

"EVIDENCE ON PUGET SOUND AND STRAITS OF
JUAN DE FUCA VESSEL TRAFFIC ASSOCIATED
WITH CRUDE AND REFINED PETROLEUM"

REGIONAL PROGRAM REPORT 78-20

by

William A. Brewer

Prepared for:

West Coast Oil Ports Inquiry

A. R. Thomson, Commissioner

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ABSTRACT

Existing patterns of Tanker Traffic in the Greater Puget Sound area are described. The total volume of crude oil and products in transit on greater Puget Sound waters is estimated at 650,000 barrels per day in late 1977. The number of crude tanker arrivals is estimated to be 200 per year. The number of loaded product tanker transits of the Sound area is estimated at 360 per year.

Vessel characteristics of world trade tankers likely to be calling at Puget Sound ports are reviewed. Although there has never been a major spill in the area the expected composite oil spill rate is .004% of oil carried by the fleet, projected to occur on or within 50 miles of Puget Sound. The Alaskan fleet characteristics are compared with the above fleet and a somewhat lower composite spill rate is forecast.

The most significant growth potential, other than transshipment of crude oil, is in the export of refined products to California, Alaska or Hawaii.

The effect on tanker traffic patterns from proposed transshipment of crude oil through oil ports at Cherry Point, Port Angeles and Kitimat is projected. Under various assumptions projected traffic ranges from 308 to 360 arrivals per year at Kitimat with a throughput of 700,000 barrels per day.

RÉSUMÉ

Ce rapport décrit les voies actuelles de trafic pétrolier dans la zone du grand Puget Sound. Le volume total de pétrole brut et raffiné sillonnant les eaux du grand Puget Sound s'estimait à 650 000 barils par jour à la fin de 1977. On compterait 200 arrivées par année de pétroliers chargés de brut et 360 de navires-citernes transportant des produits raffinés.

Le rapport analyse les caractéristiques des tankers faisant le commerce à l'échelle mondiale, qui seraient susceptibles de mouiller dans le Puget Sound. On n'a jamais eu à déplorer de déversements importants dans cette zone, mais on estime que le taux composite des déversements dans un rayon de 50 milles du Puget Sound pourrait être de .004 p. 100 des produits pétroliers transportés par la flotte. En comparant les caractéristiques de la flotte de l'Alaska à celles de la flotte mondiale, on prédit un taux composite inférieur.

Le plus important potentiel de croissance, outre le transbordement de pétrole brut, se retrouve dans l'exportation de produits raffinés vers la Californie, l'Alaska et Hawaï.

Le rapport fait une projection des effets sur les voies de trafic pétrolier des déchargements de pétrole brut envisagés à Cherry-Point, Port-Angeles et Kitimat. Selon diverses hypothèses, on estime les arrivées de tankers à Kitimat entre 308 et 360 par année et le volume quotidien à 700 000 barils.

INTRODUCTION

Mr. Commissioner:

I am William A. Brewer, an independent consultant to the West Coast Oil Ports Inquiry. I have been a consulting engineer since 1960, in the fields of natural resource development, energy and environmental policy. At present I am a Research Professor (Environmental Studies, Civil Engineering) at the University of Washington, and Director of the Washington Energy Research Center.

My direct experience with the matters before this Commission began in 1973, when I was appointed as Executive Director of the Washington Energy Policy Council; and I also served later as an energy advisor to the Governor of Washington. In 1975-76, I chaired The Pacific Oil and Ports Group, composed of the Governors' energy staffs from California, Oregon, Washington and Alaska, and including observers from the government of British Columbia as well as U.S. federal agencies. In recent years I have performed contract research and consultancy on West Coast oil matters for the U.S. Federal Energy Administration and the Environmental Protection Agency. Earlier this summer I testified in Phase I of the Inquiry, and have since assisted your staff in obtaining data and documentation from the State of Washington.

This evidence is based on study of a number of governmental documents, supplemented by company announcements, press articles, interviews and independent calculations. Most of the basic documents are in the hands of the Inquiry staff, so I will not attempt to present their contents here in detail, but will cite them as references from time to time, identified in context.

I believe the evidence is correct as far as it goes, and is current as of September 1977, but I emphasize that there are still many unknowns in governmental policy on tanker traffic and design, and also many decisions yet to be made by the industries who will operate the tanker system on the West Coast. Therefore, many of my conclusions are speculative, and will remain speculative until more information becomes available.

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West Coast Oil Ports Inquiry

In March 1977 Dr. Andrew R. Thompson was commissioned by the Government of Canada to inquire into the environmental, social and navigational safety aspects of a proposed oil port at Kitimat, B.C. and the broader Canadian concerns and issues related to west coast oil tanker traffic.

The Inquiry hearings were adjourned in November 1977 because there was then no active application in Canada for a west coast oil port. The Commissioner summed up his findings to that point and presented his Statement of Proceedings to the Minister of Fisheries and the Environment and the Minister of Transport on February 23, 1978.

The Ministers subsequently announced that "the Federal Government sees no need for a west coast oil port now or in the foreseeable future and doubts that the benefits of establishing such a port would be sufficient to offset the danger of risking a major oil spill". Consequently, the Inquiry did not continue.

This report was prepared for the Inquiry, presented, and subsequently cross-examined. Transcripts of the presentation and cross-examination are contained in the library of the Westwater Institute at the University of British Columbia.

This report was prepared under contract and does not necessarily represent the views and policies of the Department.

I. EXISTING OIL SUPPLY AND DEMAND: EXISTING TANKER
TRAFFIC PATTERNS IN THE GREATER PUGET SOUND AREA

A. Background

Crude tankers, product tankers and other tank vessels have served the greater Puget Sound region for over fifty years, as part of an integrated regional supply system. The "region" comprises Western Washington, Western Oregon and The Willamette Valley, the Mid- and Lower Columbia River Basin and, indirectly, parts of California and Alaska.

Until the mid-1950's, almost all petroleum used in the region was refined in California and delivered by small tankers, typically of the T-2 class (16,500 deadweight tons) or smaller. Much of it was, and still is handled twice or more; that is, bulk product deliveries are broken down at distribution terminals into barge shipments which serve smaller ports and industrial sites, both on inland waters and along the coast. In the period 1966-67, the total waterborne commerce in crude oil and products was equivalent to about 250,000 barrels/day -- including Canadian traffic between Vancouver refineries and Southern Vancouver Island and U.S. ports.^{1/}

From the late 1950's until 1973-74, the total marine volume declined slightly, reflecting increased deliveries of Canadian crude to the four major U.S. refineries served by the Trans Mountain Pipeline system. These refineries and two small ones near Tacoma have, today, a combined throughput capacity of 367,000 b/d.

As Canadian crude deliveries to the U.S. refiners diminished to near zero (in early 1977), the net, regional crude demands had to be met increasingly by tankers.

This trade, continued growth in demand for refined products at the smaller ports, and a lively exchange of refined products with California have all combined to increase the total volume of crude and products in transit on greater Puget Sound waters to an estimated 650,000 b/d in late 1977.^{2/}

B. Demand and Vessel Movements

Because the Washington refiners rarely operate at their rated calendar-day capacity (367,000 b/d total), I estimate that a little less than half of the total oil in transit, 312,000 b/d, is crude bound for either the Cherry Point - Ferndale area or the refinery complex near Anacortes. Another 20,000 b/d, is predominantly refined product coming to or leaving Puget Sound, refined product going to internal U.S. Northwest markets, or crude and product in the Canadian trade.

Again, I point out that much of this oil is counted twice, or more than twice, as it comes in, is refined and moves to a local market, or as it is exported from the region. On the other hand, oil spill and oil pollution statistics reflect total risks and exposures, not just one or another part of the supply system, so that we should consider all oil on all waters as the basis for the historic record.

Table 1 lists the Washington refiners, now almost entirely dependent on tanker-delivered crude.

TABLE 1
WASHINGTON REFINERS

<u>Name and Location</u>		<u>Capacity b/cd</u>	<u>Alaska Crude Capability b/d</u>
ARCO	Cherry Point	96,000	96,000-98,000
Mobil	Ferndale	71,500	10,000-35,000
Texaco	Anacortes	78,000	0- 2,000
Shell U.S.A.	Anacortes	91,000	0-15,000
Sound Refining	Tacoma	4,500	0-?
U.S. Oil	Tacoma	21,400	0-?

Note: Sources: Oil and Gas Journal March 28, 1977; FEA
West Coast Oil Study, September 1976.

My estimate of current crude volumes in transit, 312,000 b/d, is based on these six refineries operating at 85% of their calendar-day capacity (81.5% of stream-day capacity). The trend in Washington, as elsewhere, has been to use increasingly larger vessels for crude transport, so that compared to, say, the late 1950's, the total number of tank vessel arrivals has been steady or decreased slightly, even though the total volume of crude and products in transit has tripled.

The crude tankers serving these refineries were, from 1973-74 until August 1977, generally of a size considered "medium" by world standards, in the range from 60,000 to a maximum of 138,000 dwt. In 1975, Washington established an arbitrary upper size limit of 125,000 dwt, which remains effective until the U.S. Supreme Court rules on its constitutionality, perhaps in early 1978. (In March 1978 the U.S. Supreme Court ruled that the 1975 Washington State legislation was unconstitutional; Ed.).

An average crude tanker size of 90,000 dwt would produce about 180 arrivals per year, while a 70,000 dwt average size would generate 235 arrivals.* I believe the current and 1973-77 averages lie between these two limits, but it is difficult to be more precise -- the tanker trade is highly volatile, and what happened yesterday is not always a clue to what will happen tomorrow. And, since August 1977, a significant new element has appeared: ARCO's use of three 120,585 dwt tankers to deliver Alaskan crude to its Cherry Point refinery. For purposes of comparison, I will use the figure 200 to represent the current, annual number of crude tanker arrivals in Washington waters.

The number of product tanker arrivals is also an economic variable, and hence difficult to estimate for any current period. The number fell from 576 (total arrivals of tankers, but mainly products) in 1960, to 239 in 1970, for reasons explained above. But it could change upward again as West Coast refiners seek to balance product demands and technical characteristics between markets in California, Hawaii, Alaska, the Columbia River area and Puget Sound.

Product tankers in the coastal trade are considerably smaller (and also considerably older) than their crude-carrier counterparts -- many old T-2's remain in service. With an average of 140,000 b/d of products carried in tankers involved in the greater Puget Sound area (and remembering that some volumes will be counted twice), and with an average vessel size of 20,000 dwt, there would be about 360 vessels annually in transit, that is, the number arriving loaded or departing loaded. This appears to be a reasonable estimate for 1977-78.

* Based on 6.9 bbl oil per dwt. Crude densities vary within a 10-20% range.

Barge movements of products are very numerous. But beyond that, it is extremely difficult to estimate their numbers; they generally escape the reporting systems.

C. Vessel Characteristics

From 1973-74, when Washington refiners rather suddenly became highly dependent on tanker-delivered crude, until 1977, when this dependence became nearly total, much of their crude supply originated in the Mideast, Indonesia, Africa and other distant producing nations. Typically, it was delivered in foreign-flag vessels, averaging perhaps 70-90,000 dwt in size, and 9 or 10 years in age. Some were U.S.-owned, some were U.S.-controlled (through overseas subsidiaries) and many were chartered from foreign owners.

I suspect but cannot establish that this Puget Sound "fleet" was somewhat better equipped, maintained and manned than the average "world" tanker, and that the reason was rooted in the major oil companies' appreciation of Washington's strong concern for spill prevention and, as an added incentive, in the state's fairly broad suite of laws on spill liability, spill clean-up, mandatory pilotage and, since 1975, the siting of new facilities desired by the same group of companies.

While there have been some unfortunate foreign vessel incidents (e.g. the White Peony), there has never been a major spill in this trade, or an accident of the type statistically associated with major spills. Nor have the state-licensed pilots or the Coast Guard reported the arrival of truly inferior oil tankers such as the Argo Merchant. The major refiners (and most of the pilots)

state, with apparent justification, that these vessels are as good as or better than comparable U.S. flag vessels engaged in the West Coast trade.

At the same time, these tankers are quite unlike warships or merchantmen in several significant ways, and the differences between them have been examined by governments and technicians with increased interest, at least since the 1967 Torrey Canyon spill and the spate of documented oil-pollution cases which followed.

In a current study for the U.S. Environmental Protection Agency, I have attempted to profile the particular type of "world" tanker which will call on Puget Sound, in the period 1977 through the mid-1980's. A principal conclusion is that tankers delivering crude here will be somewhat smaller than the "world" averages, where a few vessels over 400,000 dwt are in service.

Washington's maximum size limit notwithstanding, there are other, physical limitations on tankers calling at the existing oil terminals. Mobil, Shell and Texaco would have to substantially expand or modify their receiving facilities to accommodate vessels in the 200,000 dwt or larger class, while ARCO would have to perform at least some dredging. All four, and in fact any operator utilizing Rosario Strait, would face potential draft limitations and navigational hazards in portions of the tanker lanes, if vessels drawing more than about 75 ft. underway* were employed.

The largest tankers proposed, to date, for the northern Puget Sound oil ports are two 188,500 dwt vessels being built for Shell with a draft of 59.5 ft. at rest, and designed for minimum draft relative to their tonnage.

A practical upper tanker size limit for these ports, even assuming that existing docks were modified, would appear to be in the range of 250,000 dwt, with a draft of 65 ft. at rest.

As to the "profile" tanker's other characteristics, I based my conclusions not on what exists today but on what is likely to appear for the next few years. U.S. federal tanker standards, as determined by Congress and enforced by the Coast Guard, are in a period of rapid upgrading. With the apparent failure of voluntary international agreements to force these reforms on a worldwide basis, and with the series of mishaps and spills in late 1976 still fresh in its memory, Congress today shows a distinct inclination to act unilaterally**, and to determine new standards for all tank vessels calling at U.S. ports, regardless of registry. Thus the near term, "world" tanker is proposed as fitting the following pattern:

Deadweight tonnage: 120,000 if the state's size limit is upheld; 150-180,000 if it is stricken.

Construction: Single skin, conventional compartmentation. Center compartments contain up to 3,000,000 gallons each in the largest vessels.

Propulsion: Single or dual boilers and turbines, driving a single propellor. No mechanical redundancy in propulsion or steering, such as bow thrusters.

* A large vessel underway at hull speed tends to settle by the stern, and it may also experience "bottom effects" in a reduced clearance situation, which affect control.

** As in its recent, related prohibition of a transshipment facility east of Port Angeles; see III A.

Segregated ballast: None or minimal now, but increasing.

Inerting: About half the vessels will have flue-gas inerting systems initially, increasing to 90% by 1985.

Electronics: Loran C; two operating radars, one of which is "collision - avoidance".

Composite spill rate: (Long term average) 0.004%, on or within 50 miles of Puget Sound, one-half of which is "operational" and one half "accidental". Includes unreported oil losses, generally offshore.* Probably improves during the period to 1985.

The Alaskan Fleet

In contrast with the "world"-class tanker profiled above, the Alaskan oil trade results in a fairly specific roster of vessels with known characteristics. Table 2, following, lists my estimate of vessels to be engaged in moving North Slope crude to Puget Sound and other West Coast ports (or through Panama). It is current as of mid 1977, and is taken from a preliminary draft of my EPA-sponsored research (not yet accepted by EPA).

The Alaskan fleet vessels will be newer, on average, than their "world" counterparts, and many of them will have additional safety features incorporated in their design. As "Jones Act" vessels, they will be U.S.-manned, with all deck and engineering officers Coast Guard licensed.

* For convenience, consider this as 40 parts per million. Much less than half of this would be reported through the existing systems, except in the case of a major spill.

To the extent that these and other characteristics combine to reduce their spill risks, the composite spill rate should be somewhat lower than the 0.004% proposed for the "world" tankers.

D. Current Supply and Demand Patterns
Related to Vessel Characteristics

Total product demand in the greater Puget Sound "Oil Region" (including Oregon, etc.) appears to be growing at about a 4 to 5% annual, compound rate, since early 1976. But the nearly flat demand from 1973-74 through 1975 suggests that all such figures are suspect, and the oil conservation initiatives now being debated in Congress could again result in lower growth rates at least through the mid-1980's. Five percent is probably an upper limit, and beyond 1985 it is likely to be considerably, perhaps drastically lower.

Regional uses follow a simpler pattern than in other parts of the U.S. There is no significant petrochemical industry, and very little use by utilities -- gas turbines for peak load generation are the only significant example.

Transportation, space heat and process heat are the dominant oil uses in the region. With natural gas supplies now in better shape, through the mid-term at least, than in recent years, gas appears to be the fuel of choice for most industrial and commercial heat. Residential space heating is largely electric in new construction, with gas as the second choice (economically) and oil largely used in older, existing housing. Thus transportation will dominate and determine the growth picture for some years to come.

TABLE 2

THE ALASKA - WEST COAST TANKER FLEET 1977

(See Text for Definitions; Footnotes on following Page.)

Owner/Operator	Vessel	Year Built	Puget Sound	DWT	Draft ft.	Seg. Ballast % of dwt	Double Hull/Bottom Inerting		Loran Collis.		Notes
							C	Radar			
<u>Atlantic Richfield Co. (ARCO)</u>											
ARCO	Heritage	1963 rebt.72	possible	53,288	40.5	21%	No	Yes	No		
Sinclair	Texas	1963	unlikely	50,063	40	14%	No	Yes	No		
ARCO	Prudhoe Bay	1971	unlikely	70,356	44	9%	No	Yes	No		Twin boilers
ARCO	Sag River	1972	unlikely	70,356	44	9%	No	Yes	No		Twin boilers
ARCO	Anchorage	1973	yes	120,585	52	21%	No	Yes	No		Twin boilers
ARCO	Juneau	1974	yes	120,585	52	21%	No	Yes	No		Twin boilers
ARCO	Fairbanks	1974	yes	120,505	52	21%	No	Yes	No		Twin boilers
(2 vessels)		1977-79 possible ¹		150,000	55	35% (USCG)	dbl.Bott.	Yes	Yes		Twin boilers, low sulfur fuel tanks

TABLE 2 - Cont'd.

THE ALASKA - WEST COAST TANKER FLEET 1977

(See Text for Definitions; Footnotes on following Page.)

Owner/Operator	Vessel	Year Built	Puget Sound	DWT	Draft	Seg. Ballast	Double Hull/ Bottom Inerting	Loran Collis.		Notes
					ft.	% of dwt		C	Radar	
Chevron (Standard Oil Co. of California)										
Chevron	Mississippi	1972	products	70,200	43.5	9%	No	No	A-C	No
Chevron	California	1972	products	70,200	43.5	9%	No	No	A-C	No
Chevron	Hawaii	1973	products	69,800	44	9%	No	No	A-C	No
										"Chevrons" backhaul refined products from California to Puget Sound carry crude from Cook Inlet to California.
EXXON										
EXXON	New Orleans	1965	unlikely	71,500	42	15%	No	No	Yes	Yes
EXXON	Houston	1966	unlikely	71,500	42	15%	No	No	Yes	Yes
EXXON	San Francisco	1969	unlikely	75,600	43	15%	No	No	Yes	Yes
EXXON	Philadelphia	1970	unlikely	75,600	43	15%	No	No	Yes	Yes
EXXON	Baton Rouge	1970	unlikely	75,600	43	15%	No	No	Yes	Yes
Manhattan		1962	unlikely	114,700	52	under 9%	No	No	Yes	No
American Sun		1970	unlikely	81,000	43.5	29%	No	No	Yes	No
(2 vessels)		1978-79	unlikely ^{1/}	165,000	55.5	35% (USCG)	No	Yes	Yes	Yes
										"Manhattan", "American Sun" have twin boilers; both are temporary time-charters, until '79. Bow thrusters, twin boilers, low sulfur fuel tanks.

all five "EXXONS" have bow thrusters; twin boilers. Extensive technical and structural updating was in process 7/6/77.

"Manhattan", "American Sun" have twin boilers; both are temporary time-charters, until '79. Bow thrusters, twin boilers, low sulfur fuel tanks.

TABLE 2 - Cont'd.

THE ALASKA - WEST COAST TANKER FLEET 1977

(See Text for Definitions; Footnotes on following Page.)

Owner/Operator	Vessel	Year Built	Puget Sound	DWT	Draft ft.	Seg. Ballast	Double Hull/Bottom Inerting	Loran C	Collis. Radar	Notes
<u>Mobil</u>							% of dwt			
Mobil Oil			unlikely	30,000						Intracoastal trade
Mobil	Meridian	1961	Yes	49,300	40	12%	No	Yes	No	
Mobil	Arctic	1972	Yes ^{1/}	129,000	55	18%	No	Yes	Yes	Twin boilers
				recertified to 124,999 in 1977						
<u>Shell U.S.A.</u>										
(2 vessels)		1978	Yes ^{1/}	188,500	59.5	35% (USCG)	dbl.Bott.	Yes	Yes	Twin boilers, low sulfur fuel tanks
<u>Standard Oil Co. of Ohio (SOHIO) and British Petroleum (BP)</u>										
SOHIO	Intrepid	1971	2/	80,800	43.5	15-20%	No	Yes		Panama Canal capability (light load), twin boilers.
SOHIO	Resolute	1971		80,600	43.5	15-20%	No	Yes		
(2 vessels)		1977		120,000	55	36% (USCG)	dbl.Hull	Yes	Yes	Twin boilers, low sulfur fuel tanks
(4 vessels)		1977-79	1/	165,000	55.5	36% (USCG)	No	Yes	Yes	Twin boilers, low sulfur fuel tanks

TABLE 2 - Cont'd.

THE ALASKA - WEST COAST TANKER FLEET 1977

(See Text for Definitions; Footnotes on following Page.)

Owner/Operator	Vessel	Year Built	Puget Sound	DWT	Draft ft.	Seg. Ballast Bottom % of dwt	Double Hull/Inerting		Loran Collis. Radar	Notes
							C	Inerting		
Standard Oil Co. of Ohio (SOHIO) and British Petroleum (BP) - Cont'd.										
Overseas Alaska ^{4/}		1970		62,000	43.5	5%	No	No	Yes	No
Overseas Arctic ^{4/}		1971		62,000	43.5	5%	No	No	Yes	No
Overseas Juneau		1973		120,000	52	20%	No	No	Yes	No
Trinidad Corp./Barber Oil Co./Mathiesens Tanker Industries ^{4/}										
Joseph D. Potts		1970	2/	81,000	43.5	15-20%	No	No	Yes	No
Prince William Sound		1975		118,300	55	36% (USCG)	Yes	Yes	Yes	Yes
Notre Dame Victory		1973		81,000	43.5	15-20%	No	No	Yes	No
										Twin boilers, low sulfur fuel tanks

Others, Time Charters, etc. (See Text)^{3/}

(TBD) Total deadweight tonnage in this category: possibly none in 1978; 501,000 or more in 1980; 1,543,000 or more by end of 1982. Most destined for Panama (?)

Footnotes:

- 1/ Subject to Supreme Court action on Washington's 125,000 dwt size limitation.
- 2/ SOHIO/BP has no internal market in the Puget Sound area. But it could utilize a transshipment capability in later years.
- 3/ The smaller Aleyeska partners and others exploring or operating outside the Prudhoe Bay area have not announced shipping plans.
- 4/ Vessels chartered to SOHIO.

With a 50,000 b/d refinery now seriously proposed for the Portland area, Oregon's demand on Puget Sound refineries will be somewhat moderated. There is a growth potential in the Spokane area, depending heavily on the outcome of transshipment proposals now before U.S. and Canadian authorities.

But, in my view, the most significant growth potential exists in the export of refined products to California, Alaska and/or Hawaii. California refiners are hamstrung by air quality regulations limiting expansion in the south and at San Francisco Bay, yet demand increases steadily. The Standard Oil Company of California has owned a large refinery site near Ferndale for many years, and the possibility of a major refinery there by 1985 seems more than fair.

Also, Dow Chemical Company was unsuccessful in recent years in obtaining a petrochemical plant site in California, and may seek to break the historic pattern with an operation in Washington. Pending site acquisition or other evidence, however, this remains speculative.

If either the products-export or the petrochemical potential were to materialize, in my view the impact on tanker traffic would be linear (proportional to volumes handled) and tanker characteristics would be based on the Alaskan fleet; the famous "West Coast-Alaskan oil surplus", at about 600,000 b/d, is very real today. This eventuality is discussed in the next section.

II. FORECAST OF TANKER TRAFFIC PATTERNS, BASED ON
CONTINUED DIRECT DELIVERIES TO PUGET SOUND REFINERS
AND PRODUCT TERMINALS SERVING REGIONAL NEEDS

A. Crude Oil Requirements

In section I, it was estimated that Washington's total current crude throughput, delivered by tanker, is 312,000 b/d, with the existing refiners operating at 85% of calendar-day capacity. At 100% capacity, crude demand would be in the area of 367,000 b/d.

The factors which could increase crude demand are:

- New refinery construction -- the likely prospect of Standard of California building a refinery on its Ferndale site by 1985 could add 100-125,000 b/d to requirements.
- Petrochemical industry -- minor requirements; a typical large, new plant would require only 5,000-10,000 b/d of naphtha feedstock (actually a refined product).
- Expansion of existing refineries and/or debottlenecking -- unknown, but possibly in the range 10,000-50,000 b/d by 1985(?).
- Transshipment -- see section III.

My estimate of an upper limit on regional crude intake is 500,000 b/d by 1985, barring transshipment but including a new refinery, perhaps one partially dedicated to petrochemical production.

Conservation and/or the postponement of significant new refining capacity could hold crude demands to near present levels through 1985, with demand growth being met through higher refinery utilization and additional product imports (see below). Thus the lower limit of crude intake would be in the range 370,000 b/d in 1985.

Of these volumes, a maximum of about 130,000 b/d could be Alaskan crude, with present refinery capacities for sour crude, or as much as 280,000 b/d with a major new refinery by 1985. With an average tanker size of 90,000 dwt in this trade, the number of vessel arrivals per year from Valdez would be 76 in the first case and 163 in the second. All vessels would be U.S. flag, of the types listed in Table 2. If all were in the 120,000 dwt class, such as ARCO's Anchorage, Juneau and Fairbanks, the number of arrivals per year would be lowered by 25%.

At least 237,000 b/d of crude intake, by 1985, will probably still be light, low-sulfur foreign crude, with an upper limit in the range of 275,000 b/d. In average 120,000 dwt vessels and with an intake of 250,000 b/d, there would be 110 arrivals per year of the vessel type described above as a "world" tanker. Removal of Washington's legal size limit would reduce the number to about 90. Table 3 summarizes these data:

TABLE 3

ANNUAL TANKER ARRIVALS TO SERVE
REGIONAL REQUIREMENTS IN 1985

<u>Tanker Type, Crude Source</u>	<u>Ad. DWT</u>	<u>Existing Refiners</u>	<u>Refinery Expansion</u>	<u>New, 150,000 b/d Refinery</u>
Alaska	90,000	76	7-35	87
Alaska	120,000	57	5-26	65
			or	
World	120,000	110	5-26	0? *
World	170,000	<u>90</u>	<u>4-21</u>	<u>0? *</u>
Total Tanker Arrivals:		<u>147-186</u>	<u>4-35</u>	<u>65-87</u>

* Assumes a new refinery would process Alaskan crude, including Outer Continental Shelf or National Petroleum Reserve No. 4.

If forced to speculate further, I would write the following scenario:

"Washington's tanker size limit will be found unconstitutional in 1978. Between 1978 and 1985 only modest refinery expansion will occur, but a major new refinery will open in 1985, based partly on product exports to California. From 1978 to 1985, the annual number of crude tanker arrivals grows only from 160 to 175, due to increasing use of larger vessels; but in 1985 and thereafter it is in the range of 240".

During the period, older vessels in the "world" fleet are replaced gradually with tankers very similar to the 1977-78 Alaskan fleet -- most notably in their greater percentage of segregated ballast. The segregated ballast requirements will increase their physical size, in relation to net cargo capacity, toward that of a present

200-225,000 dwt tanker without segregated ballast. They will be able, but marginally able, to utilize existing dock facilities, or even those updated by the refiners in the Anacortes complex."

B. Product Requirements

Regional product requirements were earlier estimated to produce 318,000 b/d of product currently in transit on greater Puget Sound -- including all Canadian traffic and, again, emphasizing that much of this product is counted twice or more as it moves to final markets, e.g. in barges.

The actual Washington-Oregon "regional", "net" demand for tanker delivered refined products is smaller -- no one knows for sure how much smaller. But in terms of tank vessel movements, it is not as relevant as it might appear.

A more useful number would be the total of extra-regional, smaller tanker cargoes; imports plus exports. Earlier, I estimated 140,000 b/d in 1977. But here again, we are data-poor; the historic pattern is not consistent with current practices, which depend greatly on an individual company's needs to balance supply and demand of specific fuels in its total West Coast marketing areas, to find customers for the heavy ends of production which are often in surplus, and to adjust to competitive pressures from other marketers.

Until 1985, at least, we estimate that Standard Oil of California (Chevron) will continue to deliver sizeable volumes of gasoline and light distillates to its many

Puget Sound distributors by small tanker. Union, Exxon, and other marketers without local refineries will constantly weigh decisions to import products, vs. product exchanges which do not result in tanker traffic. Minor brands and unbranded independents will be alert for opportunities to import "spot" purchases of products from outside the region.

About the best answers I can provide the Inquiry, without rather extensive further research, are:

- (1) There is a regional demand for gasoline and light to mid-distillates (jet fuel, diesel, heating oils) which grows currently at 4 to 5% annually; by 1985 it will be 50% greater than today and yet Puget Sound refiners cannot meet it from their present and forecast refinery runs; and
- (2) there are so many possibilities after 1985, such as net product exports from a new refinery, that speculation about that period would be fruitless.

The overall outlook, then, is for gradually increased product movements for the next 8 years. If 318,000 b/d are in transit on an average day in 1977, my "forecast" for 1985 would be in the range 400-450,000 b/d, but I would not defend it very strongly.

III. IMPACTS ON TANKER TRAFFIC PATTERNS FROM THREE
ALTERNATIVE NEW OIL PORTS AT CHERRY POINT, PORT
ANGELES AND KITIMAT, EACH INVOLVING TRANSSHIPMENT

A. Cherry Point

This alternative, the ARCO-Trans Mountain proposal presented in 1977 to the State siting authority in Washington, was apparently negated by a recent Congressional action. But as of this writing, neither the companies nor the Governor's office has announced its abandonment; it would be prudent in my view to keep it in mind as a possibility, albeit an unlikely one.

In this concept, crude moved eastward would have become available to refiners in the "Northern Tier" states -- the landlocked states formerly dependent on Canadian crude supplies -- whose minimal demand was at one time estimated by FEA^{3/} at 264,000 b/d. Replacement of the Alberta crude for which these refineries were designed implied that at least this much would have to be foreign sweet crude delivered to Cherry Point in "world" type tankers. Total replacement of historic Canadian supplies to all Northern Tier refiners would require in excess of 500,000 b/d, but several replacements and/or exchanges since have been devised, which could make 264,000 b/d more like an average demand figure than a minimal one.

The initial phase of the plan, with alternating pipeline flow directions, would provide a net eastward movement in the range of 165,000 b/d. In tankers averaging 120,000 dwt, this would generate 73 additional tanker arrivals per year (51 in 170,000 dwt vessels). Each additional 100,000 b/d, in an expanded system, would produce 44 additional vessels annually. (See Table 4).

The principal impact of this development would be to increase vessel traffic significantly in Rosario Strait and its entrances. Assuming an average size of 120,000 dwt for both Alaskan and "world" tankers, the existing refineries served through Rosario Strait generate about 157 tanker arrivals annually. Adding another 73 arrivals (ARCO Phase I) would increase crude tanker traffic by 45%. Expansion of ARCO transshipment operations to 500,000 b/d (with modification of the existing Trans Mountain pipeline) would produce a total annual number of arrivals in the range 250 to beyond 360, depending on the average vessel sizes employed.

Assuming a total transit time in or at the entrances to Rosario Strait of 8 hours per vessel (in and out), a very conservative estimate of 360 arrivals per year would mean that during 60% of the daylight hours, year around, there would be at least one large crude tanker somewhere in the Strait. With added product tanker traffic and under present, "one-way" traffic rules, there would be very real "scheduling" problems at this level of development, and very real questions of navigational hazard. Should Standard Oil Company of California build a fifth large refinery at Ferndale in the 1980's, it would appear almost essential to use Haro Strait as one leg of a "one-way" system, and even so, utilization of all present shipping lanes would be heavy, compared to the past.

These factors and others led to the Congressional rejection of the concept of the ARCO-Trans Mountain proposal. It should not be considered a dead issue, however; a possible ameliorating or mitigating measure could be that of "hooking-up" the major existing refineries to a single crude oil receiving terminal -- in this case, one based

at Cherry Point, but also serving the Anacortes complex. Another could be a repeat of the 1973 crisis, where every element of the U.S. supply network becomes critical.

The physical means exist for transshipment, quickly and not at high cost, through utilization of an idle segment of the Trans Mountain pipeline. But barring an emergency or an unforeseen compromise over environmental standards, there seems to be no compelling case for doing it on either environmental or economic grounds.

Present and projected traffic bound for Anacortes departs from Rosario Strait either eastward through Guemes Channel (with about 39-42 ft. limiting depth), or northeast and then southward again around Guemes Island (with no depth limitation, but with narrow passages between shoals and rocky islands). While it (Anacortes) is not an ideal situation, it is not that much worse than transiting all of Rosario Strait and on to Cherry Point, when the looming issue of traffic congestion is considered.

Certainly it would add costs to the Anacortes operations, and probably to other users as well, due to queueing problems and the investment in increased facilities for crude segregation required onshore.

In my view, Cherry Point would become a transshipment alternative only as the result of an emergency or a wholly unforeseen environmental compromise.

Therefore, I would strongly discount the possibility of consequential "hook-up" in this case. I would add that, today, realization of the Cherry Point alternative looks most unlikely. There are simply too many quantifiable

objections to it, too many procedural difficulties in "undoing" Federal law, and too little politically credible, organized support for an overturn.

B. Northern Tier

The Northern Tier proposal envisions an ultimate throughput of 800,000 to nearly 1,000,000 b/d (depending on ultimate, installed pumping capability) of crude eastward, plus an (optional) 500,000 b/d via a spur to "hooked-up" Puget Sound refiners. Northern Tier would only provide service to a junction east of Seattle, not the spur itself.

In average 170,000 dwt tankers there would be 249 arrivals per year, while a 120,000 dwt average tanker size would produce 353. There would be only the present product tanker or barge traffic in the Port Angeles terminal area.

Port Angeles has no physical depth limitations, as were described both for the Cherry Point access routes and for the entrances to Anacortes. In principle, virtually the largest vessels afloat could enter and dock at the proposed facility. In the event that Port Angeles becomes a transshipment port, I expect that many vessels over 200,000 dwt would become involved. And in a project of this magnitude, shippers would be encouraged to commit to large vessels, on a long-term basis, in order to realize significant economics of scale.

A "hook-up" to Port Angeles by the four majors on northern Puget Sound would add to this traffic essentially that described in Table 3, less the 20,000 b/d going to Tacoma.

The result would be in the range of 150-160 additional arrivals per year for existing regional needs, or perhaps fewer, assuming that some larger foreign-flag vessels would be used. The "hook-up" would not materially affect product tanker movements elsewhere on Puget Sound.

The industries' strong objections to the "hook-up" concept are both technical and economic, and there is no dominant political position yet favoring such a move. Even from the environmental standpoint, there is no unanimity of opinion -- the rather apparent benefits in terms of reduced spill risks in the northern Puget Sound area are offset by almost certain adverse air quality impacts at Port Angeles.

Also, in my view, the problem facing regional policy makers is not a simple choice between alternative trans-shipment sites (or none at all, which is certainly one of the more popular ones), but rather it is represented by a matrix of partial choices which would inevitably result in a hybrid system for handling oil, and in dispersed impacts on water, air and socio-economic value systems throughout the region.

I believe the siting method used in Washington in fact precludes making the "hook-up" decision in any sort of parallel time frame. Both ARCO-Trans Mountain and Northern Tier have come in with development plans which are specific, which do not involve "hook-up", and which must be approved or denied on their own merits. Then, and only then, and only with a site-specific legislative Act could the State of Washington impose a "hook-up" requirement. I have no difficulty in imagining the use of words like, "arbitrary, capricious and contrary to due process" being used in a well-financed legal opposition.

Thus, where I could not see any reasonable probability of a "hook-up" to a Cherry Point terminal, I cannot see a reasonable chance for its imposition at Port Angeles. The Northern Tier Company chooses, wisely in my view, not to deal with it except as an engineering option available for some other pipeline company to implement. The State has no mechanism for requiring it. And the industry would appear to have a good case against it.

C. Kitimat

Much of what has been said previously can be applied to discussion of the Kitimat proposal. Table 3 summarized the anticipated, regionally-based tanker traffic patterns, which are unaffected by a Kitimat development, unless there is a "hook-up".

What is different here, perhaps, is the justification of the "hook-up", and the arguments which could be employed to make it a feasible alternative.

Relative to Alaskan crude, there is an apparent cost differential between the short Valdez-Kitimat route and the longer Valdez-Puget Sound route. Offsetting this is the pipeline tariff, of course, but that is open to analysis and negotiation, and the pipeline is already built and at least partially depreciated by Trans Mountain.

It is certainly a very different situation from Port Angeles, where there is no significant cost offset, but only an important addition to present operating costs for the refiner. Relative to "world" crude, there seems to be little cost differential except for the tariff.

Secondly, either a state or a U.S. federal decision requiring a "hook-up" by existing and/or new refiners could be made; the federal "presence" and "national interest" would be the dominant elements, which are now lacking in the case of a Port Angeles "hook-up" decision. The precedent has been firmly established both in the TAPS legislation by Congress, and in the recent natural gas pipeline route decision by the President.

And finally, there is the argument that a Kitimat "hook-up" would be much more effective in reducing spill and pollution risks in both Washington and southern British Columbia waters, than would be a "hook-up" at either Cherry Point or Port Angeles. It would go toward the heart of the problem for these areas, vs. an otherwise partial solution.

With Washington's crude traffic added on to, say 700,000 b/d of crude for transshipment eastward, and average vessel size of 150,000 dwt, Kitimat would experience about 360 vessel arrivals annually; this is of course a larger throughput than the developers envision. A total throughput limited to 700,000 b/d, including Washington's share, and an average vessel size of 120,000 dwt (to account for fewer very large "world" tankers in the total mix) would result in 308 arrivals per year.

In either case, the problems and risks created in the entrances to and at Kitimat, by nearly one large vessel arriving and departing every day, would have to be balanced off against the problems and risks now existing, or anticipated, in many parts of the greater Puget Sound area. While not easy, the final decision would at least be between two distinct cases.

In the matter of a decision between Kitimat and possible alternatives developed entirely within the Puget Sound area, I believe this analysis suggests that all oil port siting trade-offs will be complex, and all are likely to be contested later, and at length, no matter what may be the outcome of the decision-making process.

TABLE 4

TANKER TRAFFIC GENERATED BY SOME ALTERNATIVE
TRANSSHIPMENT PROPOSALS

<u>Location, Scenario</u>	<u>Throughput b/d</u>	<u>Average Tanker dwt</u>	<u>Arrivals per Year</u>
Existing Traffic	312,000	120,000	157
ARCO/TERMPOL Co.	165,000	120,000	73
ARCO/TERMPOL Co.	165,000	170,000	51
Existing & Transshipm.	812,000		250 to 360 +
<u>Port Angeles</u>			
Northern Tier Pipeline	800,000	120,000	353
Northern Tier Pipeline	800,000	170,000	249
Washington Hook-up	312,000		150 to 160
<u>Kitimat</u>			
Kitimat Pipe Line Ltd.	700,000	120,000	308

REFERENCES

- 1/ Vagners, Juris and Paul Mar, "Oil on Puget Sound", Univ. Wash. Press 1971.
- 2/ Brewer, William, "The Disposition of Alaskan and Foreign Oil in Washington State", U.S. Environmental Protection Agency, (draft) December 1977.
- 3/ "Crude Supply Alternatives for the Northern Tier States", FEA, August, 1976. 264,000 b/d was FEA's estimate of "Priority I" needs of refiners with no alternative crude supply.