be missed by a single metering program of one month's duration. The potential effect of such a current reversal could be to combine with a tide and increase the maximum current experienced. (Holbrook, TR 38213.) Atmospherically-induced current oscillations of approximately 0.9 feet per second have been measured five nautical miles north and five nautical miles south of the Admiralty crossing route. (Holbrook, TR 38641.) R. J. Brown did not take these storm-generated currents into account in its design current.

26. A numerical study of tidal flow in the Strait of Juan de Fuca and adjacent waters was carried out by P. B. Crean (1978). The model indicates that, in the area of the proposed Northern Tier Admiralty Inlet submarine route, a general intensification of the flood stream due to the presence of the shoaling sill and a relatively well-defined jet over the sill at maximum ebb is to be expected. (Winter, TR 38607-10; Ex. 765.) Analysis of the factors from this model showed that the vertically-averaged tidal currents in this area exceeded 7.2 feet per second for the day modeled in the spring tide cycle. (Winter, TR 38190-91.) The model indicates it is likely that even stronger currents, on the order of nine feet per second, could occur. (Ex. 753, p. 17; Winter, TR 38610.)

27. McDermott-Hudson Engineering, in their feasibility report for Northern Tier dated November, 1977, identified an operational design current of 9.91 feet per second for the major portion of the Admiralty route which they studied (which was the old "Northern Route") and 10.68 feet per second in the section immediately offshore of Point Partridge. (Winter, TR 38191; Ex. 753, p. 17.)

28. NOAA measured current speeds of 9.56 feet per second near the Admiralty Sill area (mid channel northeast of Pt. Wilson) between December 17, 1977 and January 12, 1978. The 9.56 feet per second reading obtained by NOAA at this location was not an instantaneous current, but an average current over a one-hour period of time. The meter in this instance was located 91.8 feet below the surface. (Holbrook, TR 38642-43.)

29. Several problems were encountered in the deployment of the R. J. Brown meters. The top meter at Station 3 (which was a three-meter array at different depths) recorded no speed data for six days, and had obvious malfunctions in current direction recordings for well over half the survey. No speed data at all was recovered from the middle meter at Station 3. The bottom meter at Station 3 recorded no speed data for three days and was ten to twelve hours out of sequence with all other meters for the entire survey. The single meter at Station 4 began giving obviously erroneous or no data beginning on

October 7, 1980. The single meter at Station 5 broke loose on October 7, 1980 for undetermined reasons. It was not recovered in sufficient time for its data to be included in R. J. Brown's analysis. The data was later recovered. (Holbrook, TR 38644-47, Ex. 856; Timmermans, TR 22080-1.) It is not clear whether current meter one was located on the route at a 330 foot depth or off the route in a depression at a 370 foot depth.

30. Submerged pipelines in Cook Inlet have failed due to high currents. Submerged pipelines off the coast of Louisiana have failed due to submarine slides. While the conditions associated with these prior pipeline failures are not identical to those expected in Admiralty Inlet, these failures illustrate the importance of securing adequate geologic and hydrologic data along the route prior to construction.

31. Summary of Horizontal Design Current. Critical aspects of the pipeline design are based on the design current. Applicant's methodology both in measuring actual currents and in extrapolating that data to a design current has been subjected to considerable criticism. For its final design calculations applicant utilized only seven current meters, far fewer than the twenty-two it originally recommended to the Council, and may well have missed significant high current areas. The one month period applicant used for the collection of current data

is far less than what is needed for a comprehensive analysis and far less than what has been proposed or used on other projects. Some have ranged between six months and a year. Additionally, applicant's technique of reducing actual current readings taken ten feet off the bottom by 17% to estimate values three feet off the bottom, and taking that estimate and extrapolating it by way of surface current and tidal range tables to a derived figure for another part of the year, is highly questionable. Applicant's design current is six feet per second. A figure in excess of nine feet per second may well be more correct.

32. The applicant used state of the art equipment and sound information-gathering techniques in performing its side-scan sonar and subbottom acoustical profiling studies.

33. Side-scan sonar and subbottom acoustical profiling are not an adequate substitute for the taking of core samples.

34. A field of smaller amplitude sand waves likely exists on the route southwest of the field of previously described barchan-shaped waves.

35. Approximately ten miles east of Port Williams, there exists a bottom area which consists of loose soils with high moisture content to a likely depth of at least 50 feet and

900 feet wide. This bottom area, which overlays firmer strata, appears liquefiable.

36. Boulders are present along the route. On one portion of the route, a minimum of three dozen boulders were observed on the sea bottom in an area 300 feet by 900 feet. This would indicate that a boulder could be expected, on the average, at least once every 150 linear feet in the case of a pipeline trench 50 feet wide. The distribution of subsurface boulders has not been established but their presence would obviously shorten the average linear distance between boulders.

Liquefaction

37. A "potentially liquefiable zone" is an area in which a seismic event (earthquake) could cause the sea bottom to liquefy and lose its load bearing capacity due to volume decrease and corresponding pore pressure increase. If this phenomenon occurred, the pipe could move vertically and/or horizontally depending on the relative specific gravities of the pipe and the liquefied soils, the slope of the bottom and the pipe's position relative to that slope, and the severity and geographical extent of the effects of the seismic event. A pipeline segment that rises to the sea floor is exposed to dangers from currents, anchors and fishing gear. Such could cause pipe deformation, fracture or rupture. A pipeline segment that is moved horizontally due to a slide will become deformed

and fail if bent beyond its structural limits. (TR 3842). A pipeline segment that sinks will likewise become deformed and fail if bent beyond its structural limits. Applicant anticipates the pipe could sink thirty feet without failing, posited on applicant's expectation that soils will not liquefy to depths greater than 30 feet. This expectation is not supported by the record, as the following illustrates: (1) at applicant's .2g acceleration, liquefaction throughout the column of Type A soils in Port Angeles Harbor can be expected -- this column is stated by Forman (TR 3837) (See also Ex. 33 p. 5-1, 2) to be 40 feet in depth and is shown in Exhibit 33, drawing 1-701, to be approximately 50 feet in depth; (2) soils along the Admiralty Inlet submarine route have a liquefaction potential up to a 50-foot depth (See Finding 35); Northern Tier's assertion that soils would not liquefy in Admiralty Inlet to a depth greater than 30 feet relies on core samples which never went deeper than 20 feet (Exhibit 84); the .2g acceleration limit is inadequate and noticeably less than the .31 to .35 g acceleration the Council has found appropriate (Section III.A. infra). Applicant has presented no calculations to determine whether or not a pipe could safely withstand sinking to a greater depth than 30 feet.

38. The presence of a "potentially liquefiable zone" is significant because a pipe entrenched in such an area must have a specific gravity relatively close to that of the surrounding soil in its liquefied state in order to reduce the

likelihood of adverse movement should liquefaction occur. In high current areas, this means that the appropriate combined weight of the steel pipe and any concrete coating when full of oil should be relatively light for liquefaction when compared to the combined weight for construction and operation stability in currents. (TR 7873).

39. Applicant estimated that approximately three miles of the revised Admiralty crossing and one mile of the Saratoga crossing would be subject to liquefaction in the event of a Modified Mercalli Intensity VII+ earthquake. (Ex. 84, p. 19-22, Fig. 10 and 11.) The lateral extent of the zone would encompass at least the 1000 foot survey width of the route. (Veatch, TR 21719.) Applicant has calculated such an earthquake would cause ground acceleration of not more than 0.20 g. (Veatch, TR 3496.) The Modified Mercalli Intensity scale of VII-VIII generally equates with a Richter magnitude 6 earthquake. In terms of Richter magnitude, applicant's design level earthquake is equivalent to a Richter magnitude 6.0 earthquake. (TR 23970.)

40. Applicant's assessment of what areas are likely to liquefy at 0.2 g ground acceleration is based primarily on analysis of Vibracore soil samples. The samples taken in January of 1979 along the old "Southern Route" indicate the soil is highly variable. From sample to sample, there is ex-

treme variability in the type of soil, relative densities, shear strength and other characteristics. (Ex. 84, Fig. 10; Ex. 288; Johnson, TR 24006.) The samples were acquired at locations separated by distances too great for an estimate to be made of the horizontal scale of soil type and density variation. (Winter, TR 38160, 38175.) No soil samples have been gathered and analyzed to determine soil conditions on either side of the proposed pipeline centerline.

41. Soil samples averaged approximately one per mile. Both written documentation and oral testimony presented by applicant in or prior to the spring of 1980 emphasized that the samples (in conjunction with other geophysical work) constituted only a preliminary survey. Applicant's consultants testified in the spring of 1980 that at least three Vibracore samples per mile were required to gain an understanding of the bottom sufficient for the "final design" of the line. Several expert witnesses presented by intervenors testified at least four per mile were necessary. On the Trans-Alaska Pipeline, approximately three per mile were taken. More frequent samples are needed for a submarine pipeline than a land pipeline. (Buck.)

42. After conducting further analysis (but taking no further samples) in response to the Council's order of August 19, 1980 (and after revising the route), applicant testified

that no further Vibracore samples were necessary. Two of the samples on the old "Southern Route" are one-half to three-fourths of a mile from the revised route. No samples were taken in the four and one-half mile portion that was revised. This is in a high bottom current area. Applicant contends that its subbottom acoustic profiling and sidescan sonar tracks of the route (including a dense grid in the area of the revision) obviates the need for the additional Vibracore sampling that it previously testified was a necessity. The evidence does not support a finding that it is a usual and customary practice to substitute side scan sonar and subbottom acoustic profiling for vibracore samples; nor does it support a finding that it is usual and customary to project a soil sample in one area to another area one-half to three-fourths of a mile away on the basis of similarity of electronic echo returns between the two areas.

43. Liquefaction is a phenomenon whereby a saturated soil becomes fluid and loses its bearing capacity. In general, the probability of liquefaction increases as the relative density of the soil decreases. (Johnson, prefiled, page 4; Sherif, TR 29874.)

44. The consultants for the Applicant used Vibracore penetration techniques to gather soil samples in nearly all cases. In the marine environment, this penetration method may create an inaccurate high pore-pressure build-up in the

soil sample which would falsely be interpreted to indicate a low probability of liquefaction. The relative densities of the soil sample cannot be considered accurate. (Sherif, TR 29874.) The full extent of potential soil liquefaction along the pipeline route cannot be determined from the information provided by the applicant. (Sherif, TR 29863; Johnson, prefiled, page 13.) Laboratory analysis on soil samples is essential to accurately determine the depth and extent to which soils will liquefy. (Sherif, TR 29860 and 29950.)

45. Although applicant's consultants utilized tests on the soil samples which could indirectly determine susceptibility for liquefaction, the best state of the art technique was not used. Two devices have been built which utilize direct testing methods and provide more accurate information on liquefaction (one by Sherif, one by Seed). (Sherif, TR 29876, 29953). A laboratory analysis of proper scope could have been completed by the applicant within three to four months. (Sherif, TR 29937-29938.)

46. Liquefaction could leave the pipe unsupported for large portions of the Admiralty crossing. Because of the variability of the soil between Port Williams and Point Partridge, liquefaction could produce suspension or exposure of the pipe. (Johnson, TR 24009.)

47. The applicant has identified a potential for soil liquefaction along three miles of the proposed route between Discovery Bay and Protection Island. (Exhibit #84.) At .25 g, a seismic event significantly less than the .31 to .35 g event the Council finds appropriate for this project (see Section III A), the actual potential for liquefaction may occur in an area four times greater in length than that identified by the applicant. (Exhibit #513. TR 29911.)

48. Generally, in a potentially liquefiable zone, the pipeline is designed to be slightly heavier than the surrounding soil would be in a liquefied state. Applicant's proposed design for the Admiralty Inlet crossing (about 94,000 feet in length) indicates the following weights and specific gravities from Port Williams eastward:

	Weight per Lineal Foot	Specific Gravity
0-2,500 ft.	168 lbs.	S.G. 1.20
2,500-25,000 ft.	60 lbs.	S.G. 1.07
25,000-41,000 ft.	60 lbs.	S.G. 1.08
41,000-58,000 ft.	245 lbs.	S.G. 1.29
58,000-86,000 ft.	300 lbs.	S.G. 1.35
86,000-94,000 ft.	168 lbs.	S.G. 1.20

Applicant itself has indicated the portion from approximately 25,000 to 44,000 feet is potentially susceptible to liquefaction at 0.2 g ground acceleration. Furthermore, at a ground acceleration of .31 to .35 g (which the Council has found to be an appropriate design figure), a much greater portion of the route would apparently be susceptible to liquefaction. Though the low pipe specific gravity for most of the first 40% of the crossing (except for the first 2500 feet) would seem to afford a measure of protection from the risk of liquefaction, the situation is different for much of the remainder of the route. For instance, liquefaction occurring between 59,000 and 71,500 feet (an area which could potentially liquefy at 0.25 g ground acceleration), would be in an area also requiring heavy pipe weighting with high specific gravity to counter high bottom currents. In a liquefaction event, the pipe could be expected to sink. Lightening the submerged weight to counter liquefaction problems would increase susceptibility to bottom currents. Proper weighting for currents depends on an accurate determination of design currents.

49. Summary of Liquefaction. According to applicant's calculations, a seismic event could cause a three mile portion of the Admiralty crossing and a one mile portion of the Saratoga crossing to liquefy. This conclusion was based on soil samples taken on the average, nearly one mile apart; on geographical extrapolation of soil samples through electronic survey results (geotechnics); and on the supposition that the maximum ground acceleration that need be prepared for was 0.2 g. The Council finds, however, that at least three to four soil samples per mile are necessary; that geographical extrapolation of soil samples by way of geotechnics is not a substitute

for an adequate number of samples; and that a maximum ground acceleration of approximately 0.31-0.35 g is more appropriate. The Council accordingly finds that areas significantly larger than applicant's estimates could liquefy, and that applicant has not sufficiently studied the submarine geology of Admiralty Inlet.

Submarine Landslides

50. Liquefied soil loses its strength and behaves as a heavy, viscous fluid. Liquefied soil will flow downslope and may carry structures with it. (Sherif, TR 29876.)

51. Existing landslides and slumps have been identified in the vicinity of Northern Tier's proposed submarine crossing of the Strait. (U.S.G.S. Open File Report #80-548, Ex. 291). The subsurface profiles indicate the possibility of past slumping on the proposed Admiralty crossing. (Johnson, TR 24009.) Ground accelerations from a large earthquake could cause slope instability and landslides on the Admiralty crossing. (Johnson, TR 24008.) A slide of liquefied materials, once initiated, could cause the movement of denser, non-liquefied materials in proximity to the initial slide. (Johnson, TR 24008-9; Buck, TR 33974.)

52. The proposed Admiralty Sill crossing includes several areas where the local bottom slopes are of the order of

10% and greater. (Ex. 279 and Ex. 280.) In places, the slope is as great as 13-15%. (TR 22506) It is estimated that roughly 8% of the lineal distance of the route shown on Ex. 279 is characterized by slopes exceeding 10%. On the portion of the route shown on Ex. 280, nearly 14% of the lineal distance of the route has slopes greater than 10%. (Winter, TR 38178.) Liquefied soil will flow on slopes of less than 2.63%. On the Trans Alaska Pipeline, slopes greater than 2% were considered for liquefaction potential. (TR 34071)

53. The occurrence of landslides could subject the submarine pipe to severe pressures particularly where it is necessary to install the pipe lengthwise to the slope (i.e., parallel to the contour lines) rather than up and down the slope. (Buck, TR 33975.) Following a submarine landslide, the pipe could be left exposed to the currents. (Johnson, TR 24009.)

54. Applicant did not study the possibility of landslides caused by liquefaction. A pipe otherwise protected from liquefaction effects by weighting adjustment will not be protected from the hazards of a liquefaction-induced landslide. (Buck).

55. Turbidity currents are a phenomenon, usually induced by seismic events, where large amounts of sediment liquefy and move long distances at considerable speeds--as high

as 50 mph. While such may be unlikely in Puget Sound, it must be noted that Northern Tier's geotechnical consultants did not investigate this potential hazard, nor did they investigate the possibility that any event originating "off-site" would impact the pipeline.

56. Summary of Submarine Landslides. Separate from the problem of liquefaction on the line itself is the problem of liquefaction on adjacent slopes which could cause a landslide to flow onto the line and uncover or damage it. Along the route itself are significant areas of slopes greater than 10%. Liquefied soil will flow on slopes of less than 2.63%. Applicant did not study the possibility of liquefaction-induced landslides in adjacent areas which could flow onto the pipe.

Boulders

57. Visual inspections of the sea bottom of the Strait of Juan de Fuca reveal that boulders of a foot or more in diameter are a common feature of the sea floor and the Strait. (Holbrook, TR 38209; Sternberg, TR 38228; Winter, TR 38177.)

58. There is a strong likelihood of boulders (rocks greater than a foot in diameter) being encountered along portions of the proposed Admiralty route within a short distance of the seabottom surface. The geological locale through which the Admiralty crossing passes has a history of glacial debris.

The Vibracore samples taken encountered glacial deposits within ten feet of the sea bottom at 8 of 25 sample locations on the northern route and 6 of 22 sample locations on the southern route. Boulders can be expected to be found in association with such glacial material. (Johnson, TR 24010; Sternberg, TR 38218; Ex. 753, p. 5-13; Winter, TR 38160, 38176-77; Veatch, TR 8351-52.) Boulders may be on the subbottom surface or may be buried somewhat beneath it.

59. Various forms of glacial deposits are found throughout the Admiralty crossing area and many of the deposits contain cobbles and boulders of a wide range of sizes. (Sternberg, TR 38219; Ex. 767.)

60. The total geologic composition of the Strait and Admiralty Inlet indicates that boulders are encountered in regions on both sides of the proposed Northern Tier crossing and there is a strong likelihood that boulders will be encountered at the proposed crossing itself. (Winter, TR 38177; Sternberg, TR 38228.)

61. The subbottom profiling undertaken by Shannon and Wilson would not have been able to detect scattered boulders on a scale of a meter or less on or below the sea bottom along the pipeline route. (Sternberg, TR 38614.) Supplementation of the side-scan sonar with bottom photographs or television and

dredging samples would be necessary to get information concerning boulders. A small manned submarine could have made a visual survey in ten days. (Holbrook, TR 38385; Sternberg, TR 38615.)

62. The trenching equipment for the installation of submarine pipelines may be unable to remove boulders in excess of a foot in diameter at the depths of the proposed Admiralty crossing. (Peebles, TR 7844.)

63. The presence of scattered boulders represents a potential hazard to the submarine pipeline. Boulders not removed create the possibility of the pipeline "spanning" between the boulders and producing potentially damaging stresses on the pipeline. (Peebles, TR 7843, 7845; Sternberg, TR 38221.)

64. Summary of Boulders. Based on studies of adjacent areas and the fact the route passes through areas of glacial deposits, there is a strong likelihood that boulders will be found along the seabottom route within a short distance of the surface. Applicant's geotechnic studies could not detect scattered boulders less than a meter in diameter. The taking of dredging samples, and visual inspection through the use of small manned submarines, bottom photographs, or television would have provided essential information on this matter. Boulders not removed could cause "spanning" and consequent damaging stresses on the pipeline.

Sand Waves

65. A portion of the Admiralty Inlet crossing has a very irregular bottom with wave-like features extending well over a mile in length. This portion of the route is described as "irregular bottom (barchan-shaped) sand and gravel." (Ex. 279.) The largest of these wave-shaped features is on the order of 20 feet amplitude (vertical distance from crest to trough). The wave length (horizontal distance between crests) ranges up to several hundred feet. (Sternberg, TR 38618.) The depth of this material is unknown. (Sternberg, TR 38625.) The larger waves have slopes greater than 10% on each side of the crest, resulting in a 20% change in surface slope within approximately 100 feet.

66. The presence of barchan-shaped sand waves suggests that this portion of the route may be unstable with a tendency to migration. Sand waves are formed with moving sediment. The strength of the bottom currents in this area indicates that sediment movement is a common occurrence. (Sternberg, TR 38621-22.)

67. The configuration of these sand waves may vary over time. They may also be migrating in a particular direction. The shape of these sand waves, based upon observations of Shannon and Wilson's raw geophysical records, indicates the

possibility of migration toward the steep side of the waves. (Sternberg, TR 38619; Ex. 766.)

68. The migrating or shifting of these sand waves may cause a submarine pipeline buried in these features to become exposed at some future date. (Sternberg, TR 38230, 38622; Ex. 766.) The maximum depth of the material which is being moved by the current in this area is unknown. The pipe could be exposed to the extent that sections are left suspended above the sand, thereby allowing tidal currents to flow beneath as well as above it. (Sternberg, TR 38622-24.)

69. Applicant became aware of these sand waves as a result of geotechnic work performed early in 1979. However, no subsequent studies have been made to determine their composition or the extent and direction of their movement. It is essential to know the soil and movement characteristics of these waves and the depth of potentially migratory sediments at all locations to be traversed by the pipeline. Important questions remain as to their shape, their size, their composition, whether they are moving and how the pipeline will be trenched through this formation. Northern Tier's analysis of this feature has not been comprehensive, and is inadequate to demonstrate that the pipeline will remain buried if installed. Studies in Chesapeake Bay have discovered similar sand waves which have

migrated approximately 60 meters per year. (Sternberg, TR 38620.)

70. Summary of Sand Waves. Approximately one and one half miles of the Admiralty crossing consists of a field of sand waves, the larger of which are twenty feet high and have slopes over 10% on each side of the crest. Though the field became known to applicant early in 1979, and though the shape of the waves suggests they are migrating, no studies have been made by applicant to determine their composition or the extent and direction of their movement. It is unclear how applicant proposes to trench the pipe through this field. If trenched to an eight foot depth, it is quite conceivable the pipe could become exposed due to migrating sand waves.

Scouring

71. The elements necessary to allow scouring of the bottom in the vicinity of the Admiralty Sill crossing are present: the existence of strong currents and loose sediments. Sand particles typically will be eroded and transported with currents between 0.75 feet per second velocity (for fine sand) and 2.7 feet per second velocity (for coarse sand), depending on the size of the particles. Currents of 6.56 feet per second, for example, are capable of eroding and transporting coarse gravel on the order of one inch or more in diameter. (Sternberg, TR 38231.)

72. Scouring by currents could cause the submarine pipeline to be suspended off the bottom if the pipe were supported by rocks or boulders or between areas of hard till material, or if the pipe were not sufficiently buried in the barchan waves. (Sternberg, TR 38231-32.)

73. If significant scouring occurred in the vicinity of the pipeline, causing a change of the sea floor, the pipe, if spanning, could shift its position as a result. (Sternberg, TR 38232.)

Pipe Specifications and Laying

74. The submarine pipe across Admiralty Inlet and Saratoga Passage will have a 42 inch outside diameter (the same as the terrestrial portion) with steel walls varying between .625 and 1.000 inches, with wall thickness depending primarily on the depths in which the pipe will be laid. The minimum specified yield strength of the pipe is 65,000 pounds per square inch. In addition, the pipe will have a concrete coating varying between 2.3 and 3.7 inches, depending on the particular overall pipe weight needed for stability in the bottom soils and currents the applicant's consultants anticipate will be encountered. Submerged weight will vary between 60 and 300 pounds per linear foot. Specific gravity will vary between 1.08 and 1.35. For the deepest portions of the Admiralty Inlet crossing, buckle propagation arrestors will be built into the

pipe's walls at periodic intervals to limit the propagation of any buckling which may occur during the pipe laying process. Preliminary plans for corrosion protection call for replaceable sacrificial zinc bracelet anodes with a thirty to fifty year life (TR 3926) to be placed every 1,000 feet and for the steel pipe to be coated with coal tar enamel reinforced with fiber-glass and pipeline felt before application of concrete weighting. The concrete weighting is intended to prevent adverse hydro-dynamic effects on the pipe while lying on the bottom before trenching. The greater the weighting (especially in the deeper portions), the greater must be the tension capacity of the equip-ment on the pipe laying barges to prevent buckling of the pipe during installation. The applicant's estimates of the current velocity-submerged weight relationship indicate standard operat-ing equipment limits are being approached. Any significant increase in the current (with a concomitant increase in the required submerged weight) could exceed those limits. (Ex. 298 and 299; TR 21846, 7688; TR 22053.)

75. Applicant proposes that the line be placed on the sea floor by lay-barge method. It appears most likely that the lay barge method would be used for the Admiralty Inlet crossing due to the depths, anticipated currents, and attendant submerged weight and barge equipment tension requirements. Applicant's final decision on which method to use would not be made until final bids are in. (TR 22049).

76. The lay barge method involves welding 40-foot lengths of concrete-coated pipe on board a barge and laying it on a continuous string along the sea bottom. To avoid deforming or fracture-inducing stresses on the pipe during laying, special procedures would be used to control the curve in the pipe between the barge and the sea bottom. Depth, pipe size, currents in general, curvature, and pipe weight are all factors affecting fracture likelihood during the laying process. Submerged pipe design weight is adjusted for anticipated bottom current velocity. (TR 22050, 22117, 22127, 22458, Ex.81, Ch. 4). An increase in design current leads to a need for a heavier pipe which leads to increased stresses during laying, which leads to a requirement for a thicker pipe wall. (TR 22117, see also Finding 12.)

77. Steepness of slope can be a limiting condition for the installation of a submarine pipeline. One of the reasons indicated for abandoning the "Northern Route" was the nine percent slope on the northeast face of the Dallas Bank. (Peebles, TR 7905.) By the lay barge method of construction, approaching such a steep bank from bottom or top would create a stress condition on the pipe that could overstress the pipe during construction. (Peebles, TR 7902.)

78. Worldwide, there are three lay barges with the equipment (i.e., barge tensioning capacity of 300,000 pounds) to lay the pipe in the conditions anticipated by the applicant's

consultants in Admiralty Inlet. They are the VIKING PIPER, the BAR 347, and the ETPM 1602.

79. The lay barge can lay pipe at a maximum rate of 0.6 miles per day. (TR 8138). It can generally lay pipe within 50 to 100 feet either side of a center line. (Peebles, TR 8055. Timmermans, Pre-filed, p. 6.) A lay barge such as the VIKING PIPER utilizes 14 anchors to winch itself forward during the laying process. An anchor is lifted and repositioned approximately every 20 minutes throughout the work day. (Peebles, TR 8148-51.)

80. Summary of Pipe Specifications and Laying

The cross-sound submarine pipes will have a 42 inch outside diameter with steel walls varying between .625 and 1.000 inches. A concrete coating between 2.3 and 3.7 inches for weighting purposes will be on the outside of the pipe. Submerged weight will vary between 60 and 300 pounds per linear foot. Though not committing itself, applicant believes it most likely that the lay barge method would be used for laying the pipe across Admiralty Inlet. Lay barges can lay pipe at the maximum rate of 0.6 miles per day and generally be accurate within 50 to 100 feet of centerline. Three lay barges worldwide have the tensioning equipment necessary for this project given current estimates of pipe submerged weight during the laying process. Should there be any significant increase in submerged weight requirement (e.g. due to an upward reassessment of bottom currents), standard equipment capability might be exceeded.

Trenching

81. After laying, the applicant has estimated the pipe will rest on the sea bottom for an indeterminate time, possibly six months, until a trench is excavated and the pipe is settled in the trench. At the approaches to the shore, the trench will be excavated by backhoe, clam shell, or dragline or a combination thereof, to a water depth of 20 feet. Either the post-plow or the jet sled method will be used for trench construction of the remainder of the submarine route except in the shallower portions of Saratoga Passage, where the cutter-suction or the bucket dredge may be used. The plow method involves designing a plow especially for the project. It would be towed along the pipe, digging a furrow and simultaneously pulling the pipe into the newly furrowed trench. The jet sled method involves towing a sled along the pipe and clearing a trench through water jets. A portion of the bottom is taken off in each pass, simultaneously lowering the pipe a few inches. The jet sled may not be adequate if dense materials such as glacial till are encountered. The applicant has indicated a final decision on which method to use would not be made until final bids are in. (TR 22067, TR 7680-82; TR 21856, Section 6.4.4.4 of Volume II of Application.)

82. Plowing is economically superior for trenching if equipment is available with the pull forces needed. Equipment availability depends on bottom material, depth and speed. A plow would have to be designed, built and tested for this job. It is not known if plow design requirements might require more pulling capacity than is available from existing pulling equipment. A preliminary plow design test (probably utilizing a scale model) would have to be made before that could be determined. (TR 22085) No similar plow has been used. (Timmermans, TR 22071-073.)

83. Post plowing has not previously been performed under the conditions existing in Admiralty Inlet. (Peebles TR 7795, 7961.) A plow, in general, could furrow a two-meter deep trench, which is less than the eight-foot minimum required for the proposed project. One R. J. Brown engineer testified that it would be extremely difficult to run two passes with a plow to obtain the required depth, but that he believed a special design could be developed for a plow to furrow eight feet. (Peebles, TR 8201-02.) Another R. J. Brown engineer testified a plow could be designed to make two passes over the same line. (Timmermans, TR 22068.)

84. Preplowing (i.e., a furrow is dug prior to pipe laying) in the North Sea has removed boulders of two-foot diameter in trenches up to ten feet deep. An R. J. Brown engi-

neer believes the post plowing method would be similarly effective. (Peebles, TR 7844.)

85. A jet sled operation could cost about six million dollars more than a post plowing operation (presumably in 1979-80 dollars). (Peebles, TR 7959-60.) A stability study would be needed to determine the feasibility of the jet sled method. Jetting has been used in the North Sea to a depth of 530 feet in currents of one to two feet per second. The depth or width of that trench is unknown. (Peebles, TR 7958.) Off England, jetting has been used at depths of 100-150 feet in sustained currents of six feet per second. The depth or width of that trench is unknown. (Peebles, TR 7959.)

86. A jet sled can remove rocks up to six to eight inches in diameter from trenches up to eight feet deep. (Peebles, TR 7844.)

87. A jet sled is capable of making multiple passes along the same line. It is estimated that a jet sled would normally require no more than three passes to reach an eight-foot depth. If sufficient horsepower were available, a jet sled could clear a trench ten feet deep. (Peebles, TR 8186, 8193.) In loose sands, a jet sledded trench eight feet deep and six to eight feet wide at the bottom would have slopes extending an additional sixteen feet (horizontal distance) on

each side for an overall depression eight feet deep and forty feet wide. (Peebles, TR 8196.) It is roughly estimated a plow might leave a depression eight feet deep and up to thirty-two feet wide. (Timmermans, TR 22108.)

88. It has not been established that either the post plow or the jet sled technique could cut an eight foot (or greater, if required) deep trench in the two-mile long area of the sand waves.

89. There are several places along the proposed pipeline crossing of Admiralty Inlet where glacially overridden sediments occur within eight feet of the surface of the bottom (TM 400, 413, 492, 502 and 506). In two of these locations (TM 492 and 506), the Vibracore sampling device was unable to penetrate to the depth of the required trench. (Ex. 288.) In Saratoga Passage, samples G-1, G-2 and G-3 did not reach trench depth. G-1 was deemed not liquefiable, though it was soft, silty and only five feet deep.

90. In order to be certain that a trench is, in fact, at least eight feet deep, visual observation is required. (Peebles, TR 8185.) Electronic means are an uncertain alternative.

91. Northern Tier has proposed to trench the pipeline to an eight foot depth. Northern Tier proposes to rely upon natural processes (currents) to backfill the trench. Northern Tier has undertaken no study to determine if natural backfilling will occur, or how long it will take. It may take many years.

92. If a submarine pipeline becomes suspended between two points so that it is exposed to currents, it is possible for a phenomenon known as vortex shedding to occur. The water currents acting on the pipe can cause vibrations in the pipe which will eventually result in failure due to metal fatigue. (See Finding 12.) This has caused failures of smaller diameter pipelines in Cook Inlet, and has been mentioned as a potential danger to the proposed Northern Tier pipeline by one of the design engineers. (TR 8204-05) Whether this is a matter of concern for a 42 inch diameter pipeline with wall thicknesses of between .75 inch and 1.0 inch is not clear. Furthermore, neither the length of suspended pipe nor the strength of the currents necessary to pose a problem has been established. Because of uncertainties regarding vortex shedding and the dangers to an exposed pipe from anchors, however, it is necessary that the pipe be installed in a manner which will give a high degree of certainty that it will remain buried.

93. Summary of Trenching. Trenching is important to reduce the chances of pipe damage by high currents or by anchor contact. The pipe will initially be laid on the sea floor. Later, applicant proposes to excavate an eight foot deep trench with either a post-plow or a jet sled. (The shallow areas will be handled differently.) Both devices run along the pipe and simultaneously excavate a trench and settle the pipe in it. It is not yet known if a post plow could be built with the pulling forces necessary for this project. A jet sled excavates by means of water jets. Approximately three passes would be needed to reach an eight foot depth. The jet sled cannot penetrate dense soils and cannot remove rocks more than eight inches in diameter. If the pipe were resting on boulders, harmful stresses could result. Applicant anticipates the trench will naturally backfill but has performed no studies to verify this. Backfill, if it does occur, may take several years.

Anchor Penetration Risk

94. It is difficult to assess the likelihood of either a pipe contact by a ship anchor or of pipe damage due to such contact because probability theory must be relied upon. Applicant has endeavored to make conservative assumptions for the factors that entered into the analysis so that the result would be likely to err on the pessimistic side. No finer analysis was deemed necessary. As a result of its analysis, Applicant concluded that lowering the pipe to four feet below the

original sea bottom elevation would reduce the risk of pipe-anchor contact to an acceptable level. (Timmermans, prefiled, p. 15.)

95. Applicant has concluded that only anchors heavier than 10,000 pounds are potentially damaging to the pipe. Such anchors would normally be carried only by a vessel of 30,000 DWT or larger. (Timmermans, prefiled, p. 16.)

96. Applicant has concluded that even if natural backfill did not occur, the risk of anchor contact would not be significantly increased. This was based largely on the supposition that a large anchor will travel through the soil horizontally and will not easily be deflected downward when crossing a trench which is not wider than approximately two to three times its depth. (Timmermans, prefiled, p. 16.) However, as noted in Finding 87, the expected trenching width will be four to five times its depth.

97. The pipe would cross that part of Admiralty Inlet designated a precautionary area where vessel traffic converges from four different directions. Because of converging traffic, potential accidents and emergencies are more likely than in normal traffic lanes. (Armstrong, TR 25848-49.) To avert a potential collision or other emergency, vessels likely would drop anchors despite the known location of the submarine

pipelines if the master or pilot felt a collision or emergency could be averted through an anchor drop. (Armstrong, TR 25848; Bennett, TR 25417-18.)

II.A.2.a. SUBMARINE PIPELINE PORTIONS

(Cross-Sound and Harbor)

II.A.2.a.(2) Port Angeles Harbor Submarine Pipeline

1. Two 48 inch diameter submarine pipelines would cross Port Angeles Harbor from Ediz Hook to the storage tanks at Green Point. Three possible routes for the unloading pipelines were studied in 1978. (Ex. 30, Fig. 1) One additional route, "Route D," was studied in 1979 and became the preferred route. (Ex. 31, p. 6 and Fig. 2) Two additional routes were hypothesized but not studied.

2. The unloading pipelines on Ediz Hook will be constructed by conventional methods and equipment. The submarine pipelines extending from Ediz Hook to Green Point will probably be laid by lay barge. Total construction time is estimated to be six months. If the submarine pipeline is installed by the bottom-pull or bottom tow method, a "tidal window" would have to be used. (TR 3802)

3. The two lines will be laid one at a time and will be spaced up to 1200 feet apart at the widest points. (TR 3625) At the shore approaches, the lines will be closely spaced and will occupy the same dredged trench.

4. The bottom sediments of Port Angeles Harbor along route D consist of recent marine sediments resting on older marine sediments (Type B) of Ediz Hook near the hook and /or older glacially overridden deposits. The glacially overridden deposits occur at or near the seabottom throughout the eastern portions of the harbor crossing. Along the western portions, toward the hook, the glacially overridden deposits occur at a progressively greater distance below the sea bottom. The Type A recent marine sediments consist of very loose to loose silty fine sand with occasional shells. The thickness of the Type A soil increases to over 40 feet in depth on parts of the route. (Ex. 31, Fig. 2.) The density of the Type A soils is very low. The Standard Penetration Resistance values (N-values) (penetration force) were zero to ten blows per foot in these materials while the T-values (penetration time) from the Vibracore samples rarely exceeded 5 seconds per foot of penetration. (Ex. 31, p. 5.) Type B materials which comprise the bulk of Ediz Hook and extend into the Harbor from the toe of Ediz Hook are similar to Type A materials, although they are slightly more dense and less silty than the Type A materials. (Ex. 31, p. 5.) The standard penetration resistance values for Unit B sediments range from 15 blows per foot to 200 blows per foot with average blow counts above 55 feet in depth ranging from 25 blows per foot to 45 blows per foot. Below 55 feet in depth, the standard penetration resistance averages approximately 70 blows per foot. (Ex. 30, p. 8 and Appendix A). The glacially

overridden sediments consist of very dense, slightly silty to silty sand with variable amounts of gravel. Hard over-consolidated clay and silt layers are interbedded in these glacially overridden sediments. There is no evidence of the existence of faults in the harbor area.

5. The existing slopes on the south side of Ediz Hook are presently very steep, averaging 30° and as steep as 45° in places. The existing slopes exceed their natural angle of repose in places. (Ex. 31, p. 9; Johnson, TR 23996.) The slopes of Ediz Hook are marginally stable, especially in the steeper areas. (Ex. 31, p. 9.) There is a slump feature near the proposed submarine pipeline alignment at the eastern tip of the Hook. (Ex. 31, p. 9 and Fig. B-5).

6. Bottom depths as great as 180 feet occur immediately south of the Hook at the locale of the proposed unloading facilities. Northward from Ediz Hook, the bottom of the Strait of Juan de Fuca rises from depths of about 360 to 420 feet to about 240 feet just north of Ediz Hook. (Ex. 30, p. 4.)

7. Consultants for Northern Tier Pipeline Company have conducted detailed geotechnical investigations of underwater parts of the terminal location and much of the submarine unloading line route. (Ex. 30; Ex. 31). These investigations

included underwater test borings at the tanker berth sites; geophysical surveys including side-scan sonar, Vibracore bottom sampling, and bathymetric survey of the berthing area; laboratory testing of berthing area bottom samples; and engineering studies and analyses to develop and evaluate design parameters and considerations. Standard penetration resistance tests were conducted at several locations in the berthing facility area to allow a determination of the relative density of the soils involved. The applicant's analysis of the geophysical conditions along the route of the unloading pipelines between Ediz Hook and Green Point includes test borings, bathymetric and subbottom profiling, side-scan sonar and magnetometer surveys, Vibracore bottom sampling, laboratory testing of bottom samples, and engineering studies. A total of nine borings were taken in Port Angeles Harbor and at Green Point for the 1978 study. (Ex. 30, p. 3, Fig. 1.) In 1979, 32 Vibracore samples were taken in the harbor to study the crossing. (Ex. 31, p. 3. Fig. 1.) Current meters were installed at four sites across Route "D."

8. The Type A sediments along the pipeline corridor in Port Angeles Harbor would be susceptible to liquefaction for their entire depth in the event of a Mercalli Intensity VII+ earthquake which produced maximum ground accelerations. (Ex. 31, p. 7.) The occurrence of a 7.1-7.5 Richter magnitude earthquake would potentially liquefy both the Type A and Type B

soils on Ediz Hook and in the western 3 miles of the Port Angeles Harbor crossing. (Johnson, TR 23995-96; Ex. 339, Fig. IV-2.)

9. Liquefaction of sediments would result in a loss of bearing capacity and support for the pipe. A pipeline extending through these sediments might either settle or float to the surface depending upon the bulk density of the pipe and contents compared to the bulk density of the liquified sediments. (Ex. 31, p. 8.)

10. Occurrence of a large earthquake has the potential to cause slope instability and slumping along Ediz Hook. The unconsolidated Type A material and to some extent the Type B soils, are prone to slumping in the event of a large earthquake. (Johnson, TR 23996-97.) Submarine landslides could also occur in slopes on the bottom of the Harbor which exceed 1^{o}-3^{o}. (Johnson, TR 23997; Buck.) Once a slide of liquefiable material is initiated, it could cause the movement of denser, non-liquefied materials as well. (Johnson, TR 24008-09; Buck, TR 33974.)

11. Submarine landslides could produce a differential displacement of materials and a shearing motion on the pipe. (Johnson, TR 23998-99.) The submarine pipelines in Port Angeles Harbor on Route D would cross some slopes of 4.4% to

17.5% steepness in a parallel direction. (Johnson, TR 23999-24000; Ex. 31, Fig. B-1 and Fig. 2.) The flowing material in a landslide perpendicular to the pipe would tend to be caught against the pipe and subject it to pressure. (Johnson, TR 24000; Buck, TR 33975.)

12. The submarine unloading line route is generally stable except near Ediz Hook. (Alsup, TR 8459.) Exceptions are described elsewhere in this section.

13. No great effect on the unloading pipelines would be expected from slope failures of the magnitude indicated by the small slump feature at the east end of Ediz Hook. If the slumping involved trench materials, no significant threat to pipeline integrity is anticipated because of the strength of the concrete coated thick-walled pipe compared to the low-strength low-density nature of the materials that could become involved in such slumping. In some parts of the harbor, bottom slopes between 2.5 and 10 degrees exist. If slope failures occurred, these could make a perpendicular impact on the pipeline. (TR 8460-61 Alsup.)

14. As the result of its 1978 investigation of the Port Angeles area, Shannon and Wilson recommended that the unloading pipelines in Port Angeles Harbor be trenched to a depth below the Type A sediments in order to avoid the hazards of

liquefaction and potential anchor damage. (Ex. 30, p. 26; Veatch, TR 3566-67.) Northern Tier's engineers concluded, subsequent to Shannon & Wilson's recommendations, that it was beyond the capability of the current technology to bury the pipeline below the Type A sediments (which extend below 40 feet in some areas) in Port Angeles Harbor. It may not be possible to achieve even 11 feet of trench cover. The engineers, therefore, recommended a minimum trench cover depth of four feet in Port Angeles Harbor. (Ex. 33, p. 1-5, 6.) The larger vessels expected to call at Port Angeles Harbor to offload oil could carry anchors weighing 30 tons or more (high loading power anchors). (Ex. 33, Table 6.3). In some cases, a 15-ton anchor can penetrate 19 feet of mud. (Ex. 33, Appendix A, pp. 1-5). Applicant itself has estimated maximum anchor penetration in Port Angeles Harbor soils from 9.8 to 10.9 feet. (Ex. 33, pp. 6-34).

15. It was recommended by the applicant that coverage of 11 feet be attempted where Type A soils are more than seven feet thick, if technically achievable and economically feasible. (TR 3626, 3682.) Before making this decision, a technical and economic feasibility study of dredge modification would have to be made. (TR 3639.) In shallow water near Green Point, 5.5 feet of rock backfill is recommended to a 20 foot depth. (TR 3626.) Beyond that, for approximately 3300 feet horizontally, natural backfilling would be augmented by ten-foot rock plugs placed at 100 foot intervals. (TR 3688-89.)

Rock backfill is recommended for the pipeline trench on the Ediz Hook slope. (TR 3626.)

16. Except for the shore approaches, natural backfill is relied upon by Northern Tier as the method of covering the submarine unloading pipeline trenches. (Ex. 33, p. 5-7.) No study was undertaken to determine whether natural backfill would fill the trench along the submarine route.

17. To construct the unloading pipeline section between Ediz Hook and Green Point, trenches will be excavated in bottom materials. In the deepest part of the harbor where the fine, loose sands are the thickest, the pipeline trench would be excavated with a suction dredge with airlift equipment. Where the fine, loose sands are thinner, the trench would penetrate the dense sediments, and a combination of some or all of the trenching methods would be used including the suction dredge with airlift, the suction dredge with cutter head, clamshell dredge, and a pipeline plow. Where the fine loose sands are very thin or non-existent, the trenching would be accomplished by means of a cutter suction dredge, clamshell dredge or the pipeline plow.

18. Rock backfill in the shore and surf zones will be required at both Ediz Hook and Green Point shore approaches. In order to assure that littoral sediment transport is not im-

pacted at Green Point, special pipeline burial requirements are applicable.

19. The natural bottom contours in the pipeline trench area between Ediz Hook and Green Point may be reestablished by the action of bottom currents over a period of time which will fill the pipeline trench with bottom sediments. The likelihood of, and the length of time required for, such natural backfilling will be dependent on the types of soils in the vicinity and the strength and direction of the currents in the particular location.

II. A. 2.b. TERRESTRIAL PIPELINE PORTIONS

1. The terrestrial pipeline route runs generally west to east from Green Point to Port Williams in Clallam County, crosses Whidbey and Camano Islands in Island County, and turns south near Arlington in Snohomish County. The route goes southeasterly through King County and begins its ascent over the Cascades near North Bend. In Eastern Washington, the route runs generally west to east through Kittitas and Grant Counties and along the Lincoln-Adams County Line. It exits the state southeast of Fairfield in Spokane County. The terrestrial pipeline corridor is legally described in Exhibit 312. Certification is sought for a corridor one-quarter mile on either side of a defined centerline, except at major river crossings, where the corridor narrows to an area 200 feet on either side of the centerline. The pipeline would be laid anywhere within the proposed corridor, and the final location would depend on landowner negotiations and a variety of other site-specific conditions. (Applic. II, Sec. 6.3.2.1) The pipeline system will consist of the mainline pipe, pump stations, a pressure reducing station, and mainline valves. (Applic. II, Sec. 6.3.1)

2. The pipeline, in both its terrestrial and submarine segments, will be designed, constructed, and operated in

accordance with the Hazardous Liquid Pipeline Safety Act of 1979, 49 U.S.C. subsection 2001 <u>et seq</u>., and with United States Department of Transportation (DOT) regulations regarding transportation of liquids by pipeline, 49 C.F.R. subsection 195. It will also comply with the standards set forth by the American National Standards Institute (ANSI) concerning "Liquid Petroleum Transportation Piping Systems" (Standard B31.4). (TR 5894-95 Sandmeyer)

3. Within the state of Washington, the pipeline will be 42 inches in diameter. It will be protected from corrosion by an external protective coating and by a cathodic protection system. Where the pipeline crosses streams and rivers, a concrete coating or concrete weights will also be applied to increase submerged weight and prevent the pipe from floating out of the trench. (TR 5903, 5906-07 Sandmeyer; 7338-39 Winegar; Applic. II, Sec. 6.3.2.4)

4. Northern Tier proposes burying the pipeline in an eight foot deep trench and backfilling with approximately four feet of cover, except where additional cover is needed or is otherwise required. In solid rock, the pipe will be buried so that there is 18 inches of cover between the top of the pipe and the ground. Where the route crosses major highways and railroads, the pipeline will be encased in a larger pipe or concrete coated, and will be installed by boring under the

roadway. Where the route crosses major streams and rivers, Northern Tier intends the top of the pipe to be buried at least 48 inches below the 100-year flood level scour depth unless rock is encountered. Installation of the pipeline at canal and ditch crossings will be in accordance with the requirements of the irrigation district having jurisdiction. Similarly, where the pipeline crosses buried cables and beneath electric power lines, design clearances and cathodic protection will be coordinated with local utility companies. (TR 5912-14 Sandmeyer; 6706-10 Everett; Applic. II, Sec. 6.3.2.4)

5. Mainline block and check valves will be installed at various points along the pipeline. Check valves automatically close to prevent backflow. Block valves, when closed, prevent flow in either direction. All block valves will be remotely controlled from the main control center at the onshore storage facilities but can also be operated manually. If a line break occurs, pumping would be stopped and the mainline block valves closed to isolate the leak. (TR 5900-01 Sandmeyer; Applic. II, Sec. 6.3.3.8)

6. Seven pump stations, Port Angeles, Arlington, Carnation, Bandera, Ellensburg, Odessa and Plaza, and one pressure reducing station at Quincy, are proposed for construction in Washington. Major equipment and support facilities at these stations may include, depending on the station, centrifugal

pump units, pressure reducing valves, a surge relief tank, internal pipeline cleaning equipment, strainers, a drain system consisting of an underground tank and drain lines, an injection pump, a control building, power supply and transformers, a communications tower, a heliport, roadway, an emergency generator, and fencing. (Applic. II, Sec. 6.3.4; TR 7343 Winegar)

7. Overall control of the pipeline system will be done by pipeline dispatchers at the main control center at the onshore storage facilities. The dispatchers will be aided by the computer-assisted SCADA system. Control buildings at the pump and pressure reducing stations will house equipment needed for remote control by, and communication with, the main control center, as well as a local control and instrumentation system. (Applic. II, Sec. 6.3.6.1)

8. Water needed at the stations will likely be supplied from on-site wells. Sewage, from those times when the stations are occupied for routine maintenance or emergency conditions, will be disposed of by a septic tank or a holding tank system serviced by commercial firms. Stations with surge relief tanks will also have an oil-water separator to process rain water and oil collected in dikes surrounding the tanks. (TR 7345-46 Winegar; Applic. II, Sec. 6.3.4.4) Electrical power will be provided by the utilities serving the areas where the stations are located. (TR 7379-80 Whiteside)

9. Each station will be equipped with fire detection monitors. If a fire occurs, the monitors will be designed to alert the system to shut the station down and alert the SCADA system to close block valves. Each station will be constructed of non-combustible material to the extent practicable to inhibit fires from beginning or spreading. Unauthorized entry alarms and fire alarms will be installed at each station. Additional fire protection will include combustion detectors and automatic fire extinguishing systems in the control building and substation areas, ultraviolet smoke detectors, and portable fire extinguishers. Surge relief tanks will be equipped with heat sensing devices, and, a Halon system (Inert gas extinguishing system). If the tanks are of the floating roof type, they will have dual gas detection systems; if they are the fixed roof type, they will have a floating internal seal. Northern Tier will coordinate its fire protection plan with that of local fire protection districts. (TR 7346-49 Winegar; TR 7391-93 Kirsop)

10. To prevent damage to the pipeline, line markers identifying the pipeline and listing a toll-free phone number to call before any construction or digging is begun will be installed at road crossings or other public access crossings. (TR 5907 Sandmeyer)

11. The Butler Associates, Inc.-Williams Brothers Engineering joint venture will oversee pipeline construction

and perform planning, surveying, right-of-way procurement, administration of contracts, and monitoring and inspection. (TR 6949 Evans)

12. Before beginning construction, the applicant will negotiate permanent and temporary easements with public and private landowners. The temporary easements will terminate upon completion of construction. The applicant will negotiate for purchase of sites for the pump and pressure reducing stations. Permits will be sought from agencies with jurisdiction for all inland waterway, river, irrigation canal, highway and railroad crossings, and to cross special land use areas such as Indian reservations and national forests. Temporary sites to store equipment and supplies during construction will also be leased. (TR 5896-98 Sandmeyer; Applic. II, Sec. 6.4.4.1) Easement negotiations and final implementation of pipeline design may require minor changes in pipeline routing and construction methods. (TR 5915-16 Sandmeyer)

13. Terrestrial pipeline construction will generally require the following steps: clearing and grading the right-of-way, hauling and stringing the line pipe, trenching, removing rock (if necessary), bending the pipe to conform to the terrain, welding the joints of pipe together, inspection of the welds, applying protective coating to the welded joints, installing bedding material where necessary, lowering the pipe into

the trench, and backfilling. Tie-in welds are made to connect adjacent sections of the pipeline at various locations, such as road and water crossings and mainline valves. (TR 6696-6703 Everett)

14. Mainline valves will be set in place and tie-in welds made to the pipeline after the valve is in place. The valves will be buried, but the manual and motor-driven actuator for each valve will protrude above ground and be surrounded by a fence. (Applic. II, Sec. 6.4.4.3)

15. During the construction period, Northern Tier proposes to continually inspect to ensure compliance with construction specifications. Field welds will be radiographically inspected in accordance with U.S. Department of Transportation regulations. As sections are constructed, they will be hydrostatically tested in accordance with U.S. Department of Transportation regulations.

16. The pump and pressure-reducing stations will be constructed by several different contractors so that all stations will be completed within approximately 16 months. Work will include general clearing, grubbing, and grading; fencing; excavating for foundations and piping; construction of the control building; installation of electrical instrumentation and control systems; installation of station piping; installation

of the mainline pumps and motors (at pump stations); construction of a surge relief tank (at some stations); and landscaping. (Applic. II, Sec. 6.4.4.7; TR 7350 Winegar)

17. The vast majority of construction access roads will be existing federal, state, and county roads. The applicant will also seek right-of-way agreements from landowners to use or improve existing private roads and/or construct new roads for temporary or permanent access, if needed. (Applic. II, Sec. 6.4.4.3)

18. Cleanup and restoration procedures will include removal of equipment, surplus material, and debris; revegetation; painting of structures; and landscaping of the pump and pressure reducing stations. (Applic. II, Secs. 6.4.4.6; 6.4.5)

19. Crude oil will be stored at the onshore storage facilities in batches defined primarily by sulfur content and gravity of the oil. When a particular type of oil is scheduled for shipment, the valves to the appropriate storage tank will be opened and the valves from the tank containing the preceding batch will be closed. The oil will then flow through the pipeline with the aid of the pumps at the pump stations. Through the SCADA system, the pipeline dispatcher will be able to know at all times where each particular batch is located within the

system. The pipeline is designed as a packed line (full of oil) during all operating conditions. (TR 7366-69 Winegar.)

20. A pipeline dispatcher will be at the main control center 24 hours each day. Pump stations are designed to operate by remote control from the Green Point control center, and will be inspected and maintained weekly. Northern Tier employees will be located at strategic points along the pipeline for routine maintenance and emergency repair. These employees will be supervised by personnel at the pipeline district offices tentatively planned for Port Angeles and Spokane. Local contractors will be retained for large maintenance projects and emergencies. (TR 5923-26 Sandmeyer.)

21. Station information available to the dispatcher through the SCADA system includes such information as suction and discharge pressures, status of pump units, flow rates, surge relief tank liquid levels, quantities of oil received and delivered, valve positions, oil and equipment temperatures, position of different oil batches, and whether pumps and motors are functioning properly. The dispatcher will be able to start and stop pumps, open and close valves, and adjust pressure settings by remote control. (TR 7369-73 Winegar.)

22. By remotely controlling pumps and valves, the pipeline dispatcher will be able to start up and shut down the

system during normal and emergency operations. Emergency shutdown could be occasioned by situations such as a line break or pipeline leak, a loss of power at a pump station, or an unauthorized mainline valve closure. An individual station is designed to shut down automatically if pressure exceeds a predetermined level or if certain other emergency conditions occur. (Applic. II, Sec. 6.5.3.1; TR 7364-65 Winegar.)

23. The interior walls of the pipeline will be cleaned by scrapers that will be sent through the line at various intervals. Traps for launching and receiving pipeline scrapers will be provided at selected stations along the route. (TR 7345 Winegar.)

24. The entire pipeline will be internally inspected for wrinkles, flattening, and dents. A similar internal inspection with a Caliper pig will be done after construction is complete and once a year thereafter. (TR 5927 Sandmeyer.)

25. Weather permitting, the surface conditions on and near the pipeline right-of-way will be inspected by an aerial patrol every two weeks. (TR 5926 Sandmeyer.)

26. When the facility is abandoned, removal of the oil from the pipeline system would be accomplished by displacing it with water obtained from local sources along the route. If

the steel in the pipeline is to be salvaged, the water would be displaced by air or an inert gas and retained in specially constructed ponds for processing through oil-water separators, prior to release to natural water courses. (TR 5931 Sandmeyer)

27. Removal and salvage of the pipeline mainline valves, and equipment at the remote stations would require activities similar to construction of the system, but with a more simplified work scope. It is possible that some sections of the line, such as inland waterway, river or road crossings, would not be removed because of the complications involved. In such cases, the ends of the pipeline on both sides of the crossing would be pumped full of mud, sealed, and covered with soil. (TR 5931-32 Sandmeyer)

II. B. ROUTE SELECTION FINDINGS

1. The Northern Tier route selection process began before the company moved its intended terminal location from Cherry Point to Port Angeles. Before that move, a preliminary route had been identified from delineation on 1:250,000 USGS maps, ground and aerial surveys, and some subsequent study based on 15 minute and 7½ minute quadrangle maps. Original route selection criteria included economic and social factors such as length, terrain, engineering and design criteria, maintenance and operational problems, accessibility from roads, and avoidance of populated and environmentally sensitive areas. In 1976, Northern Tier determined to move its port site from Cherry Point to Port Angeles.

2. As originally proposed to the Council, the Northern Tier route went from the port and tank farm site near Port Angeles across Clallam County and into Jefferson County on land, turned south and around the Sound on land through Mason and Thurston Counties, north around the Sound through Pierce County and into King County, across the Cascade Mountains at Stampede Pass into Kittitas County, and then further east across the Columbia River and through Grant, Lincoln, and Spokane Counties to the Idaho border. Maps and other information available to the engineer who did the original selection work did

not show the existence or location of such features as the Skagit Habitat Management Area, the Colockum Wildlife Refuge Area, or the Gloyd Seeps Wildlife Recreation Area.

3. Subsequently, Northern Tier amended its proposed route to include changes such as a move of the Cascade crossing point from Stampede Pass to Snoqualmie Pass to avoid the Cedar River and Green River watersheds; a change of approximately 16 route miles from Lincoln to Adams County, at the latter County's request; and a move to the south in Spokane County to avoid the primary recharge area of the Spokane-Rathdrum aquifer. In June, 1979, the company submitted an amendment containing substantial modification of the location for submarine unloading lines crossing Port Angeles Harbor, a rerouting between Green Point and North Bend to cross Puget Sound rather than proceed around it, and a following change to exit Whidbey Island at Polnell Point rather than Strawberry Point in order to avoid a prospective upland development.

4. The cross-Sound route would be more expensive than the around-Sound route. The decision to cross Puget Sound was made in order to make potential hook-up of the North Sound refineries a more attractive feature of the total Northern Tier proposal. Northern Tier has made no evaluation of the costs or likelihood of hook-up. The cross-Sound route met two concerns: the increasing determination on the part of the Federal

Government to establish a single unloading port for all of Puget Sound at a point at or west of Port Angeles (an amendment to the Marine Mammal Protection Act effectively prohibits constructing a major crude petroleum unloading port at any point east of Port Angeles. The Public Utility Regulatory Policies Act (PURPA) facilitates construction of such an unloading port but gives direction toward inclusion of a hook-up feature in any such project.) Second, construction of a total project configuration which would decrease the total miles between the unloading port and the four North Sound refineries and thereby marginally reduce the tariff charged North Sound refineries for any service rendered. (See Section VII, Finding #2.)

5. The present route is described above in section II.A.2.

6. An important consideration in route selection was utilization of existing utility corridors. As proposed in 1979, over 30% of the route in Washington lay adjacent to, but not yet in, existing utility corridors.

7. Northern Tier decided against various alternate routes for portions of its proposal. For example, the company decided against crossing Puget Sound at a point south of Port Townsend because there were problems with going through a residential district on Marrowstone Island; because of the

perceived difficulty of trenching at that point on the bottom of the Sound; and because of the unusual angularities it saw as being required to avoid the Whidbey Island Historical Preservation District.

8. The company decided to avoid following the Yakima River downstream for a considerable distance because of the narrowness of the Yakima's plain, which already contains the river and a railroad track. Congestion at Stevens Pass caused by a highway, railroad tracks, an existing pipeline, and general narrowness militated against crossing the Cascades at this pass.

9. In the route selection process, several points were considered sufficiently important to become controlling points. That is, choice of crossing for a particular feature became of primary importance in the overall process, and general route selection for adjacent areas flowed from the particular alignment chosen for the particular feature. One such controlling feature was the crossing of the Columbia River. No other petroleum line crosses the Columbia upstream from the Bonneville dam. (Only the Olympic Pipeline which ships petroleum products crosses downstream.) Many high, steep, and relatively impervious landforms exist in the region of the river through which Northern Tier anticipated its project. Steep cliffs eliminated some alternatives to the chosen Columbia crossing, while others

were eliminated because of effect on wildlife refuges. Northern Tier considered an area from roughly the site of the proposed crossing on the north to Beverly, Washington, on the south.

10. Though information was available, Northern Tier's route selectors failed to discover the Skagit, Gloyd Seeps and Colockum Wildlife Refuge Areas. They knew of the Colockum Hills as a geographic feature. The route follows an existing utility corridor as it enters the Colockum HMA on the west. However, the proposed pipeline corridor leaves the utility corridor several miles west of the Columbia River and continues across the Colockum HMA to the Columbia. (Wilson TR 6614). Northern Tier chose part of the route across the Colockum Habitat Management Area because of the existence of a utility corridor.

11. Northern Tier's primary consideration in routing its unloading lines over six miles across the mouth of Port Angeles Harbor, instead of around Ediz Hook and up through the City, then east to the Green Point tank farm, was congestion in the area of the Crown Zellerbach mill located near the base of Ediz Hook. Lesser considerations included community impact problems associated with any route ascending the bluff which rises close to the base of the Hook, selection of a feasible route to the east which did not enter Olympic National Park, and the possibility of increasing pumping capacity from the berths if the present tank farm site were to be maintained.

The company did not consider a shallow-water crossing of the Harbor in that area immediately east of the congested Crown Zellerbach mill.

12. At the Port Williams landfall, the centerline site, located on a sheer 65-70 foot bluff, was chosen over a mile-to-the-south cut which runs down to sea level, the cut contains a boat launch and a park. Northern Tier understands the landward centerline to avoid the Grey Marsh Farm habitat area.

13. Route selection across major rivers other than the Columbia was made by an engineer who was permitted to work to a maximum of 100 to 300 feet on either side of the already-chosen centerline. The trench-and-fill construction method was assumed as a design criterion for these crossings; therefore, the crossing sites were studied for their amenability to this method, as opposed to other methods of crossing. Before the crossing sites were publicly identified, the engineer in charge had not done much ground reconnaissance. His recommendations within the preselected corridors were made largely on the basis of overflights and 1:12,000 aerial photographs (on which the width of a pencil line approximates 100 feet). Original crossing selection preceded environmental review and discussions with state fish and game personnel. The crossing selection effort was not intended to show any flaw in the original corri-

dor alignment. Within the restricted zones, river crossings were to be selected to achieve the following goals: minimal width and depth, stable and straight banks and channel, suitable terrain, 90° angle crossing of the stream, avoidance of bedrock, avoidance of fine grained soils, minimal effect on existing development, environmental insensitivity, suitable site for a staging area, minimal river velocity, and access to existing roads. Salmon spawning areas would have been regarded as sensitive but may not have been considered.

14. West Pass was the only wetland which affected Northern Tier's routing considerations. The company elected to place its centerline at the narrowest point in order to affect the least amount of West Pass wetlands.

15. In selecting its North and South Fork Stillaguamish crossing points, Northern Tier was unaware of the water intake locations for the Cities of Arlington and Marysville although the information was readily available. The respective intakes are downstream nominal distances from the proposed crossings of the respective forks. The company discarded a more westerly I-5-oriented route through much of Snohomish County because it appeared more populated and often under water.

16. King County route selection did not consider location of old growth forests, archaeological sites, proposed parks, or the location of the City of Snoqualmie's water line.

17. A basic route selection criterion was that lands chosen should have a ready potential for obtaining right-of-way agreements. Consequently, known Indian reservations, national park lands, state park lands, and similar enclaves were avoided.

18. Northern Tier proposes use of significant stretches of Bonneville Power Administration transmission corridors for the NTPC pipeline route. To use the corridors, Northern Tier will ordinarily have to receive permission from BPA and then negotiate successfully with those landowners from whom BPA has obtained its rights. BPA may allow work to within 25 feet of its towers.

19. Northern Tier's environmental consultant reviewed the selected route for environmental considerations. This consultant recommended minor route modifications for environmental reasons.

20. The proposed route has not been surveyed. The legal description of the centerline is derived from maps.

21. Northern Tier intends, if certified, to conduct an on-the-ground survey as well as engineering and other studies to determine the precise alignment of its route.

22. NTPC requests certification for a one-half mile corridor within which it may choose to locate its pipeline right of way at any point. NTPC proposes to locate the pipeline on the designated centerline and has determined that is the best location according to its routing engineers. NTPC anticipates numerous deviations of 100 feet or so from the centerline depending on actual site conditions. The necessity for deviations cannot be determined at this point. NTPC has identified a centerline in the corridor as the company's preferred route and about which some site specific information has been presented in the record. The USGS quadrangle maps used are on a scale of 1 inch to 2000 feet or 1 inch to 5200 feet. These maps show a single line with no corridor. Their centerline represents no specific width. It is identified in the legal description with approximations of rounded-off distances in feet from section lines. (TR 22655, 22657, 22660, Ex. 311, 312, TR 22637, 22673.) The maps do suffice to convey a generalized understanding of the centerline's location.

23. Discrepancies exist in the record with respect to centerline location. (TR 22660, 22644, Ex. 311, TR 22638, 22639)

24. The general location of the pump stations has been identified. No site specific legal description has been given or can be provided until final design. An area of some seven acres for each pump station is marked on NTPC Volume IV maps. (TR 2658-59).

25. Minor river crossings, as the term is used by NTPC, could be located anywhere within the half-mile corridor. Major river crossings would be located anywhere within a 400-foot area surrounding the centerline. The only site-specific information NTPC has presented on river crossings pertains to major crossings being on or near the centerline. (TR 22637, 22673, Ex. 70, Koloski testimony).

26. No new studies were undertaken when NTPC narrowed its corridor from two miles to one-half mile in width. (TR 22642).

27. Northern Tier proposes to locate its pipeline on the centerline wherever possible, but anticipates numerous deviations of up to 100 feet. The necessity for specific deviations has not been determined at this time.

28. NTPC would expect to survey the line before it acquired easements from landowners. (TR 22666).

29. Assuming the parallel utility concept takes precedence for pipeline routing, site-specific evaluation of environmental impacts and sensitive areas adjacent to the existing utility should be undertaken prior to route selection to insure minimum adverse environmental impacts. NTPC has located its centerline generally parallel to existing utility and transportation corridors; however, it did not consider route alternatives within such sites to minimize environmental impacts. No present law or rule mandates that Northern Tier conduct such an evaluation. For example, major rivers were examined only at centerline locations. Minor rivers and streams were not examined at all. The record shows only a few instances of alternate routes within the corridor being examined for any purpose, including environmental. There is no support in the record for the proposition that the choice of the terrestrial centerline was based upon analysis which included environmental characteristics within the corridor. (Currie TR 36847, 36853-55, Yuill, Reyes-French). (Ex. 716 and 717, TR 36501, 36502).

30. The Marine Mammal Protection Act effectively prohibits siting a major petroleum transshipment facility east of Port Angeles. Limiting consideration to Olympic Peninsula port sites, the following is properly found concerning the configuration chosen by Northern Tier:

a. A location inside Ediz Hook is the only location considered which presents a fire and explosion risk to an urban community.

b. Because of winds and currents and because the Hook is closer than any other legal site, a large spill from inside Ediz Hook is at least as likely to reach Dungeness Spit, Protection Island, Discovery Bay, the San Juan Islands, Admiralty Inlet, Puget Sound, and all the other marine waters and beaches east of 123° west longitude as is a spill from any other possible port site. The decision to cross Port Angeles harbor by submarine pipeline avoids going through the community of Port Angeles, but also substantially increases the exposure of marine resources to oil spills above the exposure risk already posed by the selection of the Harbor as a port site.

c. Both because of its location and because of the attendant hazards and complexity of the geology, currents, and other aspects (discussed below), the submarine crossing of Admiralty Inlet exposes the resources listed in Finding 30b, to a risk as great as might be reasonably conceived in establishing a pipeline connection between the Olympic Peninsula and the Washington mainland.

d. Unless the abandoned Strawberry Point landfall were redesignated, Saratoga Passage could not be crossed by a route more hazardous to the Skagit delta than the one chosen.

e. The landward portions of Northern Tier's 1979 Application amendment also carry a hazard for Island, Snohomish and King County features such as West Pass, Davis Slough, the forks of the Stillaguamish, Pilchuck River and Pilchuck Creek, the Skykomish, Snoqualmie and Snohomish Rivers, and possibly the water supply for Whidbey Island.

III. A. GEOLOGY AND SEISMIC RISK

1. The history of seismicity in the state of Washington is widely varied. The Puget Sound region is an active zone which has experienced frequent earthquakes of varying intensities. The Cascade Mountains and eastern Washington are characterized by less frequent and lower energy seismic activity. The energies of earthquakes are described in terms of two basic scales, the Richter Magnitude Scale which is a measure of the energy release at the hypocenter of an earthquake, and the Modified Mercalli Intensity, which is a measure of the "felt effects" of an earthquake on the ground surface. In this discussion, where possible, reference will be made to Richter magnitudes.

2. Northern Tier has used a design level earthquake of VII+ (Modified Mercalli Intensity) with a ground acceleration rate of 0.20 g. for Western Washington. (Veatch, TR 3496; Ex. 30, p. iii; Ex. 84, p. 16; Alsup, TR 8745). Seismologists generally equate a Mercalli Intensity VII-VIII with a Richter magnitude 6 earthquake, a Mercalli Intensity IX-X with a Richter magnitude 7, and a Mercalli Intensity X-XII with a Richter 8. (Rasmussen, TR 23970; Ex. 30, Fig. 33). Northern Tier's design earthquake is equivalent to a Richter magnitude 6.0 earthquake. (Rasmussen, TR 23970; Alsup, TR 8719-20, 8722). The total energy released by a Richter magnitude 7.0 earthquake at the hypocenter

is roughly 60 times the energy released by a Richter magnitude 6.0 earthquake. (Rasmussen, TR 23970). Richter magnitudes will be used in this analysis.

3. The proposed Northern Tier facilities in Clallam, Jefferson, Island, Snohomish and King Counties lie within a very seismically active region, referred to as the "Puget Sound" or "Puget Sound-Vancouver Island" tectonic province. This province is approximately 2° longitude wide and has a north-south trend in Washington State from southern Thurston County to about latitude 48° north, where it continues in a northwesterly direction through much of Vancouver Island. This province lies to the east of, and is parallel to, the subducted Pacific plate. (Rasmussen, TR 23960-61, 24430-32).

4. The Puget Sound province can be subject to large earthquakes. A magnitude 7.3 (Richter Scale) earthquake occurred on Vancouver Island in 1946, a magnitude 7.1 event in southern Puget Sound in 1949, and a magnitude 6.5 earthquake also in Puget Sound in 1965. (Rasmussen, TR 23962).

5. The largest possible earthquake which may take place along the proposed Northern Tier route through Western Washington is a Richter magnitude 7.5 event. (Rasmussen, TR 24432-33; Crosson, TR 42650).

6. There is no reliable basis upon which to subdivide the Puget Sound region as to its seismic risk for large earthquakes. (Rasmussen, TR 24430-32; Crosson, TR 42655).

7. The seismic record for the Puget Sound province is historically short. The actual occurrence rate of large earthquakes cannot be estimated with great accuracy based on past history. (Rasmussen, TR 23963). An earthquake such as the 1949 Olympia earthquake might occur only every 100 to 200 years. (Crosson, TR 42727, citing "Causes, Characteristics and Effects of Puget Sound Earthquakes," by Hawkins & Crosson (1975), p. 111). In the 1946-65 period alone, however, three large earthquakes occurred.

8. The 7.5 magnitude earthquake could occur anywhere in the Puget Sound area, including any point along the Northern Tier pipeline route in Western Washington. (Rasmussen, TR 23965; Crosson, TR 42728).

9. The Puget Sound area experiences both deep (more than 40 kilometers of depth) and shallow (less than 30 kilometers) earthquakes. In the past, the large earthquakes (over 6.0 magnitude) have occurred in the deeper levels. A deep earthquake affects a larger geographic area than a shallow earthquake, (Crosson, TR 42723), though the rupture surface from such large, deep earthquakes probably will not reach the ground

surface due to an intervening "soft layer." (Crosson, TR 42629-30). Both deep and shallow earthquakes could occur at any point along the Northern Tier route in Western Washington. (Crosson, TR 42722-23).

Design Earthquake

10. Earthquakes produce corresponding ground motion which is normally quantified in relation to the ordinary force of gravity acting at the earth's surface. The term 1.0 g means the acceleration which would occur from the ordinary force of gravity. The greater the magnitude of the earthquake at any point, the greater is the acceleration which will occur. (Rasmussen, TR 23967).

11. Acceleration rates from an earthquake will vary depending upon depth, topography, and type of soil within which the ground motion occurs. Acceleration in soils can be higher than bedrock acceleration in most, but not all, cases. (Rasmussen, TR 23967; Crosson, TR 42665-66, 42675-76).

12. Ground accelerations can be estimated through several methods, including the performance of a dynamic analysis of the soils for the subject site. Northern Tier has not performed a dynamic analysis of the soils along the project in Western Washington, (Rasmussen, TR 23970-71; Crosson, TR 42654-

55, 42663-64), nor has it specified design accelerations corresponding to the different soils in which the project facilities would reside.

13. The appropriate design level earthquake and accelerations are a function of the degree of risk associated with damage to a particular facility. It is inappropriate to emulate nuclear power plant design level considerations per se for an oil transportation system, given the widely different risks associated with each, and given differing soil types being considered.

14. Design acceleration levels are most important with respect to above-ground structures at the marine terminal, the tank farm facilities, and the submarine portions of the pipeline route, including the submarine unloading lines. Since a buried pipeline normally moves with the ground, acceleration levels are of less concern with respect to direct impacts on the terrestrial portions of the pipeline. (Alsup, TR 8451). In the 1949 Southern Puget Sound event, a .31 g peak acceleration was recorded. In the 1965 Puget Sound event, a .23 g acceleration was recorded.

15. For the proposed Sohio pipeline project from Long Beach, California, to Midland, Texas, the maximum earthquake that could occur within the project region was used as

the design earthquake for the project. (Rasmussen, TR 23948-49, 23951-52, 23966-67).

16. Northern Tier and its consultants have performed all engineering and design judgments for the project based upon a design earthquake of Richter magnitude 6.0 with a maximum ground acceleration of 0.20 g. (Veatch, TR 9066-67). Northern Tier has not investigated the impacts on the proposed facilities from larger earthquakes with higher ground accelerations. (Alsup, TR 8745; Veatch; Forman).

17. Northern Tier submitted an acceleration table indicating that a Richter 6.0 earthquake could have ground accelerations up to 0.20 g in "firm bedrock," up to 0.27 g in "average foundation" conditions, and in excess of 0.50 g for "below average soil" material. (Ex. 89).

18. Local soil conditions are one of the dominant factors in determining the extent of ground motion during an earthquake. (Crosson, TR 42669-70). Ground acceleration amplification factors of 2.0 or more have occurred in soils in the Puget Sound region in past earthquakes. (Crosson, TR 42665-68).

19. The probability of a Richter 6.0 earthquake in the Puget Sound region is estimated to be 85% in twenty years

and 100% in thirty years. (TR 30032). The life of the project is unknown.

20. A design earthquake of Richter magnitude 7.1-7.5 range should be used in the design of critical facilities; that is, those for which oil spills or loss of life could occur in the event of structural failure. (Rasmussen TR 23966). The corresponding earthquake design acceleration level should be 0.31-0.35 g.

21. To evaluate the adequacy of design information of the facility with regard to seismicity, ground motion data is required showing a time history of ground motion in the form of a response spectrum or the data from which such a spectrum is generated. (TR 30359). Northern Tier's application and consultant reports do not supply this type of information. (TR 30360). A single acceleration factor for each facility is not sufficient to evaluate the risk of structural failure due to seismic activity. (TR 30376).

22. The central Cascade Mountain region is one of low seismicity. Activity with Richter magnitude of 6.0 or above has not been reported in the area around the corridor. No surface faulting related to the seismic history of record has been identified. (Applic. III, Sec. 1.1-13)

23. No active faults have been mapped along the eastern Washington pipeline route. No major (Richter 6.0) earthquakes in the vicinity of the corridor are known to have occurred. (Applic. III, Sec. 1.1-15)

Marine Terminal

24. The tanker unloading facilities are to be located along the south side of Ediz Hook, a west-to-east trending accretionary longshore spit forming the north side of Port Angeles Harbor. Ediz Hook consists primarily of sand and gravel, with some cobbles, all derived from eroding sea cliffs to the west, and sands, silts, and gravels carried to the shoreline west of Ediz Hook by the Elwha River. These surficial and near surface recent marine sediments are likely underlain by older marine sediments consisting of medium dense to very dense silty to clean sand. The older marine sediments are likely underlain by glacially overridden sediments consisting of very dense, slightly silty to silty sand with variable amounts of gravel. Bedrock appears to exist presently beneath the site at depths greater than 300 feet below sea level. No boring on Ediz Hook reached "glacially overridden sediments." (Ex. 30, p. 8 and Fig. 4).

25. The marine sediments on the south side of Ediz Hook have been classified into three types A, B, and C. Type A

sediments are very loose to loose, younger sediments. These sediments range from 1.5 to 16 feet in depth in the terminal area. Type A soils are underlain by Type B sediments of much greater relative density. The thickness of these sediments could be greater than 200 feet. The Type B sediments may be underlain by glacially overridden sediments denominated Type C, though no borings reached such sediments. (Ex. 30, p. 8) No faults are known to be present at or close to the site.

26. The relative instability of the Hook is indicated by the historical record; the non-cohesive nature of the marine sediments; the differential compaction of soils; the subsurface wedge-shaped geometry of the Hook (Ex. 347); and the steep slopes. (Rasmussen, TR 23971, 23977; Veatch, TR 3332).

27. No soil borings were taken by Northern Tier on the dryland portions of Ediz Hook. Shannon and Wilson undertook one underwater test boring at the site of the proposed tanker unloading facilities on the south side of the Hook. (Ex. 30, p. 3. Fig. 1). The information gathered so far is insufficient for final design.

28. The onshore storage site is located on glacial deposits which overlie bedrock at depth. The site is mantled with a thin cover of silt. Below the surface layer, there is very dense sand, clay, gravel and silt. The storage facilities

will be situated behind the Green Point sea cliff which is a near vertical 120 foot high bluff which has been regressing at a rate of approximately eight inches per year. There is no evidence of significant landsliding or instability at the site. However, Northern Tier did not have sufficient soils data to perform a quantitative stability analysis of the Green Point Bluff. There have been landslides at bluffs to the west of Green Point. Shallow slumping in the area is related to the bluff regression and should not hamper construction or operation of the facilities. (TR 8413-14 Olmsted) Drainage from the site is generally northerly to the Strait and northeasterly to Seibert Creek.

29. Occurrence of a large earthquake has the potential to cause slope instability and slumping along Ediz Hook. The unconsolidated Type A material and to some extent the Type B soils, are prone to slumping in the event of a large earthquake. (Johnson, TR 23996-97). Submarine landslides could also occur in slopes on the bottom of the Harbor which exceed 1°-3°. (Johnson TR 23997; Buck). Once a slide of liquefiable material is initiated, it could cause the movement of denser, non-liquefied materials as well. (Johnson, TR 24008-09; Buck, TR 33974).

30. The marine terminal facilities, if designed and constructed to withstand an 0.31-0.35 g acceleration level,

would not be expected to incur damage from seismic events during the lifetime of the project. While the Type A sediments in the marine terminal area are potentially liquefiable under less than design earthquake conditions, the pilings upon which the terminal facilities are to be built will be driven through the Type A materials into Type B and C soils. Type C soils, which are not subject to liquefaction, reduce any risk that the liquefaction and movement of the softer sediments might pose to the integrity of the structures.

31. A 0.31-0.35 g design acceleration level for marine terminal facilities does not include a factor for significant amplification of peak ground accelerations over those for bedrock. The Council makes no finding at this point as to the likelihood of significant amplification.

32. Some relocation of surface materials will result from construction activities at the tanker unloading facilities. Driving of pilings will cause local displacement of bottom and subbottom materials. (TR 8456 Alsup).

33. Construction of the unloading pipeline section on Ediz Hook will not have significant impact because of the flat surface of the Hook and the character of materials that will be excavated. (Applic. III, Sec. 2.1.2.1).

34. Rock backfill in the shore and surf zones will be required at both the Ediz Hook and Green Point shore approaches. In order to assure that littoral sediment transport is not impacted at Green Point, special pipeline burial requirements are applicable.

35. Excavation of a pipeline slot in the Green Point bluff will cause temporary disturbance of vegetation in the construction area, risk of erosion problems, and temporary interference with the littoral drift of bottom/shoreline materials. The pipe will be recessed at least 30 feet behind the face of the bluff and the slot will be backfilled with a soil-cement mixture designed to erode at the natural rate of bluff erosion. The backfill will be periodically maintained. There will be no riprap barrier at the base of the bluff to retard bluff regression or potentially interfere with littoral drift. The construction method for the shore approach at Green Point will have virtually no significant long-term impact on littoral drift or bluff erosion and therefore is not expected to impact the normal beach processes at Dungeness Spit. The chosen method offers the most protection for the Spit of any considered.

36. Surficial soils and glacial till will be disturbed by construction of roads, berms and other facilities at the onshore storage site. The glacially overridden deposits that will be exposed, however, are relatively resistant to ero-

sion. A forested buffer zone will be maintained by the applicant to control sedimentation from excavated and disturbed materials into the Strait and Seibert Creek. Disturbed areas will be seeded to reduce erosion. (TR 8463-64 Alsup; Applic. III, Sec. 2.1.3.1).

37. Where extensive grading or other site preparation is required during construction at the onshore storage site, settling ponds will be maintained to minimize the introduction of sediment into Seibert Creek or the Strait. (Applic. II, Sec. 6.4.3.1).

38. Following construction, operation of the tanker unloading facility should cause no significant change to the geologic conditions at the Ediz Hook site. (TR 8956 Alsup).

39. Following construction, normal operation of the onshore storage facilities will cause no significant change to the geologic conditions at Green Point (Applic. III, Sec. 2.1.3.2).

40. Detailed submarine geology is discussed in Section II.A.2.

III. B. VESSEL TRAFFIC AND TERMINAL OPERATIONS

1. The Strait of Juan de Fuca is a significant maritime artery carrying vessels of all kinds. In 1977, 15,216 vessels voluntarily reported transit through the Strait to the Coast Guard Vessel Traffic Service. Of these, 7,198 were freighters and 1,204 were tankers. The rest were tugs, government ships, ferries and miscellaneous vessels. These numbers include both inbound and outbound vessels. In 1978, a total of 18,154 vessels were reported, including 8,318 freighters and 1,343 tankers. This number represents a daily average of approximately 51 vessel movements, including 23 freighters and 4 tankers. There are no comparable statistics for Saratoga Passage, but it is not a part of any shipping lane.

2. Port Angeles harbor is approximately one mile by three miles with a one-mile opening. Depth restrictions limit the effective harbor entrance to approximately 4200 feet for loaded tankers of 120,000 DWT and larger.

3. Port Angeles harbor traffic consists of ferries, freighters, tankers, tugboats or towboats, barges, log rafts, fishing boats, recreational boats, pilot boats, and Coast Guard vessels. In 1980, the vessel traffic in Port Angeles harbor was approximately 25 to 30 vessels of all kinds (excluding pleasure and fishing craft) per day, of which five to six

were deeper draft vessels, such as freighters, tankers and ferries. Incoming vessels for Port Angeles and all points east pick up pilots at Port Angeles, and outgoing vessels discharge them there. The pickups and discharges occur outside the Hook, except in severe weather conditions.

4. Log tows also constitute a large volume of inbound traffic on the north shore of the harbor where the Northern Tier terminal would be situated. Log tows present special maneuvering problems for oil tanker traffic because log tows are difficult to maneuver, control or stop. No other port has competing marine traffic of log tows and large crude oil tankers.

5. No traffic lanes are designated by the Coast Guard for the entrance to or exit from Port Angeles harbor, or for the pilot pick-up area located approximately one-half to one mile northeast of the end of Ediz Hook. However, Northern Tier is committed to seek a vessel traffic plan through the Coast Guard.

6. During construction of the submarine pipelines from Ediz Hook to Green Point and from Port Williams to Point Partridge, a pipelaying barge and attending barges and vessels will be deployed along the route. Vessels crossing the route will have to navigate clear of the pipelaying equipment and associated anchor lines. As pipelaying will be a continuous

operation and proceed at a rate of about 1,000 to 2,000 feet per day, it is expected that within Port Angeles harbor, a deep draft navigation zone can be maintained across the pipeline route at either end of the pipelaying spread. This condition is expected to last 30 days. Across the Strait of Juan de Fuca the construction may take 60 days.

7. Northern Tier estimates that at the maximum throughput rate (933,000 barrels/day), its marine terminal will receive a minimum of 395 tanker calls and 47 fuel tanker calls per year. Vessel traffic in Port Angeles will be increased by these calls as well as by support vessel movements, such as supply and line handling launches and tugboats. Northern Tier has described tanker berthing and departure maneuvers as requiring a minimum of two tugs per operation.

8. The applicant's estimate of tanker calls per year assumes that 116 crude oil tankers could supply 350,000 barrels per day to the four North Puget Sound refineries, should hook-up be made. Witnesses from three of these refineries dispute this figure and maintain that approximately 230 calls would be needed to supply oil to the North Sound facilities. If this figure is correct, total vessel calls at the Northern Tier terminal would be approximately 527 per year, assuming no additional fuel tanker calls would be required beyond those the applicant has already estimated.

9. Any discussion of vessel traffic volumes to serve the needs of the four north Puget Sound refineries through Northern Tier's pipeline remains hypothetical; the applicant's project, as proposed to the Council, does not contemplate service to the North Sound refineries. (See VII, Potential Future Activities).

III. C. 1. FIRE AND EXPLOSION

1. Northern Tier selected Port Angeles Harbor for its proposed marine terminal primarily on the basis of facilitating handling and unloading of crude oil tankers and controlling oil spills. The consequences of a major fire or explosion near an urban area are potentially grave.

2. Ships at the the proposed unloading berths would be situated less than 7,000 feet from downtown Port Angeles.

3. Oil ports capable of accommodating Very Large Crude Carriers and Ultra Large Crude Carriers and actually constructed in recent years have been sited miles away from residential and urban communities. The port at Bantry Bay in Ireland is separated by miles and geographic features from the nearest town. The port at Europoort in The Netherlands was intentionally located some 15 miles from associated refineries and their environs. (TR 26914, 26945-46).

4. The tankers calling at the Northern Tier terminal would include vessels as large as 327,000 dead weight tons (DWT).

5. Crude oil tankers of the size 100,000 DWT or greater are qualitatively different than the smaller vessels that have traditionally called at U. S. ports. The larger vessels have different design and operating characteristics, and possibly a greater frequency of fires and explosions resulting in total vessel loss. (TR 26916, 26919, 26920, 26551, 26533, 26653, 26506, 25432, 25778, 25775).

6. The worldwide tanker data base used by Environmental Resources and Technology, Inc. (ERT) in its fire and explosion analysis for Northern Tier does not include relevant experience with large tankers because the data were too old (1971-1972).

7. Of the eight U. S. port systems examined by the Oceanographic Institute of Washington (OIW) in its tanker risk analysis, five were unable to receive tankers greater than 60,000 DWT. The terminals at Los Angeles/Long Beach and San Francisco can accommodate vessels as large as 120,000 DWT but vessels of that size represented only 2.2% and 0.3%, respectively, of total traffic in those ports. (TR 25382).

8. None of the U. S. port systems examined by OIW has ever received tankers of the maximum size that would be calling at the Northern Tier facilities in Port Angeles Harbor. (TR 25431).

9. The number of total vessel losses during 1979 through the first half of 1980 indicates more total losses from fires and explosions for large tankers than for smaller vessels. (TR 26612, Ex. 362).

10. Northern Tier's fire and explosion studies were not factors in regard to site selection.

11. The OIW analysis is a competent study of traditional U. S. unloading terminal experience but is invalid with regard to describing the level of risk that will be imposed by the supertankers calling at Port Angeles, because it did not include data for similarly sized ships.

12. The risk probabilities predicted by ERT and OIW are made more conservative because several mitigating features which could reduce the estimated probabilities, such as recent improvements in the mandatory vessel traffic system, dual steerage and collision avoidance systems, and, after 1983, segregated ballast, were not included. (TR 10715-16). At present, the extent to which these features may lower casualty rates appears not to be quantifiable.

13. By 1983, U. S. Coast Guard regulations will require inert gas systems (IGS) for all crude oil tankers over 20,000 DWT and all product tankers over 40,000 DWT.

14. Perhaps no other single element of tanker casualty risk analysis discussed in the applicant's case has been more disputed than the effect IGS will have on lowering or reducing the risk of tanker explosions.

15. A properly designed, operated and well-maintained IGS can prevent the vapors left in emptied cargo tanks from becoming explosive, thereby preventing some explosions.

16. Certain types of tanker accidents in recent years indicate that such systems are irrelevant in the prevention of some explosions and fires.

17. Even where cargo tanks are properly inerted, the addition of oxygen in sufficient quantities will allow an explosive mixture of gases to return. A cargo tank containing inert gas can be breached by a collision or ramming and can cause an exposure to oxygen sufficient to create a simultaneous or near-simultaneous explosion. (TR 26552-53).

18. From 1979 through April, 1980, 18 explosions resulting in total vessel loss occurred in tankers ten years old or less. Fourteen of these involved tankers of 100,000 DWT or greater. (TR 26658). Some of these vessels were not equipped with IGS. Of those that were, the inerting systems had nothing to do with the cause or result of the casualties. This evidence

indicates that there are circumstances that can produce explosions that are not affected by the presence of IGS.

19. Some of the crude oil brought to the Northern Tier terminal will probably arrive in Oil Bulk Ore carriers, known as "OBO boats". (TR 26547).

20. OBO vessels are a specific type of tanker designed to carry crude oil on one leg of a voyage and bulk cargo, such as coal, ore, minerals or grain on the return leg. They presently make up approximately 15 percent of the world tanker fleet. Because many of these vessels are in the preferred size range of approximately 100,000 DWT, it is likely that there will be an increase in the number of OBO boats calling at ports on the West Coast. (TR 26934-35, 26547, 25783).

21. OBO boats are substantially different in design from conventional crude oil tankers; they contain additional and unintended void spaces that tend to trap explosive vapors.

22. OBO boats are more difficult to inert properly than are conventional tankers.

23. After discharging their cargoes, it is possible that some of the OBO boats calling at the Northern Tier facil-

ity would conduct tank cleaning operations in Port Angeles Harbor. (TR 26547).

24. Unless the tanks being cleaned have been properly inerted, tank cleaning can produce hazardous circumstances leading to fire and explosion. (TR 26546).

25. The potential additional risks presented by OBO boats have not been specifically considered by Northern Tier.

26. Northern Tier has not considered potential secondary or chain-reaction consequences of a single tanker casualty. An example of the type of consequences omitted by the Northern Tier studies is the casualty involving the tanker CHEVRON HAWAII which set on fire four barges that were in the vicinity. (TR 26963).

27. Port Angeles Harbor is presently used by crude oil tankers conducting operations such as tank cleaning and lightering (the ship-to-ship transfer of cargo). These operations present risks of explosions.

28. Northern Tier acknowledges that this risk cannot be quantified due to lack of data as to the number of tankers

currently laying over, lightering, tank washing or engaging in other activities in Port Angeles Harbor.

29. Chemicals associated with various industries near the Port Angeles waterfront, and creosoted pilings represent potential hazards in the event of a major tanker fire or explosion and have not been specifically addressed in risk probability and consequence analysis.

30. The force of the exploding tanker SANSINENA blew the vessel's mid deckhouse approximately 750 feet into the air and 150 feet inland. Based on this incident, Northern Tier calculated a maximum range of projectiles from a tanker explosion to be 1,500 feet. (TR 10,658). (See Finding 66 <u>et seq.</u> concerning the SANSINENA casualty).

31. The explosion of the tanker BETELGEUSE in 1979 blew a 1,027 pound piece of steel cargo tank 2,000 feet from the ship. An explosion involving the tanker CORINTHOS blasted valves and rivets approximately one-half mile (2,600 feet) away. (TR 26555).

32. One witness estimated that a SANSINENA-type explosion could blow objects such as heavy rivets as far as one to one and one-half miles away. (26944-26945). The report

filed by the Coast Guard subsequent to the explosion of the SANSINENA did not report the distribution of small projectiles.

33. OIW estimates that the tankers calling at the Northern Tier terminal will create a risk of about one fire every 18 years. The probability of one or more fires in the harbor would be five percent in any year and about 67 percent during the first 20 years of operation. (Ex. 106, III-6).

34. The Northern Tier facility would increase the fire risk in Port Angeles Harbor from tankers more than 16 times. (Ex. 106, III-6).

35. OIW concluded that the chance of death resulting from tanker fires at the Northern Tier terminal would be 2.4 percent per year. The probability of a nonlethal injury would be slightly less. (Ex. 106, III-6, III-10).

36. OIW modelled tanker fire impacts, assuming that oil had been spilled and had spread for one hour prior to ignition. The thermal radiation model was based on a flame burning everywhere. (Ex. 106, III-10).

37. OIW described a pool fire resulting from the spill of one wing tank on an 80,000 DWT tanker. The radius of such a fire was stated as 1,700 feet. (Ex. 106, III-12, Fig.

III-1). The area of the fire would be somewhat more than 4,500,000 square feet.

38. Within such a fire's perimeter, if at Berth No. 2, are the bunker fuel barge, berth and piping; the Berth 2 access tower and tanker service platform; the access trestle connecting Berth 2 to Ediz Hook; all dolphins and connecting appurtenances of Berth 2; the entire booster pump platform (including the pumps and surge relief tank); the walkway between Berths 2 and 1; the access tower and berth service platform at Berth 1; and more than half of any vessel tied up at Berth 1.

39. The radius for a pool fire from one wing tank of a 327,000 DWT tanker at Berth 2 is 2,460 feet. The area encompassed by such a fire would exceed 9,000,000 square feet. (Ex. 106, Fig. III-2).

40. The facilities within the burning area would include those mentioned in Finding 38, supra, as well as the entire access trestle to Berth 1 and all appurtenances; any vessel moored at Berth 1; and the small boat berth located between Berth 1 and Ediz Hook.

41. A fire consuming the contents of one wing tank of an 80,000 DWT tanker would cover much of the traffic path in and out of the harbor. (TR 11237).

42. OIW's worst case pool fire would result from a spill of the entire cargo of a 327,000 DWT tanker. The fire radius after one hour of spreading would be 5,700 feet, (Ex. 106, Fig. III-3) and the area encompassed would exceed 51,000,000 square feet. Most of the harbor and most of the open harbor anchorage areas would be within the fire radius.

43. There is no testimony addressing the amount of time required for ships at anchor to evacuate the harbor.

44. A worst case pool fire occurring near the city shoreline would include an area reaching from a point east of the ITT facilities to a point west of the Penply plant (Ex. 106, Fig. III-4), and would damage much of downtown Port Angeles. (Ex. 106, III-12). OIW calculates the likelihood of such a fire to be less than 0.6% in 20 years. (Ex. 106, III-12).

45. OIW's oil spreading model did not include the effects of wind, tidal forces, continued spreading or site-specific factors, but did assume an instantaneous spill and a coherent flame.

46. Quite frequently, an oil slick will break away from the main source of the spilled oil and drift separately. This can result in separate burning oil slicks being dispersed in different directions as changes occur in wind and tidal

movement. (TR 26586, 26587). OIW's modeling includes no such dispersion.

47. OIW calculates the probability of one or more tanker explosions along the Strait of Juan de Fuca involving Northern Tier tankers to be 1.4 percent per year and about 25 percent in 20 years. (Ex. 106, III-18).

48. Within the harbor area, OIW has concluded the risk of explosion is 2.2 percent per year and 36 percent over 20 years. This increases the existing risk of explosion in Port Angeles Harbor from tankers by more than a factor of 20. (Ex. 106, III-21).

49. OIW predicts that the probability of one or more fatalities from an explosion is 5 percent per year and 62 percent over 20 years. The probability for nonlethal injury is 4 percent per year and 57 percent over 20 years. (Ex. 106, III-26).

50. The blast from a tanker explosion can cause human injuries including eardrum rupture, fractures and lung damage. The lethality threshold is reached at a blast overpressure of 6 psi. At 7 psi, the probability of death reaches 50%, assuming direct exposure to the blast wave. (Ex. 106, III-29).

51. Damage radii vary with blast size. OIW's worst case is the explosion of an empty 327,000 DWT vessel. The worst case lethality threshold then is 1,100 feet, with near 100 percent lethality at 940 feet, and eardrum rupture out to 1,900 feet. (Ex. 106, III-31). A worst case explosion at Berth 2 would include within the near 100 percent lethality radius, the bunker fuel barge, approximately one-half of the walkway connecting the two berths, the entire tanker access trestle to Berth 2 and the tanker service platform for the berth, the booster pump platform, and much of the width of Ediz Hook to the north. (Ex. 106, Fig. III-5). Types of blast damage to structures at varying overpressures include glass failure, glass shattering, light and moderate structural damage, and structural collapse. (Ex. 106, III-30). Structural damage resulting from the explosion at Berth 2 of a 327,000 DWT tanker includes typical glass failure, occurring out to a distance of 3.1 miles and including practically all of downtown Port Angeles. Moderate damage to reinforced concrete buildings according to OIW would extend 750 feet and would include much of the bunker fuel barge, the service platform, and the access trestle. Within 1,000 feet, the explosion would cause moderate damage to the booster pump platform. (Ex. 106, Table III-18).

52. A fire at the tank farm is predicted at a rate of once every 40 years. A worst case tank farm fire was modeled as the overfilling or rupturing of a storage tank (545,000 bar-

rels), resulting in the flooding and subsequent ignition of the holding basin. The resulting fire would produce flames 300-400 feet high and within 30 seconds would cause skin to blister at a radius of 1,000 feet. The radius of severe burns or fatalities would be 200 feet. In the event an empty tank were to explode, a radial distance of 670 feet from the explosion would define the lethality threshold; lethality near 100 percent probability would exist at 575 feet from the exploding tank. The distance where rupture of the eardrum becomes possible is 1,175 feet.

53. In the assessment of potential structural damage resulting from a tanker explosion, no consideration was given to the types of building foundations in Port Angeles. (TR 11260). Many of the buildings along the Port Angeles waterfront are wooden structures and are more susceptible than normal to damage from crude oil fires or explosions within the harbor. Many structures on the waterfront were built on pilings and lack normal foundations, possibly creating weaknesses and problems for firefighting. Moreover, there are many cavities or areaways in the downtown Port Angeles area which underly sidewalks. These cavities or areaways also present risks of collapse and problems for firefighting. After a spill has occurred, it is possible that heavy hydrocarbon vapors could collect in these cavities. In a confined area, heavy hydrocarbon vapors can explode. (TR 11260, 11264, 28944).

54. In any explosion, very little blast energy is transmitted through ground shock. (TR 11261).

55. A worst-case explosion at a pump station surge relief tank could cause severe structural damage to reinforced concrete buildings 100 feet away and moderate structural damage 150 feet away. (TR 11278).

56. The strength of the proposed unloading pipelines was not analyzed on the basis of the lines' ability to withstand damage from an explosion. However, these unloading pipelines do connect to the surge relief tank and would sustain damage at the point of connection if the tank were destroyed. (TR 11283).

57. ERT calculated a combined fire and explosion frequency for tankers in the harbor of one accident every 7.69 years. (TR 10666).

58. OIW concluded that such an accident could be expected to occur in the harbor once every 13.3 years (TR 10666).

59. In January 1980, ERT completed a study for Northern Tier entitled, "Risk of Smoke Impingement on Olympic Memorial Hospital from Tanker Fires in Port Angeles Harbor." That study became Exhibit 105. The conclusion reached in the study is that the risk of having to shut down the hospital

during a tanker fire is negligible under almost any set of circumstances. (Ex. 105, 9).

60. The possibility of smoke impingement on Olympic Memorial Hospital as a result of an oil fire at the berthing facilities was examined by ERT. It was found that a large fire would have a high rate of combustion and produce a smoke plume with high buoyancy. The buoyancy would cause the plume to rise vertically and resist being bent by wind toward the hospital and the downtown. Conversely, it was determined by ERT that a small fire would produce a plume that could be bent in the direction of the hospital but that such a fire would only last a few minutes. (TR 10649A).

61. A sustained fire can produce a smoke plume capable of being bent by the wind toward Port Angeles and the hospital when a burning slick is being fed continuously by a leak from a tanker. In this case, a fire having small buoyancy and a long burning time would result. (TR 10649A).

62. An "oil lamp" effect refers to an oil fire that burns over a prolonged period rather than burning out after a single spill. This can result when a source of oil feeds the fire in a sustained manner. The fire involving the tanker BURMAH-AGATE lasted 61 days and is an example of this effect. Due to insufficient data, ERT was unable to determine the probability

of a sustained "oil lamp" fire. The set of circumstances required for a sustained tanker fire would tend to reduce the overall probability of occurrence. (TR 10662-63).

63. The longer the duration of an "oil lamp" fire, the greater are the chances of the smoke plume intersecting Olympic Memorial Hospital. (TR 10662-63).

64. The tanker BURMAH-AGATE burned five miles offshore of Galveston, Texas, for 61 days. (TR 10662-63).

65. The ERT analysis was limited to possible smoke impingement from oil pool fires or fires aboard tankers. The study did not include smoke from dock fires or potential secondary fires.

66. On the evening of December 17, 1976, the Liberian-registered crude oil tanker SANSINENA exploded in Los Angeles Harbor after it had unloaded its cargo and while it was in the process of taking on ballast and bunker fuel. (Ex. 110,1).

67. Subsequent to the accident, the U. S. Coast Guard prepared a casualty report that is one of the few documents detailing the distances of actual damage caused by the explosion of a crude oil tanker. (TR 11099).

68. The SANSINENA was a 70,000 DWT vessel constructed in 1958 with a configuration typical for its time but that is no longer built or in common use: the ship had a midship house in addition to an after deckhouse. The Coast Guard concluded that the explosion resulted in part from the vessel's design features and from poor operating procedures. There probably would have been no casualty had there been no midship house which helped trap a stationary hydrocarbon vapor cloud in the vicinity of the afterdeck. The midship house was blamed not only for trapping the vapor cloud but was also regarded as the possible source of ignition that caused the cloud to explode. (Ex. 110, 5-6).

69. The Los Angeles Fire Department initially responded with two task forces, four engine companies and five fireboats, followed by three more engine companies and three more task forces. Altogether, the fire department used ten task forces, seven single-engine companies, five foam apparati, five fireboats, nine rescue ambulances, two helicopters, two tankers, two light utility units and various miscellaneous equipment. Five task forces and two single-engine companies were held in reserve. Approximately 240 uniformed firefighting persons were actively engaged in the firefighting operation. (Ex. 110, 13-14).

70. In addition to firefighting personnel, several Coast Guard units assisted in firefighting, survivor and body searches, evacuation of survivors, traffic control and pollution surveys. Among the units that assisted were three 82-foot cutters and one 41-foot utility boat. (Ex. 110, 14).

71. Land units were hampered because of scattered debris in approaching the berth area and were required to hand-lay about 700 feet of fire hose. (Ex. 110, 13-14).

72. The initial fire caused by the explosion was extinguished within approximately three hours. Flare-ups continued on the dock, however, due to oil supplied by a broken crude oil pipeline that was severed by the explosion. Water, aqueous film-forming foam, high expansion foam and liquid protein were used to fight the fire. (Ex. 110, 14).

73. Portions of the midship deckhouse and the main tank deck penetrated approximately 16 feet into the earth and severed a 30-inch fuel pipeline near the terminal manifold. The fuel from the broken pipeline fed a fire which burned sporadically throughout the deckhouse for several days. The break was plugged with drilling mud four days later. (Ex. 110, 21).

74. The casualty resulted in six members of SANSINENA's crew known dead and 22 injured. Two crew-members

and one terminal security guard were never found and were presumed dead. (Ex. 110, 3-4).

75. Approximately 36 personal injuries were suffered by the general public. An additional 100 or so non-crew personal injury claims were made, mostly for injuries from flying glass fragments. (Ex. 110, 4).

76. The vessel was a constructive total loss. Total damages in all forms, including the ship, damage sustained by the dock and to surrounding property, pollution cleanup, and salvage amounted to about $21.6 million. (Ex. 110, 1).

77. Onshore property damage was found to vary from severe (i.e., major structural damage) to "scattered" (broken windows and interior furnishings) depending on the proximity and degree of exposure to the explosion and on what the Coast Guard termed the "vagaries" of the concussion wave. Severe damage occurred within approximately one-half mile of the explosion; damage that was classified as "heavy" occurred at distances ranging from 1 and 1/16 miles to the west to 1½ miles to the north. ("Heavy" damage was categorized as damage to plate glass windows, shades and screens). Scattered damage occurred as far west as 3 and 1/16 miles to the west. Other minor damage was reported in the city of Carson, about six miles north of the explosion. (Ex. 110, 15-16).

78. The SANSINENA is not necessarily the most severe explosion in the history of petroleum shipping; it is, however, one of the most closely studied.

79. Wreck removal operations required approximately four and one-half months.

80. Focusing, the condition in which atmospheric factors affect the travel of blast waves, can significantly extend the distances of low overpressures but should not significantly affect high overpressures. Low overpressure can cause window breakage; high overpressures are associated with more severe damage. Topography also can affect the intensity and direction of blast waves. (TR 10660).

III. C. 2. FIRE PROTECTION

1. The explosion of the crude oil tanker SANSINENA in Los Angeles Harbor was followed by a fire that was described as relatively small. Approximately 240 uniformed firefighting personnel were actively engaged in combatting that fire. The fire involving the CORINTHOS in Pennsylvania is regarded as a large tanker fire and was fought by several hundred firefighters supported by several hundred mutual aid responses from surrounding communities. Approximately 20 pieces of floating equipment were used to fight the fire. The pier fire at the Todd Shipyard in Seattle required the response of over 800 firefighters and 42 pieces of equipment. (TR 27087-88, 28915, 28856; Ex. 110, 13-14). (See Findings 66-79, Section III.C.1)

2. The Port Angeles City Fire Department provides fire protection services for the structures and people within the city limits of Port Angeles. The Department has a paid staff of 16 firefighters and an additional 24 volunteer firefighters. Its equipment includes two pumper trucks, one combination ladder-pumper truck, one rescue truck, and three additional small vehicles. One other 25-year-old pumper truck with limited equipment is kept in reserve. (TR 28918, 28935-36).

3. The Port Angeles Fire Department is land-bound despite the need for waterborne firefighting due to the shipping traffic, harbor uses and industries situated on the waterfront. The fire department currently has no fire boat or special waterfront firefighting capabilities. The fire department currently has no equipment, personnel, or training to meet the existing risk of fires on vessels calling within Port Angeles Harbor or entering within the harbor, other than borrowing small boats from the Coast Guard if available. The Department personnel are not trained to fight petroleum or tanker-related fires. There is no capability to fight from the water shore-based fires which cannot be effectively attacked from the land. (TR 28936).

4. The Department is presently understaffed and its equipment resources are inadequate for the current fire protection needs of Port Angeles. The Department lacks the expertise and capability to combat a marine waterfront fire. (TR 28935, 27061-62; Beatteay, Patterson).

5. Northern Tier's proposed fire protection system for the marine terminal consists generally of two pumps, water mains and hydrants located on the trestles, berth and booster pump platforms, water monitors, four foam monitors and one proposed fireboat. This system is designed primarily to protect the berthing facilities and not for fighting crude oil fires on tankers or on water. (Applic. II, 6-20; TR 28848-49).

6. No fire protection system, including Northern Tier's is capable of extinguishing a fully involved tanker fire; a major tanker fire generally must be left to burn itself out. (TR 28835, 27066).

7. One vessel with firefighting capability would not be adequate to control a significant tanker fire or a spill burning in the harbor. A number of firefighting vessels would be required to control such a fire; one of the vessels could be a fireboat and the rest tugboats with firefighting capability (TR 28876-77; Patterson, Hansen).

8. The extent of marine firefighting capability that is required will depend on the size of fire that is expected to be controlled. A fire covering an area of 60,000 square feet could require five to six vessels with firefighting capability simply to control the spread of oil burning across the water. (TR 28883).

9. The fire involving the tanker CORINTHOS at Marcus Hook, Pennsylvania, covered an area of approximately 140,000 square feet. OIW has calculated that the burnable spill of one wing tank from a tanker of 80,000 DWT (the most credible spill of the four OIW modeled) would have a radius of 1700 feet, or a total surface area of about 4.5 million square feet.

10. There is not necessarily a relationship between the size of a crude oil tanker and the manageability of the fire it can create. A tanker that is small by modern standards can easily supply a fire that is beyond the capability to extinguish. (TR 28898).

11. The nature of crude oil firefighting and the potential for movement of oil on the surface of water indicate that several firefighting vessels would be required to provide multiple points of attack on the fire and to control the movement of burning oil away from the tanker. Several vessels would also be necessary to provide adequate cooling of the ship's tanks to prevent further explosions and ruptures and to prevent burning oil from destroying containment booms. Fireboats must be resupplied with foam and other materials during firefighting operations; this would require a supplies warehouse or stockpile in Port Angeles and the use of smaller vessels to transport supplies to firefighting vessels. (TR 28853, 42838; Hansen, Patterson).

12. During firefighting operations, the Port Angeles Fire Chief should be in command of all fireboats and firefighting vessels. (TR 28853, 42836; Patterson, Hansen).

13. The unprotected steel trusses and other steel members of the proposed off-loading piers should be sprinklered

or in some other way satisfactorily protected or replaced by fire resistant material, such as prestressed concrete. Unprotected steel has no fire resistance and a major fire beneath the structures could cause their failure within 15 minutes of exposure. (TR 28854, 28865, 42814, 42829; Patterson, Hansen).

14. For explosions and/or vessel fires of a certain size, there should be an adequate alarm and notification system and an evacuation plan for the Port Angeles area. (TR 28855).

15. Assuming that the monitors, sprinklers and other elements are not destroyed and, further, that the steel trusses and members of the piers are made properly fire-resistant, Northern Tier's proposed fire protection system would provide reasonable and adequate fire protection to Northern Tier's berthing facilities against design or smaller fires within the system's reach. (TR 27066, 28836, 42806, 42843, 28891). (See Finding 26 for a definition of "design fire").

16. The proposed system would not be effective for fighting tanker fires away from the berthing area and would have only limited usefulness in attacking a crude oil fire on board a vessel. (TR 28837, 27065-66; Beatteay, Patterson).

17. A crude oil fire on a tanker or a fire spreading over the water of the harbor could threaten additional vessels and waterfront facilities. (TR 27070). Northern Tier's system would not be effective in these situations.

18. No mutual aid agreement will be entered into by the City of Seattle with either Port Angeles or Northern Tier. The two Seattle fire boats could not be relied upon for assistance. (TR 28855).

19. Northern Tier's proposed tank farm and pump station at Green Point and a portion of the terrestrial pipeline running eastward from Clallam County are within the area serviced by the Clallam County Fire Protection District No. 3. Stipulations between Northern Tier and Fire District Three have been submitted to EFSEC.

20. Mr. Patterson, Northern Tier's witness, indicated that if there were no disabling explosion at the facilities and if boats and equipment over and above those proposed by Northern Tier were in place, he would be inclined to believe that such equipment could confine a fully involved fire originating on a vessel at berth (not a pool fire) sufficiently to prevent an extension of the vessel fire to where it tends to overrun the city. (TR 42912).

21. Ediz Hook is a long, extremely narrow peninsula which provides the only land access to the proposed berthing sites. Marine Drive, a constrained two-lane road is the only route available for fire protection vehicles. Between the berth site and the Crown Zellerbach mill, the Hook's greatest width is approximately 200 feet; a more typical width is 120 feet. Near the berth sites, the entire width of the Hook is within the expected range of debris from a substantial explosion.

22. Northern Tier did not consider the risk or consequence of fire or the level of fire protection that could be provided when it selected Port Angeles for its port site. (TR 2251, 2381).

23. The fire protection system that would be installed at the berthing facilities would be adequate to protect those facilities; the system would not be effective to combat a fire spreading across the harbor or a major fire aboard a vessel.

24. Fires involving the crude oil tankers SANSINENA and CORINTHOS required responses by hundreds of personnel and many pieces of equipment. The firefighting capability in Port Angeles is inadequate for the current fire protection needs of Port Angeles, including the present risk of petroleum fires.

25. A response such as that provided by firefighting personnel at Los Angeles-Long Beach for the relatively small fire caused by the SANSINENA does not appear possible in Port Angeles.

26. A "design fire" refers to the largest fire which may reasonably be controlled by a given fire suppression system. A pool fire burning the contents of a single tank of an 80,000 DWT vessel could ignite an area vastly greater than the largest design fire discussed for the Northern Tier facility. Northern Tier will be receiving calls from tankers as large as 327,000 DWT.

III. D. OIL SPILL RISK

III. D. 1. SPILL PROBABILITIES

1. The risk of oil spills within the marine waters of the State of Washington will increase substantially if the proposed Northern Tier project is placed in operation. The increase in risk may be roughly gauged by comparing the volume of crude petroleum Northern Tier proposes to transship, 933,000 average barrels per day (bpd) with the amount presently arriving at the four North Sound refineries, somewhat more than 300,000 bpd; (some still arrives by way of the Trans Mountain line). Another comparison can be made on the basis of vessel calls. Northern Tier proposes approximately 395 vessel calls per year at its facility, exclusive of bunker fuel movements, and this number has been challenged as too low. The North Sound refineries receive up to 230 crude-delivery vessels per year. As to a comparison between the risk posed by Northern Tier and all present crude and refined petroleum movements on the state's inland marine waters, it may be observed that, should Northern Tier begin operations and join the Clean Sound Cooperative, it would do so as a 60% member, with all present members then comprising the other 40%. By any of these standards, it may fairly be said that Northern Tier would more than double the present risk.

2. Several aspects of crude oil movement may be related to the dimension of risk a facility poses. It is generally conceded that the risk of a spill incident from tankers is proportional to the number of tanker trips. Northern Tier would add a minimum 395 tanker calls per year at Port Angeles, which currently has very few tanker calls. Bunker fuel and petroleum barge movements pose an added risk. Risk varies with the length of a pipeline; Northern Tier would add approximately 345 miles of terrestrial line and 33 miles of submarine line within the state. Spill risk and probability also vary with the relative safety of pipeline construction and operation conditions. The particular hydrologic and geologic conditions of Admiralty Inlet and the Strait of Juan de Fuca contain severe hazards which the applicant has not shown it can master.

3. Northern Tier has presented the Council with an assessment of spill volume risk which is significantly inaccurate in several respects. The company appears to have substantially understated the maximum volumes of oil which might be released from worst case ruptures of its proposed submarine crossings of Admiralty Inlet (40,000 barrels rather than 25,000 barrels) and Saratoga Passage (27,000 barrels rather than 17,000 barrels) and has placed its worst case sites for these spills in locations notably less vulnerable than the actual worst case spill sites.

4. Northern Tier has presented the worst case spill occurring on the Port Williams - Point Partridge submarine crossing as being a spill of some 25,000 barrels, which Northern Tier states would occur in a relatively stable, low current and low vessel traffic area near the Port Williams landfall. In fact, analyzing the route, (testimony of Veatch and Timmermans, with exhibits) and applying Northern Tier's assumptions, the worst case spill in Admiralty Inlet would occur at a point northeast of Protection Island on the main Admiralty Sill. The point is some 44,500 feet east on the route from the Port Williams landfall, at the approximate site of Shannon and Wilson's core sample point TM 438. If a two fathom depression (to 51 fathoms) remains in existence some 3700 feet northeast along the route, if Northern Tier's centerline, now on the depression's southeastern extremity, stays in that depression on construction; if the Point Partridge valves are located at a low enough elevation and stay sealed upon shutdown; and if the crude in the submarine portion is not too high in specific gravity; a line rupture at this point would produce a spill in the 40,000 barrel range. Should any of the cited restraining factors fail, a line rupture would produce a spill in the 55,000 to 70,000 barrel range, depending on the interplay of the restraining factors.

TM 438 is near a three-mile long zone which Northern Tier stated would be subject to liquefaction in a .2 g seismic event. The eastern boundary of this liquefaction zone was placed halfway between TM 438 and TM 433, the next westerly core sample. Northern Tier found the sample at TM 433 to be characteristic of liquefiable soils. The record contains no opinion as to whether the soils at TM 438 would liquefy at the higher design acceleration.

TM 438 is near the main vessel traffic lanes in the Eastern Strait of Juan de Fuca and the mouth of Admiralty Inlet. Currents in the area are stronger than those expected at Port Williams. At depth, there is a net inflow across Admiralty Inlet and into the upper basin of Puget Sound.

5. Northern Tier has placed its worst case Saratoga Passage spill in the deepest part of the passage, an area of relatively minimal currents, stable soils, and infrequent large vessel traffic, and has estimated the worst case spill to be approximately 17,000 barrels. According to the Council's analysis, the worst case spill in Saratoga Passage occurs some 4000 feet east of Brown Point in a shallow bottom liquefaction zone a short distance from the Skagit Flats. A line rupture at this point would produce a spill of approximately 27,000 barrels.

6. Northern Tier did not do a formal worst case study for the submarine unloading lines crossing Port Angeles Harbor. The following approximate cases, derived from Northern Tier's data and using Northern Tier's methodology, may be taken

as representative: At a 100-foot depth, a rupture of one unloading line would produce a 26,450 barrel spill; at an 80-foot depth, a rupture would produce a 30,430 barrel spill; at a 60-foot depth, a rupture would produce a 36,530 barrel spill; at 40 feet, a rupture would produce a 52,700 barrel spill. The figures are approximations which assume that the line is in a dynamic rather than a static state. Should a single event rupture both unloading lines, the spill sizes would be essentially doubled.

7. The Council's analysis of worst case spills used for the applicant's submarine pipeline proposal contains certain limiting assumptions, such as that the leak detection system is working properly; that the dispatcher at the Green Point control center perceives the information accurately and moves promptly to shut down the line; that the shutdown system in fact does what the dispatcher directs; and that the valves close completely in a timely manner. It also assumes 933,000 barrels per day throughput, which is 95% of actual operating capacity, a factor affecting dynamic loss.

8. A more extreme event might occur if the leak detection and shutdown systems were to falter, or if there were a long-term substantial leak at a volume (3500-4500 barrels per day) below the detection system's level of recognition.

9. The most sizable single spill risk the facility poses to the state's environment is a total cargo loss of 327,000 tons or 2,400,000 barrels. A single maximum size cargo tank could spill up to 80,000 barrels. A clean break in the Admiralty Inlet or Saratoga Passage submarine pipelines at any point would produce a minimum spill of approximately 10,000 barrels.

10. There is no accurate, reliable way of foretelling how much petroleum would be spilled during the operating life of any offloading port, of foreseeing the recurrence of major spills, or of predicting the size of the largest spill to occur during the operating life. It can, for example, be said that the great majority of tankers which would call at the Northern Tier facility would carry cargoes of between 500,000 and 2,400,000 barrels. The number (if any) of such vessels which would actually sustain a total cargo loss in Port Angeles Harbor or the Strait of Juan de Fuca during the project's life cannot be stated. Likewise, the total quantity of oil to be spilled from the submarine pipeline portions of the facility cannot be computed before abandonment.

11. To properly evaluate the effect of an energy facility upon the public interest, the scope of risk posed by a project should be considered. Perhaps the best method of consideration is to learn the unavoidable risks of a facility and

to insure that all which should be done in terms of reconnaissance, study, location and design, has been done in order to minimize unavoidable risks. There is also some value in properly done statistical estimates of quantitative risks. Such estimates, though inexact, may provide a general view of the scope of a particular set of risks.

12. Northern Tier presented two quantitative risk analyses, one done by Oceanographic Institute of Washington (OIW) and one contained in the application.

13. The U. S. data base relied upon by Northern Tier excludes consideration of supertankers of the size expected to call at Port Angeles; those data are drawn from eight U. S. ports and none of these can accommodate tankers more than half the size expected at Port Angeles. (Five of the eight ports can accommodate vessels only up to 60,000 DWT; none of the U. S. data considers spills or accidents involving vessels greater than 120,000 DWT.) The Northern Tier study made no adjustment for fog or other site specific factors and recognized no factors for storms or the increasing age of the world tanker fleet because of declining tanker construction. For all spills other than those occurring at berth, Northern Tier's OIW study relies on an exposure variable, "distance traveled per port call," which assumes that each mile traveled by the tanker has the identical risks and hazards which lead to oil spillage. A test

to confirm or deny the OIW hypothesis can be performed by examining the casualty locations in Puget Sound. (Stewart, TR 37213-14.) This test shows that the hypothesis is not supported by the historical record, that the majority of vessel collisions, groundings and rammings occurred in the principal ports within Puget Sound and that there are long stretches of channel where no casualties have been recorded. (Stewart, TR 37117-18, 37213-14.) The worldwide average spill size per tanker incident has risen in the last several years (reflecting the increasing use of larger tankers) from 4,349 tons per spill in 1977 to 11,131 tons per spill in 1979. During the 1973-1976 period relied on by OIW, the average spill was 3,442 tons per incident. Exclusion of large tanker data removes from consideration the comparative difficulty these ships have in turning, slowing, and stopping.

14. For submarine spills, both analyses assume better geotechnical and design work than has been performed on the submarine pipeline. For vessel spills, neither assumes certain navigational, vessel characteristic and data problems noted in finding 13 above. Both therefore understate actual risks. Each deals only with the first 20 years of operation. This 20-year figure relates to the time required to pay interest on debt, and not to project life.

15. The OIW analysis (Ex. 165) made the following quantitative predictions for major oil spills in accidents over a 20-year period:

Oil Spill Source	Percentage Chance of Occurrence over 20 Years
1. Tanker spill	
10,000 bbls or more (in-transit and at berth)	27.5%
2,000-10,000 bbls	61%
2. Submarine pipelines (any spill size greater than 2.4 barrels)	42%
3. Terrestrial pipeline (OIW excluded all pipeline and river crossings east of Cascades) (any size spill greater than 2.4 barrels)	99%
4. Tank farm spill (spill greater than 1,000 bbls)	31%

(Exhibit 165, p. III-13 and 24; V-8; IV-10.) Oil spills of some size are a certainty both from tankers in-transit through the Strait of Juan de Fuca and Port Angeles harbor and from tankers at berth. (Exhibit 165, p. III-10 and 22) (99% probability of each). OIW's study is not representative of and likely underestimates spills from foreign flag tankers. (Stewart, TR 30483.)

16. The Northern Tier analysis presented in Application 76-2 made the following quantitative predictions for oil spill incidents over twenty years:

	Oil Spill Source	Percentage Chance of Occurrence over 20 Years
1.	Oil tanker spill (total loss only; excludes all losses other than total vessel loss)	29%
2.	Submarine pipelines in Port Angeles harbor (unloading lines; all leaks)	17%
3.	Submarine pipeline crossing Admiralty Inlet (all leaks)	30%
4.	Submarine pipeline crossing at Saratoga Passage (all leaks)	8%
5.	Terrestrial pipeline spill (spills of 5,000 barrels or more)	28%
6.	Tank farm (major fire or explosion)	20%

(Exhibit 168.) There is a 73% probability of one of these events occurring, and a 23% probability of two of these events occurring, over a 20-year period. (Exhibit 169; Murphy, TR 14074, 14112.) There is a 31% probability of a total tanker loss of both crude oil and bunker fuel tankers. (Murphy TR 14036-7.)

17. Quantitative oil spill risk analyses are not well developed. They either deal with a limited aspect of the problem, use questionable data or theory, or use statistical

models which are extremely hypothetical. (Stewart, TR 37108, 37147, 37144-5.) The integrity of a quantitative analysis is compromised to the extent a study purports to display oil spill probabilities in great detail and by various sizes. (Stewart, TR 37220-1.) The OIW risk analysis, Exhibit 165, contains these shortcomings, including an overly detailed display of oil spill probabilities by various sizes. (Stewart, TR 37108, 37152-3, 37269-70, 37163, 37254.)

18. Probability numbers used in the OIW risk analysis are hypothetical and of questionable reliability. (Stewart, TR 37115, 37202-3, 37163-4.) The use of "distance traveled per port call" as the exposure variable for in-transit spill estimates is not substantiated by the data or the analysis presented. (Stewart, TR 37116, 37177-8, 37207.) This exposure variable inaccurately uses statistical parameters for oil spill discharges. The OIW analysis assumes a least squares methodology, which is inappropriate for the Poisson distribution and equations set out in OIW's technical appendix. (Stewart, TR 37187-8, 37174.) Consequently, OIW's conclusion of a "strong correlation" is incorrect. Such a correlation cannot be developed with only the eight port samples. (Stewart, TR 37116, 37174, 37187-90, 37268.)

19. The "confidence levels" set forth in Exhibit 165 indicate a possible range of uncertainty of the OIW oil

spill frequency estimates. These confidence levels are based entirely on the assumption that the exposure variable is correct. The confidence levels are therefore products of an incorrect hypothesis. (Stewart, TR 37120.)

20. OIW reliably correlated at berth spills with "port calls." (Stewart, TR 37118-9, 37177-8, 17202-3, 37207.)

21. Over-all average spill size for in-transit and at-berth spills is extremely sensitive to the inclusion or deletion of any particular ports or large spills. The average spill sizes listed in Exhibit 135 are unreliable. (Stewart, TR 37248-9, 37218.) The at-berth spill sizes and submarine pipeline spill sizes are likely unrepresentative of typical sizes for the facility. (Stewart, TR 37123.)

22. The risk analysis in Application 76-2 relied on an exposure variable developed by OIW in 1974 and no longer used by OIW. (Murphy, TR 13842, 13847; Moore, TR 13849-50.) Northern Tier made several adjustments which lowered the oil spill probabilities it calculated with OIW's exposure variable, but Northern Tier made no upward adjustment in risk based on any factors or site-specific characteristics of the Strait of Juan de Fuca or Port Angeles which would tend to increase the probability of oil spills. (Murphy, TR 13865-66.)

23. Northern Tier lowered its oil risk estimate by an across-the-board assumption that only young U. S. flag tankers would carry Alaskan oil to Port Angeles. (Bennett, TR 25439.) The application understates oil spill risk by at least 27% due to this assumption. (Murphy, TR 13953, Bennett, TR 25439.) Northern Tier has not committed to receiving only young U. S. tankers or to shipping only Alaskan crude.

24. Northern Tier also reduced the calculated probabilities of oil spill risk because of the presence of a vessel traffic system in the area. Northern Tier did not show that other ports in its data base did not have such systems. To the extent such systems were in existence, the results from the data base were improperly reduced. (Stewart, TR 37243-5.)

25. Northern Tier has not performed a site-specific analysis of oil spill risks. (Bennett, TR 25439, 25443.) In addition to previously considered factors, such a study should include consideration of anchor damage risk to submarine pipelines, Port Angeles Harbor traffic and considerations, and channel width and traffic lanes of the harbor approaches.

26. The submarine pipelines in Port Angeles Harbor and Admiralty Inlet could spill oil due to anchors dropping in the vicinity of those lines. Anchors could be dropped on or

near the submarine pipeline if an emergency existed, if an error in judgment occurred, or by accident.

27. A number of factors make it more likely for vessels to drop anchor in the area of the submarine pipelines in Admiralty Inlet and Port Angeles Harbor than at other locations in the Strait of Juan de Fuca and Puget Sound. Among these are collision or emergency avoidance, bad weather (notably the problem of vessels crossing inside Ediz Hook in bad weather in accordance with U. S. Coast Guard Pilot specifications to pick up pilots), and anchor drag. A master or pilot will drop anchor when he thinks it necessary to protect his ship.

28. A tanker or other vessel which loses power will likely drop anchor if a grounding or collision is threatened. A vessel is more likely to experience a steering failure or engine failure as it approaches port than while steadily traveling in the open sea. (Armstrong, TR 25851.) To the extent a vessel has a steering failure or power loss in the Strait of Juan de Fuca, vessels may have little time before grounding on the shoreline.

29. There is a high correlation between fog and vessel accidents such as collisions or groundings. (Stewart, TR 27112, Bennett, TR 25395.) Fog causes or contributes to vessel collisions because of difficulties in detecting the pre-

sence and location of other ships, and in part because poor visibility prohibits the vessels from visually coordinating their maneuvers even after detection. (Bennett, TR 25397.) The Washington coast, its approach, and the Strait of Juan de Fuca experience a high incidence of fog. (Armstrong, TR 25842.)

30. There have been 60 major oil spills worldwide (i.e., greater than 1,550,000 gallons or 35,000 barrels) from tankers in the years 1967 to 1979. Those 60 spills over thirteen years spilled a total of approximately 500 million gallons of oil, which is an average spill size of 8,332,150 gallons (1,112,156 barrels). (Sorenson, Ex. 845, p. 5-6.) These years correspond with the introduction and use of large crude oil tankers in the 100,000, 200,000 and 300,000 DWT size category. Approximately one-half of the vessels calling at Northern Tier's terminal, and all of the foreign flag vessels, are estimated to be in that size range. In recent years, large spills have also originated from small tankers. The company expects large and small tankers to call at its facility.

31. There will likely be numerous spills ranging in size from a few gallons to several hundred gallons during the operation of, and cargo discharging at, the Northern Tier terminal. (Bayliss, TR 26005.) Large spills during cargo discharging also are possible. (Bennett, TR 25444-45.) Spills of refined petroleum products such as diesel fuel and hydraulic

oils will likely occur during cargo transfer and terminal operations. (Bayliss, TR 26009.)

Summary

32. The Northern Tier Pipeline project will result in a significant increase in oil exposure in the waters of the State of Washington. First, the large volume of crude oil handled will lead to numerous, small, operational spills which will constitute a new source of chronic oil pollution in the Strait of Juan de Fuca. Second, the large size of the crude carriers, the heavy tanker traffic, and the submarine pipelines will significantly increase the likelihood of a prominent oil spill in state waters. (Reid PFT p. 4) Properly designed and operated tankers and submarine pipelines are transportation forms with relatively low orders of risk. Improper design or operation increases risk. The consequences of a major spill incident involving a tanker or submarine pipeline are high in biologically productive waters.

Terrestrial Pipeline Spill Probability

33. OIW's estimated risk of a terrestrial pipeline spill in Western Washington is one spill 2.4 barrels or larger every 3.7 years. The terrestrial pipeline estimates of spill risk did not adjust for Northern Tier's commitment to build its pipe according to the latest technology and with cathodic

protection. The absence of such an adjustment makes OIW's estimate more conservative. The maximum spill from a terrestrial pipeline rupture under original design is 64,000 barrels. (Application 2.3-31, 2.11-85.) Crude oil from a terrestrial spill could enter a river or stream or ground water. The likelihood of such events is unquantifiable.

34. Operational spills at the onshore storage facilities are possible. Allowance for such spills is included in the design of the facilities. Even in the unlikely event of the entire contents of a full tank being released, all of the oil should be contained by the dikes. (TR 13797-98 Murphy, Applic. III, Sec. 2.11.2.1).

III. D. 2. SPILL DISPERSION

1. Oil spill trajectory prediction is still in its infancy. No methodology currently exists that can accurately predict the fate of an oil spill. Many factors influence the dispersion of oil spilled on the water, e.g., currents, winds, vertical mixing, spreading, diffusion, dissipation, sinking, absorption, emulsification, oxidation, evaporation, and bacterial removal. Of these factors, the most important are currents and winds. Several of the parameters most important to any prediction (including wind speed, wind direction, current speed and current direction) cannot be determined until the time of the spill. There is not sufficient knowledge about many of the physical and chemical processes involved to consider adequately the many factors important to accurate prediction. The problem is heightened by complex wind patterns and tidal currents such as those that occur in Puget Sound. (TR 31026-29, 31037-38 Raj).

Currents

2. Currents in the Strait of Juan de Fuca are characterized by a typical fjord-like pattern, with a mean flow at the surface flowing out-strait (westward), and in-strait (eastward) near the bottom. The dividing line between mean flow to the west and mean flow to the east (the depth of no

surface waters and transport southward into the main basin of Puget Sound is likely. A continuous net landward flow occurs at depth in the Strait of Juan de Fuca from the ocean to the heads of various inlet arms. As noted, there is a net seaward flow at the surface. Haro and Rosario Straits show strong surface net flows southward. Water from Haro Strait then flows westward near Victoria and exits through the outer Strait of Juan de Fuca. Rosario Strait water continues south along the west side of Whidbey Island, where it joins the northwesterly flow from Admiralty Inlet. These combined surface flows then cross the inner Strait of Juan de Fuca from Point Partridge to near Victoria, joining the southward flow from Haro Strait. At this juncture, some water heads north toward the San Juan channel, but most continues west toward the outer strait.

5. Puget Sound's main basin shows a strong northerly net flow in surface layers and a southerly net flow at depth. Water from the main basin exits mainly through Admiralty Inlet into the inner strait. A second pathway exits from the Whidbey Basin through Deception Pass into the inner strait. The mean surface flow of Hood Canal is also northward into Admiralty Inlet.

6. Downwelling over sill zones is a factor influencing oil dispersion. Spilled oil constituents could be mixed downward and enter the circulation at depth within the Strait

of Juan de Fuca. Admiralty Inlet has considerable downwelling. Downwelling could cause spilled oil to be retained at depth for a considerable period. Given split mean flows, oil retained at depth could move in a different direction than a surface slick.

7. Currents in the area between Port Williams and Protection Island are complex and poorly understood. There is a high degree of variability over space and time. Currents are weaker than in the main channel, and seem to move generally eastward.

8. The principal forces moving oil from a spill in Port Angeles Harbor into the Strait of Juan de Fuca and Puget Sound include surface currents, winds, and net circulation at depth. Factors include a net westward midchannel surface movement in the Strait of Juan de Fuca, the subsequently described nearshore countercurrent, and westerly winds which reinforce the countercurrent. Sufficient spread of oil would drive oil into the high energy sill zones (Green Point - Victoria and Admiralty Inlet) resulting in possible downwelling and transport at depth into inner waters. Depending on time of year, strength and direction of surface currents, winds, and the extent to which spilled oil enters sill zones and is circulated at depth, a spill at Port Angeles could result in either a westward or eastward general trajectory.

9. Near surface water in Port Angeles Harbor can have a residence time of several days to a week. Just outside the harbor, however, a countercurrent exists. The mean near-shore countercurrent flow is east along the shore towards Dungeness Spit, reaching a velocity of 35 centimeters per second. This is an exception to the general pattern in the main channel of the Strait of Juan de Fuca.

Wind Effects

10. Another important factor in oil dispersion is wind effect. Westerly winds oppose drift out of the inner strait. Wind effects can also modulate the mean circulation of surface waters. Because of topography and orographic (mountain-related) effects, winds tend to be up and down the western portion of the Strait of Juan de Fuca. Generally, winds from the east occur more frequently in the summer. Near Port Angeles, the most typical year-round winds throughout the year are from the west. Complex wind circulation patterns often occur over Admiralty Inlet; south winds coming up Puget Sound often collide with west winds directed up-strait. Local winds and sea breezes blowing from the land over the water can influence oil spill trajectories.

11. Finding the proper relationship between wind and currents is critical to predicting oil spill trajectories.

The Pacific Marine Environmental Laboratory (PMEL) model used by Northern Tier is the best available. This model assumes that wind generated movement is three percent of wind speed in the direction of the wind--an assumption which the designers of the model are not sure is accurate (Stewart PFT p. 22). Empirical evidence indicates that the correct wind factor varies between one and five percent, depending upon local geography, meteorology and sea state (Raj PFT p. 22). Local winds, which are difficult to predict, can also influence the movement of an oil slick. In the PMEL model, winds from the west blowing up-strait often almost exactly counteract the mean estuarine flow. Thus, even a small change or error in the wind factor can dramatically alter the predicted location of an oil slick.

12. The PMEL model does not include a factor for the coriolis force (counterclockwise spin), which may be a significant omission for longer trajectories. It does not consider cross channel non-tidal currents, current reversals, or the complex mean estuarine flow in the eastern strait. The PMEL model only tracks the oil until it first hits shore; refloat is ignored. The standard PMEL deviation is as large as eight kilometers for 12 hours of tracking. (See Raj PFT pp. 22-24.)

13. In general, PMEL studies showed that movement in any direction is possible depending on wind conditions, tidal phase and the strength of any mean currents. Oil

spilled in the main channel of the Strait of Juan de Fuca could affect the entire Strait (both north and south shores), the San Juan Islands, Whidbey Island, and some Pacific Ocean shores. A single spill would not likely impact all of these areas, but it could hit any one, or some combination, depending upon the size of the spill, time of year, weather, and location. Spill sites west of Port Angeles generally showed east to west movement. Sites outside and north of Ediz Hook in the Port Angeles area showed east and west movement. Southern Puget Sound (below the Tacoma Narrows) would not likely be impacted by oil.

14. Superimposing the size of slicks from major oil spills on proportionally-scaled maps of Puget Sound reveals the extensive area which can be impacted.

Possible Spill Trajectories

15. The fate of oil spilled in Port Angeles Harbor is difficult to predict. Spilled oil would likely be dispersed over much of the harbor, though containment and recovery of minor spills would be easier there than in the main channel of the Strait. The relatively long harbor residence times sometimes experienced by surface water may aid containment. Conversely, under the influence of the natural surface spreading of oil and of transport caused by surface currents and prevailing westerly winds, a sizable spill could be expected to result in oil exiting

the harbor. Spreading, and the near shore mean eastern flow imply that the ecologically important areas of Dungeness Spit, and Sequim and Discovery Bays could be affected. Drift cards released in the vicinity of Port Angeles in April, 1978, primarily went eastward, and were recovered along Dungeness Spit, western Whidbey Island and the San Juan Islands. Drift cards released from the Port Angeles vicinity in July, 1980, were recovered from Dungeness Spit west to the Pacific, some as far away as Grays Harbor. The vast majority of recovered drift cards released from Port Angeles had moved eastward. (Storie).

16. Oil spilled from Port Angeles Harbor or Admiralty Inlet could reach the area southeast of Dungeness Spit in a relatively short time. Oil spilled west of Port Angeles could affect the southeast side of Dungeness Spit very quickly under westerly winds or other meteorologic conditions. Oil spilled in the far eastern Strait could go in any direction, including westward out of the Strait, southward to Dungeness Spit, and northward to the San Juan Islands. Entrainment of oil in the deeper water column strata due to downwelling and vertical mixing could occur, resulting in the transportation at depth into the main basin of Puget Sound. (Long, TR 34130).

17. Drift card studies mimic oil spills to a similar but uncertain extent. While drift cards have indicated migration from Port Angeles Harbor to Dungeness Spit is probable, the

trajectory of a small product spill in May of 1979 raises some question. Despite mild winds from the west and more flood than ebb tidal currents, this spill migrated out of the harbor west to the mouth of the Elwha River. On the other hand, another Port Angeles harbor spill in June, 1981, migrated eastward along Dungeness Spit and the Quimper Peninsula. (Frazier).

18. The chances of spilled oil reaching the Pacific Ocean without beaching decrease as any assumed spill point is moved eastward in the Strait. The southward and northward components of any trajectory would tend to transport oil ashore. The chances of a spill adversely affecting the most susceptible biological communities increase as the assumed spill point is moved eastward. (Long, TR 34131-32).

19. If an oil spill occurred between Port Williams and Whidbey Island, a spill could go east or west, and could enter Puget Sound. The likelihood of oil entering Puget Sound increases with distance eastward along the proposed submarine pipeline. Depending on location of a spill, oil could also disperse throughout the San Juan Islands. A Saratoga Passage spill might well be contained within the Whidbey Basin.

Underwater Oil Spills

20. Northern Tier did not model an underwater oil spill. The state of the art of subsurface oil spill trajectory modelling is in its infancy. Knowledge is not available. Research on underwater trajectories has been minimal. Estimating the trajectory of a spill from a break in a submarine line involves not only the problems of surface trajectories, but also problems associated with subsurface oil movement.

21. Oil released from a break in the Admiralty Inlet line would initially be released under pressure. Some would probably become attached to suspended sediments. It could also form oil-in-water and water-in-oil emulsions. It is possible that oil entrained in the water column and on the surface may move in two or three directions simultaneously. Most of Admiralty Inlet, the San Juan Islands, and the Strait of Juan de Fuca are probable impact points for oil from a major submarine spill. It is also possible, although less probable, that oil could drift south into the main basin of Puget Sound, perhaps moving in subsurface cells as a result of downwelling across the sill at Admiralty Inlet.

22. Significant impact points from any submarine spill in Saratoga Passage include the Skagit Delta, Penn Cove, and the eastern and western shores of Possession Sound.

Terrestrial Spills

23. Neither ERT nor OIW performed trajectory studies for the transportation of oil spilled at river crossings. (Haury). The investigation of oil spills from terrestrial pipelines consisted of a review of the technical literature. (Alsup).

24. A terrestrial pipeline leak could have a significant effect if it occurred in a water-saturated zone, in an area of very permeable materials above the water table, over an aquifer recharge zone, or in any other environmentally sensitive area. (Alsup, TR 14353).

25. If terrestrially-spilled oil reaches the ground surface, it will flow downhill until absorbed into the ground. When the volume of oil impinging on a soil is greater than the soil's ability to absorb such oil, surface flow will result. If oil leakage occurs on a surface of low permeability, a slight surface penetration could be expected, and the leakage would flow over the surface in a downslope direction until exhausting the volume by spreading or until meeting a physical barrier. (TR 14356 Alsup). Oil leakage from the terrestrial pipeline could travel laterally or downward depending upon the subsurface arrangement of permeable zones, the amount of leakage, and the length of time the leaking occurred. The leakage from the terrestrial pipeline could reach the water table through vertical

migration or through a combination of horizontal and vertical migration. (Alsup, TR 14358; Ex. 175).

26. Oil moving through soil is influenced by gravity and capillarity. Permeability of the soil is the most important factor in determining ground movement. Soil retention capacity is also significant. There is greater lateral spreading in lower permeability soils because of capillary action (TR 14354-57 Alsup). It may be expected that oil migration through western Washington soils would be more rapid than through eastern Washington soils, because of generally higher rainfall in Western Washington, and resultant entrainment.

27. Subsurface flow of oil will stop when the threshold of residual saturation (retention capacity) is reached, or when an impermeable layer of soil is reached by vertically migrating oil. Oil could reach a water table. It would initially spread out over the surface of the capillary fringe above the water table. (TR 14357-58 Alsup).

28. The dispersion of oil in a trench backfill depends primarily on the materials in the trench, topographic relief along the trench line, and the leakage rate. If backfill were more permeable than surrounding soil, some leaked oil would remain in the trench.

III. D. 3. <u>RESOURCES AT RISK</u>

1. The coastal waters of the State of Washington and its inner waters, including the Strait of Juan de Fuca and Puget Sound, contain diverse, rich, marine resources. These resources include economically important species of salmon, shellfish, bait fish, bottomfish and clams. Economically important species are harvested commercially and recreationally, and some species are cultured. Puget Sound supports fish runs yielding an annual commercial and recreational production, (excluding Puget Sound, south of the Tacoma Narrows) of 289,584,520 pounds valued at $299,908,580.* These species have secondary economic importance in that they promote tourism. They serve important ceremonial, subsistence, and religious purposes for Indian citizens. These resources also have an intrinsic value, as an amenity to the citizens and visitors of Washington State.

2. Based on historic spill costs, an oil spill in the Strait of Juan de Fuca or Puget Sound could cost, at minimum, between $5.00 and $20.00 (current dollars) per gallon spilled. This cost range includes lost oil, costs of clean up, loss to commercial and recreational fisheries, loss to the state's tourist industry, and loss of use of the public's beaches and lands. Costs in Puget Sound would tend toward the higher figure

*Unless otherwise indicated, all production figures and dollar values are expressed as the mean annual averages for the years 1974-78.

because of cleanup difficulties and biological richness. Based on the applicant's own estimate, the cost to the State of Washington of oil spilled from the proposed Northern Tier Pipeline (assuming no hookup) would range from $165,000 to $638,000 yearly, in current dollars. A major tanker accident inside the Strait of Juan de Fuca or surrounding waters could cause economic damages in excess of $200 million.

3. The state's waters support many valuable species which are not commercially harvested. These species support a delicate web of relationships among species, including food chains. Loss of non-harvested species can result in losses of commercially and recreationally taken species. Additionally, non-harvested species, for example, marine birds and mammals, have aesthetic value and can provide non-consumptive uses such as observation and photography.

4. Fishing gear of all types is subject to fouling from contact with crude oil.

<u>Shellfish</u>

5. Economically important shellfish in the vicinity of the proposed Northern Tier pipeline include clams (hardshell and softshell); oysters (Pacific, Olympia); mussels; scallops (pink, rock, weathervane); abalone; sea urchins; sea

cucumbers; octopus; squid; crabs (Dungeness, rock); and Pandalid shrimp.

6. Shellfish species support important recreational and personal use fisheries in Puget Sound and the Strait of Juan de Fuca, and Washington coastal waters.

7. Average annual commercial production of all shellfish in Puget Sound and the Strait north of the Tacoma Narrows is 13,695,724 lbs., valued at $9,684,562 (ex-vessel). Average annual production figures for commercial ocean shellfish are approximately 22,200,000 lbs., valued at $13,890,000 (ex vessel).

8. The embryonic and larval stages of many shellfish drift in the upper water column. There are some shellfish larval forms in the water column during every month of the year; however, the majority of the species are spring and summer spawners. Oil spill effects outside adult spawning beds can therefore have detrimental consequences on shellfish stocks.

9. Shellfish are especially vulnerable to spilled oil. Many shellfish populations are long-lived and sporadic in recruitment. Because of sporadic recruitment, it may take years for a population to recover after a loss.

10. Pandalid shrimp stocks and related fisheries in Port Angeles Harbor exist in close proximity to the proposed docking and unloading facility. These shrimp are an isolated population depending on successful year-class survival and recruitment from within, rather than outside of the harbor.

11. Dabob Bay produces the majority of oyster seed used on the west coast of the United States. Dabob Bay would potentially be subject to oiling from pipeline operation.

12. Recreational fisheries utilize most shellfish resources at or above sustained yield levels. Recreational effort, therefore, cannot easily be shifted to other species or areas.

Marine Fish

13. The Pacific herring is a major forage fish linking zooplankton and predatory animals such as salmon. There are extensive herring spawning grounds throughout the Strait of Juan de Fuca and Puget Sound. There are presently three commercial herring fisheries in Washington State: the Strait of Georgia sac-roe fishery which yielded 2,000 to 4,000 tons annually from 1974-78 at $274 to $952 per ton (the largest dollar value ever reported was $1,700 per ton in 1979); the northern Puget Sound general purpose fishery; and the Puget Sound bait fishery. The

sac-roe fishery has the largest participation of Indian fishermen exercising treaty rights. This fishery must be conducted during the herring spawning period.

14. Pacific herring deposit eggs in intertidal and shallow subtidal zones throughout Puget Sound, in the southern Strait of Georgia and the San Juan Islands. Herring larvae are dispersed by tidal currents. Juvenile herring are the most abundant pelagic fish in Puget Sound nearshore waters. Adult herring migrate biannually. Spawning herring adults, larvae and eggs are especially susceptible to oiling.

15. There are several surf smelt spawning stocks near the proposed Northern Tier site. Each surf smelt spawning stock is genetically distinct and vulnerable to localized extinction. Spawning and incubation take place in upper intertidal zones. Mean annual surf smelt landings in Puget Sound and the Strait are 70,031 lbs., valued at $20,944 (ex-vessel).

16. Economically important species of Puget Sound and the Strait of Juan de Fuca bottomfish are found in the vicinity of the proposed Northern Tier site. Species include Arrowtooth flounder, Butter sole, Dover sole, English sole, Rock sole, Sand sole, the Pacific halibut, Sand dabs, Rockfish, sablefish, sea perch, Pacific Tomcod, Sculpin, skates, Starry flounder, Greenling, Lingcod, Pacific cod, Pacific hake and Walleye pollock.

The 1978 production and values for commercial and recreational catches of bottomfish were 32,847,000 lbs. and $2,964,449 (ex-vessel). The potential bottomfish harvest in Puget Sound is about 36,915,000 lbs.

17. Recent commercial harvest levels of bottomfish from Washington coastal waters have averaged 24,446,000 lbs. annually. The current coastal recreational bottomfish harvest from coastal waters is about one-half million pounds. The estimated total value of the coastal bottomfish fisheries is at least $10.2 million (ex-vessel).

18. During the transition from larvae to juveniles, fish are especially susceptible to environmental perturbations. Juveniles of most important bottomfish species live in intertidal and subtidal zones. Juvenile bottomfish, adult nearshore fish, and fish associated with kelp beds, are vulnerable to major oil spills at all times of the year.

19. The areas on the Washington coast most vulnerable to oil spills are the coastline north of Destruction Island, Willapa Harbor and Grays Harbor. The northern coast is a critical habitat for lingcod, rockfish, greenlings and sculpins, species especially vulnerable to oiling.

Anadromous Fish

20. Chinook salmon are generally found in the larger rivers and tributaries. The Elwha, Skagit, Stillaguamish, Snohomish, and Green Rivers produce important natural runs. Major hatchery runs occur in Bellingham-Samish Bay, southern Puget Sound and Hood Canal. Major Canadian runs, most destined for the Fraser River, traverse northern Washington waters on their spawning migration. Some natural and hatchery stocks do not migrate to the ocean, but spend their entire life inside Puget Sound and the Strait of Juan de Fuca. Important natural and hatchery runs of other salmon and anadromous trout species occur in the rivers and streams which flow into Puget Sound and the Strait of Juan de Fuca.

21. Recreational salmon fishing occurs throughout the marine waters of Washington. Important fishing areas exist in the vicinity of the proposed terminal and underwater crossings.

Recreational Salmon Catch

Area	Average		High	
	Number	Value	Number	Value
Coastal Waters	800,000	$42,000,000	1,200,000	$64,000,000
Strait of Juan de Fuca	100,000	$10,000,000	200,000	$13,000,000
Puget Sound	+200,000	$15,000,000	300,000	$21,000,000

Commercial salmon fishing occurs throughout Puget Sound and the Strait of Juan de Fuca.

Commercial Salmon Catch*

Area	Average Number	Average Value	High Number	High Value
Strait of Juan de Fuca		$ 2,000,000		$ 3,600,000
West Beach	85,000	640,000	158,000	1,137,000
Point Roberts - San Juan Islands	3,900,000	27,000,000	5,300,000	38,000,000
Bellingham Bay	133,000	2,400,000	220,000	3,600,000
Skagit Bay	74,000	700,000	146,000	1,200,000
Port Susan - Port Gardiner	88,000	1,000,000	125,000	1,400,000
Dicovery Bay - Admiralty Inlet	110,000	1,200,000	244,000	2,900,000
Southern Puget Sound	263,000	3,100,000	473,000	6,100,000
Hood Canal	165,000	1,700,000	475,000	4,500,000

The Port Susan-Port Gardiner area is unique in Puget Sound and southern British Columbia in that a small even-year pink salmon run occurs. Makah and Tulalip fishermen use these fisheries.

22. The average annual commercial catch for those areas of Puget Sound and the Strait of Juan de Fuca potentially affected by the Northern Tier proposal is over 5,000,000 salmon of all species, valued at about $39,800,000. The high year for those areas was nearly 7,100,000 salmon valued at nearly $59,100,000. With the large increase in the number of salmon hatcheries now under construction or recently put into production, the catch and values should greatly increase.

23. Commercial salmon fishing occurs throughout the Washington coastal area. During the period 1974-1978, the ocean troll fishery showed an average catch of 1,256,000 salmon

*Salmon production & value figures are expressed as mean annual averages for years 1974-78 except for pink salmon figures which are from mean annual aver. for odd-no. years 1973-77 with a high of 2,025,000. The average value at 1979 prices was $19,205,000 with a high of $30,175,000.

24. Treaty Indian fishermen may take fish from the State's marine waters for subsistence and ceremonial purposes. These fish are not included in the commercial and recreational catch statistics previously presented. In 1978, for coastal areas from Grays Harbor north and for Puget Sound, the tribes estimated they would catch 11,100 chinook, 24,300 coho, 24,600 chum, and 7,100 sockeye.

25. A Canadian recreational salmon fishery occurs throughout the area potentially affected by the Northern Tier proposal. It is concentrated in the Strait of Juan de Fuca and Georgia Strait. The Canadian troll fishery, primarily off the west coast of Vancouver Island, is a major salmon fishery from spring through fall. Canadian salmon fishermen conduct an intensive commercial salmon fishery in the outer Strait of Juan de Fuca.

Canadian Salmon Fishery*

Category	Average Number	Average Value	High Number	High Value
Sport	833,000	$52,796,000	1,312,000	$ 79,664,000
Commercial - West of Vancouver Island	4,807,000	66,992,000	7,938,000	97,100,000
Commercial - Strait of Juan de Fuca, Georgia Strait	3,200,000	25,000,000	5,100,000	41,200,000

26. All Puget Sound and many Canadian salmon runs pass through the Strait of Juan de Fuca. These runs, in addition to supporting locally valuable fisheries, contribute to virtually every salmon fishery in the ocean from northern California to southeastern Alaska. It can be assumed that the adult migration routes retrace the earlier routes of juvenile seaward migration.

Total Juan de Fuca Salmon Runs

Average Number	Average Value	High Number	High Value
14,413,400	$ 194,419,000	22,942,800	$286,016,900

27. Total annual average salmon catch of runs from the Skagit, Stillaguamish and Snohomish rivers is as follows:

*Canadian production and value figures are expressed in U.S. dollars as the mean annual averages for the years 1972-76

	Catch--# of Fish		Value	
	Average	High	Average	High
Skagit	875,000	1,445,400	$12,396,000	$17,862,000
Stillaguamish	144,600	229,100	1,908,000	3,355,000
Snohomish	640,800	912,300	10,722,000	15,080,000

The average annual catch of steelhead from the Skagit, Stillaguamish, and Snohomish Rivers totals 32,100 fish. The annual net economic value of this recreational fishery is $1,796,000 (Exhibit #823).

28. Risks to salmon from oil vary depending on the life-stage, duration of exposure, and the geographic area. Salmon resources at risk include intertidal and stream rearing areas, spawning areas, and areas used by juvenile and adult migrants. In the Strait of Juan de Fuca, the greatest potential risk is to nearshore migrating juvenile salmon. An oil spill would not ordinarily be lethal for migrating adults, but could cause damage through delay. (See Section III.D.4 Non-Human Impacts).

29. Admiralty Inlet and Skagit Bay are high risk areas. Skagit Bay is an important rearing area for juveniles and the migration route for Skagit River juveniles. In most years, the Swinomish Tribe operates a Skagit Bay stationary fish trap that would be especially susceptible to fouling from oil. All southern Puget Sound, Hood Canal, and Stillaguamish-Snohomish stocks must pass through Admiralty Inlet as juveniles and adults. Important commercial and recreational fisheries are conducted in the Inlet.

30. In most other areas, the same risks exist as in the Strait of Juan de Fuca but at a lower level.

Aquaculture

31. Washington is the major producer of farmed oysters on the Pacific coast. It is a major clam producer. Some of the nation's most productive clam farms are located in Puget Sound. A new industry, mussel culture, has begun at Whidbey Island and promises expansion. Washington is also a leader in state and federal salmon hatcheries for restocking public waters and in private aquaculture ventures. There is a substantial private salmon farming industry using floating net pens or cages in Puget Sound and the San Juan Islands. Farming of "yearling" salmon exceeds a million pounds a year and is expected to expand rapidly.

Aquaculture Values*

Species farmed	Dollars per year
Oysters	$ 25,000,000
Clams	10,000,000
Mussels	250,000
Salmon	4,000,000

*These values are based on figures from the years 1972-76 but do not represent mean annual averages.

32. Puget Sound has much unrealized aquaculture potential. Its bays and estuaries are protected from oceanic storms. Its waters have high natural productivity. Its depth, cleanliness, good circulation, moderate temperature, salinity, and lack of ice also contribute to this potential. Oyster production, clam farming, mussel production, and salmon culture could reasonably expand. Several additional marine shellfish species could be grown in Puget Sound aquaculture systems.

33. Puget Sound kelp are important carbohydrate producers; they also provide a spawning substrate, a fish habitat, and food and chemicals for man. Seaweed species are grown for commercial purposes in Puget Sound and the Strait of Juan de Fuca. The market for carrageenin, extracted from the seaweeds *Iridaea* and *Gigartina*, is about 2-3,000 dry tons per year at a market price of $600-1,000/ton. Any protected location in the Strait of Juan de Fuca and almost anywhere in the Puget Sound is suitable for the culture of *Porphyra*, especially areas that have moderate to high currents. *Porphyra* has significant commercial potential.

34. Aquaculture expansion in Washington can provide additional employment and income for this region. The increased threat of oil spills associated with the applicant's project could hamper investment in, and development of, the

aquaculture industry in Washington. An oil spill could kill some species and could taint aquaculture products, making them unmarketable.

Marine Birds and Mammals

35. There are many species of marine birds at Smith-Minor Islands, Cape Flattery, Protection Island and Jamestown. Protection Island is the most significant of these areas. Protection Island is also the major nesting area for marine birds in Puget Sound. Diving birds found in the Jamestown/Protection Island area are known to be highly susceptible to the effects of spilled oil. (See Long, TR 34119-20; Ex. 674, 675, 676 and 677).

36. The eastern portion of the Strait has the majority of the harbor seals and pupping sites in the area, particularly at Smith-Minor Islands, Dungeness Refuge, and Protection Island. Northern Sea Lions and California Sea Lions are abundant at Race Rocks on Vancouver Island. Killer whales frequently travel through the eastern Strait, Admiralty Inlet and San Juan Islands. (Long, TR 34121; Ex. 678.)

Freshwater Fish

37. Many of the streams crossed by the proposed terrestrial pipeline route in the Cascade Mountains region support freshwater species such as cutthroat trout, rainbow trout and mountain whitefish. The Snoqualmie River is occasionally stocked with coho or chinook salmon for recreational fishing. (TR 15181-82 Yuill; Applic. III, sec. 2.5.4.3). (See Section III.H - Habitat and III.K - Rivers and Streams Impacts on Fish).

38. In eastern Washington, the waterways of major significance traversed by the terrestrial pipeline are the Yakima River, Columbia River, Crab Creek, Rocky Ford Creek and Rock Creek. These rivers support salmon, trout, bass and carp. No salmon or trout spawn in the Columbia or the Yakima at the corridor crossing point. (TR 15182 Yuill; Applic. III, 2.5.4.2). (See Section III.H - Habitat)

III. D. 4.a. NON-HUMAN IMPACTS

Interaction of Oil and Water

1. Petroleum is a naturally-occurring complex mixture of organic compounds formed from the partial decomposition of animal and plant matter over geological time. No two samples are exactly alike. Petroleum may exist as a gas (natural gas); as a liquid (crude oil); as a solid (asphalt, tar, bitumen); or as any combination of these three states. Crude petroleum contains tens of thousands of different chemical compounds. The hydrocarbons (50-98 percent of crude oil), include cyclic and open-chain paraffins, naphthenes, olefins, and aromatic compounds with molecular weights from 16 to considerably more than 20,000. The non-hydrocarbon compounds include the chemical interaction between hydrocarbons and sulfur; nitrogen; or oxygen (acids, ketones, phenols); and trace metals. Each petroleum compound can have a different physiological impact on each of the individual species of an ecosystem. It is therefore impossible to say unequivocally that one petroleum material will always have the same effect as another. Each oil spill is unique; the variables associated with a spill are specific only to the one time and place of that spill.

2. Many factors determine the degree and duration of damage from a petroleum spill. These include: (a) the

chemical composition and physical properties of the petroleum; (b) the quantity of the petroleum and the duration of the spill; (c) seasonal, oceanographic, and meteorological conditions; (d) nature of the exposed biota; (e) habitat type and substrate; (f) geographic location; and (g) type of cleanup used. Other stresses contributed by human activities may act synergistically with components of spilled petroleum, thereby increasing the damage to certain species. An effect on one part of the marine environment frequently manifests itself in another part because of the interrelated nature of a marine ecosystem.

3. Once petroleum is lost into the sea, it immediately starts to undergo chemical and physical changes. The weathering processes occur simultaneously and are interrelated. The processes are: spreading, evaporation, dissolution, agglomeration and sinking, emulsification, microbial modification, photochemical modification, biological ingestion and excretion. Of these factors, evaporation is the most noticeable and rapid. Evaporation alone can remove about 30-50 percent of hydrocarbons in a typical crude oil spill in the sea surface within ten days. Spreading is a random phenomenon, aided by wave action, winds and currents. In restricted water, shear-produced turbulence will mix the oil downward into the water column and will permit its deposition on shorelines. Dissolution starts immediately upon contact of the oil with water and may be self-sustaining. Biological and photochemical oxidation

of the components of the oil produce additional surface-active, polar compounds which are more soluble in seawater.

The disintegration and dispersal of bulk oil slicks into water include such phenomena as the formation of macroparticles (droplet dispersion and water-in-oil emulsions), microparticles (colloidal dispersions and oil-in-water emulsions), and mixtures of soluble hydrocarbons in water.

Petroleum and seawater emulsions can be of two types: oil in seawater and seawater in oil (e.g., tarballs and "mousse"). During large spills, thick layers of oil persist for long periods and large aggregates of emulsions can be produced. These emulsions are fairly stable. Bulk oil returned in the emulsions retains initially toxic characteristics for lifetimes approaching that of the emulsions. The transport of emulsions can increase the area and duration over which a spill is felt. Microbial degradation of oil is the most important process involved in weathering and the eventual disappearance of petroleum from the marine environment; this process, however, may take years.

4. All of these processes would occur in Washington State marine waters; however, some of the processes could become more important to the weathering of petroleum in certain oil spills due to local conditions. For example, the spreading and

stranding of surface-borne slicks would be influenced by shorelines and islands. Percentages of oil stranding on beaches would increase with the amount of shoreline within the oil's trajectory. Self-cleaning by natural forces in the marine environment (e.g., wave action, scouring, erosion, seasonal beach movements) is determined largely by the magnitude of the physical forces present in different types of shoreline habitats. On high-energy shorelines (like rocky headlands), self-cleaning can be rapid. Conversely self-cleaning is a very slow process (approaching 10-15 years) in low-energy environments such as mudflats, salt marshes, tidal rivers, and some sandy beaches. In low-energy shore areas, oil can remain buried in intertidal beaches for years or decades, often retaining its high-boiling aromatic hydrocarbons. Self-cleaning may only redistribute the oil from a high-energy environment into a low-energy sink where it can become immobilized. In some cases where the oil is not buried in low-energy beaches, it can become associated with the vegetative fringe of the mudflats and low-energy lagoons (METULA and AMOCO CADIZ spills). This vegetative fringe acts like a sponge to collect oil on each tidal exchange and can be accentuated if the oil comes in on unusually high tides.

Sediments have a proven potential for long-term release of entrapped pollutants back into the nearshore environment. Once incorporated in certain sediments, petroleum tends to degrade quite slowly as observed on spills in Chedabucto

Bay (ARROW), coastal Maine, West Falmouth, Alert Bay (Canada) and the Strait of Magellan (METULA).

Oil and Biological Populations

5. The transition of an ecosystem from a severely altered state immediately following a major oil spill to a stable one may require many years. However, stability does not necessarily mean a return to the same conditions that prevailed prior to the pollution incident. The cove inshore from the TAMPICO oil spill did not reach ecological stability until ten years later, and the stable population compositions before and after the spill were different. The time required for the re-establishment of a species in a disturbed environment often substantially exceeds the time required for that species to develop to maturity. Recolonization after a spill does not necessarily warrant the conclusions of no impact to the environment. Should additional pollution stresses (subsequent oil spills or other human-induced degradation) occur in time frames shorter than that required for complete recovery, the overall result can be progressive degradation of the marine environment.

6. Observations from historic oil spills suggest that serious long-term effects could be expected from a major spill in the unique biological regimes of Puget Sound or the Strait, due to extensive tidal excursions, slow flushing of

certain restricted water bodies, high turbulence and mixing in channels, and the long length of convoluted shoreline with a variety of valuable intertidal and subtidal habitats. Serious effects could be also expected if a major spill contacted beaches or bays on Washington's coast.

7. Concentrations of oil toxic to marine life were measured 89 days after the initial spillage from the AMOCO CADIZ. Zooplankton populations have experienced substantial decline after major oil spills. Many species of fish were observed to be missing from one oil-impacted area. Individuals of other species were observed to exhibit pathological and physiological changes. Small spills also have had lasting effects on local animal and plant communities.

8. If oil is stranded and remains on a beach, the aggregate immediate mortality due to smothering, or assimilation of toxic amounts of petroleum hydrocarbons, in the intertidal region can be expected to be high.

In subtidal areas adjacent to oiled beaches, immediate mortalities of fish and shellfish would be lower and would depend upon the concentrations and persistence of dissolved and emulsified oil.

Species Vulnerability

9. The most vulnerable intertidal food fish and shellfish are clams, oysters and mussels, shrimp, Dungeness crabs, and incubating spawn of the Pacific herring and surf smelt. These organisms' vulnerable early life stages are spent in habitats where substrates are stable and hydraulic energy relatively subdued. Such habitats have a high vulnerability to oil spills.

10. Chum and pink salmon juveniles have a specially high vulnerability as well because they are almost inextricably dependent upon the food and predator protection offered by the beach shallows when they are small. Some species of zooplankton and phytoplankton also have heightened vulnerability to oil because they tend to live near or migrate close to the surface, and oil will tend to be concentrated in the upper water column.

11. Flatfish embryos and larvae may be particularly vulnerable to floating oil and to the saltwater-soluble fraction of oil associated with an oil slick, because the eggs of many flatfish species incubate at or near the surface of the water column. The latent effect of killing embryos could be lesser recruitment of that year class into the fishery. A spill

could kill larvae from surf smelt or Pacific herring and Dungeness crab. See Section III.D.3 - Resources at Risk.

Physiological Impact of Hydrocarbons

12. Marine organisms readily accumulate petroleum hydrocarbons into tissues when exposed through diet, the water column or sediment. The extent of accumulation depends on species, hydrocarbon structure, route of administration, and environmental conditions. Once ingested or absorbed, petroleum compounds can be concentrated in vital organs at higher levels than in the environment. In various exposed marine fish, aromatic hydrocarbons have been identified in all tissues and organs. Flatfish especially tend to accumulate significant concentrations of petroleum hydrocarbons in their bodies when exposed to petroleum-rich sediments. Hydrocarbon accumulations in brain tissues of marine fish may be associated with severe behavioral or physiological changes. The retention of petroleum hydrocarbons in the eyes of marine fish may result in morphological changes. Invertebrates (crustacea and molluscs) also readily accumulate hydrocarbons in all tissues and organs from surrounding water when exposed for more than a few hours.

13. Petroleum in the marine environment has the potential to alter significantly the normal life processes of a variety of organisms. Petroleum compounds bring about a variety

of long-term biochemical, physiological, behavioral, and pathological changes. The metabolism of hydrocarbons by marine fauna results in limited and variable detoxification. However, certain metabolized hydrocarbons, such as benzopyrene, can be converted into mutagens and carcinogens. Metabolites may be more damaging than the hydrocarbons themselves. Various serious sublethal effects may occur.

14. Studies evaluating effects of waterborne petroleum on salmon homing were conducted at a field site in the Puget Sound area. When monoaromatic hydrocarbons were introduced into salmon "home stream" water at concentrations greater than 700 parts per billion (ppb), the chemicals disrupted salmon upstream migration past a dam located at tidewater. At hydrocarbon concentrations of two to three parts per million, upstream movement of early migrating coho salmon past the dam was completely inhibited and for salmon migrating late, upstream movement was reduced by 50 percent. This phenomenon occurs because adult salmon avoid even low concentrations of hydrocarbons. A delay of only a few days can be extremely damaging because salmon stop feeding on their spawning ground migration and must finish their life cycle on a fixed store of energy. When that store has been depleted, the fish dies whether it has completed spawning or not.

15. Virtually no normal sand sole embryos or larvae were recovered from exposure to a slick of fresh or weathered Prudhoe Bay crude oil (hydrocarbon concentrations in the water of 300 ppb and greater); a number of different anomalies were observed. Similarly, very few normal animals at these developmental stages were obtained after exposure at 64 ppb to the weathered saltwater-soluble fraction of crude oil.

In another study, English sole were exposed to sediment-associated Prudhoe Bay crude oil for four months. Compared to control sole residing on clean sediment, the oil-exposed sole took up substantial amounts of petroleum hydrocarbons, developed liver abnormalities, lost weight, and had a higher mortality rate.

16. An oil spill in Puget Sound or the Strait would also adversely affect aquaculture. In addition to other effects, tainting might prevent marketing of the cultured product. See Section III.D.3 - Resources at Risk-Aquaculture.

17. Because marine ecosystems are built upon complex interrelationships of species, an effect on one species frequently results in effects on others. The more susceptible species can be selectively eliminated while the more resistant ones can flourish almost unchecked. Thus, elimination of a few species can alter food webs and change community structure.

Fishery Impacts

18. If an oil spill occurs, fisheries operating in the affected area will be curtailed, either because fishermen will not be able to fish without soiling their gear, or because of closures ordered by public agencies to assess the potential hazard. Acceptance of seafood products can be expected to diminish because of public health concerns. The hydrocarbon concentrations at levels too low to produce other observable effects can cause taint and result in an unacceptable product.

For major fisheries, values total nearly $300 million annually (1974-1978 average) in Washington State.

19. An oil spill could upset some fishery harvest and management strategies. If the commercial fisheries for adult salmon in the Strait of Juan de Fuca or in river mouth areas were curtailed, many more salmon than needed could escape to the spawning grounds and hatcheries.

20. Spills in various locations affected by the project could impact Tulalip fisheries.

21. Treaty tribes are prohibited from moving to another fish run in a different area and resuming the harvest. To the extent that a fish run migrating through a usual and

accustomed fishing area is destroyed or caused to avoid the area, the treaty fishery is likewise damaged. (TR 36393 Somers).

22. A large spill in one of the major rivers of the Puget Sound region could block adult anadromous fish migration, cause egg or larvae mortality, and damage spawning and rearing habitat.

23. Since smaller streams are often more important as spawning and rearing habitat than larger rivers, an oil spill in a small stream could prevent use of significant habitat downstream or upstream. There are a finite number of smaller streams which provide habitat for the fisheries. Significant habitat deterioration has already occurred. The loss of the fishery supported by a single small stream is significant if viewed alone, and becomes even more significant if viewed in light of the cumulative repercussions. Also, an oil spill in a small stream can be expected to reach larger streams and result in impacts there. (TR 36400-36401 Somers).

24. The occurrence of construction-related oil spills can reasonably be expected to occur if the Northern Tier project is constructed. (34278-89 Kay). Spills which reach rivers can cause damage to fish and fishery habitat. (34288-89 Kay).

25. Oil spills reaching freshwater would behave similarly to oil spills on marine waters. (TR 15196-97 Yuill, App. III, Sec. 2.5.4.2)

26. Oil spills occurring in wetlands may produce long-term adverse effects. Containment and cleanup of a major spill would be very difficult. Depending on the magnitude of the spill, recovery could take many years.

27. East of the Cascade Divide, impacts to fish could occur from spills entering the Yakima or Columbia river systems.

Bird and Mammal Impacts

28. Historically, large numbers of water birds have been killed or otherwise harmed by oil spills. Operation of the tanker unloading facilities at the marine terminal has the potential of adversely affecting large numbers of birds in the Strait of Juan de Fuca and Port Angeles Harbor through oil spills. Species that generally live on the sea, diving for food, resting on the surface of the water or floating on debris, are the most susceptible, frequently becoming coated with oil. The effect of oil on water birds can be considered in three broad categories: physical effects, loss of food and disturbance of habitat. (TR 15348 Reed; Applic. III, Sec. 2.5.2.1).

29. Adverse effects on individual birds can come from direct or indirect contact with oil. Long-term problems, many related to reproduction, may result from the oiling of individual birds. (TR 15349-50 Reed; Applic. III, Sec. 2.5.2.1). The importance of oil-spill-related bird losses depends on the overall population viability of the species affected. (TR 15350-51 Reed; Applic. III, Sec. 2.5.2.1).

30. Oil spills could affect any of the important water bird areas in the Strait of Juan de Fuca.

31. In the Strait, critical bird habitats most likely to be fouled by a large oil spill are mud flats, marshes, shallow water eel grass beds, kelp beds, and reefs. (TR 15354-55 Reed; Applic. III, Sec. 2.5.2.1).

32. There are no effective ways of cleaning birds or critical habitats after they have been fouled. Under the most rigorous cleanup procedures, only about 10% of birds captured and treated remain alive. (TR 15355 Reed; App. III, Sec. 2.5.2.1).

33. Very little research has been done to determine the long term impacts of oil on marine mammals. (Gornall, TR 33702-03). Seals have experienced eye irritation from spills. Few other direct impacts on marine mammals have been documented.

The greatest impacts on these species would be the fouling of resting habitats, changes in proportional time spent on water and land, changes in group relationships, and possible contamination of food sources. In general, losses of fish for marine mammals would not be significant. Also, these mammals may feed in other areas temporarily until food and other habitat conditions recover. Other species, such as the killer whale, harbor porpoise and gray whale, could be exposed to an oil spill, but would probably avoid the contaminated areas. (TR 15345-46 Reed; Applic. III, Sec. 2.5.2.1).

Economic Impacts

34. A major oil spill from a tanker or submarine pipeline associated with the Northern Tier facility could cause economic damage in excess of $200 million (1981 dollars). (Sorenson, TR 41776, 41767, Ex. 845 at p. 12). Washington state fisheries are far more valuable than the fisheries in Brittany, France, where the AMOCO CADIZ spill caused a total economic loss of $350 million. (Sorenson, TR 41775-6, 41761). The value of Washington state salmon fisheries alone is $200 million per year. (Ex. 845 at 11).

35. Costs associated with oil spills include loss of the ship and cargo, clean up, government and environmental costs, property value reductions, recreational value losses,

tourism losses and commercial and sport fishing losses. In addition, there may be intangible losses based on aesthetics, health and morale which are not readily assigned a dollar value. (Sorenson, TR 41756-8).

Existing Risk

36. Up to 45,000 barrels of petroleum may enter Puget Sound and associated waters per year from existing operations.

37. Puget Sound, the Strait of Juan de Fuca and Port Angeles Harbor have an existing risk of oil spills presented by tank vessels carrying crude oil and petroleum products and conducting transfer operations, and by other vessels.

38. There is a probability of one or more oil spills from existing tankers and barges in transit to Puget Sound ports or at berth. There is a present probability of oil spills in Port Angeles Harbor.

39. In western Washington, the existing probability of one or more storage tank spills is high. (TR 13835 Johnson)

40. There are presently no submarine oil pipelines in the Strait of Juan de Fuca or Saratoga Passage.

41. There is a current possibility of pipeline spills in Washington. Based on historical accident data for pipelines in Washington, the present risk of spills is very small (Applic. III, Sec. 1.11.5). Construction of the pipeline system would introduce oil spill risk to areas where no risk currently exists, as well as increase existing oil spill risk.

III. D. 4.b. HUMAN HEALTH

1. Northern Tier performed an analysis assessing the effects on human health of ingesting water and seafood contaminated with oil. The analysis assumed that the oil would be present in levels too low to be tasted in seafood or drinking water. The analysis reviewed the chemicals that would be present in the oil to determine whether they were likely to pose significant health risks. Estimated, worst-case exposure levels were assumed. (TR 15613-14, 15682-85 Karch).

2. The analysis concluded that human neurotoxicity is unlikely to occur as a result of ingesting contaminated water or seafood. It further concluded that lifetime ingestion of oil contaminated fish and seafood was not likely to result in teratogenic (causing fetal malformation), fetotoxic or other effects on the brain or kidneys. (TR 15682-87 Karch).

III. D. 5. PROTECTIVE MEASURES AND CLEANUP

1. For the foreseeable future, major oil spills are beyond the response resources that can be brought to bear in a timely manner. (TR 33452; 33570-71; 33199-201).

2. Protective and mitigative measures for oil spills are outlined in the Draft Oil Spill Contingency Response Plan (also referred to herein as the "contingency plan"). (Applic. II, Sec. 6.5.4) This document is necessarily preliminary. Volume I of the contingency plan deals with general provisions. Volume II deals specifically with the Port Angeles District. There is also a preliminary document for Selected Sites, Central and Eastern Washington, which deals primarily with river and stream crossings.

3. The plan is not an action plan that could be used by an on-scene commander in the event of a spill; rather it constitutes an outline of the general requirements of what such a plan would be. (Bennett, TR 33195; Hatfield, TR 33161-62) Appendix A exists only as a title.

4. The contingency plan contains an appropriate structure for this stage of development. Changes, expansion and refinement in the plan will be required prior to the start

of operations to reflect changes in details of design and proposed operational parameters. (TR 16060 Castle)

5. Procedures for notifying agencies and others, and for starting cleanup and containment response, in an efficient and acceptable manner should be devised.

6. Small spills will be handled by local Northern Tier operating groups familiar with each area. (TR 16063 Castle)

7. A centralized management team will be responsible for coordination and implementation. All personnel participating in a response organization will be specifically trained in their individual duties and responsibilities, and will be subject to periodic training classes and field exercises. (TR 16065 Castle) Volume II of the Plan, Section 404 identifies potential sites to be protected against spills. (TR 16123-24 Foget)

8. After determining the areas of potential impact, the characteristics of potential spill locations were used to select compatible protection techniques. Specific clean-up actions often cannot be predetermined, because selection of proper clean-up techniques depends on factors which vary from spill to spill. A series of decision guides for clean-up is

included in the contingency plan. (TR 16125 Foget) Flow charts describe response procedures. (Castle, TR 16064)

9. Volume II, the Port Angeles District Plan, contains a Natural Resources Inventory with condensed information on the ecology of specific areas, group/species abundance, and seasonal importance. (Castle, TR 16068)

10. Northern Tier will respond to spills from inbound or outbound vessels as requested by the responsible party, the Clean Sound Cooperative, or the Federal On-Scene Coordinator. (TR 16551 Castle; Oil Spill Contingency Plan, P. 102-1(2)) On the strength of a verbal request, Northern Tier will respond to an oil spill incident for an initial 24-hour period. Beyond that period, Northern Tier's response would require a written contract. If the Federal On-Scene Coordinator requests Northern Tier's help in responding to any incident, Northern Tier will honor that request. (TR 16622, 16659-60; Oil Spill Contingency Plan, Vol. II)

11. Northern Tier will maintain an inventory of strategically located equipment for containment and recovery of operational oil spills, and will provide an immediate response to spills within each district area of interest. (TR 16118 Foget)

12. The applicant will provide the following equipment at the tanker berth area: a 4,000-foot back fence boom installed under the dock at the tank barge location, along with 700 feet of permanent boom to be attached to ships and barge hulls at the water level on either side of the loading manifolds; approximately 4,000 feet of heavy-duty fence boom to enclose every tanker prior to offloading operations; a boom boat for deployment of booms; and two disc-type mini-skimmers. (TR 16126-27 Foget)

13. The following major equipment (some of which may be supplied and/or operated by the Clean Sound Cooperative) will be available at Port Angeles for immediate response to oil spills: two self-propelled skimmers; 7,000 feet of curtain boom with tension cables at top and bottom; 1,000 feet of fast deployment compactible boom and a 1,600-foot fast deployment boom; a fast response boom deployment boat; an 18 to 20-foot work boat with trailer and motor; a 5,000 to 7,000 barrel tank barge; and additional equipment and supplies. (TR 16127-28 Foget)

14. The following equipment will be stored at Green Point: 7,300 feet of curtain boom; two small portable floating skimmers and one portable belt-type skimmer; 1,000 feet of curtain boom and 1,000 feet of fast response boom; two small work

boats with outboard motors; twelve bird-scaring devices; additional equipment and supplies. (TR 16128-29 Foget)

15. A skimmer, boat, and boom will be maintained by Northern Tier at each pump station. (TR 16860 Foget) For each river containment site, one hundred feet of suction hose will be provided to be used with a skimmer or pump, in addition to suction hoses used on the vacuum trucks. (TR 16881 Foget)

16. High current booming material, and low-current booming material and sorbents, will be on hand for containment work in rivers.

17. The Clean Sound Cooperative is an unincorporated mutual assistance joint venture composed of 15 oil and oil transportation companies doing business in the State of Washington. The cooperative owns or has available from its members a wide range of oil spill containment and clean-up equipment.

18. Northern Tier will endeavor to become a member of Clean Sound Cooperative and will use that organization's equipment and personnel for large marine oil spill incidents or those requiring long-term manpower, supplemented by local contractors, if necessary. (TR 16064 Castle)

19. If it joins Clean Sound Cooperative, Northern Tier will become approximately a 60% member of the organization, based on its percentage of the total oil and oil transportation industry in the state. (TR 16711-18 Weichert)

20. Present equipment and technology will not provide the capability to recover significant amounts of oil in the event of a large spill at either Port Angeles Harbor, the approaches to Port Angeles, the Strait of Juan de Fuca or at the submarine pipeline crossing of Admiralty Inlet or Saratoga Passage. (TR 33199) Even if massive amounts of oil spill equipment were present, it would be difficult to prevent pollution of the coastline unless ideal, combined conditions of light wind, little current, small waves, and good visibility were sustained throughout the entire oil spill clean-up operation. (TR 33200-1).

21. Oil spill containment and open water clean-up attempts in marine waters and rivers generally fail. (TR 33196-7) The history of clean-up of large tanker spills shows that relatively little of the spilled cargo is successfully intercepted or recovered. (Bennett, TR 33197-8) Any conditions such as strong currents, tidal action, winds, waves, fog and/or the onset of darkness would hinder recovery of spilled oil. (TR 33197; Hatfield, TR 33164).

22. Containment and clean-up of oil spills would be very difficult in the Strait of Juan de Fuca because: (1) the tidal currents in these waters are swift and sustained; (2) the area experiences both high wind and frequent fog conditions; (3) the distances between mid-channel and the shore, between the Port Angeles berths and the shore, or from the submarine pipeline crossings to the shore, are relatively short and leave little time for containment prior to oil reaching shore; and (4) the movement of tidal currents in the Strait of Juan de Fuca and Puget Sound is complex and changing, so that any containment or clean-up operations would require continuous readjustment and modification. (TR 33198-99) Open water clean-up and control near Cape Flattery is not feasible. (Bennett, TR 33501-2)

23. The Clean Sound Cooperative's personnel and equipment should be able to respond effectively to the great majority of small spills and to many spills of moderate (1,000 to 5,000 barrel) size. Though effective overall response to a major spill is not possible, Clean Sound's personnel and equipment, even then, would provide marginal assistance and protection.

24. The Clean Sound Cooperative is able to provide initial response personnel to operate its equipment. Clean

Sound's contractor has some personnel available at one hour's notice. (TR 16087, 16743-44 Weichert).

25. Within 12 hours after a major spill in the Strait of Juan de Fuca, 50,000 to 60,000 feet of boom could be obtained through all local sources presently available to the applicant. (TR 16786-87 Weichert). Additional boom from other federal and out-of-state sources could be made available at varying times. (TR 16085-86 Weichert).

26. Even if on scene, and immediately available the largest oil skimmers now available have limited capability of recovering oil in open water. (TR 33199) Skimmers can recover oil in a Sea State 2, but that capability in Sea State 3 is limited. (TR 33211, 33572-3, 33538, 33478-9) In the Strait of Juan de Fuca, conditions above Sea State 2 are common and occur frequently (20% to 30% of the time) throughout the year. (TR 33211, 33459) Sea State 2 is the U.S. Coast Guard description for sea conditions having large wavelets where crests begin to break and is characterized by a gentle breeze, with wind velocity ranging from 6.5 to 10 knots; an average wave height of 0.6 to 0.88 feet; a significant wave height of 1.0 to 2.2 feet; and wave frequency of 0.8 seconds to 6.0 seconds. (TR 33212)

27. Oil spill booms allow oil to escape underneath beginning at 3/4ths knot current with virtually no containment at currents greater than 1.2 knots. (TR 33200, 33467) Wind and wave action compound the problems of boom containment.

28. Some booms set at an angle to divert or cascade oil to a sacrificial beach may be able to prevent escape underneath the boom up to 1.5 to 2 knots of current in limited circumstances, but effective diversion requires precise placement of booms and anchors. This can generally be done only with predetermined and preanchored boom locations. (TR 116370-71, 16380, 16589, 16643 Foget; 33495, 33529, 33469, 33472-3 Bennett; Ex. 639) Pre-setting of booms is not considered feasible for protecting the waters of the Strait of Juan de Fuca or Puget Sound. (Ex. 639; TR 33581).

29. The limited effectiveness of booms and skimmers on open water containment and clean-up apply to any spill size. (TR 33214)

30. Boomed oil may be released due to risks of fire and explosion around the vessel. (TR 33213, 33462-3)

31. The usefulness of diversion booming in rivers is dependent on current speed. (TR 16916-17 Foget)

32. Free drifting booms in open water can reduce the escapement problem by floating with the current, making relative speed of the current to the boom very small, and as long as current direction is constant, concentrating the oil somewhat. (TR 16591-92 Foget)

33. The equipment applicant proposes to acquire will be sufficient to provide an initial response to most small spill situations.

34. The double booming proposed by Northern Tier during tanker unloading operations would be capable of containing most operational spills at berth, especially given the protected nature of Port Angeles Harbor.

35. Oil spills from the submarine pipelines could not be contained while below the water surface. After surfacing, oil would likely be scattered and difficult to contain even in calm conditions. Further, the oil reaching the surface would escape from booms when currents exceeded 3/4ths of a knot and containment would be virtually impossible at currents exceeding 1.2 knots. The strong currents of Admiralty Inlet at the submarine crossing would make containment virtually impossible even when the oil reached the surface. (TR 33212).

36. No substantial containment is likely of oil spills from pipeline crossings of rivers due to delayed response time after leak detection, and lack of equipment deployment along the various rivers and the common existence of swift currents.

37. Inability to contain and clean up open water spills leaves beach or shoreline clean-up as the only alternative. (TR 33201) The Washington coastline between Cape Flattery and Port Angeles has extensive areas which are inaccessible for the large numbers of workers and equipment needed to attempt shoreline recovery of beached oil. (TR 33201-02) Clean-up on those sections of the coast which are inaccessible by land would not be practical and oil will have to be degraded and dissipated through wave and water action. (TR 33202-03) Some areas of the coastline of the Strait of Juan de Fuca and Puget Sound have high energy waves which will dissipate and degrade oil. Other portions of that coastline contain inlets, pools, estuaries and protected areas where the oil will not be washed by high energy waves and oil may be refloated due to tidal actions. (TR 33202-03) Such refloating creates new drifting oil slicks which can contaminate new areas or recontaminate beaches which have been previously cleaned up. (TR 33204).

38. Where the oiled coastline is accessible, oil recovery is a lengthy task requiring large numbers of laborers

and equipment. (Ex. 638 (slides); TR 33201, 33211-12) Where the oil beaches on sandy or gravel areas, the top portions of the beach are removed and hauled away for disposal. (TR 33211, 33518) For rocky areas and other shorelines which cannot be dug up and hauled off, clean-up is limited to shoveling oil, mopping rocky areas and ladling, skimming or sucking oil at the shoreline edge. (Ex. 638 (slides); TR 33203, 33212). The Mitsushima oil spill in the Inland Sea of Japan involved 200,000 people, 102,885 drums for oil/water mixture disposal, and over 38,000 ships and boats for clean-up. (Hatfield, TR 33207; Ex. 636, pp. i and 21) The AMOCO CADIZ involved a total of 6,500 people and 90 tank trucks, 140 vacuum trucks, 300 dump trucks, and over 60 bulldozers, backhoes, frontend loaders and other heavy machinery. (Ex. 637, pp. 268-272; TR 33205). There may be significant impacts to vegetation, fish and wildlife associated with the clean-up methods described in Findings 21 through 38.

39. There are significant logistical problems associated with the influx and massing of manpower and equipment required to attempt beach clean-up. (Ex. 638 slides) (TR 33164, 33167-69).

40. Spills of between a few gallons and several hundred gallons which typically occur during cargo transfer can

take between six hours and six days to clean up and one or both berths may be shut down during clean-up. (Bayliss, TR 26012).

41. The costs of clean-up vary with the size and circumstances of a spill. Direct costs of major oil spills can be massive. The AMOCO CADIZ and the Inland Sea spill in Japan each cost approximately $200,000,000 to clean up. (TR 33215; Hatfield, TR 33171).

42. A study of clean-up efforts in waters bordering the Strait of Juan de Fuca revealed an average direct clean-up cost of $26 per gallon (in 1978 dollars) or $1092 per barrel. (Hatfield, TR 33171; see also Bayliss, TR 26093; Bennett, TR 33571, Sorensen, TR 41801).

43. U.S. law requires tankers to carry oil spill liability insurance in the amount of $150 per gross ton, which is $0.75 per gallon. (TR 33571; FWPCA, 33 U.S.C. subsection 1321).

44. Direct clean-up costs do not include indirect governmental costs, damage to public and private property, damage to resources and habitat, and general environmental damage. (TR 33172) The litigation of the AMOCO CADIZ involves approximately $2 billion worth of claims. (TR 33216).

45. Recovery from international compensation funds has been characterized by litigation and payments far below the costs of clean-up and environmental damage. (TR 33218, 33520-22, 33555).

46. The Limitation of Liability Act, 46 U.S.C. 183, may preclude or limit recovery against vessels for oil spill damages.

47. NTPC proposes to carry a minimum of $35,000,000 spill liability insurance. The Federal Water Pollution Control Act sets an upper liability limit of $50,000,000 for oil spill cleanup and restoration of natural resources. (Oliver PFT (1) p. 34). This limit can be reduced to $8,000,000 by Presidential order. (NTPC application Vol. III, p. 8-18 & 19).

48. The main control methods for terrestrial spills in forested and agricultural lands are impoundment and the use of absorbents. Site-specific control recommendations for terrestrial spills have not been developed (Oliver PFT (1) p. 24.).

III. E. TRIBAL CONCERNS

1. The Council has considered the effect which certification of the proposed project would have upon Indian tribes of the state of Washington. Two of the tribes, the Makahs and the Tulalips, sought and obtained intervention status, and actively participated in the proceedings. Other Indian tribes were invited by the Council to express their views. Review of the effect of certification upon the Indian treaty fishing rights of Western Washington Indian tribes is mandated under U.S. v. Washington, 443 U.S. 658, 61 L.Ed.2d 823, 99 S.Ct. 3055 (1979); U.S. v. Washington, (Phase II) Civil No. 9213, Western District of Washington.

2. The following federally recognized Indian tribes have treaty fishing rights in waters potentially impacted by the Northern Tier Pipeline project:

General Fishing Area	Tribes
Coastal	Quinault, Hoh, Quillayute Makah
Strait of Juan de Fuca	Makah, Lower Elwha Klallam
Hood Canal	Port Gamble Klallam, Suquamish and Skokomish
Stillaguamish Snohomish	Tulalip and Stillaguamish

Skagit	Swinomish, Sauk-Suiattle and Upper Skagit
Nooksack-Samish	Lummi and Nooksack
Yakima	Yakima

3. In addition, several tribes in South Puget Sound have fishing rights to anadromous fish which must pass through Admiralty Inlet in the Strait of Juan de Fuca on their migrations to and from the ocean.

4. Annual salmon and steelhead catches by the various tribes in the project area are substantial. These fish are taken with marine and river gill nets and to a lesser extent with beach seines, purse seines, reef nets, and traps.

5. All of the treaty tribes in the project area depend on fishing and related services as a source of employment and personal income. (U.S. v. Washington; Phase II, Civil No. 9213, W.D. of Wash.; TR 27376-501 Johnson; TR 36358-830 Somers)

6. A major oil spill within the Strait of Juan de Fuca from a tanker, or from an oil pipeline rupture, or from a rupture of the pipeline in a river or stream which constitutes part of the usual and accustomed fishing places for the Indian

treaty tribes also poses a threat to the treaty fishery. The possibility of tanker spills exists today.

Makah Tribe

7. The Makahs are a federally recognized Indian tribe residing on a reservation on the northwest tip of the Olympic Peninsula.

8. By treaty, the Makahs have reserved the right to fish in their usual and accustomed areas. By case law, that right permits the Makahs to take 50 percent of the fish within those waters.

9. Currently, only 28 percent of the Makah tribe is fully employed. Water resources are essential to the Makahs, who are almost wholly dependent upon commercial fishing and tourism associated with fishing and beaches. There are virtually no alternative employment opportunities in the area. Seafood is the mainstay of the tribal diet.

10. The Makahs have lived from the sea for at least 1,000 years. Spill impacts would reduce their sources of food and livelihood and would diminish their way of life and culture.

11. A spill affecting any fish run in Western Washington would work to the detriment of the Makahs. It is not clear that lost marine species could be successfully replaced through artificial means. Any replacement would be only over the long term. The Makah economy would be hard-pressed during any long-term curtailment of fishing activities.

12. When fishing gear is fouled with oil, fish will avoid it. Cleaning gear requires great effort and lost fishing time. If badly contaminated, it must be discarded.

13. The project will result in increased tanker traffic in tribal fishing areas. The risk of collision with tribal vessels and net damage will increase.

14. Archaeological research is ongoing on the Makah reservation. An oil spill reaching Makah tidal areas would interfere with the carbon-dating processes for Makah artifacts subsequently unearthed in tidal areas.

Tulalip Tribes

15. The Tulalip Tribes of Washington is a present-day tribal entity which is a political successor in interest to certain tribes which were parties to the Treaty of Point Elliott. The Tulalip Tribes is recognized by the United States as a cur-

rently functioning Indian tribe maintaining a tribal government on the Tulalip Indian Reservation in Snohomish County, Washington. The tribe is organized pursuant to the Indian Reorganization Act, 48 Stat. 987, 25 USC subsection 476. (See United States v. Washington, Compilation of Major Post-Trial Substantive Orders, 459 F.Supp. 1020, 1039.) (TR 36374-75 Somers). The Tulalip Tribes is an entity, (recognized as such by the United States) which has the full civil and criminal jurisdiction, powers, and immunities of a sovereign tribe. (TR 36375 Somers).

16. The Tulalip Reservation is located approximately five miles north of the city of Everett, Washington. It is bounded on the east by Interstate Highway 5, to the south by the Snohomish River (Steamboat Slough) and Port Gardner, and to the west by Puget Sound. The reservation encompasses approximately 36 sections. There are approximately 1,350 registered tribal members. Approximately 800 of these live on or near the Reservation. The major means of employment and livelihood for many tribal members and their families living on or close to the Reservation is fishing. (TR 36375-76 Somers).

17. As political successor in interest to "certain parties to the Treaty of Point Elliott," 459 F.Supp. at 1039, the Tulalip Tribes have treaty fishing rights at their usual and accustomed places outside of reservation boundaries. (459 F.Supp. at 1041.) (TR 36376 Somers).

18. These treaty fishing rights are the right to take the lesser of 50 percent of the "harvestable" fish from the usual and accustomed areas or a sufficient quantity of fish to provide the tribes with a moderate livelihood. U.S. v. Washington, 384 F.Supp. 312 (W.D. Wash. 1974); Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n, 443 U.S. 658, 685-87 (1979). (TR 36376 Somers). The Tulalip Tribes' allocation is currently set by the District Court at 50%. (Id.; 36382 Somers; judicial notice). No evidence in the present record indicates that the Tulalip Tribe's moderate living needs may be satisfied by a less than 50% allocation.

19. The Tulalip Tribes have both marine and freshwater fishing areas defined as follows:

> "Beginning at Admiralty Head on Whidbey Island and proceeding south, those waters described as Admiralty Bay and Admiralty Inlet, then southeasterly to include the remainder of Admiralty Inlet including Mutiny and Useless Bay, then northeasterly to include Possession Sound and Port Gardner Bay, then northwesterly to include the waters of Port Susan up to a line drawn true west of Kyak Point and Holmes Harbor and Saratoga Passage up to a line drawn true west of Camano on Camano Island." 459 F.Supp. at 1059.

The freshwater areas were provisionally defined as the Snohomish River system, including tributaries and freshwater lakes, and the Snoqualmie and Skykomish River systems. 459 F.Supp. at 1060. These findings are provisional, subject to future expansion or limitations. 459 F.Supp. at 1060. The Stillaguamish River system and its tributaries provide vital fisheries habitat for the species of anadromous fish which are harvested by the Tulalips. (TR 36379-80 Somers).

20. The treaty fishing right of the Tulalip Tribes is a communal right held by the Tribes for the benefit of its members. 384 F.Supp. at 406. (TR 36380-81 Somers). The treaty fishery has economic, social, religious and cultural significance to the Tulalip Tribes and many of its members. The salmon fishery is a focal point of Tulalip culture. The salmon fishery also has great economic significance to the Tulalip Tribes and many of its members. The Tulalip Tribes' annual salmon catch since 1974 was as follows:

SPECIES	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
Sockeye	4,888	2,780	13,279	43,894	24,665	53,285
Chinook	1,285	2,759	8,344	7,632	9,333	12,289
Pink	-0-	17,859	-1-	6,060	-24-	35,257
Coho	69,207	39,213	30,118	59,617	75,459	37,744
Chum	21,026	2,009	22,162	4,913	17,772	3,653
Steelhead	2,306	4,209	2,453	7,017	7,133	9,882
Total	98,712	68,829	76,457	129,133	134,386	152,110

21. The Tulalip Tribes actively regulates the treaty fishery and derives tribal income therefrom. This income sup-

ports tribal government activities and provides services to tribal members. (TR 36381-82 Somers)

22. The Tulalip fishing season takes place from approximately July through the end of January, and later in some cases. The Tulalip Tribes has fisheries on chinook, sockeye, pink, coho, and chum salmon, and steelhead, in approximately that order. In addition, a spring chinook fishery used to take place but due to near extinction, has not taken place for many years. (TR 36382 Somers).

23. The tribal ceremonial and subsistence fishery for salmon is now counted as a part of the Tulalip Tribes' 50% allocation under Phase I, but is not included in the fisheries catch shown in Finding 20 above. (TR 36382 Somers).

24. In addition to the commercial, ceremonial and subsistence salmon harvests, sizeable harvests of subsistence shellfish and non-salmonid marine fish take place in Port Susan, Port Gardner, on the Stillaguamish and Skagit flats, and in Admiralty Inlet. (TR 36383 Somers).

25. The natural fisheries resource available for harvest by the Tulalip Tribes has declined over the years due to environmental degradation and increased fishing pressure.

III. F. WATER QUALITY

1. Low levels of organic and industrial wastes and petroleum-related hydrocarbons exist in the surface water in the Port Angeles area. (TR 9227 Kantz).

2. At the terminal site, pile driving and pipeline trenching will produce suspended sediments, resulting in increased turbidity levels. These increases will be temporary. Net sediment transport will generally be less than 40 miles (Kantz).

3. The Green Point site proposed for the onshore storage facilities now contributes a minor amount of runoff and base flow to Siebert Creek. (TR 9228-29 Kantz).

4. Construction of the tank farm will cause a temporarily increased amount of sediment to be carried to Siebert Creek and the Strait of Juan de Fuca. Settling ponds will be used to minimize this input. (TR 9232 Kantz).

5. During operation of the onshore storage facilities, dikes around the tanks and holding basins will control runoff and minimize potential sedimentation and oil contamination impacts on surface water. Water effluent from oil-water

separators located at the site will cause minor and limited effects when discharged in nearby coastal waters. It should not be discharged in Siebert Creek. (Applic. III, Sec. 2.3.3.1).

6. Water quality in Saratoga Passage is affected by inflow of fresh water from rivers. Waters in the Passage are often strongly stratified, because the fresh water mixes only slightly with the denser sea water which enters from the Strait. No industrial discharges affect water quality in the northern section of Saratoga Passage, but various municipalities and naval bases discharge treated sewage effluent to these waters. (TR 9236-37 Kantz).

7. Sediment samples collected from the Strait of Juan de Fuca and Saratoga Passage show low values of chemical oxygen demand, oil and grease, sulfides, and concentrations of heavy metals. The chemical properties of these sediments are not expected to cause a detrimental impact on water usage in the Strait or in Saratoga Passage. (TR 9241 Kantz).

Excavation and Dredging

8. Excavation of the submarine pipeline trench would disturb bottom sediments, suspending sediments during construction. Amounts of sediment disturbed and extent of dispersion are site-specific and will vary because of differences in currents, bottom substrates, excavation methods, and trench-

ing. Suspended sediment levels will likely increase more in shallow areas than in deep areas except at Ediz Hook, where Type A soils (loose, sandy or silty soils) occur at the greatest depth. The greatest suspended sediment impacts should occur near active dredging operations. Turbidity effects are greater with the jetting trench construction method than with the post-plowing method. (TR 9237-40 Kantz).

9. Dredging in the main channel along the Strait would encounter somewhat finer sediment than in the land approach areas. Transport of disturbed particles is highly unpredictable because of the complex dispersion processes in this part of the Strait. Currents could transport sediments great distances. (TR 9238-39 Kantz).

10. In the main channel of Saratoga Passage, construction of the trench for the submarine pipeline by the jetting method will produce more turbidity than the post-plow method. (See Section II.A.2.a.(1) for a description of these trenching methods.) Transport of sediment in this part of the Passage could be up to several miles, but the concentrations will be low because of high dilution. Sediments in the eastern part of the Passage are particularly likely to produce turbidity. (TR 9420 Kantz).

River and Stream Crossings

11. Streams, creeks, and rivers crossed by the pipeline route in the Puget Sound region (from Green Point to North Bend) include those in the Dungeness River drainage and the Stillaguamish and Snohomish River Basins. (TR 9243-44 Kantz). In the Cascade Mountain region (North Bend to Yakima River Basin), most of the streams crossed by the proposed pipeline are tributaries to the South Fork of the Snoqualmie River or the Yakima River. The proposed pipeline route crosses fewer perennial flowing streams in the Eastern Washington region (Yakima River Basin to the Idaho border) than in the other regions. The route also crosses the Columbia River, which has greater flow and lower levels of total dissolved solids than do streams in the region. The great majority of streams crossed by the route enjoy excellent water quality. (TR 9246-47 Kantz).

12. The construction activities proposed by Northern Tier will be accompanied by stripping of vegetation and topsoil, extensive grading and general reworking of the landscape. Two major concerns are erosion and sedimentation from improper construction controls and techniques (Snyder PFT 6-7). Problems that will arise if proper techniques are not followed include sediment buildup, which reduces the flow-carrying capacity of streams and promotes delta formation in lakes where weeds can thrive in the shallow water. The natural aging process of a

lake can be accelerated by deposits of nutrient-laden soil particles, leading to algal blooms.

13. A thorough knowledge of all soils along the route is essential. Erosion-sedimentation control measures employed will depend on the soil types involved. Limited soil data are available for counties through which the pipeline is proposed to cross. (Snyder, PFT 10).

14. Rapid installation and stabilization at stream crossings are critical and, with seasonal constraints, construction should be guaranteed to occur only during low flow periods. Special emphasis must be given to replacement of riparian vegetation using proper species and accepted techniques. Stringent erosion-sedimentation control is also necessary to insure that water quality is maintained. All the small streams and their tributaries and natural drainage swales must be protected. Small streams play a major role in the state's fishery production programs. Swales carry seasonal water to perennial streams, thereby also carrying any available sediment or other pollutants. Some small streams and swales are in very steep terrain with high erosion potential.

15. Crossings of marshlands or wetlands also require special attention. Reclamation of wetlands should pro-

ceed in ways that will not induce drainage. (See Section III.H. Habitat-Wetlands.)

16. The construction of access and maintenance roads can cause major erosion-sedimentation damage.

Ground Water

17. Ground water is an important resource used for domestic, irrigation, livestock, municipal, and industrial purposes. Both pipeline construction and operation can degrade ground water quality. Ground water is the only source of potable water in some areas. Because of the importance of ground water, and because its location and the characteristics of aquifers affect its vulnerability to pollution, a detailed ground water inventory is necessary. Similar concerns exist for surface waters.

18. Sediments beneath the bottom of Port Angeles Harbor and Ediz Hook were probed at a depth greater than that to be affected by project construction. The probes showed no significant ground water. There are no known public water supply wells in the vicinity of Ediz Hook. (TR 8512-13 Veatch).

19. At the tank farm site, a shallow discontinuous perched water condition occurs above a clay-silt layer beneath the site. The water level in these perched zones ranges in

depth from about five to ten feet. Northern Tier did not bore deeper than 55 feet. (TR 8513-14 Veatch).

20. Ground water studies of areas just to the east of the onshore storage site indicate that the regional water table is at or below sea level beneath the site. (TR 8514 Veatch)

21. Data on the chemical quality of the ground water at Green Point are not available. Regionally the water is generally of good to excellent quality. (TR 8414-15 Veatch).

22. At the tank farm, the significant regional ground water table probably does not receive recharge from the local surface due to the impermeability of the glacial tills beneath the site. The discontinuous perched aquifers will probably be affected by direct contact in places and by changes in surface permeability resulting from construction. These aquifers are not significant. (TR 8492 Alsup).

23. Activities associated with construction of the tanker unloading facilities and unloading pipelines are not expected to affect ground water resources. (TR 8492 Alsup).

24. Construction activities at the marine terminal will not affect public water supplies. There is one well ap-

proximately 1,500 feet from the tank farm site operated by Clallam County Public Utility District No. 1. No construction impacts are anticipated on that well. (TR 27953 Kitz; Applic. III, Secs. 2.3.2.3 and 2.3.3.3).

25. Impact to ground water or public water supplies from an oil spill in the area of the marine terminal is not expected. (Applic. III, Sec. 2.3.2.2.)

26. Northern Tier may not be able to depend upon Local Utility District #1 for water supply on the Green Point tank farm. Such water supply may only be available if the District has a surplus. (TR 27959 Kitz).

27. There are no ground water resources to be impacted by the construction or operation of the submarine portion of the pipeline. (TR 8486).

28. The important aquifers along the proposed pipeline corridor in the Puget Sound region generally occur in outwash deposits. Glacial till and bedrock, common in the region, do not contain major aquifers because of their very low permeability. (TR 8518 Veatch).

29. The ground water resources of significance in the Cascade Mountains region are confined to the Quaternary glacial drift or alluvial deposits. (Applic. III, Sec. 1.3.4.2).

30. The primary aquifers along the corridor route in the Eastern Washington region are contained in the Quaternary sediments and basalt formations. (TR 8520-21 Veatch).

31. Typical chemical quality of ground water in Western Washington is rated good to excellent. The chemical quality of water along the Eastern Washington route is generally good.

32. The proposed pipeline route passes near many communities in Washington. Most of these communities obtain their water supplies from ground or surface water sources in the immediate locality. A majority of public systems rely on ground water.

33. It is important in planning construction of a pipeline to know the depth to aquifer and the nature of the surrounding materials. This should be ascertained along the corridor.

34. Where the pipeline crosses a shallow aquifer in unconsolidated materials so that the bottom of the trench is below the water table, pollution of ground water and some loss of water may occur. (Grimstad).

35. If, during construction, the impermeable strata underlying a perched water table were to be pierced, the water in the perched aquifer would have access to the lower zone. (Grimstad PFT p.5).

36. Where the trench is within ground water, impermeable backfill material may impede natural water movement, and permeable material may cause the ditch to act as an infiltration trench. Fill material must be of the same permeability as the material adjacent to the trench to prevent alteration of water movement. If no special efforts are taken to compact the backfill, it will be more permeable than the surrounding material (Grimstad PFT pp. 5-6).

37. Oil spilled in permeable soil will move laterally and down until it encounters a less permeable stratum, if such exists. (TR 35511).

38. To correct the most dangerous situation where the ditch is constructed in permeable material and the fill is also permeable, would require an impermeable barrier between

the ditch and the aquifer to prevent downward movement of spilled oil. (Grimstad PFT pp. 9-10).

39. The pipeline will cross shallow aquifers throughout the State of Washington. From existing records, their specific locations are unknown.

40. Sufficiently detailed and up-to-date information on shallow wells does not exist. Therefore, actual field work should be done prior to pipeline construction.

41. Insufficient information has been provided to reach firm conclusions concerning the potential effects of the pipeline upon ground water in eastern Washington. Corridor maps should be prepared which show near-surface geology; water level contours relative to a base level for the unconfined aquifers; depth to the water table below the land surface for unconfined aquifers; and depth to top of aquifer for shallow confined aquifers. Work should include examination of wells in the corridor to determine depth of the well, static water level, depth of the aquifer, pump capacity size, and any history of water problems.

42. Potential ground water contamination was not a factor in identification of the sites contained in Exhibit 198,

"OSCRP (Oil Spill Contingency Response Plan) Planning, Selected Sites, Central and Eastern Washington." (TR 16437).

Island County

43. Ground water supplies on Whidbey Island and Camano Island are, for all practical purposes, finite. While on a long-term basis ground water supplies are being recharged, usable ground water supplies will be lost, if consumption, run-off and/or loss by saltwater intrusions or other contamination, cause this recharge rate to be exceeded. (Thorsen Prefiled Testimony page 9).

44. A continuous "blanket" of glacial till of sufficient depth would help protect ground water supplies from potential oil contamination from the proposed pipeline.

45. Adequate information does not exist to determine the extent of continuity of glacial till on Northern Camano Island and Northern Whidbey Island. (Thorsen Prefiled Testimony page 10).

46. The existence of glacial till on Northern Whidbey and Camano Islands cannot be relied upon to protect ground water for the following reasons: (1) The till or other glacial drift originating from the last two glacial episodes occurs, in places, fairly close to the surface of the ground,

but a given exposure of till on an upland surface is not necessarily the last, or youngest, till. Correlating particular till units in an area of multiple tills is made difficult by the fact that till tends to cut underlying materials and "drape over" the preglacial landscape. (2) Even where the existence of a middle till can be ruled out, there may be gaps or holes in the upper till. Blocks of till, ten feet or more in diameter are abundant, particularly on North Whidbey Island. (3) It is difficult, if not impossible, to determine the thickness of the glacial till on upland surfaces. On flat or gently rolling upland surfaces, the till cover may be continuous but thin. Oil from a pipeline spill or rupture could reach aquifers through perforations. (Thorsen Prefiled Testimony, pages 10 and 11.)

47. The term "till window" refers to a situation where sheetlike deposits of glacial till surround places without the till. The till's absence in the "windows" could be caused by the till having been removed by erosion or the till never having been deposited. (TR 32950).

48. Because glacial till generally has a relatively low permeability in comparison to other geologic materials, "windows" in the till deposits can be areas where underlying aquifers receive more recharge, from water infiltrating the land surface, than the aquifers receive in till-covered areas. (TR 32950, 32951).

49. Oil spilled in areas where till is absent and where the surficial deposits are more permeable than till generally, would have more opportunity to seep downward than it would in till-covered areas. (TR 32951).

50. The applicant has not supplied sufficient information to predict adequately where till windows may be located along the proposed pipeline route on Whidbey and Camano Islands.

51. The geologic mapping that has been done to date on Whidbey and Camano Islands might have missed till windows as large as several hundred feet across. (TR 32973).

52. An examination of soil log holes and borrow pits throughout Island County shows that layers of glacial till vary greatly in depth and thickness. (TR 35510).

53. Insufficient information exists at the present time to determine the extent to which ground water resources are at risk at the landfall areas of the proposed pipeline in the vicinity of Point Partridge and Polnell Point on Whidbey Island, and Brown Point on Camano Island. (TR 32937.)

54. More than half of the data concerning soil log holes in the vicinity of the proposed pipeline corridor on file with the Island County Health Department do not show any indi-

cation of glacial till in the six-to-twelve foot area beneath the surface of the ground, but rather indicate only the existence of more permeable materials. (TR 34972-34974).

55. The applicant has not presented sufficient evidence to establish that the proposed pipeline across northern Whidbey and Camano Islands would be located over areas of low permeability. Adequate evidence in this regard would have included the results of studies involving several test borings in the vicinity of the proposed pipeline corridor to define relatively permeable lenses or strata or other local phenomena, so that route realignments could have been made where necessary and possible, to avoid moderate to highly permeable surficial strata.

56. Island County is currently trying to protect its ground water by seeking federal designation of its aquifer as a sole source aquifer. Island County is also actively promoting use of the Water Systems Coordination Act to define critical water service areas. (TR 35512).

57. If an aquifer becomes contaminated, cleanup is difficult. Mitigative measures have limited utility. (TR 35512).

58. High pumping rate wells would encourage, and possibly cause, salt water intrusion into the aquifers, parti-

cularly if such wells were installed near shoreline areas. (TR 35512).

59. There is a potential for breaching confined (artesian) aquifers in the Point Partridge-Sierra area of Whidbey Island and other areas adjacent to the proposed landfall sites. Trenching near the shorelines could breach one of these aquifers. (TR 35513).

60. Breaching of a confining layer of a confined or artesian aquifer during marine excavation allows a concentrated flow of water through the breach, across the confining layer. The volume and direction of this flow depends in part upon the hydraulic gradient. The hydraulic gradient is the difference in head between the aquifer and the adjoining body of water. (TR 32947).

61. The proposed pipeline route passes through or in close proximity to several existing subdivisions in Island County which depend upon local ground water as a source of drinking water. (TR 35513).

62. Significant ground water recharge occurs in proximity to the proposed pipeline route along west Whidbey Island and through north Whidbey Island (TR 35514).

63. The proposed pipeline would intersect a wetland area, north of Crescent Harbor, which could be a major recharge area. (TR 35514).

64. Recharge areas in the vicinity of the proposed pipeline route in Island County have not been identified by the applicant. (TR 35514).

65. Information necessary to address the issue of protection of ground water adequately that has not been provided by the applicant includes: test borings along the proposed route for the purpose of defining and describing the aquifers in terms of rate and direction of flow; identification and description of ground water recharge areas in terms of rate of recharge; and base line data to indicate current conditions in the aquifers. (TR 35543).

66. There are significant aquifer recharge areas along the proposed pipeline corridor for approximately three miles on north Whidbey in the Swantown and Crescent Harbor areas. Ground water in these areas would be in immediate contact if oil was spilled from the pipeline. (TR 34918).

67. The presence of petroleum hydrocarbon contaminants below toxic levels precludes ground water use as potable water because of taste and odor problems. Inhibitory effects

on plant growth have been detected at concentrations of 0.5 percent oil in soil, with a 100 percent kill of plants at a .4 percent concentration of oil in soil. (Canning Prefiled Testimony, page 13).

68. Construction and operation of the proposed pipeline, if oil leaks occur, could damage the ground water system on Whidbey Island. (TR 32963).

69. Trenching activities at the proposed Brown Point landfall site may cause incursions of salt water into the fresh water system. (TR 32963).

70. The aquifer in the vicinity of Brown Point on Camano Island supplies a large proportion of the total fresh ground water that is used in that part of the island. (TR 32975).

71. Much recharge to the ground water system in the Puget Sound lowland area, including Whidbey and Camano Islands, occurs as slow, widespread percolation through glacial till. (TR 32998).

72. The ground water or aquifer system on Whidbey Island and Camano Island is valuable in comparison to ground water systems in the mainland areas, because there is no readily and economically available alternative supply of fresh water,

except for a pipeline which brings water from the Skagit River to the city of Oak Harbor and the Naval Air Station on Whidbey Island. (TR 32998).

73. A significant part of Oak Harbor's water supply is from ground water. (TR 35511).

74. In Island County, perched aquifers are used for domestic purposes. These shallower aquifers may recharge a principal aquifer. (TR 35510).

75. The likelihood of an oil spill occurring which would reach Whidbey Island ground water is low; the adverse consequences of such an event could be severe.

Snohomish and King Counties

76. In Snohomish County, of 48.8 miles of pipeline route, 12.2 miles are in alluvium of variable permeability with 11 of these miles having a depth to the principal aquifer of less than 50 feet. Of the remainder of the route, 11.2 miles are recessional outwash, glacially-deposited sand and gravels of high permeability. (TR 8519-8520).

77. Hydrogeological reconnaissances to determine possible impacts on ground water were not done for counties other than Island or Snohomish. (TR 8654).

78. None of the information recommended on page 22 of Exhibit 179, CONCAWE, (Conservation of Clean Air and Water - Europe Oil Companies Study Group - March 1979 Report), Protection of Groundwater from Oil Pollution, as necessary in site surveys to assess risks of pollution to aquifers and to define measures for reducing or preventing such risks is contained in the OSCRP. (TR 16480). The information necessary includes climatological information on water balance and recharge rates of aquifers; knowledge of natural groundwater flow, water entries and discharges; studies of the geological structure of substratum, thicknesses and cross-sections; and information concerning behavior of the aquifer derived from surface surveys and well tests. Good knowledge of these conditions is necessary to understand the steps to take before and after a spill. (Exhibit 179, p. 22; TR 16481).

79. Additional information required to allow assessment of the possible risks to ground water from pollution by oil, and to define measures for reducing or preventing these risks, includes: general idea of the risks of pollution; evaluation of risks of propagation of the pollution; direction of potential migration; and specifications of a hydrodynamic protection system. This and the information listed in finding 78 above, should be obtained over a larger area than that to be protected and must be available before adequate preventive or

remedial steps are taken. (TR 37682-37683; Exhibit 179, page 22).

80. Pipeline trench construction through flood plains is likely to encounter shallow ground water. (TR 37672-38017).

81. Numerous wells in King County supply water from shallow perched water tables within the Vashon till. (TR 37674). Many King County wells along the pipeline route are from 15 to 80 feet deep and vulnerable to surface contamination. (TR 38010).

82. Northern Tier's consultants made no recommendations for King or Snohomish County changes in routing due to aquifers. (TR 8536). No deep regional aquifers have been shown along the pipeline route in King County. (TR 37730)

83. The floodplain area of the three forks of the Snoqualmie River near North Bend is susceptible to oil contamination of ground water from a pipeline leak, due to very permeable coarse alluvial river gravel and sand with no underlying glacial till.

84. A shallow ground water table approximately ten feet below the surface is known to exist near the pipeline

centerline in the Snoqualmie floodplain. Deep burial of the pipeline as recommended by Northern Tier would create a 16.5 foot deep trench throughout a two-mile floodplain, and would intercept the ground water table. (TR 37676).

85. A relatively high geohydrologic gradient in the floodplain near North Bend will increase the risk of oil migration into and within ground water. (TR 37678).

86. A large leak may migrate out of the ditch into adjacent alluvium in a day's time, and go undetected for several days, or until the taste of contamination is noticed in nearby wells. (TR 37681).

87. The exact number of shallow wells and springs in the floodplain area of the Snoqualmie River is currently unknown. (TR 37682).

88. The North Bend area has been considered as one of the two largest potential sources of ground water to meet the water supply needs of the rapidly growing Bellevue-Redmond area. (TR 37683)

III. G. AIR QUALITY

1. Ambient air quality effects from construction will be limited to transient, local increases in pollutant concentrations in the vicinity of these activities. No significant impacts will occur.

2. Most of the air emissions related to the operation of the Northern Tier system result from tanker operations. Other sources include the onshore storage facility tanks and the steam plant at Ediz Hook.

3. The fuel consumption rates and emission factors utilized by the applicant in its air quality analysis were reasonable best estimates of actual operating emissions.

4. The ITT-Rayonier plant in the vicinity of the monitors at 3rd and Chestnut and 4th and Baker is primarily responsible for violations of the federal 24-hour sulfur dioxide (SO_2) standard, as well as the state 24-hour and one-hour standards. The Department of Ecology has determined that covering of ITT's spent sulfite liquor holding pond will eliminate the measured SO_2 violations and consequently eliminate projected violations of the state one-hour standards to which Northern Tier might contribute.

5. Operation of the Northern Tier facility as proposed should not cause federal ambient air quality standards for SO_2 to be exceeded. No violations of the Washington annual standards for SO_2 are predicted to occur. The incremental impact from the proposed project will not result in any new violations of the state 24-hour standard.

6. The predicted annual average of total suspended particulates (TSP) concentrations due to the combined emissions of Northern Tier and existing sources in Port Angeles are below state and federal standards. The maximum annual concentration from the proposed marine terminal is below the federal and state significance levels for TSP and will not cause a violation of the standards.

7. The proposed terminal facilities will not cause violations of the applicable federal and state standards for ambient concentrations of nitrogen dioxide (NO_2).

8. No violations of the applicable federal and state ambient air quality standards for ozone (O_3) are predicted. Recent U.S. Coast Guard regulations prohibiting most hydrocarbon emissions during ballasting will probably reduce ambient ozone levels even further.

9. The regulations in Finding 8 only apply to nonattainment areas and consequently do not apply to Port Angeles. Northern Tier has, however, committed to such practices, and this commitment could be enforced in a certification agreement condition.

10. Neither federal nor state ambient air quality standards for carbon monoxide are exceeded by existing sources in the Port Angeles area. No violations are predicted for the combined effects of existing sources and Northern Tier.

11. No significant fugitive dust emissions are connected with the operation phase of the proposed Northern Tier system.

12. The operation of the proposed Northern Tier facilities in the Port Angeles area will not cause an adverse health impact due to emissions of SO_2, TSP, NO_2 or O_3.

13. The following air emission levels and operating standards are appropriate for the operation of the proposed Northern Tier facility:

A.

	lbs/hr.	lbs/day	tons/yr	Report Abnormal Operations when over:
Particulates		500	24	360 lbs/day
SO_2		5000	250	4000 lbs/day
Hydrocarbons (O_3)	80	1000	300	40 lbs/hr

B. Stack emissions in excess of 1000 parts per million (ppm) of sulfur dioxide or when opacity is greater than 20% for more than three minutes in any hour are violations of WAC 463-39-040.

C. Northern Tier will maintain a supply of not more than 0.45% sulfur fuel which will be used for all ship operations while at berth, excluding the time necessary for steam vessels to connect to the low sulfur fuel supply after arriving at berth. Unloading operations for steam vessels will begin only after the connection has been made. Diesel engine-powered ships will be required to burn either low sulfur diesel fuel or 0.45% residual fuel in their auxiliary steam plants during all at-berth and in-port operations. An unloading operation should be curtailed or shut down if tanker emissions threaten an ambient air quality standard.

D. No ballasting emissions or purging operations shall occur within the harbor except in instances of a documented emergency.

III. H. HABITAT

1. Wildlife habitat must be composed of feeding areas, cover areas, and available watering sites. (Perry p. 17). The destruction or disturbance of habitat reduces carrying capacity. All habitat elements are necessary to support wildlife on a year-round basis. Loss of key habitat segments causes wildlife losses over entire home ranges. (Oliver (1) p. 8).

2. Approximately 200 acres of agricultural land will be cleared in the rights-of-way in Clallam and Island Counties. Crop land could lose one season of productivity. Reclaimed pasture land may not be available to livestock for two years. About 98 acres of forest land will be removed from production. (TR 9496 Reyes-French). In Snohomish and King Counties, construction will require clearing of about 166 acres of farm land and 503 acres of forest land. (TR 9497 Reyes-French).

3. Within the Cascade Mountain region, 537 acres of forest land are susceptible to removal. If the final pipeline centerline right-of-way coincides with transmission line rights-of-way, resource loss will be lower. Forest land and grass land/shrub land will be disturbed by pipeline construction in this region. The steep topography combined with a deep

snow pack results in a high-to-moderate erosion hazard in some areas of the Cascade region, especially near Snoqualmie Pass. (TR 9497-99 Reyes-French).

4. Approximately 974 acres of grass land, shrub land and 863 acres of crop land will be affected by pipeline construction in eastern Washington . Effects of construction on crop land will be temporary. Productivity losses on range land will depend on soil quality and available soil moisture. A large portion of the pipeline route (from Crescent Bar to Sprague) gets less than 12 inches of rain per year. Where there are shallow rocky soils and low rainfall, there will be slow recovery (five years or more). Erosion hazard from wind and rain in this region is most significant in the Columbia River area and in the steep hills near the Idaho border. (TR 9499-9500 Reyes-French).

Eastern Washington Habitat

5. Cliffs are unique and critical habitats to wildlife. They occur in numerous locations in the pipeline corridors in eastern Washington. Cliffs, rocky outcroppings, and talus slopes are essential as nesting sites and as feeding and reproductive habitats for many species.

6. The Columbia River canyon provides excellent habitat for predatory birds by providing secure sites for nest-

ing, thermal updrafts for hunting, habitat for prey sources, and isolation from disturbances. Species of major concern are peregrine falcons (a federally listed endangered species), prairie falcons, and golden eagles. Other predatory birds are present. (Friesz, p. 23).

7. Rocky Ford Creek and the upper end of Moses Lake provide a marshy riparian wildlife habitat area with year-round open water. It is particularly important to water birds. It also contains muskrat and beaver habitat. (Friesz, p. 24-25).

8. Sprague Lake and the Cow Creek system are a heavily vegetated and productive habitat for wildlife. (Friesz, p. 30).

9. Numerous ponds are located in the channeled scablands within one mile of the centerline between the western Spokane County line and Rock Creek Canyon. Most of these ponds support waterfowl production in years of normal precipitation, and all serve as feeding and resting areas supporting diverse wildlife. (Pineo, p. 5).

10. The pipeline route crosses Rock Creek Canyon, a significant geological feature of the channeled scablands. (Pineo, p. 5). The canyon and its drainage sustain deer, quail

and other fauna. (Pineo, p. 6). Blasting in Rock Creek Canyon would be necessary for a buried crossing. (Pineo, p. 12)

11. Gelbert Mountain is isolated, timbered, mountainous terrain, a critical habitat for many species found on it. (Pineo, p. 9).

Habitat Management Areas

12. Habitat Management Areas (HMAs), whether managed for big game, upland birds, waterfowl or other classes of wildlife, provide critical habitat necessary to support animals in the area. Critical habitat provides the necessities for survival during periods of life or death stress on a population. (Perry p. 35).

13. The Colockum HMA is a wildlife management and protection area. It is one of the state's most important sites for hunting, trapping, and nature appreciation. About 98,000 man-days of recreation took place on the Colockum HMA last year. Upland game birds and big game are the main species hunted. (Friesz p. 22, Perry p. 51).

14. The Colockum is a key winter range for big game, especially elk. The Colockum provides high quality winter range including: favorable south slopes, high food potential, vegetative and topographic cover, and large areas with few or

no roads. It has a high per-mile support capacity for elk and deer. Elk and deer use the Colockum all year long. Periods of peak use, depending on weather, extend from October through June. A Colockum area that overlaps the NTP corridor has been recognized as one of few calving areas. (Oliver cross p. 32918-20, Perry p. 33-38, 51)

15. Other animal species inhabit the Colockum. Of 103 rare, threatened, or endangered plant species in Washington State, 61 are found in the Colockum HMA. (Perry p. 28).

16. The proposed right-of-way segment in the Colockum HMA will result in a direct habitat alteration of 142 acres. The loss may continue past the project life because of the extremely long recovery time for vegetation in this area. A road along the NTP right-of-way in the Colockum HMA would reduce elk use. Damage to vegetation would lower the carrying capacity significantly for upland game birds. (Oliver p. 9, Perry p. 31, 32, 34, 35).

17. A spill into any one of the drainages on the west side of Colockum Pass would introduce oil into waters serving local irrigation districts and into the Yakima River. (Oliver p. 24).

18. The Gloyd Seeps HMA is a 10,111 acre waterfowl, upland bird and fishing area located in Grant County. The area is an important site for hunting, trapping, fishing and wildlife appreciation. (Friesz p. 28, Oliver(1) p. 16).

19. Within Gloyd Seeps, Crab Creek and numerous springs form a series of lakes, ponds, channels and marshes, providing habitat for upland game birds and pelicans. (Friesz p. 28)

20. The pipeline corridor crosses the Skagit HMA. This area provides important habitat to waterfowl, marine birds, predatory birds, and many other species. (Jeffrey p. 2).

Game Fish

21. Game fish species found in western Washington streams to be crossed by the pipeline include cutthroat trout, steelhead, Dolly Varden, rainbow trout, eastern brook trout, and whitefish. Fish occurring in lakes and ponds on or near the pipeline alignment in western Washington include bass, crappie, perch, cutthroat trout, and eastern brook trout. (Pfeifer, Attachment B). The net or mean value for steelhead in these streams averages 1.8 million dollars annually, and the gross economic value averages 3.3 million dollars annually. (Pfeifer, p. 3).

22. Sport fishing is a popular and productive activity in many eastern Washington lakes, streams and water-courses along the Northern Tier route. Anglers spend more than $115,000,000 per year (variable year dollars) in this region to fish for trout, whitefish, and many other game species. Eastern Washington waters which support substantial recreational fisheries include the Yakima River and its branches, the mid-Columbia, the Columbia Basin Project, Rocky Ford Creek and Moses Lake, the Potholes Reservoir, Crab Creek, Sprague Lake, and Rock Creek and Bonney Lake.

23. There is potential environmental damage to streams during construction. The main long-term concerns for impacts to fish are (1) siltation* and (2) oil spills. (Eldred, p. 11, 20).

Sedimentation Impacts

24. Sedimentation is the introduction of small particles of earth into a body of water. It occurs when soil-bearing surface water runs into a stream or lake, or when the fine particles within the stream bed are dislodged or stirred up into the current by disturbance. Sediment from outside the stream is often the result of bare or sparsely vegetated soil and decreased surface soil permeability. The amount of sediment generated is a function of excavation and size of bed material.

*Siltation is the introduction of very fine, small particles of earth into a body of water. Siltation is a form of sedimentation and perhaps the most damaging to fish.

Sediment transport and flushing ability depend on current speed and particle size. (Eldred, p. 11, 12).

25. The detrimental effects of sediment on aquatic resources can be measured in direct mortality or reduced production depending upon concentration and time of exposure. High turbidity and high concentrations of suspended sediment affect the feeding and consequent growth of juvenile salmonids. Heavy suspended sediment concentrations can kill fish directly by damaging their gills. The blanketing effect of sediment and its instability can reduce invertebrate composition and quantity, reduce hiding cover and living space, and directly affect fish reproduction. Within the salmonid nest environment, sediment affects survival by inhibiting intragravel water flow or by acting as a physical barrier to fry emergence. A lack of adequate intragravel water flow may result in suffocation of developing eggs or embryos where oxygenated water is prevented from bathing the eggs. Metabolic byproducts are not carried away when intragravel flow is inhibited; and toxic effects from these byproducts can result in mortalities. (Pfeifer, p. 4, 5).

26. The damage attributable to sediment depends upon the degree to which sediment will be left in the stream in relation to pre-project conditions, and the total number of game fish which will be affected, either directly by egg or

alevin suffocation, or indirectly, by loss of invertebrate food supplies. Because salmonid reproduction and rearing is often much more dense in the smaller streams than in mainstream rivers, and because the larger streams usually have a greater dilution capability, the greatest sediment impacts can be expected in smaller streams. (Pfeifer, p. 10).

27. The amount of damaging sedimentation caused by trenching in streams cannot be known with certainty without analysis of ambient suspended sediments, existing gravel quality, stream geohydraulics, and game fish utilization. (Pfeifer, p. 10).

28. On the Yakima River, any remaining suspended sediment will settle out 42 miles downstream in the Roza Dam reservoir. A decrease in the numbers of trout and whitefish between the Yakima pipeline crossing and Roza Dam could occur. (Eldred, p. 15).

29. Riparian vegetation is an essential component of fish habitat, contributing to bank stabilization and erosion control, water temperature control, instream cover, stream flow velocity control, and fish food supplies. (Pfeifer, p. 12).

30. Improperly installed culverts under roads create obstructions to fish movement. Stream channels may be de-

watered, blocking fish movement, if low water fords are used for construction traffic. (Eldred, 18, 19, Kay).

Other Construction Impacts

31. The most damaging construction disturbances will likely occur in the canyons, and in the channeled scablands. Because of rock and shallow soils, excavation will require extensive blasting, longer construction periods and more intensive noise and vibration. (Friesz p. 32). Where blasting is necessary, a large volume of rock debris will be created. If the ditch to be dug is 76 inches deep, at least 60 inches of bedrock will be displaced. Of this, only 18 inches will be returned to the ditch. Over a one mile segment, almost 100,000 cubic feet of rock would require disposal, creating revegetation and disposal problems. (Benson (2), p. 7). Rock will be encountered along significant portions of the pipeline route in eastern Washington (Vol. 214 p. 40370-40371).

32. Construction equipment operation will destroy vegetation and compact soils. Only partial replacement will occur during project life. (Pineo p. 11).

33. There will be habitat impacts from construction-related activity outside the right-of-way.

34. Indirect impacts, those occurring in areas adjacent to the NTP corridor, are mostly associated with road and related activities along the corridor.

35. The new forest "edge" created by the NTP corridor would have some positive impacts. If the corridor cuts through large expanses of a uniform forest, the induced edge would benefit species that require grass, brush, and forest. The desirability and benefit of induced edge and corridor openings depend on differences in plant communities; their size, shape, relationship to other openings or edges; and the amount of these features currently available to wildlife in the area. (Perry p. 46). The use of herbicides and mechanical cutting to control vegetative growth on the pipeline corridor will negate some benefits that may otherwise result from the creation of edge. For some species, cleared right-of-way would cause loss of habitat. Routing along an existing corridor could lessen impacts for such species. (Stendal p. 8, 9).

Game Animals

36. Riparian-aquatic furbearers would be affected by direct loss of habitat and by siltation. Problems would include oiled fur, contaminated food, and altered feeding habits. (Leschner p. 41, 42).

Waterfowl

37. The NTPC corridor bisects the Skagit - Port Susan waterfowl area. This salt marsh is one of the most important coastal waterfowl habitats in Oregon and Washington, with substantial recreational use. The pipeline will pass through the most productive part. (Jeffrey p. 3, 4).

38. Waterfowl production is significant in western Spokane County near the proposed centerline. (Pineo p. 5; Oliver (1) p. 17).

39. The release of oil into the environment is the most serious threat to waterfowl and habitats presented by either construction or operation of the pipeline. (Jeffrey p. 10).

40. Considering habitat losses and disturbance during construction operations, and the threat of oil spills, significant impacts from NTP on some waterfowl habitat are likely. (Oliver (1) p. 16).

Marine Mammals

41. Twenty-one species of marine mammals are reported in the waters of Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca. These nine species occur yearly as breeding residents or seasonal migrants: river otter, California

sea lion, Northern sea lion, harbor seal, gray whale, minke whale, killer whale, harbor porpoise, and Dall porpoise. (Everitt, p. 5, 6).

42. Direct impacts of oil on marine mammals or their feeding habits are not known. The effect of oil pollution on harbor seals is not well documented. (Everitt p. 17).

43. Disruption of harbor seal hauling areas can lead to abandonment of some areas, changes in hauling behavior, and increased abandonment and mortality of pups. (Everitt p. 17, 18) Two of the three most productive breeding areas in northern Puget Sound - the Dungeness area and Protection Island - are within the proposed pipeline corridor. (Everitt p. 26).

Uncommon Species

44. Many uncommon species of fauna and flora occur along the corridor. (Leschner p. 15, 17). (Friesz Attachment 2).

45. The bald eagle is a federally-listed, threatened species in Washington. Thirteen known nests are located in or near the corridor. The most critical nests are at Protection Island, Polnell Point, and Utsalady. Northern Puget Sound regularly attracts a large wintering eagle population. (Leschner p. 17, 18, 19) The Green Point bald eagle nest is located along

the perimeter of the proposed onshore storage site and is part of an active nesting territory. (Leschner p. 18).

46. Harassment near bald eagle territories during the breeding season will cause nest abandonment. Disturbances will also reduce the time and efficiency of attention and care for the young. (Leschner p. 20, 21).

47. The peregrine falcon, included on the federal endangered species list, is found in the Skagit flats and in the Dungeness-Protection Island area. (Leschner p. 23, 24).

Wetlands

48. Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. For purposes of classification, wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes (water plants); (2) the substrate is predominantly undrained hydric soil; or (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season. (Stendal p. 5).

49. Wetlands can include freshwater marsh, saltwater marsh, bogs and freshwater swamps. (TR 36556.) They support diverse species, recharge aquifers, and trap sediment and pollutants. Many Puget Sound wetlands have been lost or severely modified. Partial wetland loss can cause substantial habitat and water purification impacts. (TR 36317, 36319, 36326, Ex. 716) (Wetland Narrative and Slides, Snohomish County). Disturbances to wetlands are likely to cause disruption to wildlife within 150 feet of the pipeline centerline (greater distance in marshes). (TR 36564).

50. Wetland areas are located at Grays Marsh near Dungeness, Davis Slough and West Pass along the Skagit HMA, and many smaller areas along the corridor from Stanwood to North Bend. Wetlands along the pipeline corridor in eastern Washington are found in the Rocky Ford Creek, Gloyd Seeps, and east of Sprague Lake. (Friesz p. 25, p. 28, Leschner, p. 6).

51. Altering ground water movement and drainage patterns may result in destruction of some eastern Washington wetlands. The pipeline trench may intersect and drain the shallow aquifers upon which many scabrock marshes, ponds, and subirrigated wetlands depend. If vernal ponds or marshes then fail to hold water, or drain more quickly than they do now, vegetative associations would change. Wildlife species depend-

ing on existing wetland and riparian vegetation could be lost, and productivity would be reduced. (Pineo, p. 10).

52. Major estuaries within or adjacent to the proposed corridor include the Dungeness, Skagit, Stillaguamish, and Snohomish Rivers. The Dungeness estuary, along with wetlands associated with Sequim, Discovery Bay and Protection Island, is an important Olympic Peninsula habitat. The Skagit-Stillaguamish area supports about 200 wintering bald eagles and has the largest known concentration of wintering peregrine falcons in Washington. (Leschner p. 6, 8, 9, 10).

53. The best way to protect wetlands is to avoid them.

54. The applicant did not sufficiently map or otherwise identify wetlands and riparian habitats and dependent species. As an example, over 47 wetlands have been identified within the Snohomish County corridor. Twenty of these are on or within approximately 150 feet of the centerline; NTPC identified nine, omitting major wetlands. (TR 36328, 36329; Ex. 719; TR 36498-36509.)

55. Eight to ten of the 20 wetlands which Snohomish County identified as being within 150 feet of the centerline are five acres or larger. (TR 36551-36552.) NTPC utilized a

criterion of five acres or more for identifying wetlands. Northern Tier underestimated the impacts of this project on wetlands. (TR 36336, 36341).

56. Davis Slough, part of a larger wetland complex, includes mud flats, fresh and saltwater marshes, ponds and sloughs. Significant bird species are found here.

57. A more accurate assessment of wetlands, and important riparian and forest habitats would be desirable, including accurate mapping, habitat evaluation and mitigation planning. Realignment feasibility studies for all wetlands crossed or immediately adjacent to the centerline should be undertaken. (TR 36509-36510). Northern Tier's centerline location would cause a direct loss of wetland vegetation and associated riparian habitats. (TR 36566-36567).

58. In Snohomish County, wetland habitats of 11 rare, threatened or endangered species have been documented. (TR 36341, 36343, Ex. 711; 712; 714; TR 36499). Data of similar quality do not exist in other counties.

59. A permanent easement creates a potential for increased public access and more disturbance to wetlands. (TR 36570).

Fauna Impacts at the Marine Terminal

60. Impacts on marine mammals and water birds from construction of the berths will generally be temporary and local. The 75-acre site will be lost to water birds but is of minor importance to other marine fauna. The extent and period of disturbance during construction will not eliminate use of the harbor by most marine mammal or water bird species, but may for some. (TR 9406-08 Reed). The loss of eelgrass (1.5 acres) along a small portion of Ediz Hook and increased sedimentation may cause some loss of herring and crab habitats. Construction of the unloading pipelines will destroy benthic (bottom-dwelling) fauna within the pipeline trench and the disposal area. Dredging activities will destroy about 14 (out of 766) acres of hardshell clam habitat and about 25 (out of about 3,145) acres of geoduck habitat. Juvenile fish may also be at risk near Green Point due to dredging activities. Construction activities are not expected to affect zooplankton populations significantly. (TR 9438-42 Yuill; TR 33603-04 Mills; TR 33613-14 R. Johnson).

61. Impacts on terrestrial fauna from construction of the tank farm include loss of about 140 acres of woodland habitat, potential disturbance of a bald eagle roosting and nesting location, and short-term displacement and stress because of noise and increased human activity. Any displacement or loss of forest-dwelling mammalian species would not be of

regional significance. (TR 9485 Reyes-French; TR 9407-08 Reed; TR 31324-25 Leschner).

62. Ship traffic, berthing, and other activities in the harbor will cause some minor disturbance to water birds and will decrease the availability of undisturbed nesting and feeding habitats. (TR 9406-07 Reed). (TR 9439-40 Yuill).

63. If all operational discharges meet conditions specified in an NPDES permit, no significant impacts on fauna are expected. (Applic. III, Sec. 2.5.3.2.)

64. Dredging and pipeline trenching may increase the mortality rate of demersal fish eggs* or juvenile fish in eelgrass areas. Juvenile salmon could be affected by increased sediment loads in areas immediately adjacent to dredging. (TR 9452-53 Yuill; TR 33603 Mills; TR 33613 R. Johnson). There is a potential for the release of toxic substances from bottom sediments into the water column by dredging, and for reduction of oxygen. This could affect adult or larval fauna and the plankton upon which they feed. (TR 33603, TR 3614 R. Johnson; TR 33908 Westley).

*Eggs which settle on the sea bottom

Flora Impacts at the Marine Terminal

65. Eelgrass, bullwhip kelp, and salt marshes occur in places between the berthing site and the Dungeness River. (Applic. III, Sec. 1.4.2.1; TR 9428-29 Yuill). Phytoplankton in the Strait of Juan de Fuca and Port Angeles Harbor consist of primarily of centric diatoms.* Freshwater phytoplankton occur in the harbor. Phytoplankton abundances show low densities during late winter and higher densities during the spring. Freshwater flora along Siebert Creek are limited primarily to shoreline periphyton (small aquatic plants and animals). (Applic. III, Sec. 1.4.2.1; TR 9428-29 Yuill).

66. The installation of the submarine unloading pipelines will cause temporary loss of about ten acres of bullwhip kelp beds in the sublittoral zone near Green Point. (Applic. III, Sec.2.4.2.1; TR 9429-31 Yuill). The addition of pilings on Ediz Hook will provide additional substrate for algae and habitat for certain worms and small crustaceans. (TR 9431 Yuill).

67. Phytoplankton in the vicinity of the proposed submarine pipeline route consist primarily of centric diatoms. Major floral communities occur along the submarine portion. Dredging operations will remove some eelgrass and intertidal macro-algae beds and diminish floral productivity by increasing

*Round-shaped, single-celled organisms with plant and animal characteristics, used as food by fish and small animals water turbidity and thereby decreasing photosynthesis. (TR 9448-49 Yuill).

68. There are no terrestrial flora at the tanker unloading site on Ediz Hook. At the onshore storage site, there are mixed coniferous/deciduous woodlands and deciduous woodlands. There are no known threatened or endangered plant species at the Green Point site. (Applic. III, Sec. 1.4.3.1; TR 9477-79 Reyes-French).

69. The normal operation of the onshore storage facilities will have no other significant impacts on terrestrial vegetation. (TR 9479 Reyes-French).

Terrestrial Flora

70. In terrestrial areas, aquatic flora predominating in streams to be crossed are probably periphytic diatoms.* Aquatic macrophytes** are also present in some streams. (TR 9455-56 Yuill).

71. In the Cascade Mountain region (North Bend to Yakima River crossing), the terrestrial flora consist of mixed deciduous and coniferous forest at low levels and coniferous forest at higher levels. This region east of the Cascade crest

*Fresh water organisms attached to the substrate

**Water plants large enough to be seen without a microscope has been extensively logged and, in places, cleared for transmission line rights-of-way. (TR 9491-93 Reyes-French). In the eastern Washington region (Yakima River crossing to Idaho border), the dominant terrestrial flora are bunchgrasses and low shrubs. The predominant land cover and land use in eastern Washington is dryland crop and range land.

72. The pipeline segment between the Colockum Pass Road and the east side of the Columbia River intercepts populations of several rare species. One is proposed endangered, and one is proposed threatened. At present, none of these species is protected by federal or state regulations. Construction of the pipeline may result in the loss of individuals of some of these species. The extremely specific habitat requirements of these species suggest that only the hedgehog cactus would likely reestablish itself on the rights-of-way.

73. Vegetation on pipeline rights-of-way should be controlled. A control program should favor grass and shrub species on the centerline sufficient to permit visual observation of oil spills from overflights. Permanent rights-of-way would be maintained by mowing, cutting, and herbicides as needed. There are also negative effects from using herbicides.

74. Vegetation may be damaged by vehicular traffic on the right-of-way. Northern Tier traffic would be limited to

necessary inspection and repair activities. Unauthorized traffic would be limited by constructing berms, planting screens and erecting gates where necessary, practicable, and permitted by private landowners. (TR 9502-03 Reyes-French).

III. I. FOSSIL FUEL AND STEEL REQUIREMENTS

1. The major fossil fuel types that will be required by the project are: gasoline, diesel fuel, bunker fuel, and propane. (TR 11721-22 Meyers).

2. Western Washington refined products required for construction would be supplied primarily by an intrastate marine and pipeline transportation system. Eastern Washington refined products required for construction would be supplied primarily by out-of-state petroleum products pipelines originating in Montana and Utah, and by barges and trucks from western Washington and Oregon. (Applic. III, Sec. 1.16.1.1).

3. The primary energy products required for construction will be gasoline and diesel fuel for equipment, barges, and motor vehicles. Fuels should be available for these construction activities. (Applic. III, Secs. 2.16.2.1 and 2.16.3.1; TR 11723-24 Meyers). Northern Tier will promote energy conservation by endeavoring to coordinate construction activities, to transport and deliver materials and supplies efficiently, and to minimize construction worker travel distances. (TR 11726, 12757 Meyers).

4. Construction of the Washington portion of the System will require 253,058 tons of steel.

5. During operation of the marine terminal facilities, substantial amounts of bunker fuel will be required to supply the crude oil tankers. Bunker fuel requirements are expected to average 11,000 barrels per day. An estimated 1,000 barrels per day of low sulfur bunker fuel will also be required to power all tankers when they are in port to ensure compliance with air quality standards. (Applic. III, Sec. 2.16.2.2). Bunker fuels are currently being imported to the Puget Sound area from California refineries.

III. J. CONSTRUCTION TIMING IMPACTS

1. There is no time during the year when pipeline construction can be scheduled to totally preclude impacts on all resources. Construction timing must take into consideration factors besides impacts on living resources.

Saltwater Areas

2. The saltwater areas in which the submarine pipelines are proposed contain abundant and economically-important populations of fish and shellfish which sustain recreational and commercial fisheries.

3. Juvenile salmon from the entire Puget Sound area and southern British Columbia outmigrate through the Strait of Juan de Fuca. Juvenile salmonids, particularly pink and chum, use intertidal and shallow sublittoral areas of Puget Sound for rearing and migration. The period of pink and chum peak abundance in the nearshore waters extends from March 15 to June 15. Juvenile pink and chum have been documented at Saratoga Passage, Sequim Bay, Port Angeles Harbor, Davis Slough and West Pass.

4. Dredging and nearshore construction activities can have adverse effects on juvenile salmonids such as physical entrainment in suction-type dredges. Dredging and construction activities can cause water quality changes (turbidity, dissolved oxygen, pollutants) which may cause losses due to lethal and sublethal effects, increased predation, interference with growth and subsequent inability to survive in marine waters.

5. Recreational salmon fishing occurs year-round in the region of Ediz Hook.

6. Port Angeles Harbor supports a commercially and recreationally harvestable Pandalid shrimp population. This is the only area of Puget Sound other than Hood Canal where such a harvest occurs. These shrimp appear to be an isolated population depending on recruitment from within the harbor. Crabs are also harvested there. Larval and juvenile shrimp and crab are abundant in April, May and June.

7. Lingcod and rockfish habitats are located between Port Williams and Partridge Point. Lingcod spawn in the shallower waters (less than 100 feet deep) between October and May. Prior to spawning, Pacific cod concentrate south and west of Protection Island from December through March. Various species of flatfish use essentially the entire area through which the submarine pipelines are proposed in Port Angeles Harbor,

Admiralty Inlet and Saratoga Passage. Surf smelt spawning from May 15 to October 15 has been documented in Saratoga Passage at the landfall on Camano Island. Herring school in a prespawning holding area south of Protection Island from December to February. Dredging and pipelaying operations can disrupt these fish populations.

8. Marine organisms would be directly damaged by pipeline construction in the following ways: (a) killing of sessile organisms directly in the dredge path; (b) killing of sessile organisms in areas closely adjacent to dredging or in the disposal area through smothering by deposited spoils; and (c) killing of mobile benthic organisms that are in the path of the dredge by crushing or entrainment. (Westley, PFT 3; Mills, PFT 4-5). There are potential indirect effects to marine organisms as a result of pipeline construction. Depending upon the composition of the substrate material, considerable amounts of turbidity could be produced during construction. Potential adverse effects of turbidity are blockage of light and subsequent reduction in photosynthetic activity; mechanical abrasion or plugging of gills; release of toxic substances; release of substances having a high biochemical oxygen demand (especially during the naturally low dissolved oxygen period from July through October); excessive phytoplankton growth; and eutrophication. These indirect effects would have greatest impact on adult and larval hardshell clams, geoducks, shrimp and crab, because of relative immobility.

9. The following is a summary of critical periods for certain marine fisheries resources potentially impacted by construction of the proposed facility:

Species or Factor	Period
Juvenile salmon	March 15-June 15
Shrimp and crab larvae and juveniles (P.A.)	April-June
Crab abundance higher (Saratoga Passage)	April-January
Lingcod spawning (Admiralty Inlet)	October-May
Pacific cod aggregation (Protection Island)	December-May
Smelt spawning (Camano Island)	May 15-October 15
Herring holding (Protection Is.)	December-February
Low dissolved oxygen in Strait	July-October
Geoduck and clams	Year around
Flatfish	Year around

Freshwater Areas

10. The applicant has not committed to construction of any of the stream crossings, other than the major crossings, during the June 15 through September 15 proposed fish window.* (36773 Somers; 10035 Yuill.) The applicant has not determined

*Optimal construction time when there will be least damaging effects to fish that it is feasible to accomplish all of the smaller stream crossings within such a 90 day period. As an example, 56 streams are crossed between Stanwood and Snoqualmie Pass. (10035 Yuill.) To the extent that the applicant's construction activities on the smaller streams extend outside the proposed fish window, sedimentation impacts on the fishery on such streams will be increased accordingly.

11. The applicant suggests that if construction of the major stream crossings occurs between June 15 and September 15, the impacts of construction activities and sedimentation upon the anadromous fishery and its habitat will be minimized. (9465, 10012 Yuill.)

12. There will be impacts upon the fishery from construction during the fish window. (36432 Somers.) Juvenile rearing of anadromous salmonid species occurs on a year-round basis in the streams and rivers the applicant proposes to cross.

13. Summer steelhead spawn February through June; winter steelhead spawn from December through June. Chum spawn during December and January. Pinks spawn during September and October. Coho spawn from October through January. Summer and fall chinooks spawn during September-November. Spring chinooks spawn during August-October. There is only a short period during the year when spawning is not actually occurring in the streams

Northern Tier proposes to cross. Vital activities other than spawning occur throughout the summer. For example, spring chinook migrate upstream from May-August, and summer and fall chinook migrate upstream from July-October. Coho migrate upstream from July-December. Pinks migrate upstream from July-October. Chum migrate upstream from August-January. Summer steelhead migrate upstream from August-October. Winter steelhead migrate upstream from November to June. (36432-3, 36433 Somers)

14. If spawning occurs before water flows can adequately cleanse siltation from streams, fishery losses may occur due to the presence of fines (small-grained sediments). (10010, 10032 Yuill.) Flows sufficient to flush construction fines from streams may not occur in drier years. (10032 Yuill.)

15. A few days' delay in upstream migration has been known to reduce the productivity of some runs. In addition to delays caused by avoidance of high turbidity and suspended sediment concentrations, (36801 Somers) some fish would likely be delayed by actual in-stream construction activity. (36801 Somers.)

16. Intra-gravel development of eggs, alevin, and fry occur throughout the year. (36433 Somers.)

17. Since suitability of gravel for spawning, survival of incubating eggs, and emergent ability of salmon fry all depend on the percentage of fines in stream gravels, and since many of these streams are already impacted from sediment loads from other sources, the marginal impact from additional sediments contributed by construction and/or erosion may in some cases render habitat unusable or reduce its suitability for use.

Wildlife

18. Adverse wildlife impacts can be reduced by timing and locating construction to avoid critical habitat and critical periods of nesting, reproduction or winter stress. (Stendal p.8)

19. Important marine mammal reproductive periods occur from May through August. (Everitt p. 27) Sea lions would be most vulnerable to construction impacts in the winter. (Everitt p. 22) The time of greatest vulnerability for cetaceans (e.g., whales, porpoises, dolphins) is probably in late spring and summer. (Everitt p. 20)

20. Winter months are most critical for whistling and trumpeter swans. (Leschner p. 30)

21. The timing of the proposed construction activities on the onshore storage site and the pipeline route could be scheduled to reduce interference with critical activities of eagles. (Leschner p. 22)

22. Peak elk use of the Colockum extends from October through June. Fewer elk use the Colockum in summer. Deer are year-round residents on most of the Colockum HMA. (Perry p. 51) See Section III.H. Habitat-Habitat Management Areas, for further discussion on the Colockum HMA.

23. Pipeline construction during the hunting season (mid-October to mid-January) would isolate the parking lot of the Skagit HMA at Davis Slough from the adjacent public hunting area on Skagit Bay. To reduce adverse impacts on waterfowl and visitors, construction near the Skagit HMA would best be scheduled from June through August . (Jeffrey, p. 12)

24. Waterfowl use in the Skagit-Port Susan area is greatest during fall and winter. Snow geese are most numerous in January (Jeffrey PFT p. 4, 5).

25. The critical nesting period for raptors in eastern Washington extends from March through June (Pineo PFT p. 19).

III. K. RIVERS AND STREAMS

Impacts on Fish*

1. All of the rivers and streams crossed by the proposed Northern Tier pipeline in western Washington support important anadromous fish runs and other fish stocks. Coho salmon are found in each stream. Some of the streams also contain other species of salmon such as chinook, pink and chum, as well as trout.

2. Two rivers on the route in eastern Washington, the Yakima and the Columbia, have economically important salmon runs. The Yakima River supports runs of spring and fall chinook and coho salmon. The Columbia River and its tributaries above the confluence of the Yakima support runs of spring, summer and fall chinook, coho and sockeye salmon. Current production from the Yakima and Columbia River (catch plus escapement) is severely reduced. Natural production in tributaries accounts for the entire sockeye salmon run. The depressed state of Columbia River salmon stocks since development of the river make the remaining fish more critical than most prices would indicate.

*See also Section III.H. Habitat, and Section III.J. Construction Timing Impacts.

3. There are five environmental conditions essential for the survival of anadromous fish: (1) access to and from the sea, (2) an adequate supply of good-quality water, (3) a sufficient amount of suitable gravel for spawning and egg incubation, (4) an ample supply of food, and (5) sufficient shelter.

4. The applicant applied for a corridor, first two miles wide, then half a mile wide. The applicant had an obligation to generally describe physical and biological circumstances across the width of the corridor. The applicant did not meet this obligation. The applicant's failure to describe the corridor prevents specific quantification of impacts reasonably anticipated from construction because important factors often change dramatically within the corridor. This is true of the factors affecting quantities of sediment to be produced; expected zones of impact; assessment of the fisheries resource and habitat; and habitat use within expected zones of impact. (36427-29; 36821 Somers; 36214-16 Norman).

5. Anadromous fish spawn in intermittent streams the applicant proposes to cross. (10016 Yuill; 36741 Somers). The applicant did not identify such streams. (10016-18 Yuill).

6. Organic soil sediments from stream crossings which settle in gravels may decompose, creating a high oxygen

demand that can be lethal to invertebrates and developing fish embryos during spawning and rearing. (36423 Somers).

7. An analysis performed at the centerline of the proposed corridor for the Armstrong Creek crossing estimates the amount of sediment to be introduced into Armstrong Creek from trench excavation at 65 cubic yards. (36227-8 -36227-9 Norman). The introduction of this amount of material into the creek will cause substantial damage to fishery habitat and fish which use that stream. (36430 Somers). Because of moderate fine levels, the Armstrong Creek sediment estimate may be low compared to other streams. (36430-31 Somers).

8. Salmon and other fish species use rivers and streams year-round for spawning, intra-gravel development, rearing, feeding and transport. Salmon and other fish species can be adversely affected by suspended and settleable solids. Direct effects include suffocation of embryos or alevins; mechanical injury of eggs or fish; damage to gills; egg and fry loss through streambed erosion; feeding difficulties; delay of upstream adult migration; and adverse impacts on spawning success. Some indirect effects would be decreased cover, phytoplankton and insects; and increased water temperature, siltation and turbidity.

9. The development stage from egg to fry is especially vulnerable to environmental perturbations. Impacts on early stages (eggs and alevins) from in-stream construction can be mitigated, in part, by the timing of construction activities. The extent of intra-gravel deposition of fine material resulting from sediment released during construction is a crucial factor affecting future pre-emergent survival. As the percentage of fine material deposited increases, survival to emergence decreases. A five percent increase in fine sediment can cause a 19 percent decrease in survival to emergence of coho salmon fry. For a deposition of 16.1 percent fine material (material of less than 0.8 mm), pre-emergent fry survival approaches zero. If the sediment comprises 50 percent of the bottom material, survival to emergency decreases by 70 percent. (Eldred, p. 12, 21).

10. Coho and some chinook fry reside in streams a year after emerging from spawning gravel. Coho use shallow, low flow streams for spawning and rearing. Sediment deposited in spawning gravel of the smaller streams may not be easily washed out by higher water flows because of the limited capacity of these streams. Where sedimentation is washed out of the original deposit area, it can be redeposited in downstream spawning or rearing areas. (Sommers, PFT, p. 55)

11. Losses of spawned eggs resulting from erosion were observed in Washington after construction of the El Paso natural gas pipeline. During construction of the Trans Alaska Pipeline System, studies indicated that sedimentation associated with pipeline construction affected both spawning downstream (Sommers, PFT, p. 42-44) and the food chain. (Sommers, PFT, p. 45-46). Fishery resource impacts occurred from these projects despite environmental controls.

Cumulative Impacts on Fish

12. The applicant's environmental analysis does not address the existence or extent of background stresses to fish. (34302 Kay; 36453-54 Somers). The applicant's analysis did not evaluate the cumulative impacts to the fishery and habitat that would result from construction, and did not combine analysis of construction and background stress. (34302 Kay; 36453-56 Somers). The cumulative impacts to the fishery and fishery habitat from construction as proposed by Northern Tier could range from mild to severe.

Applicant's Pipeline Construction Methodology

13. The information, analysis and commitments given by the applicant do not provide a sufficient basis to ensure that adverse effects to the aquatic resources of the state will

be minimized by pipeline construction near or in rivers or streams.

14. Northern Tier proposes to use the buried pipeline construction method for river and stream crossings in western Washington. This method involves excavation of a trench in the bottom of each river and stream to below the scour depth, installation of the pipeline in the trench, and backfilling.

15. At each crossing site there will be right-of-way clearing. Such clearing involves removal of vegetative cover for at least the width of the right-of-way area. (Somers 36785)

16. A reasonable minimum design/construction criterion for all river and stream crossings in Washington is that the pipe be sufficiently protected to avoid exposure from a 100 year flood.(Garland PFT 3/1-3). In order to achieve this level of safety, the applicant proposes to bury the top of the pipeline four feet below the estimated maximum scour depth calculated for a 100-year flood condition. (Koloski PFT 5/27/29, p. 7/1-9).

17. Another important minimum design/construction criterion is that this maximum subchannel burial depth be continued a sufficient distance on either side of every stream to prevent exposure of pipe due to lateral channel migration or

avulsion. (Garland PFT 11/16-12/14; Koloski PFT 11/4-7, 15-28).

18. Northern Tier's consultants used three methods to calculate maximum scour depths: the measurement of the elevation of the deepest pool which could migrate downstream; the depth of embedment of the largest free-moving object transported downstream by bedload transport process; and a calculation of one-third the difference between water surface elevation of a river at ordinary low water and at the 100-year flood level. (Koloski PFT 6/14-29).

These methods are not adequate in every case and, in some cases, may underestimate scour potential by several feet (Garland PFT 5/5-7/11, 10/11-11/12). Some of the deficiencies inherent in these methods are as follows:

(a) Deepest pool method. The bottoms of pools often scour during floods. A measurement of the bottom of a pool taken during low flow is not a reliable measure of the depth that the pool may attain during a flood. Pools are also more likely to migrate laterally than downstream.

(b) Embedment of largest free-moving object. Objects visible in a stream bed may have been transported as a result of earlier floods, or they may not. Objects which are true indicators of deeper scour levels may not be visible on the surface.

(c) <u>One-third rule</u>. No data on western Washington rivers for the one-third ratio were provided. Data from rivers elsewhere in the United States suggest scour depths ranging from .16 to 1.75 times the elevation difference. Data from streams in the southwestern United States (which are similar to some streams in eastern Washington) suggest scour depths of up to four times the elevation difference.

The one-third method also leaves out major variables such as sediment load, channel configuration, and bottom roughness and composition. All of these variables may influence scour depth and should be verified from one river to another if the one-third ratio is applied uniformly.

19. Other, more precise methods for calculating scour are available and should be used. One of these is the "tractive force method," already tested by Northern Tier in Idaho and Montana (37026/16-37027/12). To solve the equations used in this calculation, it is necessary to have more data than have been provided by the applicant on channel configuration, the nature of the bottom materials, velocities, time periods, and sediment load during an expected flood event.

20. Design flood parameters used for the TransAlaska Pipeline, the proposed Northwest Alaska Gas Pipeline, and the (now defunct) Canadian Arctic Gas Pipeline were considerably higher than those proposed by Northern Tier. The design floods presented by applicant are not conservative. (TR 36010-11, 36142-43).

21. Insuring riprap protection only over the area disturbed plus 50 feet, as NTPC proposes, may not be adequate to prevent outflanking on the west bank of the South Fork Stillaguamish River. (TR 36008)

22. No design criteria exist to assure that alignment will be based upon locations least stressful to fisheries or least likely to create erosion control problems. (TR 36478).

23. The applicant did not use on-site soil sampling for its siltation estimates. Instead, bottom and bank soils were estimated from soil maps and well logs. The usefulness of well logs depends upon the similarity between well alluvium and conditions at the crossing site. Soil maps yield only crude estimates of erodability; percentages of erodable material out of total volume may be misjudged by 20% or 30% (36206-07 Norman). The applicant has significantly underestimated the actual sediment loads that will be produced from construction at the major river crossings. (36211-14 Norman).

24. The distinction between major and minor rivers made by NTPC does not refer to environmental significance or degree of potential impact; it refers only to physical size. Rivers approximately 100 feet wide are called major rivers. (TR 6481 Sandmeyer).

Drainage Structures

25. Crossing rivers and streams with heavy construction equipment will require bridges, culverts, or other drainage structures. Unless designed and placed carefully, such structures can serve as barriers to fish passage, will act to channelize a stream and, if their capacity is exceeded, will contribute to road washout, with resultant erosion and siltation. Poorly designed or placed drainage structures can induce hydrogeologic changes, such as increases in stream velocity. Velocity increases cause abnormal cutting of banks and channel migration, increasing sedimentation and filling or scouring of spawning and rearing areas. Stream bed excavation associated with culvert installation and ford construction can cause excessive siltation. Approaches to such structures may involve cutting down the stream banks, which causes sedimentation. Fill material around culverts can slump, causing siltation and blockage of the culvert. (Sommers, PFT, p. 65-66).

26. The applicant did not analyze impacts associated with various types of drainage structures. Most smaller streams on the route do not have a recorded history of flow conditions or drainage structures. On TAPS, the use of empirical formulae to calculate drainage information resulted in significant underestimates. This, in turn, resulted in the use of drainage structures which were undersized and sometimes inadequate to pass even normal high water flows (Sommers, PFT, p. 65-66).

Tulalip Tribes' River and Stream Concerns*

27. The Tulalip Tribes have an active interest in all projects that will damage, or have the potential for damaging, the treaty fishery. (36388 Somers). The proposed pipeline crosses usual and accustomed areas of the Tulalip Tribes, and may affect fish migrating to and from those areas. The proposed pipeline would cross approximately 56 streams within the Stillaguamish, Snohomish, Snoqualmie, and Skykomish River systems between Stanwood and Snoqualmie Pass. All these streams are important to the Tulalip fishery. Approximately 35 contain anadromous fish runs. The remainder are tributaries of streams which contain anadromous fish runs. Approximately 80-90% of the fish the Tulalips harvest are generated by these streams. (36388, 36407-08 Somers; Ex. 717 Table 1, Figure 4).

*See also Section III.E. Tribal Concerns

28. The rivers and streams within, or which serve fish migrating through, the Tulalip Tribes' usual and accustomed fishing areas, have experienced environmental degradation and habitat deterioration. Natural fish runs have declined in these river systems. Both the Stillaguamish and Snohomish River systems are producing fish far below prior capacities. Several degraded areas are downstream from proposed Northern Tier crossing sites. Northern Tier impacts could contribute, cumulatively, to a worsening of water quality problems. Fewer fish may then be available to a larger number of tribal members. (36384 Somers).

29. Fish harvest management biologists set escapement levels for anadromous runs at a level necessary to sustain present habitat capacity. If further decreases in production occur, they are perpetuated within the system. The present escapement levels allowed are insufficient to provide for "extra" fish to revive a depleted area. (36385, 36749-50 Somers). While the Snohomish and Stillaguamish River systems are considered to be at present habitat-carrying capacity for coho, they are far below present habitat-carrying capacity for chum and pink salmon. (36750 Somers). These systems are presently managed for natural production. There are no major hatchery facilities on either river. It would be extremely difficult, if not impossible, to rehabilitate any destroyed runs using native stocks.

30. A major portion of the chum and pink salmon spawning grounds on the Little Pilchuck, North and South Forks of the Stillaguamish, the Skykomish River, and the Snoqualmie River is located downstream of the proposed Northern Tier pipeline. (36385-86 Somers).

31. The Tulalip Tribes are involved in efforts to enhance native anadromous fish stocks supported by the Snohomish and Stillaguamish River systems. (36750 Somers). Hatchery fish are less desirable and more expensive than native fish. (36752 Somers).

32. The marine harvest must take place at a rate which protects natural fish runs by assuring adequate natural escapement. Any decrease in natural production forces a decline in hatchery harvest. (36454-55 Somers).

King County

33. Using Northern Tier's methodology, all river and stream crossings in King County, except the South Fork Snoqualmie, have a potentially high sensitivity to sedimentation. (TR 37668).

III. L. SOCIOECONOMIC IMPACTS

1. The total employment for the ten counties along the proposed route in 1977 was 830,500. The unemployment rate in the ten-county region as a whole was 8.4% in 1977. (Applic. III, Sec. 1.22.3.1) The 1976 average wage in the ten county region was $11,819. (Applic. III, Sec. 1.22.3.1) Assuming average land values and an average permanent pipeline corridor width of 75 feet, the 1978 assessed valuation of the proposed route is approximately $2.7 million (1978 dollars). (Applic. III, Sec. 1.22.3.1) Total employment in the ten county region may increase to 1,053,097 in 1995. (Applic. III, Sec. 1.22.3.1)

Clallam County and Port Angeles

2. Manufacturing, tourism, and fishing are the basis of the Clallam County economy. Forest products, tourism and commercial fishing provided either direct or indirect employment for an estimated 10,640 to 11,280 persons in 1976. (Applic. III, Sec. 1.22.2.1) The 1975 per capita income in Clallam County was $5,650. (Applic. III, Sec. 1.22.2.1)

3. Total Clallam County employment was 16,450 in 1977. Unemployment in the County is seasonal and is highest during winter months. The variation reflects the County's dependence on the forest products industry, fisheries and tour-

ism. At present, Clallam County unemployment is high (up to 20%) due to a slow-down in the forest products industry. Future employment in the County will likely continue to vary seasonally. (TR 26304 Cleland;) (Applic. III, Sec. 1.22.2.1)

4. The County's total employment has been estimated at 18,002 in 1982 and 21,084 in 1995. The average employment growth rate between 1976 and 1995 is estimated to be 2.0% (Applic. III, Sec. 1.22.2.1-2)

5. The site of the proposed tanker unloading facilities is currently not assessed for property taxes because it is public property. The tidelands and harbor areas to be used by Northern Tier are currently either leased by the Department of Natural Resources to Crown Zellerbach and Peninsula Plywood or not leased at all. The 1.5 acre area on Ediz Hook proposed for project parking and security facilities is owned by the federal government, leased to Port Angeles, and subleased to Crown Zellerbach, which pays leasehold excise tax. (Applic. III, Sec. 1.22.2.1)

6. The Green Point site owned by Northern Tier and proposed for the onshore storage facilities had an assessed valuation of $210,972 and a tax liability of $3,215 in 1978. (Applic. III, Sec. 1.22.2.1)

7. Construction activities will involve an expenditure by Northern Tier of \$167.6 million in this county (1978 dollars). This expenditure will confer some positive economic benefits, primarily in the form of increased jobs, income, and taxes. (TR 11665 Moriyama)

8. Construction activities will result in approximately 600 primary jobs in Clallam County during the 22 month period. 500 additional secondary jobs would be created in Clallam County during this period. At the peak of construction, the total number of direct and indirect jobs in the county is estimated to be 750. (TR 11665-66 Moriyama)

9. Primary construction wage payments for work performed in Clallam County will total \$25.4 million based on 1978 wage scales. Secondary employment opportunities resulting from construction activities in Clallam County will generate an additional \$14.9 million in wage payments statewide, \$8 million of which will be associated with secondary jobs in Clallam County. (TR 11666 Moriyama) It is estimated that Clallam County expenditures by all workers during the construction period would total about \$11.2 million, or approximately 33% of total wages received. (TR 11667-68 Moriyama)

10. A potential negative impact from construction is that some existing employers (industries in the county) may

lose certain skilled workers to the project because of the project's competitive salaries.

11. Other potential impacts include loss of some log storage, the disruption of log storage operations in Port Angeles Harbor, permanent loss of timber land due to clearing the site of the onshore storage facilities and potential decreases in residential land values directly adjacent to the tank farm.

12. Based on 1978 tax data, approximately $7.7 million will be paid in state and local sales taxes during the construction period. The state will receive approximately $6,930,000 of the total revenue. Clallam County will receive $710,000, while Port Angeles will receive $57,800. (TR 11668 Moriyama)

13. During construction of the marine terminal and submarine pipeline, applicant will pay an annual leasehold excise tax on all leases of public property. The onshore storage facilities and the on-land pipeline will not be subject to this tax. The annual revenue to be derived from the leasehold excise tax will depend on the price in the lease agreement to be negotiated between the applicant and the governmental entity involved. (TR 11668-69 Moriyama)

14. During construction, the applicant's property tax liability will increase as each of the project components is completed. (TR 11669-70 Moriyama)

15. A total of 124 primary and secondary jobs will be created in the county as a result of the marine terminal operations. Yearly operations will generate close to $3.9 million (1978 dollars) in wages paid directly to Northern Tier employees and resident tanker crew members and indirectly to the secondary work force. Approximately $1.9 million (1978 dollars) of these wages will be paid to residents of Clallam County. (TR 11672-73 Moriyama) Should Northern Tier locate its national headquarters at Port Angeles, approximately 40 additional jobs with a payroll of approximately $1,000,000 per year can be anticipated.

16. In 1978 dollars, supply purchases for the marine terminal will be about $220,000 annually and will generate $9,900 in sales tax revenues for the State. Local governments will receive an additional $1,100 each year from the sales tax. Further local sales tax revenues will be generated by employees' expenditures. (TR 11673-74 Moriyama)

17. Northern Tier would be required to pay an annual 1.8% public utility tax to the state on gross income derived from pipeline operations. (TR 11674 Moriyama)

18. Assuming 1978 tax rates, the project components would generate approximately $2.4 million in property taxes. (This estimated property tax liability does not take into account the effect of the special school funding limitation which was imposed in response to Washington's Basic Education Act of 1977.) (TR 11674-75 Moriyama)

19. Normal marine terminal operations should have little measurable effect on the commercial fishing industry, on most of the marine resources on which the industry depends, or on agriculture or forestry uses. (TR 11676 Moriyama)

20. Normal operation of the marine terminal and pipeline in Clallam County should not materially affect local land values, with the possible exception of land near the on-shore storage facilities site. Shoreline property should be unaffected by normal operations. The only expected adverse effect on shoreline property values would be from a major oil spill. (TR 11676-77 Moriyama)

Jefferson, Island, Snohomish
King and Kittitas Counties

21. Based on 1978 costs (exclusive of state and local taxes), activities outside Clallam County will involve an estimated expenditure of over $313 million by Northern Tier.

(TR 12693-94 Moriyama) Construction activities will create an estimated total of nearly 1,100 primary jobs. During the peak period of construction, the total number of primary and secondary jobs is estimated to be around 2,650. (TR 12694 Moriyama) Construction wage payments are expected to total $42 million (1978 dollars). Secondary jobs are expected to generate an additional $23.6 million in wage payments. (TR 12695 Moriyama) Approximately $14.7 million (1978 dollars) should be paid in state and local sales taxes during the construction period; the state will receive approximately 90% of the total revenue, and the counties 10%. (TR 12696 Moriyama; Applic. III, Sec. 2.22.3.1)

22. On the basis of the assessed valuation, an estimated $295 million, the pipeline will generate approximately $4 million (1978 dollars) in property taxes outside Clallam County during its first year of operation. (TR 12701-03 Moriyama)

23. The construction may create certain adverse economic impacts. A temporary diversion of tourist expenditures in Island and Jefferson Counties may occur. Other adverse impacts include the permanent loss of timber land and the potential loss of fish and shellfish.

24. Operation of the pipeline outside Clallam County will create nine new jobs. Nine employees will staff the Spokane

District Office. Direct employment opportunities will create indirect jobs in the region. (TR 12700 Moriyama)

III. M. TRANSPORTATION

1. Heavy industrial and logging activities in Port Angeles and its environs result in a high proportion of truck traffic on area roads. (Applic. III, Sec. 1.14.2.4)

2. During peak tourist season, considerable congestion occurs on U.S. 101 along Lincoln, First, and Front Streets, and in the downtown area near Laurel and Oak Streets. A major traffic problem is Marine Drive which passes through a narrow restricted opening between Crown Zellerbach plant buildings, crosses numerous railroad tracks, and carries heavy intraplant traffic. It is the only land access to Ediz Hook. (Applic. III, Sec. 1.14.2.6)

3. The only rail service in Port Angeles runs from east to west along the shoreline, providing access to industries. (Applic. III, Sec. 1.14.2.7)

4. Road access to Green Point and the tank farm site is by an east-west county road connecting to U.S. 101. The other significant roadway is the Old Olympic Highway, a two-lane road that originates at U.S. 101 and proceeds northeasterly toward Green Point before turning east toward Agnew. There are a number of narrow collector and local roadways from the Agnew cutoff that provide limited access to Green Point.

The Agnew cutoff is occasionally subject to icing in winter months. (Applic. III, Sec. 1.14.3.1)

5. No serious traffic congestion problems occur on Clallam County highways outside the city of Port Angeles. (Applic. III, Sec. 1.14.3.3, 1.14.3.4)

6. Construction of the Northern Tier terminal on Ediz Hook will create substantial land transportation impacts on the City of Port Angeles. These will include construction worker travel; heavy use of access and haul routes (forty one-way truck trips per day minimum); and traffic controls at intersections throughout the City. This will result in the need to upgrade, maintain and restore the Ediz Hook road. (Pittis, TR 26117-21)

7. Northern Tier has proposed certain measures to diminish these impacts, such as timing of shifts and traffic, carpooling, and the use of rail and barge for transporting materials. An agreement reached between the City of Port Angeles and Northern Tier contains certain transportation mitigation measures including a provision requiring Northern Tier to restore the Ediz Hook Road.

8. Northern Tier has not provided sufficient information on sources of supplies and haul routes to assess land

transportation impacts. (Leach, TR 26136-37; 26217-8) Northern Tier has significantly underestimated the gravel requirements due to drainage and soil conditions at the proposed Green Point tank farm. (Leach, TR 26137)

9. The access routes to the tank farm are inadequate to handle the heavy truck traffic required to haul construction materials. (Leach, TR 26138-39) The Old Olympic Highway and Port Williams Road are narrow and without sufficient ballast to handle the anticipated sustained heavy loads from construction. (Leach, TR 26226) Both roads should be rebuilt to current design standards to avoid traffic disruption. (Leach, TR 26139-40)

10. There is inadequate sight distance at the place where Northern Tier proposes an intersection of its tank farm access road with the Old Olympic Highway. (Leach, TR 26140-41) Northern Tier truck and general construction traffic will require road redesign, upgrading, maintenance and restoration. Clallam County places conditions on permit holders for the development of log yards which require the holders to build or reconstruct county roads before construction of yards in order to accommodate the impacts of heavy equipment traffic. (Leach, TR 26204-05) Clallam County and Northern Tier have agreed on a procedure for studying and attempting to resolve land transportation problems.

11. The existing railroad will likely deliver some construction materials to Green Point. (TR 12349-50 Fitzroy)

12. Operational traffic to and from the project in general will, under normal conditions, have little impact.

13. All pipe for the submarine pipeline is to be shipped by tandem barge to the lay barge. No overland truck or rail transport should be required. The potential impact on marine traffic in Admiralty Inlet and Saratoga Passage is negligible. Traffic problems may occur at the entrance to Port Angeles Harbor. (Applic. III, Sec. 2.14.2.1)

14. During pipeline construction, traffic impacts in any local area will be less than might be indicated by the amount of time the peak work force is estimated to be in the county. This is because each work force will move along the route in a pipeline "spread," so that traffic impacts will occur at different places and times as work progresses. (TR 12811-12 Olender) In most cases, existing highways will be adequate to accommodate the additional traffic. For a few roadway segments, the increased construction traffic may cause a significant short-term impact. To lessen the impacts of the increased traffic volume during construction, Northern Tier will cooperate with state and local authorities. Efforts will include rerouting traffic, encouraging carpooling or vanpooling among

employees and contractors, and scheduling deliveries or shifts to avoid local peak periods. (TR 12812-13 Olender)

15. The major state highways (in terms of traffic volume) that will be crossed by the pipeline system include: S.R. 20 in Island County; I-5 (south of the junction with S.R. 532) and U.S. 2 (east of S.R.9) in Snohomish County; U.S. 10 (about three miles southeast of North Bend) and I-90 (near the entrance of Snoqualmie National Forest) in King County, in Kittitas County, and (about 2.5 miles west of Sprague) in Lincoln County. (TR 12361 Fitzroy) Crossing at all major highways and improved roads will be accomplished by boring underneath them. Unpaved roads will be traversed by using the cut and cover method of construction. Northern Tier is committed to several measures to expedite traffic flow in the affected areas. These measures include (1) ensuring that for those roadways where the cut and cover method is used at least half of the roadway will be kept open at all times and (2) advising local traffic enforcement agencies about construction and delivery schedules, especially in the event of overweight or oversized loads. (TR 12361 Fitzroy; TR 12810-12 Olender; TR 12817 Crutcher)

16. Northern Tier will cooperate with the Department of Transportation and local agencies to minimize construction-related traffic problems or damage to roadway surfaces. Prior to constructing a crossing of any county roadway, Northern Tier

will submit its plans to appropriate local agencies for review and comment and will cooperate with these agencies in developing appropriate techniques for mitigation of construction impacts.

17. The majority of Island County roads have limited lane width and narrow shoulders. Base and surfacing for these roads is for low-volume light traffic. There are few north-south trending roads. (TR 35439, 35440)

18. Pipeline construction traffic would effectively compress the equivalent of many years road usage into a few weeks. In freeze-thaw or wet conditions, this intense heavy usage has the potential for destroying roads. Usage during dry weather may result in appreciable wear on the roadway surfaces. (TR 35440) A typical mile of 30-foot-wide roadway with average daily traffic of 400 cars or less costs $150,000 to $200,000. (TR 35440)

19. S.R. 20 on Whidbey Island normally carries a heavy volume of tourist traffic in the summer.

20. Agreements referenced as follows in Section VI.-Stipulations of this Order contain substantial mitigation measures:

Finding 1(c)	(Lincoln County)
Finding 1(d)	(Spokane County)
Finding 1(e)	(Adams County)
Finding 1(i)	(Grant County)
Finding 1(l)	(King County)
Finding 1(m)	(Kittitas County)
Finding 1(r)	(Clallam County)

III. N. POPULATION AND HOUSING

Clallam County

1. Clallam County had an estimated population of 46,000 in 1979. About 40% of the population resides in Port Angeles, and about 11% lives in the communities of Sequim and Forks. The remaining population lives in unincorporated sections of the county, primarily along the northern quarter between the Strait of Juan de Fuca and Olympic National Park. Since much land within the county is publicly owned, the effective average density of Clallam County is greater than it appears. (Applic. III, Sec. 1.12.2.1; TR 11632-33 Moriyama; Ex. 424)

2. Construction of the Northern Tier project in Clallam County will result in the in-migration of a new population consisting of primary and secondary workers and their families. (Hansen, TR 28124-25)

3. Northern Tier predictions and Urban Institute forecasts of construction-related population impacts on Clallam County use the same assumptions as to length of construction period, absence of delays or stoppages, and project costs and components. Northern Tier predicts a 910 person average increase and 1561 person peak increase. The Urban Institute forecasts a 1431 person average and 1891 person peak increase. Northern Tier's labor share estimates are less than half that experienced

by comparable projects; the Urban Institute forecasts are also significantly lower, though higher than Northern Tier's. (Beasley, Hansen, Moriyama) Both estimates leave out significant numbers of people who will work on the project, such as inspectors, project managers and engineers.

4. Various occurrences, including changes in project costs; unexpected construction difficulties; overlapping construction time periods; delays in the construction process; a higher percentage of non-local pipeline or construction workers; or a decision to add a third berth, additional storage tanks or other facilities in the first phase of the project; could result in higher average and peak populations. (Hansen, TR 28137-39; Moriyama, Ex. 131) (Beasley) Pre-construction estimates of total work force for other energy projects have been substantially exceeded in practice.

5. The risk of a low estimate falls on the local governments and agencies which must provide local services for the new population and project. The public services most sensitive to population changes are housing, police and fire services, park and recreational facilities, public utilities, medical facilities and schools. The expansion of most of these services requires considerable planning lead time. (Hansen, TR 28140-43) A 25% population increase over the Urban Institute forecast is reasonable for planning purposes.

6. Northern Tier predictions and Urban Institute forecasts differ on the Clallam County housing demand which would be created by a construction population influx, and on the ability of the area housing supply to accommodate that demand. There is historically a significant frictional component* in Clallam County. Northern Tier's prediction assumed no frictional component; the Urban Institute's forecast did. The Urban Institute's transient housing survey was later and more comprehensive than Northern Tier's. The Urban Institute's rental share of available housing was lower, as was its worker-per-unit prediction. The summer transient housing vacancy rate is historically 2.1%. Increases in non-local workers over levels expected would increase deficits. The Urban Institute's forecast is for a 402 unit year round deficit and a 601 unit peak deficit in Clallam County.

7. Adverse impacts from a housing shortage include an increase in the cost of all housing, especially low income housing, and competition between workers and tourists for transient housing.

8. Northern Tier did not study the marketplace's ability to respond to the housing demand by providing new housing.

*Units vacant but not available for occupancy, e.g. apartments being renovated

9. Requiring Northern Tier to provide new temporary housing in response to the anticipated average and peak demands would alleviate many but not all impacts.

10. During operations, Northern Tier-related housing demand would be small.

Island County

11. The U.S. Naval Air Station on Whidbey Island is currently undertaking a substantial housing renovation project involving the total rehabilitation of some 1,200 single-family housing units. This project will commence in October 1981 and is scheduled to continue through January, 1985. This project will involve an estimated seven percent of the 1980 housing stock on Whidbey Island. The renovation of approximately 300 housing units per year is anticipated, resulting in the need for the community to absorb naval families into the private housing sector. (TR 35783) Between 100 and 150 families will be seeking to locate in off-base housing by the summer of 1981. (TR 35783, 35784) It would be difficult for the community to absorb more than 250 new families into the private housing sector. (TR 35784)

12. Applicant has proposed to undertake its project on Northern Whidbey Island at the same time as the navy's

housing renovation. Applicant has not presented any substantive proposals to house its workers, their dependents, or any others attracted to the project. (TR 35785)

13. The applicant has indicated that the total direct and indirect population influx generated by the pipeline-related work force will be approximately 548 people during the summer peak. No information exists on how these people will be adequately housed. (TR 35786.) The pipeline-related population cannot be absorbed into the Island County community without significant social and economic impacts. Housing supply in particular, poses problems. (TR 35787)

King County

14. Using 1980 census data for household size, and Northern Tier and draft SEPA EIS data on population influx as a result of pipeline construction, between 300 and 350 additional King County households would be created as a result of pipeline construction. (TR 38029) In Bellevue and the Bellevue I-405 corridor, there are only about 200 to 280 units of temporary lodging, with substantially less available from June to October. (TR 38029-30). Due to the lack of vacancies in apartments and mobile home parks, pipeline construction workers may be expected to take over most temporary housing (motel/hotel) in the area. (TR 38031-32)

15. Pipeline construction would create the greatest housing impact on areas within 30 to 40 minutes driving time of the pipeline route, i.e., the area north of I-90 and east of Lake Washington. (TR 38028)

All Counties

16. Submarine pipeline construction, if conducted as described, would not produce a population impact.

17. The population of 14 counties would increase during construction periods. Some cities and towns would be adversely affected by population influx, but impacts will likely be short-term.

18. Applicant has committed to a preconstruction housing survey along the pipeline route in the state. Applicant has already studied 12 cities and towns it expects would experience 5% or greater worker-related population increases. In many areas, housing supply should exceed demand.

III. O. PUBLIC SERVICES AND UTILITIES (EXCLUDING ELECTRIC SUPPLY)

Clallam and Jefferson Counties - Law enforcement

1. The area to be impacted by the Northern Tier project is served by five local law enforcement agencies. These are the Port Angeles Police Department, the Port Townsend Police Department, the Sequim Police Department, the Clallam County Sheriff's Department and the Jefferson County Sheriff's Department. The Port Angeles Police Department and the Clallam County Sheriff's Department are understaffed in relation to national averages . (TR 11761 Meyers; Applic. III, Table III-2.15-1)

2. Construction-related population growth will increase adverse effects on law enforcement beyond any caused by existing staff shortages of the Port Angeles Police Department and the Clallam County Sheriff's Department. The construction population will also cause the police-to-resident ratio in Sequim to fall slightly below the national average for towns of similar size.

3. Major construction projects create a greater need for law enforcement services than would be indicated solely by the number of people attracted to areas by such projects. Traffic and related problems will be created, as may civil and

criminal disturbances. The number of workers employed will not remain constant during the construction period. The number of workers at their jobs will fluctuate during peak and slack periods and this may be reflected in law enforcement needs. It is expected that job-seekers will outnumber jobs.

4. Normal operation of the project would not cause significant population-induced demands on law enforcement. Abnormal incidents, such as fires, explosions, and spills, would create intense, but temporary demands for law enforcement services.

<u>Other Counties - Law enforcement</u>

5. The law enforcement capabilities of communities along the route would be strained during construction. In most cases, these effects will be short term. Severe pressure will be put on Island County, in part because the sheriff's department is already understaffed. Pipeline operational impacts on law enforcement capability should be minimal under normal operating circumstances.

<u>Clallam County - Other Public Services</u>

6. The Northern Tier would have substantial impacts on water, sewer, and solid waste-related services in Clallam

County. Northern Tier has not specified solid waste disposal sites for dredge spoils or hazardous waste, and has not dealt with the disposal of effluent from its proposed septic and sewer systems. Under certain conditions, Local Utility District No. 1 may be able to serve the tank farm's permanent needs, obviating any requirement for development of a new source.

7. The telephone company appears able to accommodate expected growth.

8. Clallam County and the City of Port Angeles will not be able to provide adequate emergency service response to a Northern Tier-related spill, fire, or explosion.

9. Additional children would be added to the Port Angeles and Sequim school districts during construction of the proposed project. The state's Basic Education Act does not cover all the impacts. Portable classrooms do not provide as high quality an educational environment as do permanent facilities. Six months lead time for school facilities and personnel is required.

Medical Services

10. There is an existing and projected need for more Clallam County mental health, drug and alcohol addiction treatment facilities which may be aggravated by the project.

11. Mental health and counseling services in the project area are being used to capacity; service cutbacks are anticipated due to funding problems. The only comprehensive mental health clinic in the region is the Peninsula Counseling Center in Port Angeles which has six full time professionals. The center provides counseling and outpatient treatment for 800 to 900 patient visits per month. The Family Research Center deals with child abuse problems; the case load is currently at the center's capacity. Drug abuse problems are handled by the Community Counseling Center, the Peninsula Counseling Center, or the local hospital. Each of these is operating at maximum levels. The Phoenix House, a service organization to help solve alcohol related problems, is at capacity. (TR 11736-37 Meyers; TR 28359-60 Garlick)

12. In 1977, the number of primary care physicians in Clallam County was 1 per 1,840 residents. A sudden influx of people could strain existing primary care services. (TR Meyers; Applic. III, Sec. 1.15.2.5; TR 28193, 28236 Mather)

13. During construction there may be an increase in highway traffic accidents. (Applic. III, Sec. 2.18.2.1)

14. Six additional hospital beds would be needed in Clallam County as a result of construction. (Applic. III, Sec. 2.18.2.1; TR 28236 Mather) Increased demands on area

hospitals and primary health care and mental health facilities caused by Northern Tier-induced employment during project operation will be small. (Applic. III, Sec. 2.18.2.1)

15. Olympic Memorial Hospital, located on a bluff overlooking the proposed port site, is the only full service hospital in Clallam and Jefferson Counties. The Port Townsend (40 miles away) and Forks (70+ miles away) facilities are not comparable. The hospital is the only medical facility which could provide treatment to persons injured in fires, explosions or other accidents at the berth site.

16. Northern Tier construction and operation will cause a substantial increase in the demand for hospital services on a day-to-day basis.

17. Any evacuation of burn or other patients to Seattle hospitals would depend initially on Coast Guard capabilities. Coast Guard facilities are presently located on Ediz Hook adjacent to the proposed site.

18. Whether or not the Coast Guard facilities would be moved farther from the North Tier site is unknown. Movement of these facilities to a location outside Clallam County would adversely impact the county.

19. Any physical or mental health problems in any one community outside the Olympic Peninsula should be of short duration. (TR 12736 Meyers) All counties studied, except Island County, meet the primary care service standard of one doctor to every 3,500 residents. (Applic. III, Sec. 1.15.3.3) Increases in accidents or injuries and/or demands on health care and emergency room facilities will depend upon local variables. In any particular community along the route, these health impacts should last for less than three months. (Applic. III, Sec. 2.18.4.1)

III. P. ELECTRICAL ENERGY SUPPLY, DEMAND, AND ALTERNATIVES

1. The Northern Tier Pipeline Company proposes to use electricity to pump the crude oil through its entire 1,491-mile pipeline. Current forecasts predict a 99 percent certainty that resources in the region will be unable to meet the anticipated electrical energy load during the project's lifetime even without any consideration of additional demand from Northern Tier.

2. The region's principal supplier of natural gas, a viable alternate fuel for many pump stations, has been for several years unable to sell all the gas it has by contract made available to customers in the state.

3. Northern Tier proposes seven pump and one pressure-reducing stations in Washington, two pump stations in Idaho, and four pump stations in western Montana. All are located within the Bonneville Power Administration (BPA) service area. At 933,000 barrels per day throughput, the facility's average demand within the BPA service area would be approximately 186.9 megawatts. Supplying 186.9 megawatts average demand requires over 293 megawatts nameplate capacity.

4. If regional energy demand increases as anticipated, new resources, in addition to those scheduled to come on line, will have to be acquired to meet the Northern Tier demand. Completion of all generating facilities scheduled to come on line and carrying out of all planned conservation measures will not suffice. The Northwest Power Act, PL 96-501, requires that BPA meet its preference and investor-owned utility customers' demands, but it does not guarantee the availability of resources. Rather, it provides a mechanism for conservation and resource acquisition.

5. Predicted overall regional load growth during the next nine years will be substantially greater than any load increase caused by Northern Tier. However, the addition of Northern Tier demand would increase the probability and magnitude of actual shortfalls during project operation.

6. The current Washington State Energy Office curtailment plan treats a pipeline such as that proposed by Northern Tier as a priority user. The implication of the status accorded Northern Tier is that, should a shortfall occur, Northern Tier would receive its full energy requirements while utilities within the region cut back the amount of energy supplied to non-priority residential, commercial, and industrial customers. The curtailment suffered by non-priority customers in all classes would be greater by the amount needed to meet Northern Tier's demand.

7. The Northwest Power Act requires a determination by BPA that a substantial user of electrical energy is or is not a "new large load" (greater than 10 average megawatts). This determination could be made for the entire Northern Tier proposal or for each individual pump or pressure reduction station. No such determination has been made. "New large loads" are assessed higher rates for the purchase of energy than are other new loads. A new large load customer would pay essentially all capital costs incurred by required new generating capacity. Any portions of the Northern Tier project not designated "new large loads" would be supplied power at a lower melded rate. At such a rate, Northern Tier would pay only a portion of the capital costs incurred in constructing new generating capacity necessary to serve the Northern Tier demand. The balance of these capital costs would be passed to other residential, commercial, and industrial customers.

8. The Northern Tier project will supply 1.11 jobs per megawatt of demand. The statewide average for all industries is approximately 30 jobs per demand megawatt.

9. Northern Tier's demand would impact affected public and private utilities differently. Only Grant County Public Utility District will likely be able to increase its supply sufficiently. Difficulties would be posed for the rest. Perhaps the most seriously affected would be the Lincoln Electric

Cooperative (Odessa pump station), where Northern Tier's requirements would constitute an addition equal to 70% of present demand. Similarly affected would be Clallam County, the City of Port Angeles, and Inland Power and Light (Plaza pump station).

10. To the extent that the cost of supplying NTPC's demand is not met by NTPC rates, the impact will fall on other ratepayers. This impact varies depending on both the difference between incremental costs and rates charged NTPC, and the size of NTPC's consumption compared to total consumption by the utility. The Lincoln Electric Cooperative and other publicly-owned utilities will have to pay incremental costs if (as BPA predicts) BPA has insufficient resources to serve Lincoln's needs and the utilities themselves have to supply the necessary energy.

11. Neither Northern Tier nor anyone else has indicated a means by which individual utilities will be able to meet the company's electric energy requirements.

12. The following table provides basic information on NTPC Washington electric demand. Note that, in its PSD application, Northern Tier indicated that it might never ship as much as 700,000 barrels per day east of Arlington, but that its position before the Council is based on 933,000 barrels per day.

		ELECTRICAL DEMAND			
		Initial (709,000 bpd)		Ultimate (933,000 bpd)	
Pump Station	Utility	Average Load AMW	Peak Load (MW)	Average Load AMW	Peak Load (MW)
Marine	Port Angeles	3.8	15.6	4.9	15.6
Port Angeles	Clallam Co PUD	11.1	11.6	15.0	16.6
Arlington	Snohomish Co PUD	6.7	7.1	11.0	11.5
Carnation	PSP&L	7.4	7.8	11.6	12.3
Bandera	PSP&L	6.8	7.2	9.6	10.1
Ellensburg	PSP&L or Kittitas PUD	10.1	10.6	16.8	17.8
Quincy	Grant Co. PUD	0.3	0.3	0.3	0.3
Odessa	Lincoln Electrical Coop.	3.4	3.6	10.7	11.2
Plaza	Inland P&L	7.3	7.6	11.6	12.3
		56.9	71.4	92.2	107.7

III. Q. PRIVATE SECTOR ECONOMICS

1. The major private sector industries in the Port Angeles and Clallam County area are tourism, fishing (commercial, sport and food processing) and forest products.

Tourism

2. Tourism accounts for approximately 1/3 of the employment in Clallam County, employing over 5,000 people for the years 1977 through 1979. (Conradus, TR 28027-8.) Olympic National Park attracted 2,995,600 visitors in 1978. In 1978, Bogachiel State Park and Sequim Bay State Park, each located in Clallam County, had 109,400 and 865,200 visitors, respectively. Dungeness Spit is a National Wildlife Refuge attracting people for beachcombing and sightseeing. (Conradus, TR 29030-1.)

3. The M. V. Coho, a Blackball Transport Inc. ferry, transports some 500,000 passengers (most of them tourists) each year between Port Angeles and Victoria. Maintaining the ferry's scheduled runs is critical to the operation's well-being. The M. V. Coho is sufficiently maneuverable to avoid many potential delays. Delays, such as those which might be caused by harbor construction or significant tanker anchoring, could affect the ferry schedule. The Port Angeles harbor facility stipulation contains a provision which warns against adoption

of a harbor traffic management plan which would significantly impair the ability of the M.V. Coho or successor ships to meet existing schedules.

4. The influx of construction workers to eastern Clallam County may result in fewer transient accommodations being available for tourists, particularly during early summer when construction activity reaches a peak. The influx of construction workers together with construction-related noise and traffic, may decrease the attractiveness of certain local areas. Some diversion of tourist expenditures to other localities during construction may be expected. Local expenditures by construction workers may offset these effects on the local business community. (Applic. p.2.22-18, Vol. III).

5. The Thunderbird Boathouse and two public boat launch ramps are situated on Ediz Hook and would be displaced by the Northern Tier terminal. (Ingham, TR 28429-32; Conradus, TR 29056. Ingham, TR 28429.) There is no other equivalent location available for the Boathouse and the ramps. The principal advantage is the easy and safe access to fishing areas in Port Angeles Harbor and the Strait of Juan de Fuca. (Ingham, TR 28433.) Relocation of the Thunderbird Boathouse to any other part of the harbor might affect the business. (Ingham, TR 28433.)

6. A major oil spill in the Port Angeles area could substantially affect tourism and decrease recreational activities.

Fish Processing

7. Clallam County fish processors depend on local fisheries. A spill in or near Clallam County could lead to the economic failure of fisheries or processing companies.

Coast Guard Facility

8. A U. S. Coast Guard facility, including air and water operations and a group command, is presently located at the tip of Ediz Hook adjacent to the proposed Northern Tier site. The need to relocate the Coast Guard facility, and the scope, cost, or site of any relocation have not been discussed in the record of this case. Relocation outside Clallam County would have a major economic impact on the County.

Possibilities of New Petroleum-Related Development in Clallam County

9. If the Northern Tier facility is constructed, petroleum-related development in the county is made more likely.

10. The key considerations in determining whether or not a crude oil refinery or a petrochemical facility could be constructed at a particular site are: existence of a supply of crude oil; demand for and marketability of the product; adequate utilities and public services to operate the facilities; transportation access (particularly by water) to the facility; land availability; consistency of the proposal with applicable regulations; and public acceptance. (Ex. 123; TR 29008 Conradus).

11. Clallam County has been considered as a potential site for refineries or petro-chemical facilities in studies by the United States Corps of Engineers, the Oceanographic Commission of Washington and the United States Department of Energy. (Conradus.)

12. In some respects, Clallam County is more favorably located for the development of an oil-related facility than other potential West Coast sites. Clallam County is closer to markets than Alaskan sites. It does not face environmental restrictions similar to those placed on petroleum related facilities in California. (Ex. 123; TR 29009-29011 Conradus). Two additional factors increasing the likelihood of petroleum-related development in Clallam County are the stated capability of the proposed Northern Tier line to carry refined products, and the Marine Mammal Protection Act prohibition against locat-

ing or expanding oil facilities east of Port Angeles unless the product is consumed within the state.

13. There are three principal constraints which may inhibit the development of either a crude oil refinery or a petrochemical plant at Port Angeles or in Clallam County. These are: (1) lack of water availability in certain areas; (2) air quality restrictions in the vicinity of the ITT plant; and (3) existing adopted ordinances and plans. None of these constraints is insurmountable. (Ex. 123).

14. There are no present plans which indicate that a crude oil refinery or a petrochemical plant is likely to be built along the terrestrial portion of the pipeline route. There are no expected long term private sector economic impacts outside Clallam County from the construction and operation of the proposed project.

Agriculture

15. Approximately 200 acres of agricultural land will be cleared in the rights-of-way in Clallam and Island Counties. Crop land could lose one season of productivity. Reclaimed pasture land may not be available to livestock for two years. About 98 acres of forest land will be removed from production. (TR 9496 Reyes-French).

III. R. NOISE, LIGHT AND GLARE

Noise

1. Noise generated by construction activities associated with the construction of the proposed project, either on land or at sea, is exempt from state noise standards, except to the extent that it affects Class A residential areas between 10 p.m. and 7 a.m. (WAC 173-60-050 (1)(c), (3) (a), WAC 173-70-050 (2)(e); TR 39128, 39131 Saunders)

2. Construction of the tanker unloading facilities will involve noise-producing equipment such as pile drivers and diesel-powered machinery. Because of the distance between the Ediz Hook site and Port Angeles, construction noise will be audible in Port Angeles, but not greatly annoying. (TR 13054-55 Earsy; Applic. III, Sec. 2.6.2.1)

3. During some portions of construction of the unloading pipelines, residents closest to the northwest corner of the Green Point storage site will experience some hearing interference and annoyance from noise. (TR 13056 Earsy) Construction of the storage tanks, support facilities and pump stations at the onshore storage site will affect approximately 10 to 15 households during daytime hours for various lengths of time over the construction period, but the maximum degree of impact will be confined to possible interference with speech

and some annoyance. (TR 13056-57 Earsy; Applic. III, Sec. 2.6.3.1)

4. Construction activities will generally be limited to daylight hours, when noise from other sources raises background noise levels. (TR 13045 Earsy)

5. The major sources of noise during operation of the berths will be the electric motor driven booster pump units and transformers. This noise will not be audible in Port Angeles and will be only slightly audible at the public parking area on Ediz Hook. (TR 13055-56 Earsy)

6. Noise during operation of the tank farm will be caused primarily by the electric motor-driven pump units at the pump station. During periods of low noise from natural sources, the pump units will be audible and may be annoying to the closest residents. (TR 13057-58 Earsy)

7. Construction of the underwater pipeline across the Port Angeles Harbor entrance, the Strait of Juan de Fuca, and Saratoga Passage, will involve the use of a laybarge containing diesel powered equipment. There will be no significant noise impacts from this equipment except at Ediz Hook because the barge will be situated at least 2500 feet from shore and

because few residences are close to the pipeline in shoreline areas. (TR 13068-69 Earsy; Applic. III, Sec. 2.6.4.1)

8. Construction of the terrestrial pipeline will require the use of noise-producing equipment, including diesel-powered machinery. At distances of about 200 feet from the pipeline route, peak noise level exposures of approximately 70 dBA may be experienced for a brief period (typically 3 to 10 days) during daytime hours. Drilling and blasting are not generally expected to be required along populated portions of the route. (TR 13069-71; Applic. III, Sec. 2.6.5.3)

9. Construction of the pump stations will affect residential areas approximately 1,500 to 2,000 feet from the station sites. Maximum noise levels will intermittently affect people outdoors and possibly cause minor interference with speech. (TR 13071 Earsy)

10. During operation of the pipeline, residents approximately 1,500 feet from the pump stations will hear some noise during periods of low background noise levels. There will also be noise from automobiles, light trucks and from inspection by low flying aircraft. Maintenance of the pipeline may occasionally involve the use of welding equipment and cranes. Inspection and maintenance operations should not result in significant noise impacts because of their expected brief duration. (TR 13071-73 Earsy)

Light and Glare

11. The tanker unloading facilities, unloading pipelines, and onshore storage facilities will all require some degree of lighting during construction and operation. Light and glare impacts on the community are expected to be minimized by directing the light to project areas. The facilities will be located at considerable distances or shielded by vegetation and topography from residential areas. (TR 13058-59; 13064 Earsy)

12. Some lighting will be needed for the construction of the underwater pipeline, but light and glare impacts will be small because of the general remoteness of the route from residences. (TR 13058-59 Earsy)

13. Construction of the pipeline and pump stations will be conducted almost entirely in daylight. Necessary security lighting will generally be confined to pump station construction sites. Welding glare along the pipeline will be shielded from passers-by. Topography and existing vegetation will also provide some natural screening for glare during construction. (TR 13074-75 Earsy)

14. Operation of the pipeline will not cause significant light or glare impacts. Lighting will be installed at

pump stations for security and maintenance purposes. Impact from that lighting will be minimal because of the fixture type, the plan to direct the light toward the center of the site, and the use of topography and vegetation to break the line of sight between the stations and surrounding residential areas. (TR 13075 Earsy)

III. S. AESTHETICS

1. A major aesthetic concern is the imposition of man-made structures on the natural environment.

2. The visual character of the proposed site for the tanker unloading facilities (berths) is presently dominated by several low structures. (Applic. III, Sec. 1.19.2.1) The site is clearly visible from a distance of about 1.5 miles, and many of the views from this distance are unobstructed. Sensitive public views from beyond three miles include those from the Olympic National Park Headquarters and Visitor Center, from points along the access road to Olympic National Park, and from the Hurricane Ridge viewpoint within the park.

3. The tank farm site is visible primarily from a small residential area to the south and west, from a larger agricultural area to the east, and from offshore. (Applic. III, Secs. 1.19.3 and 1.19.5)

4. During construction, views of the berth site will be dominated by the construction activity rather than the facilities. This activity will not significantly alter the visual character of Ediz Hook and Port Angeles Harbor. (TR 13185 Gillespie)

5. The most significant visual impact of construction of the tank farm will be the excavation of a vertical trench (for the unloading pipelines) in the shoreline bluff. Where the storage tanks will be located, the visual character will be dominated by large equipment and by the clearing, excavation, and grading of the heavily wooded land. The construction activity will be visible to some residents of a subdivision half a mile south of the site. (TR 13188-89 Gillespie)

6. During operation, the visual character of the berth site will be dominated by the tankers. The berths will not present a significant contrast to existing harbor structures. (TR 13186 Gillespie)

7. During operation of the tank farm, the proposed vegetation buffer will screen ground level activity from all offsite views except from the subdivision half a mile to the south. The upper portions of several storage tanks will be visible to marine traffic in the Strait and to viewers in the vicinity of Ediz Hook. The restored vertical slot in the bluff will be visible throughout operation. (TR 13190-91 Gillespie)

8. Northern Tier has committed to retaining a landscape architect to recommend design mitigation measures for above-ground facilities, including excavating a narrow slot in the Green Point sea cliff and backfilling that slot with mater-

ials that match the adjacent beach in color and reflective character; painting storage tanks to minimize visual impact; and maintaining a buffer zone of trees around the onshore storage site. (Applic. III, Sec. 5.3.19.1)

9. Visual characteristics of the Port Williams landfall are uncertain because the landfall location is uncertain.

10. At the Point Partridge landfall, an existing notch widening will cause a slight lowering of the horizon as viewed from offshore. Visual impacts from construction are expected to be minor and short-term. During operation, the only visible structure above ground will be the check valve. (TR 13196-98 Gillespie)

11. The pipeline trench excavation and laying operation at Polnell Point will be visible from the surrounding area and offshore. After construction, the beach will be restored to near its original appearance. There will be no long-term visual impacts. (TR 13198 Gillespie)

12. Visual impacts resulting from construction activity at Brown Point are similar to those described for Green Point. This activity will be visible from offshore and from onshore areas to the south and across Saratoga Passage. (TR 13199 Gillespie)

13. Northern Tier has committed to use a narrow slot excavation at Port Williams and Brown Point as described above for Green Point, to use backfill materials that match the adjacent beach, and to angle the Brown Point right-of-way through existing vegetation on top of the bluff so that the horizon will not be interrupted. (Applic. III, Sec. 5.3.19.1)

14. The existing visual character of the proposed terrestrial pipeline route varies according to terrain, vegetation and development. During construction, the visual character will be affected by the presence of equipment, piping, and activity. The presence of the pump and pressure reducing station sites will be the major visual consequence. The visual character of stations close to public viewing areas may be more important than that of other stations. (TR 13200-02 Gillespie)

15. Special design measures will be applied to reduce visibility or improve appearance for the pump and pressure reducing stations at Arlington, Bandera and Quincy. (TR 13202-03 Gillespie)

16. When it is necessary to use a right-of-way through a forest, various methods to reduce the visual impact of forest clearing will be used. Removal of trees from forest lands will be avoided to the extent possible. Areas where there may be particular visual impacts include: segments or portions

of Whidbey and Camano Islands; between Stanwood and Arlington; along the crest of two hills south and southeast of Monroe; the Snoqualmie River crossing to a point south of North Bend; and several locations along Snoqualmie Pass, and Gelbart Mountain. (TR 13203-04 Gillespie)

17. During operation, the major visual impact will be from maintenance of cleared right-of-way through previously heavily forested areas. Northern Tier will develop detailed vegetation clearing and restoration plans for visually sensitive areas. (TR 13204-05 Gillespie)

18. Construction of the pipeline crossings of some major rivers, including the Dungeness, the North and South Forks of the Stillaguamish, the Pilchuck, the Skykomish, the Tolt, the Snoqualmie, the South Fork of the Snoqualmie, and especially the Yakima and the Columbia, will cause visual impacts. These impacts will include the presence of staging areas, vegetation clearing and grading, and actual construction. After construction, the shorelines and staging areas will be restored, landscaped and redesigned. Applicant made no commitment to restore minor stream crossings. During operation, visual impacts will be limited to the presence of block valves and to the maintained pipeline right-of-way. At the Columbia River crossing, the block valve on the west side will remain highly visible throughout operation. (TR 13205-07 Gillespie)

19. Construction of the highway crossings may cause visual impacts at points where roads are subject to heavy traffic. Applicant will reduce long-term visual impacts at these points by careful design of the crossing, and by vegetation restoration and landscaping. (TR 13207-09 Gillespie)

20. Aerial crossing of rivers or streams would cause some visual impact.

III. T. ARCHAEOLOGY, CULTURAL AND HISTORIC RESOURCES

1. The Northern Tier pipeline and related facilities have the potential to affect cultural, archaeological and historical resources adversely.

2. In assembling its application, Northern Tier conducted a Phase I overview of cultural resources. The Phase I study did not constitute a thorough review of all recorded and informant sources. A cultural resources study for a project such as Northern Tier proposes should include a careful, complete review of all sources of information concerning the history, prehistory and culture of the project area.

3. Northern Tier also conducted a partial Phase II reconnaissance of cultural resources. The Phase II reconnaissance is of doubtful usefulness in establishing research strategies and survey needs for Northern Tier's proposed Phase III study.

4. No portion of the Phase III study has been undertaken. The Phase III study should result in the identification and evaluation of all cultural resources in the project area.

5. No portion of Phase IV, which consists of mitigation of adverse effects on cultural resources, has yet been accomplished. Cultural resources are known to be located within the project impact area. Northern Tier Pipeline Company has identified a number of known cultural resources within the proposed route of the pipeline. There are known to be 50 or 60 more recorded cultural resources within the proposed pipeline corridor. (Prefiled testimony page 2, lines 9-11 Onat and TR 32613-14 Onat). In addition, other cultural, archaeological or historical resources, as yet unidentified, may be present.

6. There is historical evidence of a 19th century sailing vessel (the AUGUSTA) sunk off the coast of Ediz Hook. Present construction plans should not disturb the possible site.

7. No prehistoric sites have been identified on Ediz Hook near the proposed terminal facilities. (TR 13305-06 Howry) No impacts on historic or prehistoric sites are presently expected at the marine terminal facilities.

8. Documentary and field research to date has identified no cultural resources on the Green Point storage facilities site. (TR 13306-07 Howry)

9. The most likely cultural resources along the cross-Sound underwater pipeline route are submerged historic

marine features. (Prefiled testimony page 9, lines 6-8 Howry). Examples of such features are the Yacht ELSIE and the scow ABC VIII, in the vicinity of the proposed route west of Point Partridge on Whidbey Island. Historical data and geotechnical studies have not identified their location along the route. (TR 13309-10 Howry; Exhibit 84).

10. Nationally significant, registered cultural resources occur at two locations in the terrestrial corridor. At the eastern edge of Whidbey Island, near Polnell Point, the right-of-way traverses a prehistoric site which extends inland for several hundred feet from the shoreline. The site would be disturbed by site clearing, ditch excavation and vehicle access. In eastern Washington, the right-of-way crosses several historic transportation routes. The most significant of these is the Mullan Military Road, which is listed as a National Historic Civic Engineering Landmark. (TR 13311-12 Howry; Ex. 155).

11. Numerous locations along the pipeline corridor have the potential to contain significant prehistoric resources. Areas of exceptionally high potential include river crossings, past river terraces, and wetlands and shorelines, particularly in areas adjacent to upland or "dry" sites. The Columbia, Skykomish, Stillaguamish, and Snoqualmie Rivers are examples of high resource potential areas. The applicant will conduct a site-specific examination of each river crossing as part of the

project's cultural resources program. Additional areas of resource potential include some high elevation terrain. (TR 13312 Howry; Ex. 152, 155; prefiled testimony page 4, lines 22-26 Onat and TR 32615 Onat).

12. The proposed pipeline crosses part of the central Whidbey Island Historic District (Ebey's Landing National Historic Reserve). Historically the area to be crossed by the pipeline has been used for agriculture. The total traversed distance within the District is approximately 5,700 feet. The affected area has not been identified as critical. The pipeline should not appreciably affect the property's historic or associated scenic values except during construction. The applicant has committed to right-of-way restoration conditions which will minimize change in the Historic District and present agricultural uses. (TR 13313-14 Howry; Ex. 153, 154)

13. Because of inadequate surface or subsurface visibility or other limiting factors, some cultural resources will be discovered only during the construction phases of the project. The applicant will develop a program for addressing the mitigation of impacts to cultural resources discovered during construction. (TR 13347-52 and 13365-77 Howry).

14. Analysis of recovered data and the preparation of standard professional reports are a part of an adequate

mitigation program. The applicant, through its cultural resource professionals, will prepare such reports. (TR 13361-62 Howry).

15. Mitigation of effects on cultural resources includes permanent curation of recovered data and materials in an acceptable facility. The applicant will contract only with those cultural resource consultants or organizations which can demonstrate the capability to provide for curation of recovered materials in a suitable facility. (TR 13360-61 Howry).

III. U. RECREATION

Clallam County and Port Angeles

1. Public recreational facilities within the Port Angeles Harbor include a boat launch, two boat havens, two public piers, and a city beach. The harbor is extensively used for recreational boating and fishing. (Applic. III, Sec. 1.20.2)

2. Port Angeles is the site of an extremely popular Salmon Derby held every year. The Salmon Derby brings many visitors to Port Angeles and is an important contribution to the local economy. Construction activity and tanker traffic could interfere with sport fishing held as part of the Derby. Northern Tier has proposed mitigation measures intended to minimize disruption to Derby activities including halting construction during the actual occurrence of the Derby.

3. No developed recreation areas exist near the site of the proposed onshore storage facilities at Green Point. (Applic. III, Sec. 1.20.3; TR 13158 Gillespie)

4. The City of Port Angeles owns and operates a swimming pool, sports fields for soccer, softball and football, a campground, day use parks, tennis and basketball courts, tracks,

foot trails, jogging paths and a gymnasium. Additional recreational facilities in the city include the boat launches on Ediz Hook, privately owned bowling alleys, a golf course and movie theaters. (Frizzell, TR 27653)

5. At the present time, most of the recreational facilities in the City of Port Angeles are being used at capacity. (Frizzell, TR 27653 and Ex. 406.) The City's facilities are used extensively by Clallam County residents because comparable facilities do not exist in the unincorporated area.

6. The major <u>site-related</u> recreation impact caused by the tanker unloading facilities would be the disruption of use and displacement of the Thunderbird Boathouse and adjacent public boat launch on Ediz Hook. This displacement will increase the demand on other already overcrowded boating facilities in Port Angeles Harbor. (TR 13153-54 Gillespie; Applic. III, Sec. 2.20.2.1) There is no other location which has the same parking and close proximity to fishing areas. (Frizzell, TR 27654) Automobile traffic congestion will increase on the access road to any usable public boating facilities on Ediz Hook. (TR 13155 Gillespie)

7. Clallam County has significant recreational opportunities including the Olympic Mountains, the Olympic National Forest, the Olympic National Park, the marine coastline

on the Strait of Juan de Fuca and the Pacific Coast. Marine recreational activities include sports fishing, shrimping, crabbing and oyster harvesting. (Jacobs.)

8. Clallam County operates the following parks: Salt Creek Recreation Area; Pillar Point Fishing Camp; Dungeness Recreation Area; and Camp David, Jr. (Jacobs, TR 27679-81.) Clallam County also operates two public boat launches in eastern Clallam County. Both launches receive heavy use from May through October 1. Clallam County's parks and launches are presently used at capacity during the summer season. (Jacobs, TR 27681-82)

9. Gray's Marsh Wildlife Refuge, near Sequim, is directly north of the corridor. Sequim Bay State Park is located approximately 3.5 miles south of the corridor and Dungeness Spit State Park is located approximately 4.0 miles north of the corridor in Clallam County. (Applic. III, Sec. 1.20.4.1)

10. The Port Angeles Comprehensive Plan includes a capital improvement schedule for the years 1975-2000 with an estimated cost of $168 million. (Frizzell, TR 27740.) Port Angeles has built a new $2 million municipal pier and is funding a convention center. (Frizzell, TR 27747; TR 27719.) The waterfront trails plan is also under way. (Frizzell, TR 27657-60.)

on the Strait of Juan de Fuca and the Pacific Coast. Marine recreational activities include sports fishing, shrimping, crabbing and oyster harvesting. (Jacobs.)

8. Clallam County operates the following parks: Salt Creek Recreation Area; Pillar Point Fishing Camp; Dungeness Recreation Area; and Camp David, Jr. (Jacobs, TR 27679-81.) Clallam County also operates two public boat launches in eastern Clallam County. Both launches receive heavy use from May through October 1. Clallam County's parks and launches are presently used at capacity during the summer season. (Jacobs, TR 27681-82)

9. Gray's Marsh Wildlife Refuge, near Sequim, is directly north of the corridor. Sequim Bay State Park is located approximately 3.5 miles south of the corridor and Dungeness Spit State Park is located approximately 4.0 miles north of the corridor in Clallam County. (Applic. III, Sec. 1.20.4.1)

10. The Port Angeles Comprehensive Plan includes a capital improvement schedule for the years 1975-2000 with an estimated cost of $168 million. (Frizzell, TR 27740.) Port Angeles has built a new $2 million municipal pier and is funding a convention center. (Frizzell, TR 27747; TR 27719.) The waterfront trails plan is also under way. (Frizzell, TR 27657-60.)

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and turn zones, and could detract from the appearance of Ediz Hook beaches. (Applic. III, Sec. 2.20.2.2)

16. Operation of the Northern Tier project could result in oil spills which damage and cause the closing of parks and launches on the Strait. (Jacobs, TR 27688-91.)

Other Counties

17. Three state parks in Jefferson County are adjacent to waters crossed by the submarine pipeline. (Applic. III, Sec. 1.20.4.2)

18. Numerous recreational resources exist along the pipeline system, including city, town, county, and state parks, state and national forests, and state and national trails. The highest concentrations of public recreational facilities along the proposed route occur in Island County on Whidbey Island and in King County near North Bend. (Applic. III, Sec. 1.20.4, Sec. 1.20.5)

19. No direct impacts to any state parks are anticipated as a result of the construction of the underwater pipeline because of the distance of the parks from water areas to be disturbed. (TR 13164 Gillespie.)

20. Construction of the Port Partridge landfall on Whidbey Island will directly disrupt public access north along the beach from Libbey Beach County Park. It will disrupt private access to the beach from the Sierra Community Subdivision. Access to other portions of the beach will be available via Libbey Beach County Park. (TR 13165 Gillespie.)

21. Temporary interruption of beach access will occur at the Polnell Point landfall on Whidbey Island and at the Brown Point landfall on Camano Island. (TR 13165-66 Gillespie.)

22. The underwater pipeline in both the Strait and Saratoga Passage will pass through good sport fishing areas. Recreational boating and fishing in these local areas will be temporarily interrupted during construction. There are alternate resources available. (TR 13166 Gillespie.)

23. The planned but as yet undeveloped Three Forks Park near North Bend in King County may be traversed. Pipeline construction is not anticipated to severely affect future development of this park, but may constrain future park design and use.

24. The pipeline will pass through part of the Colockum HMA in Kittitas County and part of the Gloyd Seeps HMA

in Grant County. Hunting at both Colockum and Gloyd Seeps may be disrupted during construction and maintenance. (TR 13168-69 Gillespie.) The applicant has proposed to mitigate adverse recreational impacts on these areas by scheduling construction activities to avoid periods of peak recreational use insofar as is practical and consistent with other scheduling constraints upon the applicant. The applicant has not specified limits of practicability or any other such scheduling constraints.

25. The pipeline will cross the Snoqualmie National Forest and the Wenatchee National Forest. In the Snoqualmie National Forest, the pipeline will cross the Pacific Crest Trail near Snoqualmie Summit. Near the Asahel Curtis Natural Area, it will cross another trail. Other than these two trails, no developed recreational facilities will be encountered, though some proposed trail routes will be crossed. The anticipated impact will be impairment of recreational use of the pipeline corridor during construction. (TR 13168-70 Gillespie.)

26. There are twenty-five recreation areas within one mile of the centerline. Two areas are in Clallam County, nine in Island County, four in Snohomish County, six in King County, two in Kittitas County, and two in Grant County. Impacts on these areas will include visibility of clearing, construction equipment, traffic, and some disruption of access. (TR 13170 Gillespie.)

27. The main impacts on recreational resources at river and road crossings will be short-term disruption of recreational activity, and the visual impacts of clearing and construction activities. (TR 13175-76 Gillespie.)

28. Should an oil spill occur, there could be an interruption of use of, and a degradation of the value of, nearby parks or recreation areas. (Applic. III, Sec. 2.20.4.2)

29. Use of the pipeline right-of-way by off-road vehicles could disturb plant and animal habitats. (Applic. III, Sec. 2.20.4.2) (See Section III. H. Habitat)

III.V. LAND USE, SHORELINE MANAGEMENT, AND COASTAL ZONE

III. V. 1. Land Use

1. It is the obligation of the Council, upon the development of a site certification, to carry out the goals, policies, and rules of local land use regulations.

2. The Council adopts by reference the Findings and Conclusions of Council Orders Nos. 529, 550, 579.

III.V. 2. Shoreline Management

III. V. 2.a. Clallam County

1. In 1974, Clallam County enacted a Shoreline Management Master Program (hereafter, Master Program), subsequently amended.

2. The Master Plan designates portions of the area proposed for the terminal facilities as "urban." The underwater offloading piplines between the end of Ediz Hook and the Green Point tank farm would lie within "urban," "rural" and "conservancy" environments. The bluff approach at Green Point and portions of the tank farm and pump station lie in a conservancy environment. The proposed landfall at Port Williams is within a "rural environment." (TR 27354.7-11, Gilmore.)

3. In a "conservancy" environment, "utility" lines are permitted if underground. Dredging is prohibited. (Master Program, pp. 23-24.)

4. "Utilities" and dredging are permitted in "rural" and "urban" environments, provided that dredging in "rural" environments is not for the purpose of obtaining fill material. (Master Program, pp. 33-37, 56-59.)

5. The Master Program defines "utilities" as "services which produce and carry . . . oil." (<u>Master Plan</u>, pp. C-9/C-10.)

6. Excavations at the bases of cliffs are prohibited in rural environments. (Master Program, p. 31.)

7. In 1979, the Master Program was amended to prohibit energy facilities as defined within RCW 80.50.020 unless "it is demonstrated to the satisfaction of Clallam County . . . that local economic and environmental resources and conditions will be adequately protected from substantial adverse impacts." (Exhibit 395) (Resolution 215). In granting approval of the amendment, the Department of Ecology admonished the County that the amendment was not to be interpreted as permitting the county to veto Findings of the Siting Council. (See letter, Elmer C. Vogel, Deputy Director DOE to Clallam County Commissioner, Richard Lotzgesell, August 10, 1981.)

III. V. 2.b. <u>City Of Port Angeles</u>

1. In 1975, the City of Port Angeles adopted a Shoreline Management Master Program (hereafter, Master Program).

2. The proposed project would be within an "urban" environment in Port Angeles.

3. The proposed project is a "utility."

4. Dredging would be required to emplace the pipeline.

5. "Utilities" and dredging are permitted uses under the Master Program.

6. The Master Program has been amended to prohibit energy facilities as defined in RCW 80.50.020 unless it is demonstrated to the City that resources will be adequately protected. City Ordinance 2065 accomplished this amendment by incorporating a similar provision of the Clallam County Shoreline Management Master Program. (Discussed above in III.V.2.a., finding No. 1.) In giving its approval to the County amendment, the Department of Ecology noted: "In no way is this review process to be interpreted as having a veto authority over the EFSEC contested hearings.

III. V. 2.c. Jefferson County

1. In 1974, Jefferson County and Port Townsend enacted a Shoreline Management Master Program (hereafter, Master Program).

2. The submarine pipeline would lie within "natural" and "conservancy" environments in Jefferson County. (TR 12881, Meyers.)

3. The pipeline is a "utility." (Master Program, Section 5.1401.)

4. "Utilities" are conditional uses in "conservancy" and natural environments. (Master Program, Sections 4.405, 4.505.)

5. Dredging will be required to emplace the pipeline.

6. Dredging is a conditional use in both "natural" and "conservancy" environments. (Master Program, Sections 4.405, 4.505.)

III.V.2.d. Island County

1. Island County enacted on June 26, 1976, a Shoreline Management Master Program (hereafter, Master Program). The Master Program and its subsequent amendments remain in effect.

2. The pipeline route would pass near Polnell Point and Davis Slough (terrestrial). Those areas are designated as "rural" environments in the Master Program.

3. The pipeline route would pass near Point Partridge and Brown Point. The Master Program designates those areas as "shoreline residential" environments.

4. The submarine pipeline route would cross Admiralty Inlet, Saratoga Passage and Davis Slough. The Master Program designates those areas as "aquatic" environments.

5. Dredging would be required for emplacement of the pipeline.

6. Oil pipelines are within the definition of "utilities" in the Master Program.

7. "Utilities" are a primary use in shoreline "residential" and "rural" environments.

8. "Utilities" are not among the enumerated permissible uses in "aquatic" environments.

9. Dredging is a permissible use in shoreline "residential," "rural" and "aquatic" environments provided the conditions of Island County Ordinance 16.21.075(B) are satisfied.

III.V.2.e. Snohomish County

1. In 1974, Snohomish County enacted a Shoreline Management Program (hereafter, Master Program) that has been in effect during the pendency of Application No. 76-2.

2. At each of the following locations, the proposed route passes through areas that are designated "rural" and areas that are designated "conservancy": Davis Slough, West Pass, North and South Forks of the Stillaguamish River and the Pilchuck River. The route passes through a "conservancy" environment at Pilchuck Creek. The route passes through "rural" and "natural" environments at the south bank of the Skykomish River Crossing. (TR 37340, Rice.)

3. The proposed project is a "utility." "Utilities" are permitted in "conservancy" environments. "Utilities" are prohibited in "natural" environments unless "unavoidably necessary." (Snohomish County Shoreline Management Master Program, p. F-65 (1975).)

4. Dredging would be required to emplace the pipeline as proposed. (TR 37345, Rice.)

5. Dredging is permitted in the "rural" environments. Dredging is prohibited in the "conservancy" environments

except as required to maintain existing navigation channels and facilities. Dredging is prohibited in "natural" environments. (<u>Master Plan</u> at F-23.)

6. The proposed project would utilize riprap for shoreline stabilization. (TR 37345, Rice.)

7. Shoreline stabilization is permitted in "rural" and "conservancy" environments. Shoreline stabilization is prohibited in "natural" areas except where necessary to protect existing development. (<u>Master Plan</u> at F-61.)

III. V. 2.f. King County

1. In October, 1976, King County enacted a Shoreline Management Master Program (hereafter, Master Program) which has been amended.

2. The proposed route includes the following stream crossings in King County: Cherry Creek, Harris Creek, Griffin Creek, Tolt River, Tokul Creek and the South Fork, Snoqualmie River. (TR 37745, Peterson.)

3. The Master Program designates the aforementioned locations "conservancy" environments. (TR 37740, Peterson.)

4. The proposed project is a "utility." (King County Ord. 3688, Section 256.)

5. The Master Program permits "utilities" in conservancy environments. (Ord. 3688, Section 611.)

6. The Master Program requires that utility routes be designed to minimize visual impacts. (Ord. 3692, p. 33.)

7. The Applicant proposes a river-crossing method of open-trenching that would require excavation and fill below the ordinary high water mark. (TR 37741, Peterson.)

8. The proposed project does not purport to mitigate dangers to public safety or fisheries resources in King County.

9. The Master Program prohibits fill and excavation below the ordinary high water mark within a conservancy environment, except to mitigate conditions that endanger public safety or fisheries resources. (Ord. 3680, Section 613.)

10. The proposed project would require stream and river bank protection. (TR 37743.)

11. The Master Program prohibits construction of "utility" projects that require extensive stream and river bank shoreline protection. (Ord. 3692, p. 33.)

III. V. 2.g. Kittitas, Grant, Lincoln and Spokane Counties

1. The proposed pipeline would be in accord with applicable provisions of the Shoreline Management Master Programs of the counties of Kittitas, Grant, Lincoln and Spokane.

III. V. 3. Coastal Zone

1. No findings entered.

IV. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) (Includes Hydrostatic Water Withdrawal)

1. Northern Tier has requested water withdrawal allowing it to use approximately 194,000,000 gallons of water to perform hydrostatic testing of its proposed pipeline and associated facilities. After testing procedures have been completed, the water will be discharged usually within a few days and usually to the same water body and at approximately the same location from which the water was withdrawn. To accomplish discharge of the hydrostatic test water and also discharge of stormwater runoff during construction, Northern Tier has requested that the Council issue an NPDES permit for "Temporary" or "Construction" discharges. Northern Tier has also requested a second NPDES permit to establish the terms of allowable pollutant discharges in connection with runoff and tank bottom water to be emitted from the tanker unloading facility and the tank farm during operation of the proposed project. This second permit may be identified as the "Permanent" or "Operational" permit.

2. Northern Tier plans to make its withdrawals and discharges at various points along its Port Angeles to Idaho border route. In the main, the company has not specified locations for water withdrawal or for discharges. The company has

stated that the nature of pipeline construction and testing as well as water conditions require that the company have the maximum possible flexibility in designating withdrawal and discharge points. Problems arising during final design or encountered on the ground during construction may determine the most desirable withdrawal and discharge points, as may the timing of tests which may be determined by speed of construction and varying stream flow. On the other hand, the acceptability of the particular withdrawal or discharge is dependent in a large part upon the location of the particular event.

3. Water that is withdrawn from and later returned to a source (even if the discharge is made at a point identical to that from which the withdrawal was made - a matter not guaranteed in this case) diminishes the source of the impounded water by twice altering the flow volume (or total volume) of the water body. Moreover, impounding the water for a period of hours, days or weeks in a pipe or other facility and then discharging that water together with some additional suspended solids increases the suspended solids content of the source of the impounded water.

4. Northern Tier has not with any specificity indicated the sources from which it intends to obtain water for hydrostatic testing. The company has not shown that water in each of the sources it has generally identified is available

for Northern Tier's use, nor has the company described all existing water rights, withdrawal authorizations, or restrictions which relate to the various sources from which it seeks hydrostatic test water.

5. Water rights unidentified in this proceeding exist on Crab Creek and Cow Creek below Silvan Lake and Sprague Lake, from which Northern Tier proposes to take hydrostatic test water. Low flow periods critical to the rights of downstream users occur from May through October of any calendar year.

6. Northern Tier has not submitted full plans for its withdrawals or discharges and has not established approximate times of commencement for these events.

7. Northern Tier's concern that specific permitting conditions regarding discharge sites and techniques not be presently imposed on it places the Council in the unusual position of not reviewing or being informed of any of the specificities of what it is asked to authorize until after the time for informing the Council of the proposal and for scrutiny in a public forum have passed. Many factors important to a Council determination on the propriety of proposed discharges would not be made known to the Council, under Northern Tier's plan, until 20 days before the discharge dates. The time period would not

afford the Council flexibility in utilizing the services of state agencies with expertise in the subject matter.

8. The findings above in this section are made without the availability of substantial information necessary to properly review and, as necessary, condition the withdrawals and discharges proposed by Northern Tier. Examples of the lack of information have been stated in preceding findings. Site-specific studies have not been done, and normal review, comment and cross-examination procedures have not focused on many aspects of Northern Tier's proposal.

V. MITIGATION

Oil Spills

1. The Council is cognizant of the extension of the mandatory U.S. Coast Guard Vessel Traffic System (VTS) west of Admiralty Inlet to Cape Flattery. This provides for mandatory movement of vessels transiting the U.S. side of the Strait of Juan de Fuca in designated inbound-outbound lanes in conjunction with a defined separation zone, strict application of the Bridge to Bridge Radiotelephone Act, and radar surveillance of all traffic (both by U.S. and Canadian authorities). This is defined as an "active management system" as opposed to the previous "passive management" role in the Strait. It is designed to identify all parties at risk, and to safeguard crews, vessels, and the environment from vessel casualties.

2. The U.S. Coast Guard Commercial Vessel Safety Program provides cradle-to-grave inspection of U.S. flag tankers. This includes plan review prior to start of construction to insure compliance with design standards for hull structure, propulsion units, cargo containment and handling, navigation, life saving and fire fighting equipment, and operating safety. Further inspection is carried out during construction and periodically during the service life of the vessel.

3. Under existing laws, treaties and Presidential Initiative, the Coast Guard boards and examines all foreign flag tankers upon their initial entry into the United States and, as possible, annually thereafter.

4. The U.S. Port and Tanker Safety Act of 1978 requires the Secretary of Transportation to establish a Marine Safety Information System; this responsibility has been assigned to the U.S. Coast Guard. The Marine Safety Information System provides a valuable tool for efficient and effective on-board examination of vessel safety and qualifications. Such inspections are often made only after the vessel arrives at port. The System provides each district office with computer capability to access history of vessel ownership, casualties, pollution incidents, violations of federal safety and pollution regulations, and past boarding examination information to identify areas of special attention.

5. Projected reductions in casualty probability provided through mandatory compliance with the VTS in the Strait may be offset by the increase in tanker traffic calling at the Northern Tier facility. The Council is not in a position to determine this effect, nor has testimony been provided to quantify any projection of such effects.

6. The responsibility to provide a presence of the U.S. Coast Guard sufficient to operate and enforce the programs identified above rests with the federal government. This presence cannot be guaranteed by the state of Washington for the protection of state interests.

7. Strict terminal regulations and surveillance by terminal operating personnel could reduce the potential for accidental oil spills. The record makes reference to this opportunity and indicates such provision is standard practice at in-state offloading facilities. There is no evidence of the scope or depth of regulations that might be proposed by the applicant nor of the manner in which they might be implemented and enforced.

8. A well-designed oil spill contingency plan, while not insuring that spills will not occur, provides rapid response to control and contain accidental spills and minimize damage to the environment. Equipment and logistics are a vital part of such a plan. An outline plan was provided by Northern Tier but it is too abbreviated at this time to assure that the objectives can be met.

9. The proposed pipeline route could be relocated to avoid submarine crossings of Admiralty Inlet and Saratoga Passage. Environmental reasons advanced by the applicant to justify its abandonment of the around-Sound route are specious.

The cross-Sound route presents a configuration posing a particular risk to the state's valuable marine resources. The submarine pipeline design is based on current, soil, liquefaction, seismic and related parameters lower than those which may reasonably be expected to be encountered.

Fire and Explosion

10. During the course of the hearings, references were made to other transshipment terminals, worldwide, which had the capability to handle tank vessels of the size anticipated to call at Port Angeles. The specific criteria for siting such terminals were not presented by any party. The Council is officially aware of the size, location and configuration of the following facilities.

Locale	Terminal	Depth	Vessel Capacity	Distance and Bearing to City Center
Rotterdam	Europoort	23m	250,000 DWT	20km (12.5 mi) W.
Rotterdam	Maasvlakte (Sea Island, 6000 ac. superseding Europoort)	30m	700,000 DWT*	32km (20 mi) W.
Le Havre	Antifer	---	700,000 DWT*	20km 12.5 mi) NW
Bordeaux	LeVerdon	---	250,000 DWT	85km (53 mi) NW
Goteborg	Floating Term.	25m	225,000 DWT	13km (8 mi) W.
Marseilles	Fos	23m	400,000 DWT	40km (25 mi) W.
Genoa	Genoa	---	130,000 DWT	8km (5 mi) W.

*The largest tankers afloat (and calling) are 550,000 DWT.

Genoa	New Offshore Platform	50m	ULCC's	2.8 km beyond old terminals
Bantry	Bantry Bay		500,000 DWT	

11. Port Angeles is the only potential oil port site on the Olympic Peninsula which poses a fire and explosion risk to an urban community. Feasible alternate sites exist west of the city which could mitigate the consequences of fire and explosions, the risks of oil spills from harbor accidents and anchor drops, the displacement of existing harbor uses, the intensification of air quality problems for the city, potential impacts on Olympic Memorial Hospital, and the possibility of damage from geologic and seismic hazards associated with the Hook.

Surface Water Quality

12. To minimize soil loss and to preserve water quality, it would be necessary to develop a temporary erosion-sedimentation control plan equivalent to that described in the King County Conservation District Manual. This should be completed prior to commencement of construction and should apply to all portions of on-site work and associated storage areas and access routes.

13. Existing state (and federal) water quality criteria would be exceeded by the proposed construction activi-

ties in crossing rivers and streams. The most significant of these standards are the turbidity standards which, for Class AA and Class A streams, would be exceeded with any digging or heavy equipment operation in a stream.

14. Approvals for short-term modifications of water quality criteria have been conditioned to attempt to minimize water quality impacts. These conditions include, as appropriate, limitations on design, construction practices, timing, and the establishment of dilution zones. It is appropriate that any short-term modifications be conditioned and granted on a case-by-case basis. The following conditions are reasonable design/construction criteria and could be required of Northern Tier (Asseltine Prefiled 5-10) for mitigative purposes:

(a) Small streams, those with an average annual flow of five cubic feet per second (cfs) or less, or with a flow less than five cfs at the time of crossing, should be crossed in the dry. Because small streams are vulnerable to disturbance and valuable to the fisheries resource, no exceptions should be made to the dry crossing requirement without justification and review of alternate design/construction plans. The method of crossing in the dry would be at the contractor's option, but could include culverting or fluming the stream, boring, tunneling, aerial crossing, and jacking.

(b) Streams larger than five cfs could be crossed in the dry under some circumstances. If the applicant proposes not to cross some of these streams in the dry, an application for short-term modification of the water quality standards could be submitted and approved for each crossing prior to construction. Each application should state why a crossing in the dry is not feasible, and should include design and construction plans for the crossing.

(c) No equipment should be allowed to operate in, or cross through, small streams. Any disturbance of the natural stream channel should be kept to a minimum. If the stream is diverted through a culvert or flume and the bed is trenched, precautions (such as compacting the trench) should be taken to avoid excess turbidity during the actual diversion process and when the stream is returned to its natural channel.

(d) For any streams not crossed in the dry, the water quality standards could be modified on a short-term basis to allow a dilution zone of five stream widths or 500 feet downstream, whichever is less. Beyond this point, the water quality standards should be met. The effect on construction practices would vary, depending upon the nature of the soils in the stream or river bed. In granular strata with few fines, few water quality problems will occur. In stream or river beds with a high fine or silt content, special construction methods would have to be used to confine turbid water to the immediate construction area. These could include curtaining the construction area, sheet piling and various methods to reduce water velocity. All applications to cross streams "in the wet" should include soil test borings to a depth of four feet below the planned trench bottom. These should be in sufficient number to provide a true representation of soils over the full crossing length.

(e) If the stream crossing is to be wholly or partially in solid rock, less than four feet of cover depth may be allowed. A geologist should verify that solid rock exists before lesser cover is approved.

(f) Dry washes, especially those with any history or potential of flash flooding, should be treated as perennial streams. Scour and bed erosion, as well as bank erosion, should be controlled, and the pipe located and constructed so that pipeline integrity is maintained.

(g) All crossings should be made on a straight reach of stream at an angle as close to 90° as possible. Water quality monitoring should be required during construction. Valves shall be required on each side of each stream having an average annual flow over 20 cfs.

(h) At all stream crossings, bed and bank disturbance should be minimized. Restoration should approximate natural conditions, including trench backfill, shape, gradation, and soil density, conformance to pre-existing contours, with bank and trench protection to 100-year flood level, and adequate riprap in accordance with United States Army Corps of Engineers or State of Washington Department of Transportation standards. Riprap, gabion blankets, and vegetative cover are preferred. Riprap should be used on all slopes steeper than 4:1 or 5:1 and revegetation on all flatter slopes to the 100-year flood level. Vegetation could be used in combination with riprap or gabion blankets. Restored banks should be smooth and continuous.

(i) There should be post-construction inspections to assure that stream and bank integrity are maintained. These should be conducted at least once a year for the first three years, and thereafter, semiannually. Inspections should also be conducted after each ten year flood event.

15. To minimize adverse physical effects on aquatic resources, in-stream construction work is frequently scheduled for those periods of the year when important species are not abundantly present - a period commonly referred to as "fish windows." The periods of upstream migration, spawning, incubation, rearing and downstream migration vary not only between species but between streams. To ascertain the most likely "fish

windows," these use periods must be superimposed over time for each major stream.

16. As a result, the Department of Game submitted the following timing recommendations as a mitigation measure on any in-stream work:

CROSSING	TIMING
Dungeness River	Aug 1 - Aug 31
Siebert, McDonald and Matriotti Creeks	Aug 1 - Sept 15
Other Olympic Peninsula small streams	Aug 1 - Sept 15
Davis Slough & West Pass	June 15 - Aug 15
Pilchuck Creek	July 1 - Aug 31
N. Fork Stillaguamish River	July 1 - 31
S. Fork Stillaguamish River	July 1 - 31
Pilchuck River	July 1 - Oct 31
Skykomish River	July 1 - Aug 15
Tolt River	July 1 - Sept 15
Snoqualmie River	July 1 - Sept 15
S. Fork Snoqualmie River	July 1 - Sept 15
Yakima River	Oct 16 - March 15
Columbia River	July 1 - Oct 15
Church Creek	July 1 - Sept 30
Armstrong Creek and Little Pilchuck Creek	July 1 - Oct 31
French Creek	June 15 - Oct 31

N. Fork Cherry Creek, Cherry Creek, Harris Creek, and Griffin Creek	July 1 - Sept 15
Other Western Washington small streams and wetlands	July 1 - Oct 31
Kittitas County streams and wetlands	July 15 - Oct 15
Cow Creek	June 30 - Sept 30
Other Eastern Washington streams and wetlands	June 30 - Sept 30

Ground Water Quality

17. In some circumstances, a contaminated ground water condition may be corrected by heavy pumping of a well or wells drawing from the polluted aquifer, provided the recharge rate is equal or greater than the withdrawal rate. Where the latter condition does not exist, a series of injection wells may be constructed immediately outside the zone of contamination, and unpolluted water injected at or close to the center of contamination.

18. This process is slow, expensive, uncertain and requires a knowledge of the hydraulic gradient, transmissivity of the water bearing materials and recharge rate. This information is not currently available for any portion of the project site, including the pipeline route.

19. High pumping rate wells of this kind would encourage, and possibly cause, salt water intrusion into the aquifers, particularly near shoreline areas. (TR 35512).

20. Correction is essentially the same as previously described, but requires a line of additional injection wells between the shoreline area and pumped well(s). Correcting the breaching of an artesian zone is even more expensive and time consuming.

21. Preventative measures should be considered wherever a producing or potentially producing aquifer is near a proposed site due to the difficulties from pollution and the high cost of any purification. (TR 16484).

Pipe Exposure

22. In order to assure protection against pipe exposure, maximum scour depths for all streams in western Washington should be calculated using both the one-third method and the tractive force method. (See Section III.K. Rivers and Streams.) Pipe burial depth should be based upon the deeper of the scour depth calculated.

23. For those streams in eastern Washington which are subject to flash floods (and similar in composition and

behavior to streams in the arid regions of the southwestern United States), maximum scour depths should be calculated using both the tractive force method and a calculation of four times the rise in water surface elevation above ordinary low water (37044/9-16). Pipe burial depth should be based upon the deeper of the scour depth calculated.

24. At all stream crossing sites, the top of the pipe should be buried four feet below the maximum scour depth so derived. (Garland PFT 10/23-25).

25. Based on the sinuosity and corresponding meander amplitudes of streams in western Washington, the horizontal distance of maximum subchannel pipe burial depth should be no less than five times the width of the stream channel except where bedrock is encountered in the trench excavation. This applies even to streams which are presently confined by bank stabilization structures such as dikes and riprap. It is not reasonable to assume that streams so confined will remain confined as long as stabilization facilities are maintained; dikes, levees and riprap are commonly breached during floods of lesser magnitude than a 100 year flood (Garland PFT 13/10-18; Norman).

26. Northern Tier's application lacks historical data such as aerial photographs or maps which would indicate the past channel migration and avulsion behavior of the indivi-

dual streams at the proposed crossing sites. These data are necessary for an accurate estimate of future migration rates and potential for avulsion. Based on present local conditions of topography, bank stability and composition, channel configuration, sinuosity, and presence of man-made stabilization structures, the following minimum horizontal distances are appropriate for maximum subchannel burial at the specific crossing sites (Garland PFT 14-20; Norman):

Pilchuck Creek. A distance at least sufficient to account for westward channel migration of up to 400 feet over the next 10 years.

North Fork Stillaguamish. A minimum distance of 1000 feet to the southeast from the valley wall at the northwest end of the crossing.

South Fork Stillaguamish. Between sag bends from a point 200 feet northwest of the north bank, southwest a total distance of 500 feet. Additionally, it will be necessary to repair or remove the row of pilings along the north bank.

Pilchuck River. A distance 10 to 15 feet south of the south bank and into the slope before starting upgrade.

Tolt River. Beneath the entire active channel complex from the top of the existing streambank northwest of the river to the point of intersection of the southwest valley wall and existing valley floor.

Snoqualmie River. Beneath the entire active channel complex, that is, across the entire Snoqualmie Valley flood plain.

27. Exposure of the pipe between the overbend and sag bend at a stream crossing can pose greater integrity concerns than short length exposure of the horizontal buried line. (TR 36008). The slope angle typically proposed by NTPC (1.5 Horizontal:1 Vertical) should be lessened to 2H:1V or 3H:1V (TR 36008, 36064)

28. Where realignment to avoid a wetland is not feasible, directional drilling should be given serious design consideration. Directional drilling of Davis Slough and West Pass appears to be technically feasible. (TR 36021, 36024, 36094, 36101).

29. There are no apparent technical limitations to the use of aerial crossings utilizing pipeline bridges. (Ex. 707) (TR 36025). Extra casing or concrete coating could be used to guard against vandalism. (TR 36025)

Sensitive Areas

30. The primary protective measure for wetlands is planning to avoid them. Within the one-half mile corridor, there should be sufficient latitude to by-pass them. The habitat evaluation procedure, or HEP analysis, is an appropriate tool for identifying secondary mitigation measures for wetland and riparian loss. (TR 36320, 36328, 36346, Ex. 718; 713; 715).

31. To avoid disruption of tile drains without adversely affecting receptor ditches, the recommended burial of the pipeline through the French Creek area of Snohomish County is eight to ten feet deep. (TR 36894-95).

32. Major disruption to habitat and wildlife within wildlife management areas or refuges (i.e., Skagit HMA, Colockum HMA, Gloyd Seeps HMA) could only be eliminated by avoidance of these areas. Seasonality of use by various species of big game and other wildlife, habitat succession, and user groups preclude concise, effective, mitigative measures to assure continued long-range maintenance of habitat and management programs for public benefit.

This aspect would necessitate substantial amendment to the application or submission of a new application.

33. For purposes of public convenience and worker safety, no construction activity should take place when and where lawful hunting is occurring.

Socioeconomics

34. The applicant intends to mitigate potential economic-related impacts associated with pipeline construction by drawing its construction schedule, to the extent possible, so that peak personnel requirements do not occur during the summer tourist season and by assisting the counties in applying for grants and loans. (TR 12709-10 Moriyama)

35. Northern Tier's present lack of information on land transportation would require preparation of a preliminary and final land transportation plan prior to commencement of the construction of the marine terminal facilities on Ediz Hook. (Pittis, TR 26116-18)

36. The Burlingame Bridge across the Dungeness River would have to be reconstructed to HS-20 structural capacity in order to handle Northern Tier truck traffic. (Leach, TR 26139-40)

37. Northern Tier plans to negotiate use, maintenance and improvement agreements for suitable private roads with the owners. (TR 12812-13 Olender)

38. The applicant should comply with procedures recognizing all of the ordinary county permits and/or franchises in order to protect and safely use county roads and right-of-way off the project site. (i.e., Island Co. TR 35441-42)

39. In order to mitigate construction period impacts on Olympic Peninsula law enforcement, Northern Tier should provide funding for six fulltime deputies (one per shift) for the Clallam County Sheriff's Department; nine fulltime officers for the City of Port Angeles Police Department; and one fulltime officer for the Sequim Police Department; each for a five year period commencing six months before construction. Following that period, funding should be provided for one sheriff's deputy and one Port Angeles police officer for the life of the project. Such funding should include money for training, facilities, equipment and support personnel as necessary.

40. If the project is built, Northern Tier should provide Island County sufficient funding for three additional deputies for an 18 month period or until the end of Island County construction and testing, whichever is longer, commencing six months prior to the start of Island County construction. Funding should include ancillary provisions as set forth in finding 39 above.

41. Should the project be certified, Northern Tier must develop approved solid and hazardous waste disposal plans and septic and sewage disposal methods before construction commences. Under certain conditions, the Clallam County Public Utility District's LUD No. 1 may be able to serve the tank farm's permanent water supply needs, obviating any requirement for development of a new source.

42. Should Northern Tier locate in Port Angeles and Clallam County, it has responsibility to initiate and sponsor development of adequate and detailed oil spill, fire, and explosion emergency response plans prior to the commencement of any construction or operation phase. Such plans should include appropriate provisions for communication of incidents to emergency response personnel, response team training and additional equipment necessary for any such emergency created by project siting.

43. Six months in advance of the start of construction (or longer, if more lead time for facilities and personnel placement is required) Northern Tier should furnish the Port Angeles School District, to the extent not covered by state funding, with funds sufficient to retain six teachers, six portable classrooms, and such funds as may be required for concomitant support staffing, supplies, bussing and planning expenses,

and additional costs for a five year period. Northern Tier should, in similar fashion, fund the Sequim School District's cost of obtaining two busses, of planning for contingencies, and of meeting such expenses as may subsequently be demonstrated to result from Northern Tier's presence and not covered by the Basic Education Act.

44. While not insurmountable problems would accrue to Olympic Memorial Hospital at Port Angeles during normal operation, or even during oil spill incidents, hospital functions could be disabled from a major fire or explosion. There is nowhere else for a victim of such an incident, or other sick or injured persons to go for treatment in the immediate area. It may not be apropriate that Northern Tier be made to bear the burden of moving the hospital to a safer location but there is no reason that the hospital should be placed in jeopardy from Northern Tier. The problem posed could be mitigated by relocation but would impose a heavy financial burden on the community or on the applicant.

45. If blasting is required within the vicinity of residential areas, special measures must be used to mitigate noise impact. (TR 13069-71; Applic. III, Sec. 2.6.5.3)

46. Mitigation of effects on cultural resources is not complete unless recovered data and materials are permanent-

ly preserved in the best feasible condition. This requires not only secure, monitored, long-term storage in an appropriate, regulated environment, but initial preparation, continuing maintenance, and accessibility for research or for loan to reputable organizations for display purposes.

47. Maintenance and operation have the potential for adversely affecting significant cultural resources. Additionally, long range effects of construction activities, such as changes in erosional regime and provision of easy access, may result in adverse effects. It is important that long range impacts be mitigated through the development and implementation of a cultural resources management plan.

48. In order to mitigate partially the impacts of the Northern Tier project on park and recreation uses in Port Angeles, additional recreational facilities and additional funds are required. (Frizzell, TR 27661-62.)

49. If issued, any site certification agreement should vest power to construct and operate the designated facilities only in Northern Tier Pipeline Company. Northern Tier should not transfer such a permit without prior approval from the Council. A transfer of common stock sufficient to shift management control of the company is considered a transfer of the permit.

50. If the Northern Tier project is constructed, it would be necessary to relocate certain existing harbor facilities and uses which would be physically displaced on Ediz Hook to another area. A conceptual plan has been developed to mitigate displacement of log storage areas, the Thunderbird boathouse, two boat launching ramps and the pilot station. The plan moves these facilities to the city side of the harbor. The plan includes two rubble mound breakwaters; a water storage area for up to 14 cargo barges; standing booms and anchors to provide for 30 acres of water storage for logs; a 300-boat marina (9,000 linear feet); an eight-lane boat launch ramp (120 linear feet); parking for up to 400 cars (or equal land area for a lesser number of cars and boat trailers); paved road access on or from Lincoln and/or Francis Streets in Port Angeles; and replacement of the Salmon Club facilities. Moorage is contemplated also for vessels larger than sports fishing boats and marina users, including tugs for Northern Tier's tankers, a fireboat, oil skimming vessels, USCG vessels and other large craft. (Hendricks, TR 42103-4.)

51. No application is pending before any federal, state or local agency for construction of the displaced harbor facilities. The necessary permits and processes have not been identified; nor have the substantive standards to be met been identified. (TR 42097-9) The permits may not be obtainable. (Ex. 869, p. 19; TR 42099.)

52. The relocated harbor facilities are themselves major capital projects which might in turn cause significant impacts. No environmental impact assessment, SEPA compliance or other study has been performed to assess adverse impacts of proposed construction or operation of these facilities. (TR 42096)

53. The proposed activities of harbor dredging, creation of parking by landfill on the tidelands or in the water, and the creation of vehicular access to the site are serious concerns which affect whether or not permits can be obtained, and affect the feasibility of construction of the proposed harbor facilities. (Lean, TR 42544-5; Weiner, TR 42554-6; Carr, TR 42134 A-B.)

54. The plan does not identify any alternate locations along Port Angeles Harbor for the displaced Ediz Hook boat launch ramps. (Hendricks, TR 42092-3.) The displacement of existing recreational facilities, including the ramps, moorage, and the Thunderbird Boathouse will create serious impacts.

55. The City of Port Angeles Shoreline Master Program (SMP) applies to proposals for construction of marinas, boat launch ramps, vehicular access and parking located within and adjacent to designated shorelines. The present City of Port Angeles SMP prohibits the filling of tidelands or water for the

purpose of creating additional land and requires that parking be situated on uplands. (Carr, TR 42134 A; Ex. 395.)

56. A condition that permits for the displaced facilities be obtained before Northern Tier may commence construction is favored by Clallam County and the City of Port Angeles.

Liability Coverage

57. Northern Tier has retained a risk management consultant. A specific program covering the exposures during the construction and operating phases of the project would be developed when a date for commencement of construction is known. The program would define loss exposure, devise a loss control program, and develop a financial response program. The response program would use commercial insurance and other formal financial alternatives for covering loss beyond that which could be assumed by Northern Tier. (TR 17299-300 Rodehaver; Applic. III, Sec. 8.4.9).

58. Northern Tier would require each contractor on the project to maintain various insurance coverages to protect against loss from bodily injury, property damage, and sudden and accidental pollution damage. In addition, Northern Tier would maintain excess coverage up to the limits typically covered on projects of similar scope. (TR 17300 Rodehaver).

59. During the construction period, Northern Tier would require copies of all reports of incidents that involve property damage or bodily injury. Major incidents, including bodily injury and property damage, would be monitored by Northern Tier and Northern Tier would provide assistance to third parties through direct communication with contractors or their insurance companies where possible and appropriate. (TR 17300-01 Rodehaver).

60. Were the pipeline operational, claims would be submitted directly to Northern Tier. Areas of exposure to loss include injury to persons, damage to property of third parties, and pollution, which could involve either personal injury or property damage. For commercial insurance, specific loss coverage would be negotiated at the time of purchase. (TR 17301-04 Rodehaver).

61. Northern Tier has proposed the following claims-handling procedure to be effective if the project were operational. For undisputed claims, payment can normally be made within ten days of receipt. For disputed claims under $10,000, if there is a question on either liability or value of the loss, the company would voluntarily submit to arbitration pursuant to RCW Ch. 7.06. For claims that exceed $10,000, Northern Tier and its insurance carrier would appoint a claims-handling organization to investigate and adjust claims. (TR 17306-08 Rodehaver).

VI. STIPULATIONS

1. The applicant has entered into a number of stipulations with state agencies, local governments, and private parties in an effort to mitigate the adverse impacts of the proposed project. Official notice was taken of all stipulations but no action was taken by the Council to approve or disapprove. These stipulations are as follows:

a. Stipulation between Northern Tier and Washington State Department of Transportation (undated)

b. Stipulations between Northern Tier and the City of Port Angeles:

(1) Negotiating Guidelines and Procedures (April 15, 1980)

(2) Amendment to Negotiating Guidelines (June 24, 1980)

(3) Payment by Northern Tier for review, analysis, and other activities by City of Port Angeles (May 27, 1980)

(4) Housing Survey and Plan (May 27, 1980)

(5) Water, Sewer, and Solid Waste (June 24, 1980)

(6) Policy of Preferring Qualified Local Workers (September 2, 1980)

(7) Transportation (February 17, 1981)

(8) Oil Spill Contingency (June 16, 1981)

c. Stipulation between Northern Tier and Lincoln County (September 2, 1980)

d. Stipulation between Northern Tier and Spokane County (September 18, 1980)

e. Stipulation between Northern Tier and Adams County (October 6, 1980)

f. Stipulations between Northern Tier and Port of Port Angeles:

(1) Regarding Seamen's Center (November 24, 1980)

(2) Regarding Construction Inventory (November 24, 1980)

g. Stipulation between Northern Tier and the East Columbia Basin Irrigation District (August 6, 1980)

h. Stipulation between Northern Tier and the Quincy Irrigation District and the East Columbia Basin Irrigation District (December 3, 1980)

i. Stipulation between Northern Tier and Grant County (December 15, 1980)

j. Stipulations between Northern Tier and Washington State Department of Natural Resources:

(1) Regulatory (January 9, 1980)

(2) Proprietary (January 9, 1980)

k. Agreement and Stipulation re Port Angeles Harbor Facilities (entered into by Port of Port Angeles, ITT Rayonier, Inc., Crown Zellerbach Corporation, Foss Launch & Tug Company, Puget Sound Pilots Association, Port Angeles Salmon Club, and Northern Tier) (March 24, 1981)

l. Stipulation between Northern Tier and King County (May 6, 1981)

m. Stipulation between Northern Tier and Kittitas County (May 19, 1981)

n. Stipulation between Northern Tier and Department of Ecology (June 23, 1981)

o. Stipulation between Northern Tier and Clallam County Fire Protection District No. 3 (June 24, 1981)

p. Amendment to Stipulation between Northern Tier and Lincoln County (July 2, 1981)

q. Amendment to Stipulation between Northern Tier and Adams County (August 26, 1981)

r. Stipulation between Northern Tier and Clallam County (July 27, 1981)

s. Stipulation between Northern Tier and City of Seattle (July 29, 1981)

2. The parties to the stipulations have made a good faith effort to identify the impacts associated with the proposed project and to devise reasonable and feasible measures to mitigate certain of those impacts.

3. Implementation of the above noted stipulations other than those between the applicant and the DNR and the Port Angeles Harbor Facilities stipulations and the non-noticed part of the DOT stipulation is feasible. Terms of the stipulations constitute reasonable mitigation methods.

4. Unresolved issues discussed in the mitigation findings that remain include:

- Oil spill risk caused by vessel casualty or submarine pipeline failures;
- Fire and explosion risk in Port Angeles Harbor;
- Timing of river crossing construction;
- Construction in sensitive areas, except Three Forks Park;
- Socio-economic impacts as follows:
    - Law enforcement in Port Angeles, Clallam and Island Counties;
    - Recreation facilities in Port Angeles;
    - Fire protection in Port Angeles;
    - Educational services in Port Angeles;
    - Risk posed to medical facilities in Port Angeles-Olympic Memorial Hospital.
    - In Clallam County, housing, fishing and tourism losses, electrical energy impacts, ground water contamination, and secondary petroleum-related development.

5. The stipulation covering displacement of harbor facilities and uses does not solve the full range of harbor problems. Impacts on harbor users such as the Thunderbird Boathouse and Blackball Transport, Inc., will continue. The stipulation addresses only the harbor use problems of the signatories. (Oliver & Crutcher, TR 42572.)

6. Portions of the stipulation deal with a harbor management plan. The Port of Port Angeles has no rules and regulations for, or experience with, harbor management or vessel traffic systems. (Hendricks, TR 42105; Oliver TR 42566.)

7. Clallam County and the City of Port Angeles take the position that all federal, state, and local permits and approvals for components contemplated in the harbor management agreement should be obtained before commencement of construction of the Northern Tier facility.

8. The agreement also addresses the circumstances of harbor log storage areas affected by Northern Tier operations. If the agreement were implemented, the only likely consequence to the forest products industry (electric supply and air quality problems aside) would be the oiling of logs in the harbor.

9. Pursuant to the terms of a stipulation, the City of Port Angeles and Northern Tier have agreed to undertake a housing survey.

10. Procedures to implement reviews of construction plans to cross state and county roads are found in the Stipulations between Northern Tier and other parties.

VII. POTENTIAL FUTURE ACTIVITIES

1. The Northern Tier Pipeline Company application is for a crude oil transshipment terminal and pipeline facility. From the first days of the Northern Tier Application, one of the major benefits advocated for the facility the company proposes is that it offers a potential for offloading at Port Angeles the crude petroleum now delivered by tanker to the four existing northern Puget Sound petroleum refineries, thereby greatly reducing the risk of oil contamination of Puget Sound, Admiralty Inlet, North Puget Sound and associated waters. This prospective benefit has been advanced through the course of the case. (case record in general.) The 1979 amendment to the application, which introduced the proposed crossing of Puget Sound, brought the route closer to the North Sound refineries and thereby enhanced the possibility of hookup.

2. Northern Tier has expressly disclaimed having applied to EFSEC for hookup to the North Puget Sound refineries. (Applic. II, 8-20, TR 13726 Beasley). Though the Council was promised that it would, the Northern Tier application does not include an application for those facilities which would be needed to connect the four existing North Puget Sound refineries to the Northern Tier facility. On the record in the present matter, Northern Tier committed to submit a hook-up application considerably before the close of the contested case hearing, but no

such application has been forthcoming. (Crutcher TR 42, Jan. 28, 1980.)

3. The four refineries consist of Atlantic Richfield Company (ARCO) and Mobil Oil at Cherry Point, and Shell Oil and Texaco at Anacortes, Washington. ARCO, Texaco, and Shell representatives testified that their companies oppose mandatory hook-up to Northern Tier because it would be substantially more costly for the refineries to hook up to Northern Tier than to continue with tanker deliveries, because of amortization costs of existing facilities, and because increased costs could render some refinery operations uneconomic.

4. Hook-up of the Northern Tier system to the North Puget Sound refineries is a condition of expedited federal government processing of the Northern Tier application. The decision under Title V of the Public Utility Regulatory Policies Act of 1978 ("PURPA"), announced on January 17, 1980, conditioned expedited processing of the Northern Tier application "on the requirement that the pipeline be made physically available to the four major Puget Sound refineries." The initial right-of-way grant issued to Northern Tier by the U.S. Department of the Interior on April 21, 1980 includes a stipulation which reads in part as follows (Beasley, TR 13687-88):

> GRANTEE agrees to make its west-to-east pipeline physically available to the four Puget Sound

refineries: Shell Oil Company, Texaco, ARCO and Mobil. Physical availability means construction of a connecting pipeline from the west-to-east pipeline to said refineries or to other pipelines that connect with said refineries. GRANTEE further agrees that the connecting pipeline shall be in place and shall be fully capable of accepting tendered OIL for transportation to said refineries on or before the time of commencement of PIPELINE operation, except where such capability is impossible for causes not within GRANTEE's control.

5. The physical facilities stated and identified in the application which would need to be built for such a hookup include a third berth at the Port Angeles terminal, a third off-loading and submarine pipeline across Port Angeles Harbor, additional storage tankage at Green Point, storage tankage and pumping facilities near Arlington (Applic. III, p. 8-22.) in Snohomish County and a pipeline connecting the four refineries.

6. Northern Tier's intentions and plans regarding hookup are vague. In its application, the company identified a future third tanker berth and third offloading (submarine) pipeline across Port Angeles Harbor to supply North Puget Sound refineries. Such a proposal and application for hookup are not part of Application 76-2. (NTPC Application 76-2, pp. 8, 20-23.) The proposed third berth for hookup is uncertain based on the record presented, in part because Northern Tier has stated to the Environmental Protection Agency in its Prevention of Significant Deterioration permit application (PSD Air Quality Application) that no third berth is anticipated to meet the

condition of hookup. (PSD Vol. I, pp. 1-1 and 1-2.) The PSD application to EPA states that Northern Tier's demand forecast for Midwest oil has proven too high. (PSD Vol. I, pp. 1-1 and 1-2). No such reduced demand forecasts have been presented to EFSEC.

7. Northern Tier has not done any design studies or reconnaissance for hook-up. (Beasley, TR 13726.) Engineering and environmental studies sufficient for an application have not been performed. (Beasley, TR 13705; 13726-28.) No geological or geotechnical work has been performed and no route selection or financing investigation has been made. (Beasley, TR 13704-6; 13760.)

8. Northern Tier has made no estimate of the economic costs and impacts of hook-up on the four North Puget Sound refineries or on Washington consumers of those refined products. (Beasley, TR 13759.)

9. No reduction in number of tankers on the state's marine waters as far west as Port Angeles would result from hookup to the North Sound refineries. Northern Tier's application states that 116 additional crude oil tanker calls per year at the Northern Tier facility could supply 350,000 barrels per day to the North Puget Sound refineries, were hook-up to occur. Approximately 230 tankers carried a similar quantity of crude

oil to the four North Puget Sound refineries in 1979. Northern Tier's reduction to 116 tankers for the North Puget Sound refineries is unsupported, and its derivation unexplained other than by a general explanation that larger tankers would be used. (Formway, TR 39974, 40019-20; Ferguson, TR 40883, 40979-80.) ARCO, Texaco and Shell anticipate little or no change in their tanker fleets with or without hook-up to the Northern Tier facility. They reject the notion of using larger tankers if Northern Tier were built. (Formway, TR 39975; Malseed, TR 40872 and 40906; Ferguson, TR 40883, Ex. 848, p. 9.) Mobil likewise would not change its current fleet size or mix were hook-up to occur. (Ex. 848, p.9)

10. The stated premise in the Federal expediting decision for requiring hook-up was that "This modification will reduce environmental hazards to valuable American and Canadian marine resources by virtually eliminating crude oil tankers in the Sound east of the Port Facility." The record contradicts such a conclusion. (Malseed, TR 40869-71; Ferguson, TR 40877-8, 40883-5.) The two refineries in Tacoma will continue to have crude oil tanker traffic in Puget Sound. Certain types of crude oil presently received at some of the North Puget Sound refineries could not be moved by the proposed Northern Tier pipeline and would continue to move by crude oil tanker in Puget Sound. (Malseed, TR 40870-1; Ferguson, TR 40884-5.) About 50% of the crude received by Shell and Texaco could not move through

the pipeline. (Malseed, TR 40921-2 and 40942-3; Ferguson, TR 40878A and 40965-8.) Refined product shipments and inter-refinery movements of feed stocks would continue with hook-up. (Malseed, TR 40870-1.)

11. Crude oil traffic would also continue to move on Puget Sound to the extent the Puget Sound refineries continued disposing of bunker fuel and selling bunkers to vessels. (Ferguson, TR 40878, 40885-6, 40970-1.) Bunker crude could be moved by tanker or barge to Port Angeles.

12. Elimination of certain crude oil tankers due to hook-up does not physically remove the hazard of that crude oil to Puget Sound since the crude oil shipments would be substituted in the submarine pipeline the applicant has proposed beneath Admiralty Inlet and the Saratoga Passage. Oil spilled west of Port Angeles could reach Puget Sound.

13. Delivery of crude petroleum to the North Puget Sound refineries by way of Northern Tier would substantially increase those refineries' per barrel costs. The present tanker-delivered cost for the leg between Port Angeles and the four refineries ranges between 3¢ and 5¢ per barrel/year. (Formway, TR 39969; Ferguson, TR 40876; Malseed, TR 40905.) Northern Tier did not provide information and cost estimates for hook-up, making tariff estimates more difficult. The North Puget Sound

refineries gave general estimates that 50¢ to $1.00 per barrel was a likely range. (Formway, TR 39968, 39974; Ferguson, TR 40876-7; Malseed, TR 40905-6). A 50¢ per barrel tariff would result in a cost increase of $54,750,000 per year or $63,875,000 per year if 300,000 or 350,000 barrels per day, respectively, were supplied through the Northern Tier system.

14. A study on the economic impacts of hook-up calculated a total additional cost to the four North Puget Sound refineries of $31,430,500 per year based on a tariff of 35.1¢ per barrel at 350,000 barrels per day. (Ex. 848.) This total cost and tariff assume the hook-up volume of 350,000 barrels per day constitutes one-third of the Northern Tier pipeline throughput from Port Angeles to Arlington. (Mead and Sorenson)

15. The total annual cost of $31.4 million stated in finding 14 may be increased for several reasons. First, the total annual cost will increase proportionally if the throughput to the North Puget Sound refineries contitutes a higher percentage of total throughput; reduced Midwest demand increases this likelihood. At 933,000 barrels per day, hook-up throughput could constitute 37% of total throughput. Second, the total annual cost of $31.4 million assumes immediate switch of 50% of the Alaskan fleet to larger tankers. If the reduction for larger tankers is removed, the total cost of hook-up to the refineries is increased to $37.2 million per year. (Transportation savings

then are only 6¢ per barrel rather than 10.5¢ per barrel.) Third, much higher tariffs and annual costs to the refineries will occur if the Interstate Commerce Commission methodology is used rather than the method assumed in Ex. 848. Fourth, tariffs and costs will increase approximately 10% each year after 1980 until construction of the Northern Tier line is actually completed. Fifth, calculation of tariffs over 20 years, Northern Tier's estimate of the time to retire debt, increases the tariff approximately 50% over the rate in Ex. 848 which assumed 30 years. (Sorenson)

16. Hook-up of the North Puget Sound refineries to the Northern Tier system is unlikely unless mandated.

17. There is no present evidence to suggest that either a crude oil refinery or a petrochemical plant is likely to be built along the terrestrial portion of the pipeline route.

18. A crude oil refinery or petrochemical plant in Clallam County is possible. (See III.Q Private Sector Economics; Secondary Development).

VIII. MONITORING, SURVEILLANCE AND QUALITY CONTROL

1. The recommended disposition requires no findings.

IX. ALTERNATIVES

A. ALTERNATIVE SITES FOR PART OR ALL OF PROJECT

1. Northern Tier, upon abandoning Cherry Point, chose the Port Angeles port site without having demonstrably or seriously considered any alternate sites.

2. More than two years after its choice of Port Angeles, Northern Tier presented Low Point, a largely undeveloped site some 15 miles west of Ediz Hook, as its principal alternate site for study and comparative purposes. Other potential sites exist west of Port Angeles.

3. Facilities at the Low Point alternative could include two single-point moorings that could be located north of Low Point. Submarine pipelines would be constructed from the moorings to the onshore storage facilities, which would be located adjacent to shore, as shown in Figure III-7.2.2 of the Application. The Low Point alternative would involve an additional 28 miles of pipeline and one additional pump station that would be located north of Port Williams. Use of a Low Point site would substantially reduce the consequences of fire and explosion, reduce the risk of damage from anchor-dropping to submarine pipelines, cause less community and harbor disruption, increase the difficulty of handling minor operational spills, decrease the likelihood that a major spill would reach

the inner Sound, increase the risk of collision with in-transit vessels, but decrease the risk of harbor collisions. More streams would be crossed, another pump station would be required, but fewer air quality problems would likely result.

4. An alternate port site west of Port Angeles would be preferable to the site proposed by Northern Tier.

5. Swan Wooster was engaged by Northern Tier to perform an engineering study investigating alternate deepwater port sites (in the Port Angeles vicinity) for suitability as a supertanker terminal. Swan Wooster was also charged with recommending the most feasible type of berth facilities, and preparing preliminary engineering designs and construction cost estimates. At the time Swan Wooster was retained, the Northern Tier board of directors had already selected Port Angeles as the site of its terminal. Swan Wooster's criteria were engineering in nature. Swan Wooster's conclusion that Port Angeles harbor was indeed the most suitable location was based largely on operational factors, such as the comparative ease of servicing vessels at a fixed berth instead of a single point mooring (SPM) and the ease of controlling at least minor operational spills within a partially enclosed harbor. It should be noted that collection of any significant amount of oil in a boom would create explosive vapors likely to require either that a tanker leave its berth or that the port release the boomed oil to re-

duce fire and explosion risks. Currents in excess of 3/4 knots, sufficient wave conditions, or a large enough spill, will cause oil to escape a boom. Swan Wooster did not consider the consequences of fires and explosions, air quality matters, or the trajectories of spilled oil not contained by a Port Angeles Harbor boom.

6. The decision of Northern Tier to locate in Port Angeles Harbor was made no less than three months prior to adoption of the so-called "Evans Statement" in the state's Coastal Zone Management Program. Northern Tier filed an application in March of 1976 with the State Department of Ecology showing Port Angeles as a location.

7. As to a particular location within the Ediz Hook site, the berths were initially placed farther east on the Hook to allow possible construction of a salt terminal and continued, if reduced, use of log booming and rafting areas. The initial site was abandoned for the present one when Swan Wooster learned that the harbor leases in the present location were soon to expire.

8. Northern Tier considered four potential tank farm sites. Lacking condemnation authority, the company could not purchase land at its preferred location, some two miles

from Green Point; but could and did at the present site. The ability to acquire the property determined the site selection.

9. At an early time, Northern Tier considered routing the unloading lines entirely on land to the Green Point tank farm. A general pipeline routing principle is to avoid developed areas wherever possible to reduce the risk of the lines being damaged by other construction activities. Northern Tier did no cost comparison or construction analysis between an all-land route and a submarine route between the berths and the tank farms. The company did not compare the risk or potential impact of a pipeline rupture on an all-land route as opposed to a harbor crossing. The company did not consider a shallow-water crossing around the Crown Zellerbach mill.

10. An alternate location for the Port Williams landfall is a route following the county right-of-way to Marlyn Nelson Park, some 3,000 feet south of the present centerline. Geotechnical, engineering, oceanographic and other studies would be necessary to determine the feasibility of such an alternative. Any construction planned near the park's boat launch should consider mitigation of impacts during the heavy-use summer season.

11. The Northern Tier proposal poses a great oil spill risk to the state's inland marine waters when compared to any alternative system discussed in these proceedings. In its

present form, the Northern Tier proposal contains the longest stretch of submarine line suggested in any proposal. The fact that Northern Tier has not accurately ascertained the geophysical conditions of its chosen site significantly increases the risks.

12. The around-the-Sound route originally proposed by the company was later rejected in favor of the cross-Sound route. No adequate justification has been advanced for the change.

B. ALTERNATIVE PROJECTS AND METHODS

1. The alternative possibility of adding capacity to the midcontinent pipeline system has to a large extent been accomplished, both through physical additions such as expansion of the Koch-Williams Bros. pipeline to Minnesota and through increased availability of capacity in existing lines.

2. Wyoming, North Dakota and Montana crude production has increased to the point where export is now occurring.

3. Other west-to-east pipeline proposals, such as Trans Mountain and Foothills have been made, but no other proposal is now being actively pursued.

4. The Federal Export Administration Act allows crude oil exchanges of Alaska oil with Canada or Mexico without obtaining Congressional approval. (Tussing, TR 22949.) Canadian policy permits the exchange of Canadian oil for oil of North American origin. (Tussing, TR 22951.) A volume of U.S. and Canadian exchanges exists and is occurring.

5. The three main producers of Alaska North Shore (ANS) crude oil have signed an agreement to build and ship ANS crude through a new 36 inch pipeline, seventy-eight miles long across the Isthmus of Panama and parallel to the Canal. The pipeline will have a capacity of more than 500,000 barrels per day and involves a construction cost of $250 million. (Phillips, TR 40808-49.) The new Panama Pipeline will allow a reduction in transportation costs for ANS crude now being shipped through the Canal. (Phillips, TR 40843).

C. NO ACTION

1. Approval now could close off future options. (Phillips, TR 40794).

2. Approval of a major capital construction project is not without potential harm to the public interest if the project fails for lack of demand. (Tussing, TR 23083-84).

3. Tankers presently move all available petroleum from Valdez to destinations or transshipment points. The petroleum moves to market.

4. Petroleum exchanges with Canada continue.

5. Other proposals for transshipment have been advanced. Throughput agreements for the Trans-Panama Pipeline System have been signed and construction of that line is impending; no other proposals are being actively pursued at present.

X. COMPLIANCE WITH GUIDELINES

The Council's first obligation under RCW 80.50.040(10) is to prepare a written report to the Governor containing a statement "indicating whether the application is in compliance with the Council's guidelines." At the time Application 76-2 was first filed, the statement read "indicating whether the application is in compliance with the Council's topical guidelines." Section X of this Order addresses that reponsibility.

The Council's guidelines, topical or otherwise, are presently contained in sections 110 through 620 of Washington Administrative Code (WAC) Title 463, chapter 42. The provisions of this chapter were first filed on February 4, 1977, some seven months after the present application was filed. Northern Tier's application, in its 1979 amended form, bespeaks an effort to comply with the cited provisions of chapter 42. Findings 1 through 6 below address the extent to which Application 76-2 complies with the (topical) guidelines now set forth in WAC 463-42-110 through 620.

Before February 4, 1977, the Council's topical guidelines were set forth in what was then WAC 463, chapter 12. Those provisions, carried over from the Council's predecessor agency, the Thermal Power Plant Site Evaluation Council, by RCW 80.50.800, were written to serve as topical guidelines only for the siting of thermal power plants. At the time RCW 80.50.800 was passed, matters were still pending on applications for thermal power plant siting authority which had been made to the predecessor agency. A discussion beginning below at finding 7 discusses the extent to which Application 76-2 deals with the topical guidelines set forth in former chapter WAC 463-12.

1. No party has challenged Northern Tier's compliance with the following Council guidelines: WAC 463-42-110 (graphic material), -120 (sources of information), -170 (description of applicant), -240 (energy transmission systems), -260 (multipurpose use of transmission routes), -270 (safety where public access is allowed), -280 (radiation levels), -360 (transportation facility construction), -370 (transportation of fuels and waste products), -410 (compatibility with water quality standards), -430 (system of heat dissipation), -440 (characteristics of aquatic discharge systems), -470 (wastewater treatment), -480 (NPDES application), -500 (air pollution control), -510 (air pollution impact), -520 (emission control), -540 (odor control) and -590 (noise and glare).

2. Other parties have challenged Northern Tier's compliance with the following Council guidelines: WAC 463-42-130 (construction and study schedules), -140 (potential for future activities at site), -150 (analysis of alternatives),

-160 (safety standards compliance), -180 (site description), -190 (legal descriptions and ownership interests), -200 (land use plans and zoning ordinances), -210 (construction on site), -220 (contour maps), -230 (access), -250 (criteria, standards and factors utilized to develop transmission route), -290 (protection from natural hazards), -300 (security concerns), -310 (emergency plans), -320 (earth removal), -330 (surface-water runoff), -340 (landscape restoration), -350 (transportation impact), -380 (environmental safeguards---geologic and hydrologic survey), -390 (water source and usage), -400 (water supply), -420 (spillage prevention and control), -450 (hydrographic study of waters), -460 (ground water activity), -490 (solid wastes disposal), -530 (dust control), -550 (inventory of potentially affected vegetation, animal life, and aquatic life described), -560 (impact of construction and operation on vegetation, animal life, and aquatic life), -570 (description of measures taken to protect vegetation, animal life, and aquatic life), -580 (aesthetics), -600 (energy consumption), -610 (historical, archaeological, and recreational site preservation/creation), and -620 socioeconomic impact).

3. Northern Tier has complied with the following guidelines not cited in finding one above: WAC 463-42-130, -140, -200 (compliance with the laws is not the issue here), -300, -350, -400, -460 (risk is not the issue at this point), -490, -530, -580, -600 and -620 (propriety of analysis is not the issue.)

4. Northern Tier has not complied with the following Council guidelines: WAC 463-42-150, -160, -180, -190, -210, -220, -230, -250, -290, -310, -320, -330, -340, -380, -390, -420, -450, -550, -560, -570 and -610.

5. Northern Tier's non-compliance with the following guidelines is inconsequential or could be reasonably cured in the course of post-certification design: WAC 463-42-160, -190, -220, -230, -320, -330, -340 and -610.

6. Northern Tier's non-compliance with the following guidelines is consequential, cannot be cured after certification in a manner consonant with the public interest, and is indicative of the basic inadequacy of this application: WAC 463-42-150, -180, -210, -250, -290, -310, -380, -390, -420, -450, -550, -560 and -570. Detailed analysis is presented in prior sections of this order.

a. As to WAC 463-42-150, the applicant did not sufficiently analyze the consequences of fire and explosion in urban as compared to rural environments, and did not usefully compare its cross-Sound route with any alternative.

b. As to WAC 463-42-180, the application did not describe all the general geologic characteristics of parts of its submarine route, and did not describe the effects of storms on marine current movement.

c. As to WAC 463-42-210, the applicant's description of facility costs omits several significant components, such as working capital and interest during construction.

d. As to WAC 463-42-250, the applicant indicated certain factors which caused it to abandon a different submarine route across Admiralty Inlet, but neither set forth standards nor explained how any such standards might have been satisfied by selection of the three portions of its route which incorporate submarine crossings of the state's marine waters. Route selection criteria have been mentioned which mitigate against crossing Habitat Management Areas and parklands.

e. As to WAC 463-42-290, the applicant has not described a means of protecting against storm-induced marine currents or landslides originating near the submarine route. It has not described methods for protecting the submarine pipe against liquefaction hazards in high current areas. The applicant did not describe the full range of force and hazard which might be encountered from currents, and cannot be said to have described means of protection against such hazards.

f. As to WAC 463-42-310, the applicant has described no emergency plan which would assure the public safety in the event of a fire or explosion at its marine terminal site or in Port Angeles Harbor. The applicant's oil spill response plan for surface water spills is understandably embryonic; its plan for controlling submarine pipeline oil spills gives no present or prospective assurance of protection.

g. As to WAC 463-42-380, the Council has given the applicant two opportunities to perform such surveys for its Admiralty Inlet and Saratoga Passage crossings. On the second occasion, the Council strongly and specifically indicated its informational requirements. Nevertheless, the applicant has not presented the Council with the results of a comprehensive hydrologic survey or the results of a comprehensive geologic survey. The applicant did not meter currents long enough or accurately enough, did not meter at all over much of the routes or in enough locations, and did not evaluate well enough the variety of non-tidal currents for the applicant's hydrologic survey to be considered comprehensive. Likewise, the applicant took too few core samples, omitted samples entirely from areas too broad, and analyzed too inadequately features such as liquefiable soil, sand waves and boulders for its geologic survey to be regarded as comprehensive. An acoustic subbottom profile grid, for example, is not an adequate substitute for a core sample.

h. As to WAC 463-42-390, the applicant has not provided a description of water rights, withdrawal authorizations or restrictions relating to proposed sources, and the

Council is thereby handicapped in treating the interests of other water users.

i. As to WAC 463-42-420, the applicant has not accurately described the amounts of crude oil which might be accidentally discharged from the various submarine portions of its pipeline transmission route.

j. As to WAC 463-42-450, the applicant has not presented the range of data called for in regard to discharge locations and does not propose to do so until 20 days before commencing discharges.

k. As to WAC 463-42-550, the applicant only partly described affected vegetation, animal and aquatic life.

l. As to WAC 463-42-560, the applicant did not properly describe the magnitude of impacts on vegetative, animal and aquatic life from abnormal incidents.

m. As to WAC 463-42-570, the applicant never presented an insurance or bonding arrangement, but only a generalized assessment of the feasibility of such arrangements.

7. Under the former provisions of WAC 463 chapter 12, as in effect on July 6, 1976, the provisions of WAC 463-42-

110 do not apply, and the provisions of WAC 463-12-150 would apply prospectively.

8. The applicant has complied with the provisions of former sections WAC 463-12-130, 140 and 155.

9. Various uncited provisions of other former sections have been complied with; have not been complied with but can reasonably be met; or do not apply.

10. The applicant did not comply with particular subsections of former sections WAC 463-12-100, 105, 115, 120, 125 and 135. As set forth below, the failures to comply are consequential, not curable on the record, and indicative of an inadequate application.

a. The applicant's failure to provide geological, climatological and other information, as required by WAC 463-12-100(1), is discussed above in finding 6, as is the applicant's failure to provide cost information required by WAC 463-12-100(2), the applicant's failure to describe methods of protecting the facility against natural disasters as required by WAC 463-12-115(5), the applicant's failure to furnish a comprehensive geologic survey as required by WAC 463-12-120(4), the applicant's failure to identify outfall configurations and related information, and hydrographic and other studies as provided in

WAC 463-12-125(6 and 7), and the applicant's failure to submit descriptions of vegetation, fish and wildlife, which were required by WAC 463-12-135.

b. WAC 463-12-100(4) required a description of need for power, financing and marketing arrangements, and cost of power production. The applicant did not furnish such information.

c. WAC 463-12-105 required a description of ownership interest in the site, land use plans, zoning ordinances, an occupancy survey within a 25 mile radius, and attestations by local government executives as to the consistency of the proposal with land use and zoning provisions. The applicant did not supply such information.

XI. PREEMPTION FINDINGS

1. The issue of preemption is not reached.

XII. CONCLUSIONS OF LAW

1. The Energy Facility Site Evaluation Council of the State of Washington has jurisdiction over the location, construction, and operation of energy facilities within the State as specified and described in RCW 80.50.020.

2. The application of the Northern Tier Pipeline Company for a proposed oil port, tank farm, and crude oil trans-shipment pipeline meets the specifications contained in RCW 80.50.020 and is properly under the Council's jurisdiction.

3. The Council has satisfied the statutory requirements contained in Chapter 80.50 RCW and in Chapter 43.21 RCW (SEPA) by evaluating the application; commissioning independent consultant review; conducting zoning and land use consistency and compliance hearings; conducting evidentiary hearings into compliance of the application with the Council's guidelines as set forth in WAC 463, Chapter 42; conducting required and optional public hearings; developing and issuing a draft and final Environmental Impact Statement; and developing from the evidence, exhibits and other materials presented to the Council, these findings of fact, conclusions of law and order, constituting the required recommendation of the Council to the Governor of the State of Washington.

4. The applicant has not complied with the Council's current guidelines as set forth in WAC 463, Chapter 42, in particular Sections 150, 180, 210, 250, 290, 310, 380, 390, 420, 450, 550, 560, and 570. Certain of the applicant's failures to comply with Council guidelines are substantial, non-curable on this record, and representative of an inadequate application.

5. The legislature has determined a need for additional energy facilities in Washington State. In response to that need, the legislature created the Energy Facility Site Evaluation Council and charged it with overseeing procedures for evaluating sites for energy facilities, and with recommending to the Governor approval or disapproval with regard to each proposed facility. The legislature did not quantify the demand for particular energy facilities which might be proposed to the Council.

6. While the Council has attempted to inform itself on the broad question of national need for crude oil transshipment facilities, it is neither possible nor appropriate for the Council as a state agency to make a definitive determination on the national need for the facility proposed by the applicant.

7. In March, 1978, the Council, acting on behalf of the State of Washington and its citizens, made a formal request to the federal government for a decision on whether or not the proposed facility was needed to provide crude oil to other regions or the nation as a whole. A definitive response was never received by the Council. No clear showing of national need was made on the record of this case.

8. At least three major benefits to the citizens of this state have been set forth in the application for the proposed facility. The first is that, should the facility be built, monetary benefits in the form of jobs and taxes would accrue, and would provide economic benefits directly and indirectly to affected citizens, some local governments, and the state itself. These economic benefits, while valuable, would be limited in amount and over time, in comparison to the economic resources placed at risk through construction and operation of the proposed facility. The second projected benefit, that a common use facility at Port Angeles would reduce significantly the risk of a major spill reaching the state's inner marine waters, does not have the persuasive force that it did in 1976 for several reasons: because recent wind, current, and oil spill trajectory studies show that a very likely path of a major Port Angeles spill is east; because a promised application to the Council for facilities necessary to hook up the Puget Sound refineries was never delivered; and because the applicant's

inadequate reconnaissance of its submarine route makes it impossible to determine that a pipeline through those portions of the state's inner marine waters would not be unacceptably susceptible to a spill. The third projected benefit, that petroleum supplies to eastern Washington would be assured, has some merit, but now appears less plausible for the following reasons: Northern Tier no longer contends that a refinery might be built in eastern Washington; supplies arriving in Montana via Northern Tier would likely increase the price of product in eastern Washington; no supply-induced shortages of petroleum in eastern Washington have been shown, though marketing reorganization activities may have caused some eastern Washington consumer difficulty and more product could be moved to eastern Washington from West Coast refineries through rail, truck, barge and potential product pipeline facilities than is presently moved. However, this said, the importance of an adequate petroleum supply to the economy of eastern Washington cannot be overstated.

9. Implicit in the charge by the legislature to the Council to balance demand against the public interest, and the legislative grant of power to the Council to recommend a position of acceptance or rejection of an application, is the recognition that the demand for a particular facility, while it exists, may not be great enough to outweigh the facility's net detrimental effects on the broad interests of the public.

10. On balance, it is not possible for the Council to determine that the projected benefits of the proposed facility will outweigh the projected risks to the environment, health, welfare, and safety of the people of this state.

11. Technically sufficient operational safeguards have not been proposed by the applicant to prevent, detect, minimize and contain oil discharges from the submarine portions of the pipeline and thereby protect the welfare of state citizens who depend on Puget Sound, Admiralty Inlet, the Strait of Juan de Fuca, and associated waters for food, income, and recreation. No reasonable conditions can be imposed on the applicant's proposed submarine route because the applicant has not demonstrated that it has enough accurate data and site-specific information to understand the geology and hydrology of its chosen route, in order to have identified, and designed for, major hazards to construction and operation.

12. The applicant's analysis of risks associated with spills from portions of the underwater pipeline is based on understatements: of the maximum amount of oil which may be spilled from these segments of the pipeline; of the maximum currents which may be encountered along the submarine route; of the likelihood of pipeline exposure through soil movement or placement of pipe on boulders; and of the portions of the sub-

marine route susceptible to liquefaction in a seismic event of the scope encountered in the region during the last 35 years.

13. The proposed oil port is not a pipeline. That it would supply a pipeline does not at all increase the safety of the port. In recent years, ports capable of receiving supertankers have been sited many miles from urban communities. The port site proposed by the applicant was selected without prior analysis of the potential risk to the Port Angeles community. Subsequent studies which were made of the port site were for the primary purpose of justifying the prior decision. The applicant's port site, chosen largely because it offered a sheltered spot for berths and some advantages in controlling small spills, is located less than 7,000 feet from downtown Port Angeles. Any ship's maneuvers in the harbor would lessen this distance. An emergency response of the order and volume which can be provided at Long Beach, California, or Seattle, Washington, is virtually impossible in an isolated community such as Port Angeles. No sufficient reason has been shown to put the people of Port Angeles and their property at risk from the applicant's proposal. Locating the port in a remote and relatively unpopulated area would not eliminate the possibility of an explosion or spill fire, but it would tremendously reduce the potential consequences should either event occur.

14. The vast inland marine waters of Puget Sound constitute one of the state's greatest resources. The proposed facility threatens to have substantial adverse impacts on the Strait of Juan de Fuca, Admiralty Inlet, Puget Sound, and the waters east of Haro Strait. The state's inland marine waters support a large and growing water-oriented economy. They are biologically the most productive waters in the United States, perhaps in the world. Their enormous resource value stems from their combined nature as a large, rich, intricate, protected and deep body of water; they can be considered a marine lake. Their present and potential biological productivity is unparalleled and is the focus of much commercial activity and the source of many jobs. These waters currently provide food and recreation, and currently receive marine traffic including crude oil tankers comparable in size to any which call in the U.S. The size, depth and protected portions of these waters make them suitable as a practical matter for consideration as a future locale for the transshipment of petroleum. Any transshipment proponent should carefully consider the intricacy, cleanliness and richness of these waters. Any such proponent should approach these waters with a sensible respect for the complex currents, soils and geology, wind and biota, which have been shown to exist there. Any such proponent should learn the circumstances on the seabottom before choosing a submarine route. If the actual circumstances of a proposed submarine route cannot be demonstrably engineered, the state's inland marine waters should be skirted.

15. The applicant has never presented the Council with any detailed analysis of why it is preferable to go under the Sound rather than around it. The applicant has presented studies on its preferred route south of Protection Island, and has contrasted certain aspects of that route with an alternate north of the same island, but it has not presented more than the barest generalities on why the Sound as a whole should be put at risk from a pipeline. Two reasons apparent from the record of this case are: on a tariff allocated on a per-mile basis, the applicant would, in the event of hookup (for which an application has not been made), be able to offer North Sound refineries a tariff comparably lower than what would result from an around-the-Sound route; and second, the timing of the applicant's decision allowed a cross-Sound route to be covered in the Federal Government's Environmental Impact Statement. Three of the applicant's stated reasons for the submarine route are in error: it will cost marginally more, not less to go under the Sound; Northern Tier had committed to rerouting out of the Tacoma and Seattle watersheds before, not when it determined to cross under the Sound; and the risk to the state's resources from the present alignment is incomparably greater, not less, than that posed by the prior route.

16. The contingent costs to the public of any major fire, explosion or spill, and the possible day-to-day costs to the public of subsidizing new generating capacity necessary to

meet the substantial electric demand made by Northern Tier's pump stations may become unreasonable.

17. River crossing and flood plain problems are solvable through certification agreement conditions, although the applicant's proposed approach to crossing many of the state's streams is inadequate.

18. The applicant has not met its responsibility to prove that the holders of existing water rights would not be adversely affected by water withdrawals necessary for testing of the pipeline prior to operation.

19. Pipelines are generally a proven, safe, and efficient technology. The efficiency of a pipeline is demonstrable; that the industry has, in general, proven itself and that most lines at most times are quite safe does not confer those two qualities automatically on any particular line proposed. A properly designed and engineered line on a well-studied and well-chosen site is part of the proven and safe technology. The port site, the Admiralty Inlet and Saratoga Passage crossings, and many of the river and flood plain crossings were not well studied, particularly before they were chosen. The Council knows enough about the conditions under Admiralty Inlet and Saratoga Passage to appreciate the need for careful and thorough reconnaissance and study of these conditions prior to route

selection, design and approval. The applicant's design and engineering make broad assumptions about physical seabottom circumstances which should have been, but have not been, defined. The Council's examination of proposals for other pipelines in other places indicates that adequate data gathering and analysis can be accomplished within reasonable time and cost limits.

20. The seismic design for the facility proposed by the applicant would provide protection for an event which is significantly less than what the region has experienced during the last 35 years. Ground acceleration levels are generally discussed in terms of bedrock values; but except between Sprague and Plaza, Northern Tier does not propose to build in much bedrock. The actual scope of the 1949 and 1965 seismic events in the Puget Sound region exceeded the applicant's proposed level.

21. The applicant proposes to go into business as a common carrier utility, a public service company, in a particular business normally regulated in this state by the Washington Utilities and Transportation Commission. Certain public service obligations over and above those attendant on an ordinary business are assumed by any entrant into a regulated public service industry. Protecting the public's interest may outweigh permitting a particular proposed facility. The Council is not limited to mitigation measures in meeting the public's legitimate concerns. The determination of whether a facility of this kind

should be built and placed in operation cannot be left to the financial marketplace; private markets are not a proper forum for determination of the public interest.

22. Portions of the applicant's proposal are inadequate. The submarine pipeline routing, study and design, and the potential consequences of a major fire or explosion in the Port Angeles Harbor are not curable, cannot be minimized on this record, and are inconsistent with the premises of the public interest set forth in RCW 80.50.010(1) and (2).

23. Apart from conclusion 22 above, the rest of the applicant's site and transmission line route would be acceptable, given the establishment of proper conditions and mitigation efforts.

24. The Council should not issue a National Pollutant Discharge Elimination System (NPDES) Permit for the facility as presently proposed.

25. The Governor of the State of Washington should reject Application Number 76-2, Northern Tier Pipeline Company.

From the foregoing findings of fact and conclusions of law, the Council issues the following order.

O R D E R A N D R E C O M M E N D A T I O N

The Energy Facility Site Evaluation Council orders, declares and determines that Application 76-2 of the Northern Tier Pipeline Company does not comply with the Council's guidelines and that criteria specific to the site and pipeline routing clearly establish that the port site and submarine pipeline site are improper. The Council recommends that the Governor of the State of Washington reject Application 76-2 for certification of a crude oil port, tank farm and crude oil transshipment pipeline and associated facilities. The Council further orders that its recommendations as embodied in the above findings of fact and conclusions of law be reported and forwarded to the Governor of the State of Washington for consideration and action.

ENTERED INTO this 27th day of January, 1982

WASHINGTON STATE ENERGY FACILITY
SITE EVALUATION COUNCIL

By Nicholas D. Lewis
Nicholas D. Lewis
Chairman