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ENERGY RELATED DEVELOPMENT IN THE COLUMBIA RIVER ESTUARY:

POTENTIAL, IMPACTS, AND MITIGATION

COLUMBIA RIVER ESTUARY STUDY TASKFORCE

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I. INTRODUCTION

The purpose of this study is to provide the necessary information for identification and mitigation of impacts associated with energy related development in the Columbia River Estuary . This study includes five elements. First, an overview of the existing transportation infrastructure, dredging requirements, and other constraints and opportunities for locating energy facilities in the Columbia River Estuary is provided. This includes a general bulk shipping cost comparison between Lower Columbia River ports and the Esturay. Second, information on potential energy related development options is presented. This includes a demand and benefit-cost analysis of coal transshipment, the most likely energy related development at this time, as well as a description of the competitive position of the Lower Columbia River with other west coast ports. The third element identifies potential energy related development sites within the estuary and describes the most likely areas for deep draft development based on rail upgrade and dredging costs. Fourth is a description of estuarine impacts associated with selected energy related development options. This includes impacts associated with dredging a deeper channel, impacts to air and water quality and estuarine biota, impacts to the local economy, and impacts to the Columbia River Estuary from coal port development upriver. Finally, local, state, and federal mitigation policy is reviewed, and mitigation strategies for specific energy related development impacts are proposed.

To fulfill these objectives, many sources of data were utilized. Extensive computer modeling is required to accurately determine amounts of dredging that would be required for excavation of a new navigation channel and for neccessary maintenance dredging. These data are not available. Therefore, use of existing engineering studies,[9,21,48,63] U.S. Army

Corp of Engineers data, [1,4,26] and information obtained from experts in the field were used to derive quantities and costs for dredging to various sites.

The descriptions of potential energy related development in the Columbia River Estuary were drawn largely from the study Energy Related Use Conflicts for the Columbia River Estuary.[12] Potential sites within the Columbia River Estuary identified for development were drawn mainly from the Final CREST Mediation Panel Agreements, and The Columbia River Estuary Regional Management Plan.[5,22] The assumption was made that an appropriate planning designation would be a major factor in siting of new facilities in the estuary region.

Costs of infrastructure upgrading were obtained from previously published reports, [8,9] discussions with the Port of Astoria staff and Burlington Northern engineers, and testimony before the Senate Commerce Committee [31].

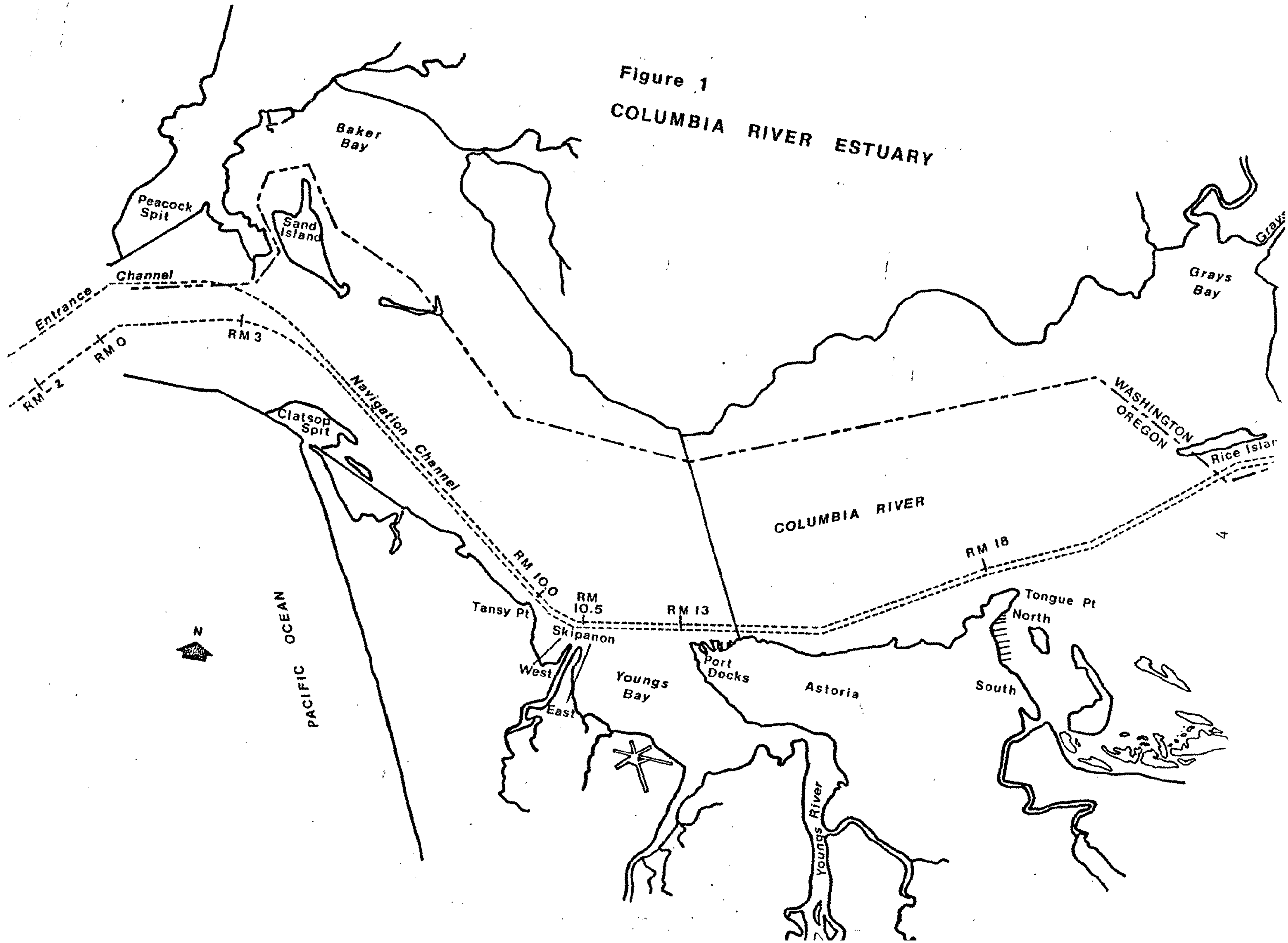
Impacts to the estuarine biota from increased salinity resulting from deepening the navigation channel were based on extrapolations of the U.S. Fish and Wildlife Service Fish and Wildlife Coordination Report Navigation Channel Deepening, Columbia River at the Mouth.[33] Other impact descriptions are drawn from a wide variety of federal, state, private, and university research.

Mitigation policy analysis was derived mainly from the Columbia River Estuary Mitigation Policy Paper,[74] and the resultant framework was used to formulate strategies to mitigate the impacts of energy related development.

This study proposes methods to mitigate for the specific impacts of energy related developments (e.g. coal dust) and other attendant impacts (e.g. increased bank erosion caused by ship wake). Mitigation strategies for on site dredging and filling and offsite DMD will be considered in a later report.

Figure 1

COLUMBIA RIVER ESTUARY



2. POTENTIAL FOR ENERGY RELATED DEVELOPMENT IN THE COLUMBIA RIVER ESTUARY

2.1. REGIONAL DEVELOPMENT: CONSTRAINTS AND OPPORTUNITIES

Environmental and economic characteristics of the Columbia River estuary influence the siting of energy related development in the estuary region. Certain characteristics (e.g., deep draft vessel access, proximity of estuary ports to preferred international trade routes) favor energy related development in the area, while other characteristics (e.g., navigational access maintenance requirements, limited land transportation infrastructure) limit potential energy related development. The following is a brief discussion of the locational attributes of the Columbia River Estuary (from the river mouth to river mile 46) in comparison to the Lower Columbia River (river mile 46 to river mile 105), presenting advantages and impediments affecting potential energy related development.

2.1.1. DEEP WATER ACCESS

The U.S. Army Corps of Engineers has maintained a stabilized entrance channel across the Columbia River bar since the 1880's. The federally authorized project, last modified by Congress in 1954, provides an entrance channel 48 feet deep (measured from MLLW), one-half miles wide, and five miles in length, extending two miles seaward and three miles landward. The bar entrance channel is stabilized by two converging rubble mound jetties extending seaward from the Washington and Oregon shores.[1]

The Columbia River navigation channel, first authorized by Congress in 1877, has been deepened at intervals since that time. The present authorized project provides for a channel in the Columbia River 40 feet deep (measured at MLLW) and 600 feet wide from River

Mile 3 to the Burlington Northern railroad bridge at Vancouver, Washington (river Mile 105.5). From Portland to Lewiston, Idaho, the river depth is maintained to 14 feet, linking the lower Columbia River to a 460 mile system of commercial river navigation.[1] Waterborne commercial traffic transiting the Columbia River bar and navigation channel in 1978 was 45,050,000 tons.[1]

Dredging requirements for maintenance of deep draft navigational access are significant. Maintenance dredging at the mouth of the Columbia River (RM $^{-}2$ to $^{+}3$) averages approximately 5.3 million cubic yards per year (1976 through 1980 average), with an annual cost of about $3.1 million.[1] Annual maintenance of the Columbia River navigation channel (RM 3 to 105) and Willamette River entrance requires excavation of approximately 3.2 million cubic yards of sediment (1976-1980 average), with an annual cost of approximately $1.7 million per year.[1] Annual dredging of the Columbia River bar alone represents 45 percent of the entire dredging performed by the Portland District of the Corps of Engineers, and 36 percent of the District's total dredging costs.

During periods of high swell, vertical motion of ships transiting the mouth may exceed 20'.[2] Because of the 48' maintained depth of the entrance channel, vessel draft is restricted to about 38'. The Corp of Engineers is currently studying the feasibility of deepening the entrance channel to 55' to allow 40' draft ships to transit the mouth.

- <u>Dredging and Dredged Materials Disposal Requirements</u>

Columbia River at the Mouth.

Most of the dredge spoils from the entrance channel have traditionally been placed in three in-water disposal areas beyond river mile ¯3.5: (areas A, B, and E), with in-estuary disposal at site D when bar conditions prohibit ocean disposal. Sediments placed at site D tend to move down channel and upchannel, with upchannel movement dominant, probably moving mainly into the north channel and onto Desdemona Sands. This is supported both by radioactive tracer studies and bedform analysis.[3] Area E is presently the preferred site, being a source of beach nourishment for Peacock Spit.[4] However, large quantities of material placed in this area may impact crab populations near shore.[5]

The COE has expressed reservations about the capability of the present sites to disperse the large amounts of material generated by substantially deepening and maintaining the mouth and navigation channel, [6] and has begun consultation with resource agencies on additional or alternate sites. Alternate sites are discussed in section 3.5.

Washington State Parks has expressed interest in locating a sump where the North Jetty meets Cape Disappointment, and rehandling the material by pipeline dredge onto Peacock Spit for Washington State beach nourishment.[7] This method, if approved by resource agencies, would provide an almost unlimited disposal site for future project spoils. Clatsop Spit is also a likely candidate for this method of disposal. Questions regarding this method center around the cost of double handling of spoils and technological feasibility of sump siting. This method, compared to ocean hauling, may be more attractive in the future when fuel prices again rise.

Navigation Channel

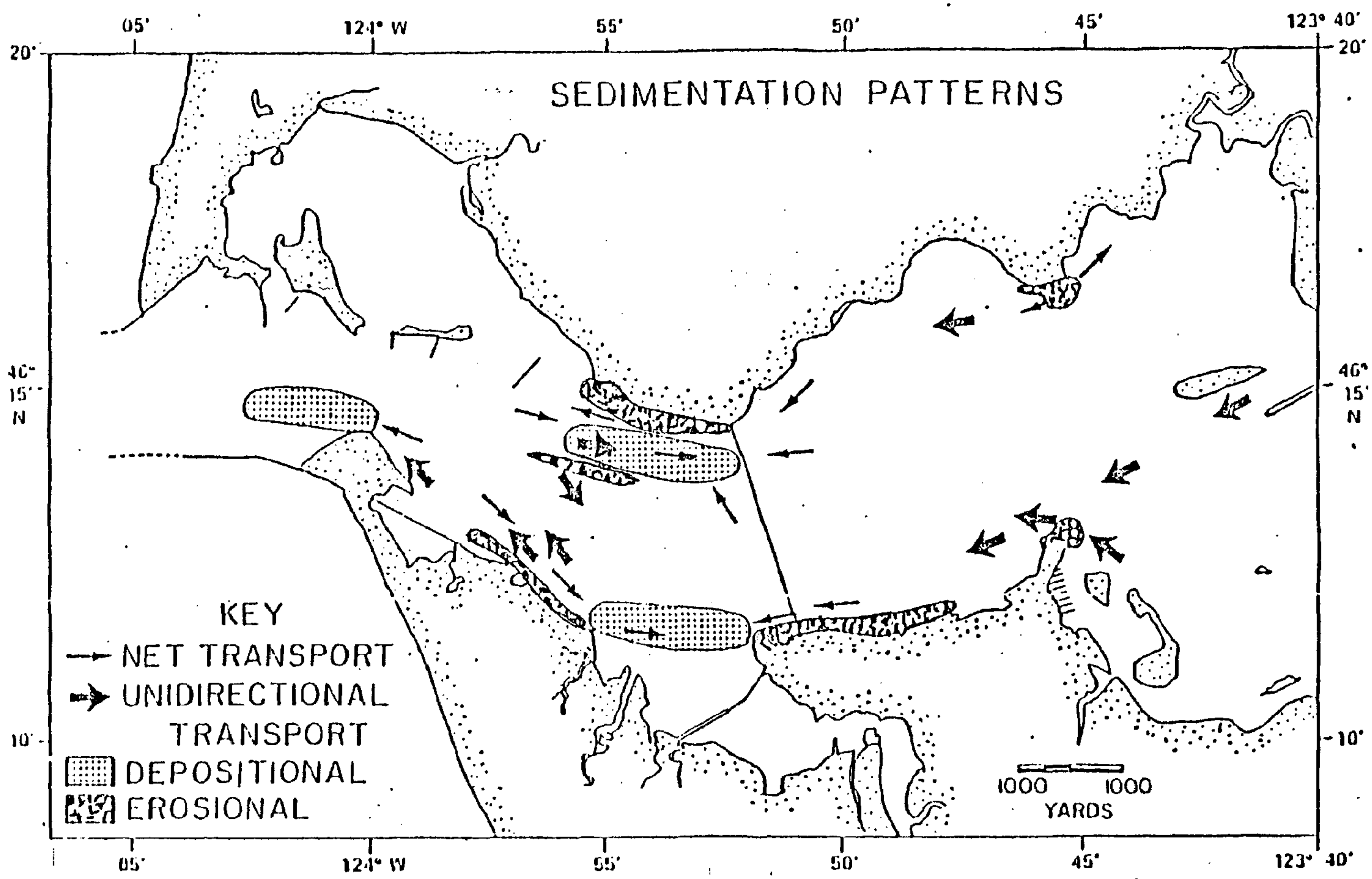
Hopper dredge spoils originating from Clatsop Shoal (RM 0-2.6) and Desdemona Shoals (RM 5-7.8) are primarily placed at the ocean Site E, with disposal at Site D when bar conditions prohibit passage to open ocean sites. Flavel Shoal (RM 11.3-12.6) spoils are primarily placed at Site D or Site 54, the Harrington Sump. Bedforms on Flavel Bar indicate that this reach of the river is an area of convergence of bedload transport, recieving bedload sediments from landward in the spring and seaward in the fall.[3] It also is approximately midway between the excursion limits of the turbidity maximum in the estuary, and thus also recieves significant deposition of suspended sediments.[3] The Harrington Sump spoils are periodically rehandled by pipeline dredge to Rice Island.

Upper Sands Shoal is handled in the same manner as the Flavel Shoal, being first placed by hopper dredge at Site 54, Harrington Sump, then subsequently rehandled by pipeline dredge to Rice Island. For a generalized representation of shoaling areas in the Columbia River Estuary see Figure 2.

2.1.2 Rail Infrastructure

The Columbia River navigation channel is linked with railroad service throughout most of its navigable length. Three railroads service the Portland-Vancouver area: Burlington Northern, Union Pacific, and Southern Pacific. Burlington Northern and Union Pacific provide mainline, heavy-duty service to Washington ports downstream to the Longview-Kelso area. No rail transportation exists along the Washington shore of the Columbia River downstream of Longview-Kelso. West of Portland, Burlington Northern railroad is the only line

FIGURE 2. After E. H. Roy et al, 1982[3]



Sedimentation patterns in the Columbia River Estuary based on convergences and divergences of bedform sediment transport. Unidirectional transport arrows reflect dominant transport directions for all seasons. Net transport direction arrows reflect resultant direction of reversing transport indications, integrated over tidal and seasonal time frames.

connecting Oregon ports with mainline rail traffic. The 93 mile branchline connecting Astoria with Portland is adequate for only light-to-moderate traffic, and upgrade for heavy bulk transport would be expensive. The branchline to Astoria passes through several small towns en route from Portland. Relocation of the line to bypass these towns would add significantly to the cost of upgrade. Estimates of upgrade costs (including bypasses) range from 17-55 million dollars,[8,9] with 40 million dollars being the most likely figure.

2.1.3 Comparison Between Columbia River Estuary and Lower Columbia River Ports

A comparison of bulk coal shipping costs between Tongue Point and the Port of Kalama demonstrates the locational aspects of facility siting on shipping costs. Because of the differential in shipping costs between rail and vessel traffic, coal arriving in Panama ships at Tongue Point (RM 18) from Montana would cost approximately $1.60 more per ton F.O.B than at Kalama (RM 72).[9]

Differences in vessel shipping distances do not compensate for differences in rail shipping distances (see Table 1).

Table 1 shows that an increase in vessel size by 15,000 DWT can make Tongue Point more competitive than Port of Kalama on a cost per ton delivered basis. The Columbia River bar and navigation channel at present limit vessel draft to 38'. The 40' loaded draft of 55,000 DWT vessels would require some dredging of the bar and channel to allow year round access to Tongue Point. It is expected that the Corps of Engineers MCR Project will be approved, allowing for a 55' entrance and 40' navigation channel. The Corps of Engineers standard 2' overdredge and judicious use of the tides would allow 55,000 DWT coal

Table 1

KALAMA-TONGUE POINT COST COMPARISON

PORT	COST FROM MONTANA[8]	DISTANCE TO YOKOHAMA	(x1000) DWT	COST TO YOKOHAMA[8]	TOTAL[9]
Kalama	19.20	4290	40	17.70	36.90
Tongue Point	20.80	4240	40	17.50	38.30
Tongue Point	20.80	4240	55	15.20[9]	36.00

colliers access to Tongue Point or other estuary ports. The tidal window is assummed to be unavailable for 55,000 dwt colliers upriver as far as the Port of Kalama.

2.1.4 Highway Systems

Portland and Astoria are connected by U.S. Highway 30, located on the Oregon shore of the Columbia River. Highway 30 is a principal arterial highway that is well maintained and has been improved in past years. It passes through all population centers along the river. On the Washington side of the river, Interstate Highway 5 connects Portland-Vancouver and Kelso. Downstream of Kelso, Cowlitz and Wahkiakum Counties are served by Washington State Highway 4, parallelling the river to Cathlamet. Highway 4 is considered a medium duty road.[8] From Cathlamet to the northern end of the Astoria-Megler Bridge, no improved highway access to the Columbia River is present. A portion of U.S. Highway 101 follows the Columbia River from Megler to Ilwaco, near Cape Disappointment.

2.1.5 Air and Water Quality

Existing development and population concentrations along the lower Columbia River do not present significant impacts to maintenance of water and air quality. The ability of the region to incorporate new, moderate contributors to present water discharges and air emissions is good in comparison to upstream areas. New industry proposed for siting in the Portland-Vancouver vicinity would, generally, represent significant marginal increases in existing water and air pollutant loadings.[11]

2.1.6 Labor Force

The civilian labor force in Clatsop County, Oregon and Pacific and Wahkiakum Counties in Washington has fluctuated little in recent years. Clatsop County has a labor force of between 12,000 and 13,000, while the labor pool in Pacific and Wahkiakum counties is approximately 6,200 and 1,300 respectively.[8] Lumber, wood products and fishing have figured prominently in the employment history of the estuary area. Heavy industry, manufacturing, and supporting services and supply networks for such activities are not present in Clatsop, Pacific and Wahkiakum Counties.

2.2. CATEGORIES OF POTENTIAL ENERGY RELATED DEVELOPMENT

The following discussion identifies four categories of energy related development, the factors which influence each category of development, and the probability of such development in the Columbia River Estuary. A thorough and inclusive analysis describing all energy facilities and the interrelationships and competition between different categories of energy development is not possible in this discussion. However, the potential for siting of each category of energy related development is described in order to establish a basis for formulating strategies to mitigate for estuarine resource impacts.

2.2.1 Electric Generation Facilities

At present, electrical power resources in the Northwest are a combination of hydroelectric generation (73 percent of average load capacity) and thermalelectric generation (27 percent).[12] No generation facilities are located in the Columbia River Estuary area.

- Hydroelectric

Future development of hydroelectric power resources, traditionally an abundant energy resource in the Northwest, is limited. In the next 20 years, increases in peak generation capacity will focus on small to medium sites (i.e., low head hydroelectric projects and refitting of existing diversion structures). The cumulative power generation capacity of such sites is considered to be substantial. A 1980 hydroelectric power inventory prepared by the Corps of Engineers identified thirty-four existing and potential hydro sites on tributaries of the lower Columbia River. Only two of these sites are on tributaries to the Estuary, one on the Gray's river (Wahkiakum county, Washington) and one on Big Creek (Clatsop County, Oregon).[12] An additional site at Youngs River Falls, Clatsop County, has been identified by the City of Astoria as a potential hydroelectric generation facility.[13] Each of these projects are viewed as local opportunities and are not in response to regional demands for electricity. Power generation in excess of local needs would be made available to the Bonneville Power Administration or Pacific Power and Light Company.

- Coal and Nuclear

It is generally accepted that major new additions to electric generation capability in the Northwest must rely on thermalelectric generation facilities.[12] These facilities include nuclear and fossil fuel plants. Such facilities are expected to meet regional growth in Northwest power demand. Planned thermal generation facilities are distributed inland in the northwest, with plants located east and west of the Cascades. The lead time for siting and construction of thermalelectric facilities is well in excess of ten years. No thermalelectric plants have been proposed for the CRE area.[12] Two large thermalelectric generating facilities exist on the Columbia River, both located in Oregon. The Trojan pressurized water nuclear reactor (1130 MW) at River Mile 70 and the Beaver combined cycle gas/oil power plant (660 MW) at River Mile 53 are the nearest thermalelectric facilities and would be the primary sites for expansion of generation capacity. The Beaver facility is well suited to relieve the larger thermal power plants in the region (Trojan and the 530 MW coal-fired plant at Boardman) of peaking capacity. It is likely that additional generation capacity will be added at Beaver within 15 years.[12] The Trojan plant was originally planned for two units and that site could accommodate another unit if necessary. The probability of expansion at the Trojan site over the next 25 years is low. Thermal power plants are the most likely means of meeting forecasted modest regional load growth in the northwest. The economies of scale leading to construction of large new thermal power plants dictate that new plants be sited near fossil fuel sources and fossil fuel transportation networks, and near existing power distribution grid infrastructures. Thus, major new thermal power installations in the CRE area are unlikely. Non-conventional sources of electric power, including wind, solar and tidal driven systems and use of waste materials as heat for thermal power plants, have not been proposed for the lower Columbia River nor the estuary study area.

2.2.2 Fuel Processing Facilities

Energy processing facilities convert carbonaceous raw materials (petroleum, coal or biomass) to fuel commodities and non-fuel derivatives. All types of processing entail the transport of raw materials and processed products. Processing facilities with locational needs for marine terminals and dependent upon waterborne transportation of raw materials and products are included in this category of potential energy related development.

- Petroleum Refining

Petroleum refining (i.e., separation of petroleum into various petroleum products) generally requires a marine terminal, pipeline and rail service. Raw materials must be received in bulk quantities. Processed products are shipped from the site via land or water in order to establish efficient, integrated distribution operations.The Northwest presents a compact and well defined petroleum marketing area. Refining activities have in the past, primarily served regional needs. Consumption of petroleum products is not expected to increase significantly within the next five years, although regional population growth may cause moderate increases in demand (conservation adjusted growth).[12] As an established regional market, approximately 70 percent of Northwest petroleum product supplies are satisfied by four major refineries located in Anacortes and Cherry Point, northern Puget Sound. Crude materials are received at existing refineries as marine shipments (Alaska and foreign sources), with nearly all refined products consumed in western Oregon and Washington.[12] Significant amounts of refined products also reach the Northwest via pipeline from Utah and Montana. Puget Sound production and the Willamette Valley are linked by the Olympic refined product pipeline. There are no significant facilities for petroleum refining in the Columbia River Estuary area. A small asphalt refinery located in Portland is the only refinery in the State of Oregon. At present, existing Puget Sound refineries operate at approximately 80 percent of capacity and are well situated for expansion of facilities.[12] It is expected that any supply deficits in crude materials and refined products may be overcome by moderate increases in marine imports, pipeline shipments, and refinery production. Factors that could stimulate new refinery development in the Columbia River Estuary area are: (1) the potential for transshipment of petroleum produced elsewhere on the West Coast and received on the Columbia River for shipment to regions outside the Northwest, and (2) potential oil production from state and federally controlled marine areas, i.e., development of outer continental shelf lands.

- Petrochemical Processing

Petrochemical processing includes production of non-fuel organic commodities (e.g., industrial chemicals and organic agricultural chemicals) and inorganic commodities (e.g., agricultural fertilizers) from petroleum derivatives and natural gas feed stocks. At present, production of industrial petrochemical products in the Northwest is limited. Existing facilities on the Columbia River include two chemical plants in Kalama, Washington (River Mile 75) producing organic commodities used in the forest products industry.[12] Production of agricultural chemicals occurs on a small scale in Western Oregon and Washington. A fertilizer plant near St. Helens, Oregon (River Mile 85) represents the largest facility using petrochemical feed stocks for production of bulk chemical commodities along the lower Columbia River.

While significant demand is present in the Northwest for forest industry and agricultural chemicals, local production and shipment of commodities from remote domestic and foreign sources is adequate to meet supply needs. Moreover, production facilities at Kalama and St. Helens are well suited for expansion. Major growth in the production of petrochemical products is not anticipated since: (1) it would be neccessary to significantly increase natural gas supplies and shipments to the area, (2) petroleum refining does not occur in the area as a source of by-product feed stocks, and (3) competition from existing petrochemical suppliers located near natural gas supplies and refinery complexes is sufficiently vigorous to meet near-term (within the next 25 years) increases in demand.[12] Petrochemical production facilities require access to a wide variety of raw materials found only in proximity to petroleum sources. There is no advantage to importing liquified natural or petroleum gas for the sole purpose of producing industrial or agricultural chemicals. Thus, no petrochemical production facilities are expected in the Estuary, because there is not a distinct locational advantage to siting such industry in the area.

- Coal Gasification

Synthetic petroleum gas may be produced from coal by means of chemical addition of hydrogen under heat. A significant amount of heat is lost during the gasification process, requiring large quantities of cooling water to absorb waste heat. Differentiation of coal into synthetic gas allows shipment of a more concentrated source of energy while obviating the movement of great quantities of solid coal -- in effect exchanging energy lost as waste heat during gasification for energy expended in bulk transport of coal over significant distances. It is likely that industrial scale synthesis of gas from coal will occur near the sites of coal extraction in Montana, Wyoming, and North Dakota. However, if large quantities of coal are transported to locations along the Columbia River for use in coal-fired thermalelectric plants or for transshipment to foreign ports, undetermined quantities of coal might be utilized in small scale coal gasification facilities. Synthetic gas produced at such facilities would be used in specialized circumstances, probably near existing energy related development. For example, the Portland General

Electric Company operates the Beaver gas/oil fired 660 MW power plant at Port Westward, Oregon, and has proposed production of medium BTU synthetic gas from coal as a source of fuel for this combined cycle, turbine plant.[12] Gasification of coal is considered an inefficient use of fuel energy in certain applications, due to heat liberated during gasification -- heat of insufficient quality to be used as a source of electrical generating capacity. However, in instances of costly existing turbine generators (requiring gas or petroleum fuels and incapable of using coal), and where coal-fired plants would represent a significant marginal increase in air contaminants, use of relatively clean burning synthetic coal gas may be a feasible alternative. Generally, in light of present gasification techniques, power generation utilities considered plants fueled directly by coal in close proximity to extraction sources to be the most cost effective (e.g., the 530 MW plant at Boardman, Oregon). Thus, coal gasification facilities of modest scale may occur in Oregon and Washington in the near future, but no locational advantage to siting a synthetic coal gas facility in the lower estuary is perceived. No proposals for coal gasification plants have been made for the lower estuary.[12]

- Alcohol Fuels

Alcohol fuels are produced by conversion of biomass to ethanol (produced from agricultural crops and crop wastes) or methanol. Forest industry wastes are the logical candidate material source in the Northwest for methanol production. Both methanol and ethanol are of particular interest as a supplement or partial replacement for petroleum fuels, especially in farm use. Alcohol fuels would be produced from renewable resources and might encourage full utilization of existing biomass commodities. The potential for large scale methanol production in the Northwest is generally unexplored. However, since methanol contains more BTU's per unit weight than export grade coal, and since use of methanol fuels create less air and water pollution problems than combustion of coal or petroleum derived fuels, it is considered a likely high volume, long distance export commodity. In light of abundant wood waste resources in the northwest, it has been suggested that future export of methanol may become competitive in foreign energy markets.[12] At present, large scale methanol production facilities have not been proposed for siting in the Columbia River area. Bulk shipment of methanol probably would not be constrained by the present limits to navigation in the Columbia River system.

2.2.3 Gas and Oil Exploration

The lower Columbia River, adjacent estuarine shorelands in Oregon and Washington, and related marine areas are not considered significant locations for gas and oil production, nor does it appear that significant potential for oil and gas production exists in this region of the Northwest, at least during the next 25 years. Discussion of the extraction of gas and oil in this section includes onshore (areas east of the Columbia River mouth) and offshore (state and federally controlled marine waters) exploration and production activities. Onshore regions in the study area have received little or no attention regarding extraction of oil resources, while exploration and modest commercial production of gas is underway on the Oregon side of the lower Columbia. Gas production near Mist, Columbia County, Oregon, 10-15 miles south of the Columbia River at River Mile 50, is of sufficient volume to warrant construction of a pipeline connecting with existing distribution lines near

Clatskanie.[12] North and west of the Mist area commercial gas companies have leased privately owned and publicly held lands for the purpose of exploration and extraction. In 1980, Oregon State leased approximately 10 square miles along the south shore of the Columbia River, including certain aquatic areas, extending from Westport Slough (River Mile 43) to Wallace Island (River Mile 48) for gas exploration and extraction.[12] Thus, additional potential for gas production is suspected and, following two to three years of exploration, gas wells could be in production within five years.[12] If production ensues, leasing activity may be expanded, reaching further north and west into submerged and submersible lands in the Columbia River occupied by the Columbia White-Tailed Deer and Lewis and Clark National Wildlife Refuges. Commercial interest in gas resources is also evident on the Washington side of the river. Washington State has leased 46 parcels on or near the Columbia River in Wahkiakum and Cowlitz counties for the purpose of gas exploration and subsequent extraction activity. Lease activities have focused on the Puget Island (River Mile 38-46) area, though this is not indicative of special knowledge of major reserves in the area.[12] Generally, exploration for gas resources may be expected to take place in the Columbia River Estuary area within the next five years. However, little information is available to suggest if commercial extraction will take place along the margins of the Estuary or in submerged or submersible areas of the study area. Present gas production may be from relatively confined pockets or narrow geological folds rather than from major reservoirs. Further, it is not possible to state that gas production, if feasible in the area, would lead to activities in estuarine shorelands and aquatic areas. Directional drilling could be used to tap gas resources beneath the estuary, holding operational impacts in estuarine areas to a minimum. The magnitude of gas resources may not be sufficient to require extensive pipe, pump station, treatment, storage, or transshipment terminal facilities. State and federally controlled marine waters of the Pacific Northwest have not been the object of intensive oil and gas exploration. The status of marine areas near the Columbia River as a source of oil and gas is perceived as low, since the region has not been a candidate for federal leasing since 1977, and is not included in Department of Interior lease planning in the present five year lease schedule (commencing 1982).[12] The low priority of these marine areas results from three principal factors: (1) insignificant resource estimates based on preliminary explorations,[14] (2) frequency of severe weather and extreme wave conditions, and (3) presence of valuable commercial fishery resources and general vulnerability of these and other marine resources. While the latter two factors are not significant impediments in and of themselves, considered in relation to other west coast gas and oil resource potential in California and Alaska, the Pacific Northwest is at present categorized as a low priority region.

It is likely that marine areas in the Northwest will be reevaluated for the presence of gas and oil resources at some future time due to depletion of proved petroleum resources elsewhere, with renewed exploration occurring within 5-10 years. Since extraction of identified resources follows exploration by three to five years, no probability of commercial production of oil and gas in federal marine waters near the Columbia River is foreseen during the next 10-15 years, at a minimum. Although petroleum leasing policy in state marine areas controlled by Washington and Oregon is independent of federal policy, it may be assumed that the absence of commercial interest in federal marine areas implies that exploration and extraction of petroleum resources will not take place in state marine waters during the next 5 years. In general, if extraction of petroleum resources takes place, facilities supporting near shore and outer continental shelf activities would be placed in the Estuary, on waterways with sufficient water access. The magnitude of necessary support facilities is as speculative as the likelihood of petroleum production in the region. However, bases for material staging and transport and for transfer of work crews would be needed during exploration or small scale commercial testing, while extensive regional scale petroleum development may require large industrial port sites for fabrication of marine structures and handling of large volumes of extraction equipment. The Columbia River Estuary is a prime location for this type of activity. Evidence of this is provided by the fact that there was a large OCS drilling rig construction facility proposed at the Skipanon River in the late 1970's to supply structures for California and Alaska OCS drilling activities. The project was never carried out because of lack of demand.

2.2.4 Transportation and Transportation Systems

This category of energyrelated development is not directly linked with local or regional electric generation, processing of energy related materials or petroleum extraction activities. Rather, commercial shipments of energy resources are either received and distributed inland or shipped from inland locations and stockpiled at marine terminals for subsequent overseas export.

- Petroleum Transshipment

A major petroleum transshipment facility would not likely be sited in the lower Columbia River because of bar and river constraints to movement of deep draft ships. Efficient and cost effective bulk shipment of crude oil requires vessels of draft deeper than that feasible for the Columbia River bar and navigation channel. Moreover, 70 to 90 foot draft navigational access is available, or relatively easily attainable, at existing Puget Sound refineries. In addition, offshore sites for oil transfer (mooring buoys and offshore terminals) are not feasible due to the wave regime of the Northwest coast.[12] In the event of new nearshore or outer continental shelf oil production in the vicinity of the Columbia River mouth, oil would most likely be brought ashore via pipeline and transhipped to existing refineries or loaded directly from offshore sites. In the instance of offshore production sources new refinery capacity would not be established in the study area due to the limited market potential of the Northwest. Crude petroleum would be shipped elsewhere on the West Coast.

- LNG and LPG Transshipment

Shipment of liquified natural gas (LNG) and liquified petroleum gas (LPG) requires marine terminal facilities and processing plants for gas liquification or conversion of low temperature or pressurized liquid to gas. Marine terminals may be sited in the Estuary since bulk marine transport of these petroleum based commodities commonly takes place in vessels which are not impeded by the draft limitations of the Columbia River.

Consumption of natural gas and petroleum gas in the Northwest, as a preferred fuel in domestic, utility, and industrial applications, is expected to increase moderately during the next 25 years.[12] Present gas demand is met by supplies piped from Canada and the Southwest. Reduction of gas supplies brought about by the expected termination of Canadian gas shipments could be compensated for by increased supplies from new continental U.S. sources or by Alaskan gas. Additional delivery capacity is present in the existing pipeline systems extending to the East and Southwest, while Alaskan gas may be received via marine shipments or newly constructed pipelines. Marine shipment of LNG to the Northwest through the Columbia River Estuary area within the next 15 to 25 years -- although unconstrained by present channel and bar dimensions -- is unlikely for two reasons. Existing refineries on northern Puget Sound have pipeline systems to the Willamette Valley and an LNG facility capable of augmenting Oregon's present gas supply by approximately 14 percent is in place at Newport, Oregon.[12] The latter is likely the only such facility that will be developed in Oregon in the near future. No LNG terminals are anticipated along the Washington shore of the Columbia River. Expected future consumption of LPG, as with LNG, may experience moderate increases due to inelastic market factors. Shipment of LPG does not require cryogenic equipment. Due to the longer history of LPG use, distribution throughout the northwest is complex. LPG is shipped, stockpiled and marketed by a number of small companies. Bulk shipment is commonly in smaller quantities than other petroleum products, and distribution is accomplished by pressurized tank cars, trucks and small supply vessels rather than by extensive pipeline systems. Present sources of supply are Canada, California and South America. In the event of moderate consumption increases, large LPG marine terminals in the Columbia River Estuary are not expected because existing distribution facilities based in Puget Sound and the Portland-Vancouver area could be expanded. No proposals for establishing LPG marine terminals in the lower estuary area are expected during the next 25 years.[12]

- Coal Transshipment

As discussed above, the probability of siting marine terminal and other transportation infrastructure in the Columbia River Estuary for importing of petroleum, LNG/LPG or other non-solid fossil fuel materials is very low. In contrast, the probability of export of fuel commodities from locations on the Estuary is high. The conclusion that transportation facilities for the export of energy resource commodities, specifically coal, will be sited on the Columbia River within the next five to ten years is supported by several identifiable factors. First, the Columbia River Estuary is the threshold of a low-level transportation route through the Coast and Cascade mountain ranges, extending through a high interior plateau to the Rocky Mountains. Waterborne and rail transportation facilities may utilize this corridor for shipment of bulk quantities of coal mined in the central and northern Rocky Mountains. Shipment from the interior (Montana, Wyoming, and Utah) may take place over existing transportation infrastructure to Columbia River marine terminals with comparatively short voyage distances to Eastern Pacific destinations. Second, the western U.S. has extensive proven reserves of bituminous and sub-bituminous coal, quantities which surpass present and expected domestic demand and are available for export.[15] Further, the rapidly expanding economies of the Pacific Rim represent a long term market for U.S. coal since the nations of this region have indicated (1) the intention to expand present sources of energy supply, with the objective of decreasing dependence on petroleum based fuel sources, (2) the need to stabilize existing sources of imported coal, emphasizing diversification of coal supplies less subject to interruption due to labor disputes or political difficulties, and (3) the need to offset present bilateral trade imbalances with the U.S. through importation of bulk quantities of coal.[9,16]

The factors noted above are central to U.S. participation in the Pacific Rim coal export market since U.S. mined coal is not competitive on the basis of price. Indications are that Pacific Rim nations are willing to obtain 15-25 percent of their coal demands from the U.S. in the interests of security of supply, supply diversification, and correcting trade imbalances while foregoing marginally cheaper, higher BTU sources of coal mined in Australia, Canada and South Africa.[9, 16, 17] It has been estimated that the U.S. share of the Pacific Rim coal export market may be 5-11 million short tons in 1985, expanding to 25.5 million short tons in 1990, and 40-65 in 2000, with a mean estimate of 50 million tons.[9, 17] More recent projections assume slower growth rates, reflecting the present"oil glut."[18] With the growing demand for U.S. coal and the aggressive marketing efforts of Northwest port authorities, some portion of the Pacific Rim coal export market will be captured by ports on the Columbia River within the next 20 years. The amount of coal that will be exported from these ports is speculative, yet it is certain that lower cost, higher BTU central Rocky Mountain coal will represent a significant portion of the Pacific Rim export market initially. Northern Rocky Mountain coal may be exported in increasing quantities in later years. Thus, if coal transshipment terminals are sited on the Columbia River in advance of proposed terminals elsewhere along the west coast, export coal from the central and northern Rocky Mountains would be shipped via the lower Columbia River. Export volumes of Rocky Mountain coal from the Northwest during the next 20 years could range from 15-20[8] to 50[9] million short tons, most likely 30 million tons per year[10]. If both central and northern Rocky Mountain coal were routed to the Columbia River, two to four export sites, assuming two berth terminals with 8-10 million tons per year capacity would be needed.[17] Fewer Columbia River sites would be required if a portion of the export volume were transshipped via Puget Sound ports. At present, feasibility studies for export coal terminals have been undertaken at seventeen sites on the West Coast. Of particular interest are three deep water sites on Puget Sound (Cherry Point, Tulalip, and Steilacoom) and four sites on the Columbia River (Port of Astoria - Tongue Point, Port of Kalama, Port of Vancouver, and Port of Portland). Competition among Puget Sound ports and proposed export terminals on the Columbia River, with the likelihood of substantial inducements offered to coal suppliers and buyers, will determine the distribution of coal export facilities.

- Demand

Demand for steam coal by Pacific Rim countries is the driving force behind West Coast coal port activities. Projections of expected exports vary considerably, with initial projections for 1985 differing by 5.5 million tons/year (from 5.3 - 10.9 mt/y) and growth rates varying from 1.5 mty to 3.2 mty.[17] High initial export projections and rapid growth estimates should be approached with caution, as the present oil economy has depressed steam coal exports.[18] Using the mean growth rate from six coal export studies of 2.5 million tons/year*, and the mean initial export projection in 1985 of approximately 8 million tons/year, this yields a West Coast export demand of 20 million tons/year by 1990, and 45 million tons/year by 2000.

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*Burlington Northern, WPPA, WOCOL, ICE, Westpo, CPSEDD.[17]

One of the most recent export studies, published in February of 1982, predicts that Pacific Northwest coal ports can expect to move approximately 50% of the tonnage by 1990, and 70% by 2000.[17] This would mean Pacific Northwest ports would share 10 million tons/year in 1990, and 32 million tons/year by 2000. Assuming the trend to deeper draft shipping continues and coal export activity is restricted mainly to deep water ports, it is likely that the lower Columbia River area would contain one of the major Pacific Northwest ports exporting coal to the Pacific Rim countries, moving approximately 10 million tons per year by 2000.

- Benefit-Cost Analysis

Benefit-cost analysis of coal transportation facilities and associated federal navigation projects in the Columbia River Estuary is a very complex, in precise process. While it is relatively easy to identify primary beneficiaries and capital costs of such a project, secondary and tertiary beneficiaries and opportunity costs of land and capital are much harder to assess. To further complicate benefit-cost analysis, two different viewpoints must be addressed: the federal viewpoint and the regional viewpoint. The following discussion of benefit and cost issues is drawn largely from American Geophysical Union Water Resources Monograph 2, Benefit-Cost Analysis for Water System Planning, 1972.[19]

From the federal standpoint, distribution of benefits and costs are irrelevant. The important factor is that total benefits from the development exceed total costs. This makes the proposed coal export facilities difficult to analyze, as a major portion of the benefits will accrue to a consortium that contains a foreign partner. This raises the question of federal/regional expenditures to benefit a foreign investor.

From the standpoint of the region containing the project, distributional aspects are much more important. Increases in salaries, benefits, and jobs to local residents are distributional factors that are closely watched, as are project costs born by the city, port, and county. The different points of view in regard to benefit-cost analysis are contained in Table 2.

TABLE 2

Federal and Regional Benefit-Cost Considerations

Federal

Benefits

1) Amount of savings from diverting traffic from higher cost modes of transportation. (40,000 - 150,000 dwt shipping) Benefits accrue to carrier.

2) New traffic generated by new waterway. Benefits accrue to Port.

3) Development of new business, increase in net incomes. (Excludes incomes of business that shift to new location to take advantage of new situation.) Benefits accrue to region, nation.

Costs

1) Cost of construction of navigation features, including mouth, channel, docks, aids to navigation, and other harbor facilities.

2) Operation, maintenance and replacement costs.

3) Opportunity cost of land and capital committed to the project.

Region

Benefits

1) Savings to local shippers.

2) Increased profits of local barge, tug, and shipping companies.

3) Increased net incomes of other local companies.

4) Increase in salaries, benefits, and jobs in local economy.

5) Increase in local tax revenues.

6) Development of new transportation infrastructure to support project and related enhancement of other rail and shipping commerce.

Costs

1) Portion of construction, O&M and replacement costs borne by the region.

2) Local contributions to harbor and port improvement.

3) Opportunity cost of capital and land.

4) Social cost of industrialization, increased pressure on social services.

5) Negative impact on present waterfront businesses.

From the above viewpoints, it can be seen that a marginal project from a federal standpoint may be supported on a local level due to distributional effects. This depends mainly on the distribution of costs of the channel dredging in the case of proposed coal export facilities. If these costs are borne by the federal government, the net distribution of benefits is to the region. If dredging costs are borne by the region in the form of user fees, the region may experience no net benefits due to foregone business caused by higher throughput costs. The present Administration has emphasized the concept of user fees, and has introduced legislation to implement that concept.[20] Recognizing this, benefit-cost and other economic analysis of coal facility siting in the Columbia River Estuary should assess the impact of user fees on project viability.

- <u>Competitive Position of the Lower Columbia River on the West Coast</u>

Previously published reports (8, 9, 15, 16, 17) all concur that Southwestern coal ports will capture a certain portion of coal exports regardless of port activity in the Northwest. This is due to the proximity to Utah coal, which is expected to constitute the major portion of coal exported from southern West Coast ports. Therefore, competition is expected to be mainly from Puget Sound (Washington) ports. For the purpose of this siting analysis, Tongue Point is compared with Cherry Point and Steilacoom in terms of delivered cost of coal to Yokohama, Japan. While these costs are estimates only, and are subject to constant change, they will serve to illustrate transportation cost attributes of the various sites.

The main component in this comparison is the total estimated cost of delivering coal to a given destination. Lack of deep water (~ 50') that will accommodate 100,000 DWT shipping is a major constraint to potential lower Columbia River coal export facilities with regards to transportation costs.

Assuming that the Corps of Engineers MCR Project is completed and 55,000 DWT shipping is feasible to Tongue Point, total transportation cost of Montana coal to Yokohama through Tongue Point is estimated to be $36.01 per ton.[10*] This does not compare well with 100,000 DWT shipping of Montana coal from Cherry Point or Utah coal from Steilacoom to the same destination, at $33.05 per ton and $33.35 per ton respectively.[9] An average cost differential of $2.50 per ton means a coal shipper may save 12.5 million dollars per year by shipping out of Puget Sound ports, assumming 5 million tons per year shipping capacity. Lower Columbia River coal export potential may be increased by dredging of the bar and navigation channel to depths sufficient to accommodate shipping of 100,000 DWT class vessels or larger. The Corps of Engineers is studying the feasibility of deepening the bar to 60-70' and the channel to 50-60'.[6] This would allow 150,000 dwt shipping to call on lower Columbia River ports, [17] and increase their competitiveness relative to other Northwest ports. Shipping Montana coal to Yokohama from Tongue Point in 150,000 DWT ships is estimated to cost $32.36 per ton.[10] This compares favorably with 150,000 DWT shipping of Montana coal to Yokohama from Cherry Point at $31.55 per ton and with Utah coal to Yokohama from Steilacoom at $31.80 per ton.[9**]

Average annual operation and maintenance dredging cost estimates of almost 30 million dollars (see Table 4) indicate user fees would add approximately $3.00 per ton to transportation costs to Yokohama for a 10 mt/y facility. It is considered likely that some form of user fee will be

*Power function interpolation of previously published estimates.[9]
**These calculations do not include possible user fees associated with dredging of the Columbia River mouth and navigation channel to Tongue Point.

instigated for such navigation projects in the future.[21, 22] Once cargo is attracted to particular export terminals, and trade patterns and efficient service established, it is expected that these terminals will be able to maintain a share of the coal export market in spite of any marginal cost disadvantages. Additional rail transportation costs and the need to amortize potential costs of upgrading rail lines and extensive dredging of the Columbia River entrance and navigation channel may make the total estimated transportation cost of coal shipped from ports on the Columbia River Estuary marginally more costly than coal shipped from alternative west coast ports. However, early entry into the market would assure Columbia River Estuary ports a continued portion of export demand. Therefore, it highly probably that one or two major coal export facilities will be sited in the study area within 10 to 20 years.

3. COLUMBIA RIVER ESTUARY ECONOMICS: Analysis of Potential Columbia River Estuary Energy Related Development Sites.

3.1 INTRODUCTION

The most comprehensive study to date of potential energy related development, impacts, and use conflicts in the Columbia River Estuary, Energy Related Use Conflicts For the Columbia River Estuary,[12] prepared for the U.S. Fish and Wildlife Service (USFWS) identified eight sites for OCS support and three sites for coal export facilities or OCS support below River Mile 25. Oregon local comprehensive plans and the Washington shoreline management plan limit areas available for development within the Estuary. The Pacific County Shoreline Management Plan precludes development of major facilities requiring deep water access in Baker Bay.[23] Potential OCS support sites in Baker Bay identified in the USFWS report are therefore highly unlikely to be developed. Thus, large scale energy related development is essentially limited to the Oregon side of the estuary. The Port of Ilwaco and Port of Chinook are discussed as potential sites only because they were identified in the above mentioned report as potential OCS support sites and are zoned water dependent development.[23]

3.2.1 Criteria for a High Potential Site

Criteria for high potential sites are the following:

a. Appropriate zoning for water-dependent development.

b. Access to the main navigation channel.

c. Adequate area (80+ acres) of upland to support the aquatic site.

d. Availability of rail and highway access.

Probabilities for particular categories of development that are most likely at a given site over a 20 year time frame are based largely on the above cited energy-related use conflicts report and information contained in Section 2.2, Categories of Potential Energy Related Development. Economics of site specific transportation infrastructure upgrading are discussed in Section 3.5, Dredging Estimates and DMD Costs, and Section 3.6, Site Specific Rail Upgrade costs.

3.2.2 List of Sites

The potential sites are as follows:

High potential:
- Tansy Point
- East Bank, Skipanon River
- West Bank, Skipanon River
- Port of Astoria Docks
- North Tongue Point
- South Tongue Point

Low potential:
- Port of Ilwaco
- Port of Chinook

3.3 HIGH POTENTIAL SITE DESCRIPTIONS

3.3.1 Tansy Point

The CREST Mediation Agreement identified the Tansy point area for large (80-100 acre) water-dependent development, with the exception of bulk coal or ore facilities, citing "potential conflicts with adjacent and nearby uses"[24] that include residential homes and seafood processing facilities. This does not preclude use for other energy related projects. Tansy Point is an attractive development site for the following reasons:

a. Naturally scoured deep draft vessel access adjacent to the shoreline.

b. Proximity to the river mouth (RM-10).

c. Little or no maintenance dredging of the berthing area would be required due to the high degree of river scour.

d. Potential for 3,600 feet of deep water berthing frontage exists.

e. Fewer biological impacts associated with major development than at most other development sites.

f. Total of 80-100 acres available for development.

A possible disadvantage to Tansy point is the existing use of the area, and deed restrictions on certain parcels. For an 80-100 acre contiguous site to exist, property ownerships would have to be consolidated, 21 homes and businesses would have to be relocated, and improvement of the highway and rail line would be necessary. The cost of remedial measures for these problems is estimated to be similar to project costs at other sites (50-90 million dollars). Since bulk coal/ore shipments are not allowed under the mediated agreements, and it is unlikely that any LNG or LPG facility would be sited in the Estuary (see Section 2.2.4) the most likely energy-related facility at this site would be OCS support services (see Section 2.2.3). This type of activity would not necessarily require consolidation of the whole parcel to operate. Due to the uncertainty of OCS activity on the West Coast and the property consolidation problem, energy related development at Tansy Point over the next 20 years is seen as low.

3.3.2 East Bank, Skipanon River

The East Bank of the Skipanon river is one of the best large acreage water-dependent development sites with deep draft access in the Columbia River Estuary. Reasons for this include proximity to the river mouth, (RM-11.5) and access to the main ¯40 foot navigation channel 2,100 feet to the north.[4] With minimal or no alteration to adjacent estuarine wetlands, up to 200 acres of upland and 1500 feet of Skipanon River frontage would be available for construction of bulk commodity storage and ship berthing.

Dredging requirements are small relative to sites further upriver. (see section 3.5). The Skipanon River channel is authorized at ¯30 feet deep and 200 feet wide.[4] To fully develop the deep water characteristics of the site, a ¯40 foot channel would need to be dredged to the main river channel. Alternately, conveyor galleries could provide access to the channel, thus avoiding the need to dredge the Skipanon Waterway. The combined cost of this work is estimated to be much less than at other site options further upriver. See Section 3.5 for a discussion of dredging costs. Highway and rail access are available to the site. Upgrading of the rail line and trestle across Youngs Bay would be necessary for the bulk coal/or
Based on the uncertainty of energy-related development, present potential, and the long lead time required for new Corps of Engineers dredging activities, probability of an energy related facility on the East Bank of

the Skipanon River is estimated at near zero until the late 1980's, when increased demand and more certainty in the energy markets will raise this probability to medium through the 1990's.

3.3.3 West Bank Skipanon River

This site consists of two non-continguous parcels of land of approximately 32 acres and 52 acres in area separated by the City of Warrenton sewage lagoons.[24] Though the present upland configuration does not make coal or bulk ore handling feasible due to unit train loop track requirements, it may be possible to arrange a loop track right of way with the adjacent 97 acre lumber mill and log storage facility. Direct access to the Skipanon Waterway or main Columbia River ship channel is limited. Conveyor galleries across the log storage sites and through a "Conservation Aquatic" corridor to the north to a loading pier near the navigation channel would allow deep draft berthing access without significant dredging. This method could also be used to connect the two parcels of land by passing over the sewage lagoons. Rail and highway access is good.

Upgrade of the rail and trestle would be necessary for the coal facility option.

Due to the two-parcel configuration and limited access to deep water berthing, only facilities designed for shipments of bulk energy commodities (LNG, oil, coal) would be able to efficiently utilize this site, using pipeline or conveyor to reach deep draft ships in the main channel.

Because LNG or oil energy facility development in the Columbia River Estuary is expected to be virtually non-existent over the next 20 years (see Section 2.2) and the proximity of less restrictive coal facility sites, energy related development on West Bank Skipanon River is estimated to be very low over the next 20 years.

3.3.4 Port of Astoria Docks

The Port of Astoria Docks is also a feasible location for energy related development. The Port has expressed special interest in a bulk coal handling facility.[25] The Port has direct access to the -40 foot main navigation channel, and is located at RM-13. Through the mediated agreements, 2,340 ft. of continuous berthing area could be made available with direct access to approximately 85 acres of upland, 52 acres of which is already levelled and surfaced. This would require filling between Pier 2 and Pier 3, destruction of an existing warehouse, and construction of a thirteen acre 1,280 ft. pier to the west of the existing facility. This total area would be sufficiently large to accommodate a 100-car coal loop track, bulk storage area, and loading/unloading machinery. There is good highway and rail access to the site. Additionally, development of a coal handling facility at the Port of Astoria docks would eliminate the need for upgrading of the Youngs Bay trestle, and double unit train crossing of Highway 101. The rail upgrade costs from Portland to Astoria would be much less than at downriver sites. However, this advantage may be offset by the greater dredging costs of being further upriver (see Section 3.5). Another possible constraint to coal port development at the Port docks is local resistance to wind blown coal dust. Though this is a problem at any site, fugitive coal dust in the city proper may be more of a problem than at more rural sites. Even with state of the art washing and coating equipment, significant amounts of coal dust do escape during handling,[26] and the strong prevailing west winds common to this area could cause considerable problems. Development of an energy related facility at the

Port of Astoria Docks is seen to be low until 1990, medium to the year 2000.

3.3.5 North Tongue Point

Tongue Point has been extensively studied for potential use as a coal handling facility, and as a result a great deal of site planning has already been completed.[9,27]

The mediation agreement allows for filling between the existing south edge of the "North Tongue Point" site to midway between pier five and six. This would create roughly 80 acres of new upland, for a total upland area of approximately 120 acres. Also contained in the agreement is a provision for access channel and turning basin dredging, rail routing on site, and pile supported rail access structures.[24]

The main advantage to the North Tongue Point site for energy development is the proximity to rail service necessary for efficient operation. Estimates for the rail upgrade between Portland and Tongue Point are about half of the rail upgrade costs to the Skipanon and Tansy Point sites.[10]

In addition, the North Tongue Point option would eliminate the need for coal train traffic through downtown Astoria.

The Tongue Point sites are somewhat more protected from the strong western winds that blow most of the year in the Columbia River estuary, and this may serve to lessen the impact on air quality caused by fugitive coal dust.

A major drawback to the North and South Tongue Point sites is the high cost of new work and maintenance dredging of the Columbia River navigation channel to accommodate large coal colliers. This may offset all of the above advantages, and force development further down river (see Section 3.7) Development of an energy related facility at North Tongue Point is estimated to be low through 1990, and medium to 2000.

3.3.6 South Tongue Point

The South Tongue Point site consists of 100 acres of upland with immediate rail and highway access. Development of South Tongue Point for an energy-related facility is directly related to the North Tongue Point development site. Under the mediated agreement, a pile-supported access corridor between the two sites is provided for, and a navigation channel of up to 25 feet deep and 500 feet wide is allowed to the eastern side of the site.[24]

Development of South Tongue Point would add approximately 2,500 feet of shallow draft pile supported berthing and 100 acres of upland to potential Tongue Point development.

Development of North Tongue Point is a prerequisite to development of South Tongue Point for water-dependent use. Therefore, energy related development at South Tongue Point is the same for North Tongue Point, low through 1990, and medium through 2000.

3.4 LOW POTENTIAL SITE DESCRIPTIONS

3.4.1 Port of Ilwaco

The Port of Ilwaco's main constraint to energy facility development in this area is space, with only approximately 26 acres available on a DMD site surrounding the boat basin. The area designated as "development" is bordered by extensive marsh and mudflats to the east, and by Fort Canby State Park and more marsh to the west. The brackish marsh areas have been designated "natural" in the Columbia River Estuary element of the Pacific County Shoreline Master Program,[23] and are therefore not available for development. Channel access is limited, with severe shoaling problems.[5] The boat basin is located approximately 3.5 miles from the main Columbia

River navigation channel, and is maintained at -10 feet.[4] The access channel is federally authorized at -10 feet deep by 150 feet wide. Dredging and maintaining the long access channel 30 - 40 feet deeper than present conditions would be very costly. Thus, aside from a potential support role consisting mainly of transportation for OCS activities, energy related development at the Port of Ilwaco is perceived to be near zero for the next 20 years.

3.4.2 Port of Chinook

The Port of Chinook has the same development problems as cited above for the Port of Ilwaco. Shoaling threatens to shut off the access channel entirely,[5] and 2.8 miles of very extensive new work and maintenance dredging would be required to modify the present -10 foot channel to -40 feet, with the same difficulties mentioned above for the Port of Ilwaco. Although development land exists away from the water, no extensive piers or water related facilities exist of the size necessary for energy-related development. No rail line serves Pacific or Wahkiakum Counties along the Columbia River, and this eliminates the possibility of bulk energy commodities being shipped in or out of the Port of Chinook or the Port of Ilwaco. Given the above constraints, energy related development at the Port of Chinook is estimated to be near zero for the next 20 years.

3.5 DREDGING ESTIMATES AND DMD COSTS

The amount of material dredged to each potential development site depends on the shoal that must be removed. This discussion begins with estimating this amount of material, and calculating the cost of disposal of that material at the closest available DMD site. The estimates for individual shoals are based on the percentage of the total channel dredging to Tongue Point that is performed on a particular shoal over a five year period of pre-MCR Project dredging. The percentages are then multiplied by total estimated dredging quantities to estimate new quantities for particular shoals. For the purpose of this analysis, the following assumptions are made: 1) the MCR Project has been completed, with the bar dredged to -55' and the channel maintained at -40'. 2) The percentages of total dredging required per shoal will remain the same at the new depths. Due to higher energy costs in the future, both on site dredging costs and spoil transportation costs will be greater than at present. Assuming that all dredging can be accomplished using the Corps of Engineers new 6,000 cy hopper dredge Whaler and the older 3,600 cy hopper dredge Biddle, it is estimated on site dredging costs will be approximately $1.07/cy.* Columbia River clean sand and water weigh approximately 1.5 ton per cubic yard.[28] Assuming a transportation cost of 4¢/ton mile, this yields an average dredge and disposal cost of about $1.50. This is considered a conservative estimate, as some estimates have ranged as high as $2 to $4 /cy.

Mouth and channel configuration will be as follows:

Mouth:	660' @ 55' depth (inbound lane)
	660' @ 65' depth (outbound lane)**
Channel:	300' @ 40' depth (inbound lane)
	400' @ 55' depth (outbound lane)**

*Includes $.07 amortized cost of new dredge at 7-5/8% interest over 50 years assuming 50 mcy/y capacity.

All estimates of new work dredging quantities are based on existing Corps of Engineers data,[29] previously published estimates,[9] and conversations with the Corps of Engineers. Estimates for mouth and channel operations and maintenance dredging requirements are based on extrapolations of unpublished Corps of Engineers data contained in the Feasibility Study for Coal Export Facility at Tongue Point.[9] Table 3 contains the individual shoal new work dredging quantities expressed as a per cent of the total volume, and the estimated cost of dredging each shoal. Cost calculations are contained in Appendix A.

Potential disposal sites used for cost of disposal calculations include those sites presently in use or identified for future use by the Corps of Engineers, and those contained in the Columbia River Estuary Regional Management Plan.[5] Transportation costs of the material are calculated by using the nearest, and thus most cost efficient sites. Cost estimates assume that estuary in-water sites will be used to their estimated capacities, and no land sites are used due to restricted availability of upland sites. Due to the large quantities of materials also involved in O&M dredging on a yearly basis, it is assumed that the present disposal areas at the mouth, E, B, A, and F will be utilized, with an average haul distance of approximately 4 miles past RM-0.

New work dredging and DMD costs do not solely determine whether a potential project will be economically viable, as these costs may be amortized over several decades. The most important factor is whether the project can absorb the cost of maintenance dredging and still maintain a net profit.

**Depth sufficient to accommodate 150,000 DWT colliers in loaded condition.

TABLE 3

New Work Dredging Estimates

Shoal	River Mile[26]	% Total[26] Dredging	Estimated Volume (mcy)	Estimated Cost Total (mill)/per cy ($)
Mouth	-2 to +3	100	12 mcy	17.2 / 1.43
Desdemona	5.0 - 9.4	5	.7 mcy	1.3 / 1.79
Flavel	11 - 13.4	81	11.3 mcy	19.7 / 1.74
Upper Sands	16.3 - 16.8	14	2.0 mcy	2.3 / 1.15
TOTAL			26 mcy	40.5 /

Obtaining accurate estimates of maintenance dredging quantities is difficult without extensive numerical modeling. The Corps of Engineers Waterway Experiment Station is presently conducting physical and numerical modeling to estimate shoaling rates at various locations in the channel and on the mouth. These estimates will be available around October, 1983. Therefore, the following discussion of possible annual maintenance dredging quantities and costs for the mouth and the main navigation channel relies on the assumption that the percentage of material removed from different shoals for a 55' channel will be the same as for the current 40' channel.

Swan-Wooster (1981) assumed exponential shoaling rates with increase in depth for O&M dredging. This study extrapolated those numbers for a two foot greater channel depth, yielding an average shoaling rate at 55' of 5.75 feet per year, or 10,900,000 cy per year in maintenance dredging requirements.

Spoil disposal for maintenence dredging will not be able to follow the same pattern as new work disposal, because the sites available for in-water O&M dredged material disposal may fill up in a matter of a few years. This may restrict a larger proportion of the spoils to open ocean dumping, raising the cost/unit of material transported.

Using the same dredging and transportation costs and transportation distances as developed above, O&M dredging volumes and costs are contained in Table 4, and cost calculations are found in Appendix A.

Discussions with the Corp of Engineers and other sources indicate that these cost estimates are conservative, and may increase substantially over the next two decades.

Estimates have usually fallen near the $2-3.00 range, with some as high as $5.00/cy by 1990. It should also be noted that continued use of some of

TABLE 4

Operations and Maintenance Dredging Estimates (Per Year)

Shoal	RM[26]	% Total Dredging[26]	Estimated volume (mcy)	Estimated cost Total Millions	Per cy($)
Mouth	-2+3	100	7.5	10.7	1.40
Desdemona	5-9.4	5	.55	1.0	1.79
Flavel	11-13.4	81	8.8	15.5	1.76
Upper Sands	16.3-16.8	14	1.5	2.1	1.40
TOTAL		100	18.4	29.3	

the proposed new sites may not be possible, due to rapid movement of the placed materials back to the channel, or conversely, mounding at rates high enough to restrict continued placement of materials at the disposal site. Continued use of the Harrington Sump/Rice Island system at the magnitude described above may lead to an accelerated increase in estuarine shoaling, which conflicts with stated local, state and federal management objectives. If alternate environmentally sound in-estuary sites cannot be identified, O&M dredge spoils will be disposed of in the open ocean in ever increasing proportions, with a steadily increasing cost associated with that method.

3.6 SITE SPECIFIC RAIL UPGRADE COSTS

For the purpose of this analysis, the Burlington Northern rail line from Portland to Tansy Point has been divided into discreet segments as follows:

- Portland to Tongue Point
- Tongue Point to Port of Astoria Docks
- Youngs Bay Trestle and Track to Warrenton
- Warrenton to Tansy Point

The cost of rail upgrade at any one potential development site is the cumulative cost of all segments between the site and Portland. Information on rail upgrade costs for different segments around the Astoria/Warrenton area will be available from the Department of Transportation in mid-December. These estimates will be used to determine over-all rail costs to a given development site. For the purposes of this draft, published estimates of certain segments,[8,9] conversations with Burlington Northern,[30] and calculations based on estimated per mile upgrade costs of one million dollars per mile[31] are used to construct Table (5).

Table 5

Rail Segment Upgrade Cost Estimates [8,9,12,15,30,31]

Segment	Estimated Length (miles	Segment Cost (millions)	Total cost from Portland (millions)
Portland to Tongue Point	93	40	40
Tongue Point to Port of Astoria Docks	4.8	4.8	44.8
Port of Astoria Docks to Skipanon			
- rail	1.8	1.8	
- trestle	1.5	17	63.5
Skipanon to Tansy Point	1.8	1.8	65.3

There are several rail factors that are common to more than one site, and several are listed below.

1. Unit train movement west of Astoria would cross Highway 101 at two locations approximately 1.6 miles apart. This would create significant delays of 10-15 minutes at each crossing for highway traffic. Burlington Northern has imposed an embargo on rail traffic crossing Youngs Bay beginning October 1, 1982, with eventual plans to replace the entire trestle.[30] This replacement may involve attempting to move the trestle north of the highway to eliminate the multiple crossing of the highway. This replacement is estimated to cost between 15 and 20 million dollars.[10,32] Sites west of Youngs Bay must figure this amount into project costs, and hence into commodity throughput costs. Locating upriver from Youngs Bay will lower F.O.B. costs of commodities compared to sites west of Youngs Bay by eliminating the need to rebuild the rail trestle.

2. Though the existing track between Tongue Point and Portland will support coal unit train traffic in its present condition, it is expected that the tracks would deteriorate rapidly under such heavy usage.[30] Cost estimates for strengthening the rail line range between 27-55 million dollars.[8,9,15] This would add approximately 55¢/ton F.O.B. surcharge to the price of coal over the amortization period.[9]

3. Use of sites west of Tongue Point must address potential public and tourist business resistence to coal train movement through downtown Astoria. For a 10 million tons/year facility, train traffic is

estimated to be between three and five 100-car unit trains moving through the town twice daily (once in, once out), 350 days per year.[10,33] That is equivilent to one train passing a given point every two and one-half to four hours. For a 15 million tons/year facility, the frequency increases to one train passing a given point every one and one-half to three hours.

3.7 COST OPTIMIZATION IN SITE SELECTION (RAIL VS. DREDGING COSTS)

There are essentially four factors involved with determining economically optimal site development in the Columbia River Estuary: cost of the facility, railroad upgrade costs to the site, dredging costs to the site, and maintenance dredging costs over time at each site. The following table (Table 6) contains estimates of the above criteria for four sites, using data from Tables 3, 4, and 5, along with facility costs estimates from the Port of Astoria[34, 35] and other sources.[9] Maintenance dredging cost estimates should be considered accurate for the first five years of maintenance dredging only, as it is expected that costs will increase in the future at an unknown rate. The twenty year estimate is for comparison only.

Table 6

Optimal Site Selection Data*

Site	RM	Facility costs	Rail Upgrade costs	New Work Dredging costs	Maintenance Dredging costs	Total Cost 1 year	5 year	20 year
Tansy Point	10.0	N.A.	65.25	17.2	10.7	N.A.	N.A.	N.A.
East Skipanon	10.5	65	63.5	18.5	11.7	158.7	205.5	381.0
Port of Astoria Docks	13.0	50	44.8	38.2	27.2	160.2	269.0	677.0
North Tongue Point	18.5	93	40	40.5	29.3	202.8	320.0	759.5

* Costs in millions of dollars

The data presented in Table 6 suggest that over time maintenance dredging is the most important factor in the profitability of a given site. Development sites downriver from Flavel Shoal (Skipanon, Tansy Point) have a distinct cost advantage over sites that must dredge Flavel Shoal to operate.

4. POTENTIAL IMPACTS OF ENERGY RELATED DEVELOPMENT IN THE COLUMBIA RIVER ESTUARY

4.1 Dredging and Dredged Material Disposal

4.1.1 Salinity Changes From Channel Deepening

Salinity exerts a major role in determining the composition and distribution of communities within the Estuary, and changes in salinity patterns are likely to redistribute both species and areas of productivity.

The amount of salt water intrusion and salinity change resulting from deepening the entrance and navigation channels is difficult to predict. Salinity changes resulting from previous channel deepening efforts are masked by the natural variability of the system.[36] Thus, data on increases in salinity associated with incremental increases in channel depth are not available. However, it is possible to make general statements regarding potential effects of channel deepening on the Estuary.[37] Increased channelization of the river may affect the Estuary in two ways.

First, deepening the channel would increase the volume of the salt water wedge, and thus salinity intrusion into the Estuary.

Second, increased channelization might cause a reduction in overall river currents within the Estuary, allowing greater salinity distribution into the peripheral bays.[36]

The most significant impact to biota will be at the upriver end of the affected area, where a former freshwater zone will become a brackish zone. This will eliminate saline intolerent freshwater biota from the area. Cathlamet Bay may be the area of greatest impact. The main effect would be changes in abundance and distribution of many species. Assessing this impact requires information on species abundance, distribution, functional relationships, and relationships between organisms and physical factors. This information is not available at the present time.[36]

The Columbia River Estuary Data Development Program (CREDDP) has produced a large data base that can potentially address many of the channel deepening impacts. Preliminary review of the CREDDP data suggest the following impacts to the biota from deepening the channel to 50-60'.[36]

-Emergent plants.

The distribution and productivity of emergent plant, water column, and benthic primary producers can be estimated and mapped by CREDDP, and for the most part, information will be adequate to ascertain changes brought about by higher salinities. In order to rigorously define emergent plant associations in Cathlamet Bay and other parts of the estuary and to show the relationships between these associations and such physical factors as salinity, a great deal of statistical analysis must be performed on existing CREDDP data. Unfortunately, at present, CREDDP can only fund partial analysis. This analysis should be intensified to generate results of sufficient resolution.

-Benthic diatoms.

At present, the Corp of Engineers is funding a study to determine the existing upstream limit of salinity intrusion using diatom species as indicators. This will be useful as a supplement to the physical studies of salinity intrusion and will also be beneficial in determining changes in the benthic diatom community after the channel deepening.

-Phytoplankton.

Phytoplankton productivity may also be altered if salinity intrusion is increased. The first step in determining the effects is a characterization of the species composition of phytoplankton assemblages on each side of the freshwater/brackish water interface. Then, knowledge of the productivity levels common to each community, combined with the already developed model of phytoplankton productivity, can be used to predict the new productivity levels after the channel deepening. The quality of this evaluation can be increased by further refining existing models of phytoplankton productivity. Most importantly, the link between primary producers and higher trophic levels must be assessed so that the effects of altering primary productivity patterns can be determined.

-Zooplankton.

The effect of channel deepening on zooplankton has not been identified as an area of concern by resource agencies. CREDDP has many stored zooplankton samples taken from the mouth of the estuary to the extreme western part of Cathlamet Bay, in or near the navigation channel. Sample processing to date has been limited to spring and summer collections only. Therefore, to produce a complete annual picture of zooplankton abundance or to characterize the tidal/diel/depth distribution of the important zooplankter Eurytemora, some additional proccessing must be done. The freshwater community was not adequately sampled by CREDDP, and it will be most affected by an upriver shift in salinity. It will require a full annual series of zooplankton samples to adequately describe communities in this area.

It is preferable that fish be sampled at the same time to establish trophic linkages between the zooplankton and fish.

-Benthos.

The effect on benthic infauna are mainly related to changes and abundance brought on by the salinity increase. CREDDP intends to analyze field data using various multivariate techniques to determine relationships between infauna and salinity. Knowledge of these relationships can be used to formulate predictions of changes in the benthic infaunal communities in response to an upriver shift in salinity intrusion.

-Epibenthos.

According to many resource agencies, the most important epibenthic organism to examine is Dungeness crab because of its commercial value. The link between this organism and its prey has not been studied in the Columbia River Estuary. This trophic link can be examined by processing crab stomach samples already collected by CREDDP. Resource management agencies have expressed interest in determining the use of the estuary by juvenile Dungeness crab, including their abundance and migration routes. Although CREDDP will only be able to give cursory information on this subject, a synthesis of existing data collected by NMFS, CREDDP, and other resources may suffice in ascertaining the estuary's use by juvenile Dungeness crabs.

-Fish.

Resource management agency concerns about fish are mainly focused on juvenile salmon distribution, migration routes and timing, and utilization of Cathlamet Bay. In order to examine trophic linkages between salmon and their prey, fish stomachs must be analyzed. CREDDP has several thousand stored samples, but can only fund processing a few hundred at the present time. Additional processing would increase the knowledge of fish feeding requirements.

A tremendous amount of data has been collected by CREDDP, NMFS, and other researchers, and these data have never been synthesized. Therefore, the first and possibly the most important step in assessing impacts on fish would be to fund a fisheries biologist/estuarine ecologist to synthesize existing data into a comprehensive report on fish ecology in the Columbia River Estuary.

Once this is completed, studies to fill in the gaps can be initiated.

-Other organisms.

Other organisms which should be included in an impact assessment are birds, wildlife, and marine mammals. The effect on birds and wildlife will most likely be minor. However, marine mammal food requirements and activity patterns should be examined because any change in their abundance and distribution may have adverse impacts on the commercial salmon industry.

Physical characteristics and biological interrelationships in an estuary are very complex and will never be fully described and quantified. However, the currently planned CREDDP studies, additional CREDDP work, and new investigations such as those described above are all steps toward a more complete characterization of the estuarine ecosystem, and are neccessary to fully delineate impacts related to navigation channel deepening. Table 7 contains a summary of CREDDP study reccommendations to reach this goal.

Table 7

Summary of CREDDP Study Recommendations

1) Describe the present vertical mixing processes and salinity intrusion patterns. This would require analysis beyond what is planned by CREDDP.

2) Modify and refine the two-dimensional vertical model to be produced by CREDDP in order to predict the extent of salinity intrusion after channel deepening.

3) Calculate suspended sediment fluxes using CREDDP data.

4) Use the WES sediment transport model along with the results of #3 and the CREDDP two-dimensional horizontal model to predict future shoaling patterns.

5) Fund a fisheries biologist/estuarine ecologist to synthesize Columbia River Estuary fisheries data.

6) Assess the need for further field work to fill the gaps in #5.

7) Assess the need for field work concerning juvenile salmonid use of Cathlamet Bay tidal marshes.

8) Conduct further stomach analysis on fish to determine their food requirements. Emphasis should be placed on Cathlamet Bay samples.

9) Call a meeting of "crab authorities" to discuss current information on Dungeness crab use of the estuary before considering new field work. Synthesize existing data on Dungeness crab in the estuary.

10) Conduct further analysis of zooplankton data to better define their abundance and distribution in time and space.

11) Describe the emergent plant communities of the estuary and their relationships to salinity levels. This would require analysis beyond what is planned by CREDDP.

Table 7 continued

12) Conduct a further processing and analysis of CREDDP phytoplankton samples in order to ascertain post-channel deepening changes in phytoplankton productivity.

13) Examine marine mammal activity patterns and food requirements in the estuary.

14) Perform laboratory activity patterns and food requirements in the estuary.

15) Conduct stable carbon isotope analysis to assess the relative contribution of each primary food source to the food web.

2. Ecological Effects of Sediment Removal and Relocation

- Water quality impacts related to mouth and channel dredging are expected to be slight. Sediments in the lower Columbia River are "clean", in that there are no significant concentrations of organic material or contaminants present.[38] Increases in turbidity are a localized, temporary occurrence. Due to the large volume and flow of the river, turbid water is rapidly diluted and flushed from the estuary. The estuary historically experiences high turbidty conditions during the spring freshet, and channel dredging impacts are seen as small in comparison.[39] Dredging impacts to benthic fauna will be severe in the short term, as large numbers of organisms will be removed from the channel. However, as it is not possible to dredge the entire channel at once, it is not likely that entire bottom communities would be eliminated. Surviving organisms and recolonization from the rest of the estuary would provide a source of juveniles to recolonize the newly disturbed sediments.[40] The rate of recovery to previous conditions depends on the successional stage of the community at the time of dredging. Recovery to a previous "mature" community condition would take longer than recovery to an intermediate, "colonizer" community condition. This concept is borne out by previous studies in which mature, stable communities took a year or longer to recover,[41,42] while colonizer communities subjected to frequent disturbances required less than a month to recover to previous levels.[43] It is probable that benthic communities found in the Columbia River channel are of the latter type, being subjected to periodic dredging and frequent disturbance from large vessel propwash. Thus, it is expected that damage to secondary production in the estuary represented by benthic invertebrate communities in the navigation channel would be small.

The above discussion indicates that on-site impacts from dredging would be very small, and that the focus on estuarine impacts should be the impacts of salinity intrusion, as disscussed above in Section 4.1.1.

It is anticipated that dredging for deep draft access to potential energy related development sites will utilize both open ocean and estuarine in water disposal sites, at least in the short term.

Disposal of dredged materials off the mouth of the Columbia River has been well studied.[44,45] Impacts to benthic and epibenthic organisms from the deposition of large quantities of spoils can be expected.

The main affect of deposition of material on macrofaunal communities at disposal sites is a significant reduction in densities and a concurrent rise in diversity.[45]

The diversity increase may be ascribed to "successional stage" non equilibrium communities,[46,47] temporary removal of predators or competitors, juviniles imported with the sediment or river plume,[45] or simply cropping of the most abundant species. Whatever the mechanism, diversity increases are relatively short term, usually lasting less than one year.

Decreases in densities were caused by smothering of the fauna present. Some species are able to burrow up through sediments rapidly enough that the spoil deposition does not eliminate them.[45] Densities remain low for 10 months to a year after deposition.[45,47]

Open ocean dredged material disposal associated with a deep draft channel is expected to occur constantly. It is expected that due to the restricted area used for placing dredge spoils, benthic and epibenthic communities would be impacted at least semiannually, and this may permanently alter community structures in the disposal areas off shore from the estuary. The selection of areas that are considered to be less critical habitat than others would lessen impacts on fisheries and organisms that utilize these areas.

Two methods of disposal may partially alleviate the problem of dredge spoil disposal:

1) Increase haul distance to deeper water;
2) Disperse the spoils over a wider area.

The first method has the disadvantage of considerably increasing the hauling time and costs of the material, and possibly causing greater impacts to dense offshore benthic communities. The second method may increase total impacts on benthic communities by affecting a larger area, though the impacts per unit area would be lessened compared to the present method. This may lead to more rapid recovery of the affected communities.

4.2 Electric Generating Facilities.

-Thermalelectric. With the possibility of coal transshipments from the Lower Columbia River also comes the possibility of locating relatively small coal fired electrical generating facilities along the transportation route.

Environmental impacts of coal fired electrical generation are well documented.[48] Construction impacts in the estuary would be limited to excavation of water intake and outfall channels, and possibly runoff from the construction site. This would be a temporary, localized impact, and probably insignificant compared to normal estuary disturbances and turbidity levels. Much more significant are the long term impacts from stack emmissions and thermal effluents.

Stack emmissions include fly ash, unburned hydrocarbons, carbon monoxide, nitric oxides, and oxides of sulphur. Sulphur dioxide in particular has been linked to decreases in crop and timber production, corrosion of almost all types of buildings, and lowering or property values.[48] In addition, areas of high precipitation such as the lower Columbia River are highly susceptible to acid rain conditions.

Acid rain can lower the pH of lakes and small rivers,and affects soil pH.[12] It is unlikely that acid rain could significantly affect the large volume of water in the Columbia River, but it may affect quiet, shallow water areas in the Estuary.

The need for large amounts of cooling water for thermalelectric power plants makes large sources of water such as the Columbia River economically attractive for plant siting. Cooling water intake structures have been shown to be extremely destructive of estuarine planktonic organisms and fish that use the estuary.[49] A generating plant on the Hudson River, New York killed almost 1½ million fish during a two month period in 1969, and 80% of all planktonic forms are killed passing through the cooling system of a Connecticut plant.[49]

Salmon in the Columbia River would be especially vulnerable to entrapment at power plant cooling water intakes, as they are known to feed and migrate near shore where intakes would be located.[49]

The effects of thermal effluents in the Columbia River are very well studied, mainly in conjunction with operations at the Hanford Nuclear Reservation in Eastern Washington, and hydroelectric dams along the river's entire route.[50,51] Due to the large volume of the lower Columbia River, it is unlikely that a moderate sized coal fired thermalelectric plant would appreciably raise the temperature of the entire river. Localized impacts would be unavoidable, and it is likely that salmon and other cold water fishes would be excluded from the area.[48] The localized increase in temperature at the outfall may increase predation of juvenile salmon even temporarily exposed to the elevated temperatures, decrease their resistance to disease and pollutants, and interfere with migration.[49] All marine and estuarine species in the area exposed to even periodic warm water eddies may experience interference with reproductive patterns.[49]

Changes in the structure of local primary production communities would be expected if temperature changes are constant, as warm water species replace cold water species. In terms of non-vascular plants, this usally means the replacement of benthic diatoms and macroalgae with blue-green algae.

Wet scrubber systems for the control of fly ash collect very fine particulates that do not settle out in waste water treatment ponds and are therefore passed into the river. Potential constituents of this waste water may include substances such as dilute acids, boron, and radioactivity, with their own effects on the aquatic ecosystem.

- Hydroelectric. Three sites are being considered for low-head hydroelectric generation in the Columbia River Estuary area, although none have been proposed for the estuary itself. Two of the sites, Big Creek and Youngs River, are on the Oregon side of the estuary, and the third, Grays River, is on the Washington side.

Air impacts from construction would be considered small, and impacts related to operation would be virtually nonexistent although some increase in air moisture content near the sites is possible in drier months.

Water quality impacts are related to turbidity and hydrocarbon pollution during construction, and temperature and nitrogen supersaturation increases during operation.

Coffer dam construction and demolition is necessary to build the main containment structure. Equipment in and over the stream bed during construction of both the coffer dams and the main containment dam leak hydrocarbons, cement, and other wastes into the river,[48] with potential adverse impacts on emergent vegetation, phytoplankton, diatoms, and fish spawning grounds. In addition to direct damage to the river bed by heavy equipment, silts released from gravel washings and Coffer Dam demolition may cause down river turbidity and fine sediment deposition to rise to unacceptable levels.[48] This could inhibit primary production in the river, and render salmon spawning gravels unsuitable for use.

Water passing through generator turbines and over spillways tends to become supersaturated with nitrogen.[49] High nitrogen supersaturation greatly reduces salmon tolerance to temperature increases. At 110% nitrogen supersaturation, a one degree celsius rise in temperature can cause gas embolism and death, while at higher levels temperature increase are not necessary to cause gas embolism.[52]

Considering the cumulative impacts of existing dams on the Columbia River, new low-head hydroelectric dams at the three proposed sites will have little effect on the Columbia River Estuary. They may, however, have considerable effect on their respective rivers.

Impoundment tends to raise water temperatures by slowing movement and increasing the surface area of the river exposed to insolation.[53,54] A moderate rise in temperature associated with smaller hydroelectric projects probably would not prevent adult salmon from migrating or spawning.[45,50] There is a possibility that such an increase in temperature may decrease or eliminate reproductive success of downstream spawners by increasing metabolic rates and stress on eggs and juveniles,[51] and making them more susceptible to other physical and chemical stresses.[50,52]

- Economic Impacts of Generating Facilities

Economic impacts from electrical generating facilities have historically been considered to be positive. Electrical generation is a "major act of production" and, like all production, increases income.[48] Typical construction operations last about five years, with wages and salaries starting low, rising to a peak after the first 2-2½ years, then tapering off to previous low levels.[48] This is because it takes many more workers to construct a facility than to operate one. Since the employment impacts are temporary, so are the impacts to social services, although these impacts may be severe during the construction phase.

Long term growth stimulated by a new source of energy may cause significant impacts to the environment, social services, and tax structures. In many cases, "revenue is added with the first boom, but then the county can be left holding the bag for all the added infrastructure costs".[56] To make up for added costs of police and fire protection, education facilities, water and other utilities brought on by the influx of activity that an increase in power availability brings, and which the new utilities tax input does not cover, counties may have to raise tax rates and/or assess homes and properties at higher rates. This can have a very strong negative impact on people and businesses not economically connected with the new power plant.

Given the overall effect of the "boom and bust" cycle of construction and long term costs of development, some county officials in other areas have come to the conclusion that "the bottom line here is that it doesn't pay to be developed."[57]

4.3 Fuel Processing Facilities

4.3.1 Impacts

Probability of fuel processing facilities locating in the Columbia River Estuary is near zero (see Section 2.2.2). There are many air, water, and solid waste emmissions associated with operation of the four types of fuel processing facilities addressed in this report, many of which have been identified as potential carcinogens.[58]

Two very good treatments of fuel processing facility operational impacts (with bibliographies) are contained in reference 11 and reference 53.

4.4 Impacts from Gas and Oil Exploration

It is likely that gas exploration in the Columbia River Estuary area and oil exploration offshore will take place in the next five to ten years (see Section 2.2.2).

Impacts related to these two activities are quite different in nature, and will be addressed seperately.

Exploratory drilling for gas in the Columbia River Estuary area will not take place in the estuary itself because of potential damage to sensitive aquatic areas, but rather directional drilling techniques can be utilized from upland sites to tap reserves under fragile estuarine areas.

Problems are encountered with removal of gas reserves and the resultant reduction in subsurface pressure. This may lead to subsidence of estuarine areas above the gas pocket, which could radically change estuarine community distributions. Preventive measures require pumping water into the gas resevoir, both to reduce subsidence and maintain well head pressure. The consideration of water supply could be very important in some areas.

Exploratory drilling produces cutting surplus drilling muds, chemicals, and various fugitive gasses from the well head.[12]

Standard procedure is to collect these materials into waste pits, allow them to dewater, and then to reuse them or dispose of them offsite. Waste quantities generated are on the order of one cubic yard for every 9-14 meters depth, and 20-40 kilograms of chemical additives per day.[12]

Safety, location, and maintenance of waste pits and "mud sumps" is imperative. A waste sump leak occurring on an unnamed tributary to the Walluski River (Clatsop County) caused a serious turbidity problem, and almost a month passed before the river approached its normal clarity.[59]

Impacts from exploratory drilling and minor production within the Columbia River Estuary area are expected to be small.

Offshore oil exploration and production impacts do not directly affect the estuary. Impacts to the estuary center on construction and support of offshore facilities. Onshore activity generally occurs in three phases: development, production, and decline.[60]

The prime activity during the development stage is construction. Construction is very labor intensive, so local areas undergo the greatest stress in housing and services during this time.

Construction of drilling rigs requires deep water access, which means dredging in the Columbia River Estuary, and considerable amounts of upland. A proposed steel structure fabrication yard on the Skipanon River near Warrenton, Oregon, was predicted to require approximately 2.5 mcy of dredging and 344 acres of upland,[61] although project redesign reduced this requirement somewhat. In addition to drilling rig construction, there is a need for temporary and permanent shore services.[60,62] Impacts to social services are also greatest during this period. Estimates of workers drawn from outside the county to work in the steel structure fabricators yard range from 600 to 1500 individuals, not counting families.[61] It may take several years for state and local government revenues generated by oil production to catch up to costs of providing all the necessary infrastructure and social services for this influx of people. Also, states such as Texas, Louisiana, and Oklahoma that supply these workers also experience disruption in tax bases and social services. This phase may last seven to ten years.[60,62]

A major problem facing communities dealing with an oil boom is the inequity in pay between oil workers and the local workforce.[60] Pay scales for oil workers are quite high, an influx of large amounts of disposable income into a community increases consumption of local goods and services and therefore drives up prices. Residents not financially connected with oil money suffer from these higher prices, and this tends to increase the social dichotomy between "locals" and "oil people." Hostilities generated by this social dichotomy have led to vandalism against oil facilities in Scotland.[60]

Other problems associated with rapid growth are discussed in Section IB.B, economic impacts of generating facilities.

The next phase, production, may last 5 to 10 years, depending on the size of the exploited fields. Oil fields off Oregon's shores are expected to be of small to moderate size,[14] and thus production will be on the lower end of the time scale. Activities in the estuary are mainly transportation oriented, with personnel, supplies, and materials being shuttled between the shore bases and the drilling rigs.

Impacts associated with increased ship traffic in the estuary are discussed in section 4. The production phase of activity brings a decrease in employment opportunities, as it takes fewer workers to maintain the facilities that it takes to build them. This means there is less stress on infrastructure, but increased unemployment is likely to increase the pressure on economic social services.

A recurring theme in previously published reports on onshore impacts related to offshore oil development is the need for rigorous planning at the earliest onset on activity to prevent the boom town-ghost town scenario.

A good summary of potential impacts from drilling for gas and oil along the coast is found in the USFWS publication Managing Oil and Gas Activities in Coastal Environments.[63]

4.5 Transportation and transportation facilities.

It is highly probable that no LNG, LPG, or oil transshipment facilities will be located in the Columbia River Estuary, as described in Section 2.2.4. Impacts from these types of facilities may be very great.

Potential impacts from LNG and LPG facilities and transshipment activities are described in detail in "LNG and LPG Hazards Management in Washington State"[60] and an extensive bibliography on this subject is contained in LNG and LPG Hazards Management: A Bibliography.[65]

Oil spills and hazards of oil transshipment are probably the best studied of all pollution problems. A small sample of the available literature on oil spill hazards, impacts to marine environments, policy and cleanup technology are contained in Oil Spills and the Marine Environment,[66] Oil Spills and Spills of Hazardous Wastes,[67] and "Effects of Oil on Marine Ecosystems: A Review for Administrators and Policy Makers"[68].

The oil spill cleanup capacity in the Columbia River Basin, an oil spill protection plan for the Lower Columbia River, and a case study of an oil spill on the Columbia River are contained in Oil Spill Cleanup Capacity on the Columbia River Basin,[69] Oil Spill Protection Plan for the Natural

Resources of the Lower Columbia and Willamette Rivers,[70] and Columbia River Oil Spill Study,[71] respectively. One factor of note in these studies is that oil tanker traffic is responsible for a very small amount of the oil spilled into the Columbia River, and that the majority of oil comes from general cargo and passenger traffic.[69]

One of the more interesting, efficient, and economical methods of oil spill cleanup was recently tested on the Lower Mississippi River. "Antipollution pillows" were thrown onto the spill, and each 8 oz, standard chicken feather pillow quickly soaked up 8 lbs of oil sludge, not including the weight of water.[72] Use of this method in conjunction with oil containment booms may have application potential on the Columbia River.

It is likely that a coal transshipment facility will be operational in the Columbia River Estuary within 10-15 years. Impacts associated with coal export facilities fall mainly into four catagories:

1. Water Quality
2. Air Quality
3. Noise
4. Adjacent and nearby use.
5. Hazards.

Water quality impacts would be related to direct settling of coal dust on the estuary surface, and storm water runoff from the development site. The problem of direct coal dust input to the estuary varies with the different site options. Sites such as the Port of Astoria Docks or East Skipanon may deposit coal dust in the relatively calm Youngs Bay area, while the Tongue Point site would impact Cathlamet Bay.

Low current velocities allow the dust to settle through the water column and become incorporated into the sediments. This is a very gradual process, and as yet, there is no evidence that this process inhibits the normal functioning of estuarine ecosystems.[26] However, if prevailing winds consistently deposit dust in a restricted area of the Bay over an extended time period, coal dust buildup in the sediments could cause significant problems. Shiploading facilities at the Superior Midwest Energy Terminal have been shown to spill an estimated 10-20 tons of coal per year into the adjacent shipping channel.[73]

A potentially more severe water quality impact may occur from polluted precipitation runoff from the coal handling site. This wastewater would contain coal dust and other waste matter such as dilute acids, hydrocarbons, and other dissolved solids.

An average of 66-80 inches of rain per year falls on the CRE area,[49,74] often at very heavy rates. One inch of rain falling on a 100 acre site assuming 90% runoff [75] creates approximately 2.7 million gallons of water. Rainstorms in Astoria periodically drop three to three and one-half inches of rain over a 24 hour period.

This generates an average of approximately 6560 gallons per minute of wastewater flow over the 12 hour period that must be treated. Greater flow rates can be expected for the 100 year storm.

Flow equalizer ponds, large capacity settling ponds, and overload filter systems would be necessary to handle high pulses of site wastewater runoff associated with storm fronts in the Columbia River Estuary area.

Air quality is impacted from fugitive dust originating from dumping, stacking, reclaiming and loading, or merely wind blowing over stacked coal.

The Draft EIS for the proposed Port of Kalama facility estimates coal dust emissions from a 15 mty facility using state of the art emission controls would average 115.3 tons per year.[75] Adjusted for a 10 mty facility, this equals 76 tons per year for a facility likely to be located in the CRE area. This emission figure may be high, due to the frequency of rain and the probability that part of the throughput will be loaded directly on to ships, thus reducing handling points. 76 tons per year does not approach the threshold for a prevention of serious deterioation analysis, set at 250 tons per year.[75] However, considerable local citizen opposition to 76 tons per year of fugitive coal dust is possible. Near the Neptune facility in Vancouver, B.C., which has sprinkler dust control and shuts down when windy, residents on a hillside up to three miles from the coal yard complain that outside patios and furniture are "covered with coal dust," and that "you have to wipe it off constantly."[76] Intensive use of baghouses and sprinkler dust control systems may alleviate this problem to a considerable degree, but some coal dust deposition on Astoria and nearby communities would be unavoidable.

Noise

Noise problems would generally only be a problem at the Port of Astoria Docks site. Tongue Point and Skipanon sites are relatively removed from population centers, and thus noise generation is less of a problem. Noise from coal handling equipment can be expected to be about 70-dBA 100 ft from the source,[75] slightly louder than the sound of aircraft overflights at 68 dBA.[58] Noise levels of less than 70 dBA are not likely to be bothersome during the day due to the general din of activity within the city. However, at night the city is quiet and the sounds emanating from the coal facility would be easily discernible, and possibly a source of irritation for nearby residents.

Noise from rail traffic would impact many homes along the rail line between Portland and Astoria. The coal unit trains would move through or near, the towns of St. Helens, Scappoose, Rainier, and Astoria. Rail road traffic generates approximatly 75 dBA of noise, and these towns may be affected by the high rate of traffic generated by coal transportation (see Section 3.6).

Adjacent and Nearby uses.

Coal port activity in the CRE is likely to impact adjacent and nearby uses, especially for the Skipanon and Port of Astoria Docks option. The largest impact expected is on waterfront business in downtown Astoria from coal train movements. As noted in Section 3.6 100 car coal trains would be moving slowly along the waterfront rail line every 2½ to 4 hours to feed a 10 mt/y facility. For example, Ocean Foods' fish packing plant is separated by the rail line. At present, low train traffic has not made this arrangement a problem. As it may take a coal unit train 10-15 minutes to pass a given point, this may significantly inconvenience the fish packing operations.

Tourist related businesses would also be impacted by coal train activity. Noise, vibration, dust and restriction of access due to passage of the trains would significantly impact the Pier 11 development, and possibly cause a loss of revenue due to forgone tourist trade.

The rail line forms the southern boundary of the parking lot for the Thunderbird Motel, Astoria's largest motel. Coal train passage so near to the building may prevent full economic returns to the owners of the motel.

In short, coal facility operations at Skipanon or Port of Astoria sites would impact the tourist industry in Astoria considerably, mainly because of coal train movement through the heart of the city. This is addressed in section 2.2.4 Benefit Cost Analysis.

Hazards

There are two primary hazards related to handling and shipping coal, with the main concern being fire. Coal that has been stored and loaded in the rain has a tendency to spontaneously combust when confined in ship holds. Over 20 incidents of elevated temperatures requiring immediate fire fighting action have been reported, and there have even been reports of coal barges arriving at Gulf ports on fire.[77]

The other problem is apparently also related to damp, confined coal. An Indonesian bulk carrier in the Port of Los Angeles/Long Beach reached temperatures of 130 degrees in the hold. Aside from fire problems, high heat released sulphuric acid from the coal, threatening the structural integrity of the hold of the ship.[77]

Given the above situations, and the fact that the Coast Guard is expected to release regulations banning loading coal in heavy rains,[77] coal port facilities in the Columbia River Estuary would need to plan for eliminating the hazards of damp coal.

4.6 Impacts to the Estuary from coal Port Development Upriver

The Port of Kalama and Port of Portland are actively pursuing coal port activity. Because of their relative advantage of quality rail infrastructure and shorter rail haul distances compared to Astoria, these ports are able to economically ship coal in 45,000 dwt colliers, thus eliminating the need for extensive and costly dredging. The lack of dredging requirements removes a very time consuming obstacle to coal facility completion. It is expected that the first coal export facility operating in the Pacific Northwest will be able to capture some portion of the export market and hold it even in the face of more competitive prices from other ports in the future. (see Section 2.2.4). Thus, at least one of the upriver ports is expected to be in operation in the next five years.

The only known impact to the Columbia River Estuary from coal export facilities upriver would be related to increased ship traffic. An increase in ship traffic has two main effects; an increase in the occurence of oil pollution and an increase in ship wake erosion at design capacity of 15 mt/y, one Port facility shipping coal in 45,000 dwt colliers could potentially receive 330 colliers per year.[75] Assuming that both ports are functioning at 80% capacity (12 mty) this translates to 350 ship calls per year on upriver coal ports. This is a 10% increase over 1979 levels of shipping in the Columbia River.[10]

The quantity of oil spilled into the Columbia River is a function of vessel trips. Also, 78% of all spills occurring below Bonneville Dam occurred in the Portland/Vancouver area. (During the period 1973 to 1978).[69] This is because spills occur more often at transfer points than at transit points. Of these spills, 42%(by volume) were in the "dry cargo/passenger" category.[69] Spills in this category were mostly less than 100 gallons (78%).[69] Therefore, it is unlikely that increases in Columbia River shipping traffic from coal port activity at Kalama or Portland poses a significant increased threat of a major oil spill. Though very difficult to quantify, it should be noted that incremental increases in ship traffic mean incremental increases in oil pollution on the Columbia River, mainly from bunkering and deballasting procedures.

Increased ship traffic in the Columbia River is expected to impact shorelines by increasing erosion caused by ship wakes. The periodic saturation and dewatering of shore dike or material by tidal action combined with waves generated by passing ships tends to undermine dike facing material. This material then slumps, exposing the upper portion of dikes to erosive action from waves.[78]

Determining the extent that ship wakes are responsible for erosion at a given site is not possible. Many factors, such as river currents, wind generated waves, stage of tide, and dredging in addition to ship wakes all are responsible for shoreline erosion.

As ship traffic is expected to increase approximately 10%, it can be assumed that there will be an incremental increase in shoreline erosion associated with ship wakes.

Ship wakes also have been shown to be responsible for fish strandings.[79] Juvenile fish may be swept ashore by ship generated waves and stranded on sandbars. The extent of this problem has not been quantified, and the increase in strandings due to coal port traffic upriver would be difficult to assess.

5. Local, State, and Federal Mitigation Policy Analysis

5.1 Definitions

Energy related development in the Columbia River Estuary area will create unavoidable impacts to natural (air, water) and human (economic, social) resources. Migitation is defined in this application as the means by which these adverse impacts to natural and human resources are minimized. A concurrent study being conducted by CREST addresses mitigation for site specific impacts to the estuary (e.g. habitat compensation), and therefore compensation for site specific impacts will not be contained in this report.

5.2 Mitigation by Federal and Washington State Agencies

The following discussion draws heavily from information contained in the CREST Mitigation Policy Paper.[80]

At the federal level, USFWS has taken the lead in developing mitigation policies, resulting from their broad mandate to protect fish and wildlife resources. Their mitigation policies are based on HEP, the Habitat Evaluation Procedure (102 ESM). This is a system for evaluating the habitat for a selected species, and has broad applicability to wildlife management.

The USFWS use "mitigation" to cover the entire permit review process including aspects such as modifying project design, and as such, has applicability to potential energy related development impacts to the Columbia River Estuary area. A recent statement of USFWS mitigation policy is presented in the Federal Register, Vol. 4C. No. 15 (1981). The USFWS objective for the Columbia River Estuary can probably be summarized as "no net loss of in-kind habitat value". Application of this concept may be difficult when considering impacts such as particulate emissions or economic impacts to adjacent use, but certainly this concept is pertinent to impacts to the ecosystem from project construction (e.g. dredge & fill) and from project operation (e.g. wastewater runoff).

In Washington State law, there is no specific requirement for mitigation. State resource agencies can, however, request mitigation as part of the federal 404 process and the shoreland permit process.

The acceptability of a mitigation proposal would therefore depend on the priorities of WDG and WDF, and whether they would require mitigation to be ecosystem and habitat based (e.g., reduction in fugitive coal dust) or specifically aimed at increasing populations of economically important species through artificial means (e.g., hatcheries to mitigate for hydroelectric impacts). The kind of mitigation required in the past has included examples of both these categories, so that mitigation in Washington is a very flexible and somewhat unpredictable process. Such a case-by-case approach to mitigation without appropriate guidelines makes mitigation planning difficult. Mitigation is usually determined during the permit process instead of during comprehensive estuary-wide mitigation planning and implementation, and therefore it is more difficult to delineate cumulative impacts.

There are obviously advantages to mitigation on a case by case basis. For every development, resource losses and mitigation are carefully evaluated by resource agencies. There are disadvantages for developers, however, since the amount and time of mitigation cannot be accurately predicted, causing delays and problems with cost estimation. As more estuarine developments occur, and mitigation becomes a more familiar concept, patterns of development impacts and mitigation actions are emerging which can be used to give predictability.

Many impacts from potential energy related development must be mitigated on a case by case basis, for magnitudes of impacts vary with project design, location, size, and function. Thus, the mitigation process used in Washington State will be applicable for impacts not directly affecting aquatic habitat or species of concern.

CREST has developed a habitat based mitigation policy that addresses impacts to the aquatic ecosystem from dredge and fill activities.[80] This method will be applied to site specific dredge and fill impacts from energy related development in the CRE in a forthcoming report for the Oregon Department of Energy.

6. MITIGATION: STRATEGIES FOR POTENTIAL ENERGY RELATED DEVELOPMENT IMPACTS

6.1 Dredge, Fill, and Dredged Material Disposal Impact Mitigation

Dredge & Fill Impacts

- salinity changes
- destruction of benthic communities
- loss of shallow water habitat
- increased shoreline erosion
- impact on fisheries

- Salinity changes.

Mitigation planning for salinity changes in the Columbia River Estuary caused by dredging a channel sufficient to accommodate coal colliers (or any 55' draft vessel) would be difficult for three reasons. First, there is no consensus on how great the salinity change would be. Physical and numerical modeling of the proposed Coal Export Channel is underway at the U.S. Army Corps of Engineers Waterway Experiment Station to attempt to delineate the extent of salinity intrusion caused by the proposed channel. This information will not be available until late 1983. Secondly, there is no consensus on what impact a given change in salinity would have on the estuary, or even if it would be a positive or negative impact. Given that an effect is determined to be present, it could take years of monitoring and study to quantify that effect. Lastly, it does not appear possible to mitigate for salinity changes within the estuary if the impact affects the estuary as a whole.

Given the above constraints. Mitigation for increased salinity within the estuary caused by an increase in mouth and channel depth would need to be negotiated by state and federal resource agencies, ports, the Corp of Engineers, and other interested parties.

-Impacts to benthic communities.

It is not possible to totally avoid impacting benthic communities during dredging operations. However, it may be possible to mitigate the effects of removal of large portions of the populations present by restricting dredging to late winter and early spring. This is based on the hypothesis that large numbers of juveniles entering the disturbed area in early spring would quickly colonize the exposed sediments.[40] A Potential Problem with dredging later in this time period is that juvenile coho salmon are passing through the estuary in may, and use the navigation channel extensively.[81]

-Loss of shallow water and intertidal habitat

A detailed mitigation mechanism for mitigating loss of shallow water and intertidal habitat is described in the CREST Mitigation Policy Paper[80], and is applicable to this type of impact.

-Increased Shoreline erosion.

The amount of shoreline erosion caused by channel dredging has been an issue of debate since 1958, especially along the Hammond-Warrenton waterfront. Residents contend that channel dredging alters the current flow such that shoreline erosion is inevitable. Erosion experts indicate slumping of the shoreward side of the navigation channel may contribute to bank erosion of adjacent shoreline areas, and that dredging exacerbates this condition.[78]

Mitigation for possible increased shoreline erosion could consist of two parts. The first part would consist of the Corp of Engineers Waterway Experiment Station conducting experiments on numerical and physical models to determine if the dredging would cause an increase in erosion. Alternately, differencing studies using old photos may be used to determine pre-project erosion rates, and monitoring programs could determine if dredging the deeper channel had led to an increase in erosion rates. The second part, if studies turned up positive evidence of increased erosion, would be some sort of erosion control initiated by the Corp of Engineers in areas indicated by the model.

Spoil Disposal Impacts

-impacts to in-estuary shallow benthic communities

-impacts to open ocean benthic communities

-impacts to fisheries.

- Impacts to in-estuary Shallow Benthic communities

Partial destruction of shallow benthic communities within the estuary from in-estuary disposal of spoils would be unavoidable if that option is pursued. Mitigation possibilities include timing disposal activities as discussed under dredging mitigation below, and dispersing material over a wider area to lessen the impact per unit are.

The best mitigation for in-estuarine impacts in to haul the spoils to open ocean sites, thus eliminating the in-estuarine impact altogether.

-Impacts to open ocean benthic communities

Impacts to open ocean benthic and epibenthic communities from placement of up to 18 million cubic yards of dredge spoils each year will be significant. (see section 4.1.2) Potential mitigation strategies may take three forms. The first option would be to disperse the spoils over a much wider area, thus reducing the amount of spoil deposition per unit area. This would lessen the impact per unit area, but increase the areas affected, and it is not known if there would be a net decrease in impacts. The second option is to increase the haul distance to deeper waters, and identify more sites. Thus, the frequency of deposition at any one site would be reduced. The third option calls for placing a sump at one or both sides of the mouth, and rehandling sediments onto either Peacock Spit or Clatsop Spit.

The best overall mitigation strategy may be a combination of all three options, thus reducing the total amount placed in open ocean sites (option 3) and decreasing both the frequency and amount of deposition at a given site (options 2 and 1).

-Impacts to fisheries

Impacts to fisheries, with the exception of crabs, is expected to be slight. Pelagic and epibenthic fish that feed in the disposal areas are able to avoid the actual deposition of spoils. There appears to be some evidence that deposition of clean dredge spoils may increase the productivity of benthic communities by keeping them in a high production, "early successional" stage.[82] This would help ameliorate any impacts inherent in temporarily excluding these fish from their primary feeding grounds.

Impacts to crab fisheries may be difficult to mitigate. Crab do not possess the mobility of pelagic and epibenthic fish, and therefore will not be able to avoid being covered by spoils. Even if the wide dispersal of spoils option is taken, fine suspended particles tend to clog crab gill structures. Mitigation of impacts to crab populations by attempting to artifically increase population numbers at present may not be economically or technologically feasible.

As a commercially available crab is three to four years old,[83] it is unlikely that a site would not be impacted at least once during the life cycle of a crab. Possible attainable mitigation goals may include funding of research to increase survival rates of eggs and juveniles, and therefore partially offset losses due to dredged material disposal.

6.2 Development Specific Impact Mitigation

1. Electric Generating facilities

- Hydroelectric. Impacts to fish and wildlife from construction and operation of hydroelectric facilities have been studied extensively on the Columbia River ever since Bonneville and Grand Coulee Dam construction began in the early thirties. Very good discussions of these impacts and their mitigation are contained in references seventy seven and seventy nine.
- Thermalelectric-Extensive literature exists on impacts and mitigation[84,85,86] concerning operation of thermalelectric generating facilities. Discussions of these impacts and possible mitigative actions are contained in <u>Evaluation of Power Facilities: A Reviewers Handbook</u>,[48] "Impact of Cooling Waters on the Aquatic Resources of the Pacific Northwest,[49] and <u>Tenth Annual Report: Environmental Quality 1979</u>.[58]
- Economic Impacts. See Section 6.3.

2. Fuel Processing Facilities.

Mitigation of impacts related to all forms of fuel processing facilities center on best conventional pollution control technology. Standards (1979) for emissions from fuel processing facilities may be found in reference 58, and other potential mitigative actions in reference 12.

3. Gas and Oil Exploration.

Identified impacts.

- Drilling and subsidence.
- Dredge and fill
- Increased ship movement, oil spills
- Economic and social

-Mitigation of drilling activities in the CRE would be minimal. Potential impacts are related mainly to possible rupture of drill mud collection basins and potential subsidence from reduction of subsurface pressures. Mitigation to reduce the possibility of drilling mud contamination of streams would be based mainly on requiring reinforcement of existing collection pond design. Location of ponds below river grade and pumping up to the river may also be a possible technique.

Subsidence due to reduced subsurface pressure is usually mitigated for by pumping water into the gas or oil resevoir, thus preventing collapse of the resevoir walls. This creates an additional problem of consuming significant quantities of water.

A good summation of mitigation techniques for oil and gas drilling is contained in reference 63.

-Mitigation techniques for dredging impacts are contained in Section 6.1.

-Mitigation techniques for dealing with increased ship traffic and associated oil pollution are contained in Section 6.5.

-Mitigation of economic and social impacts may take many forms.

Impacts to be considered include:

1) Added infrastructure costs. (fire and police protection, water supply, etc).
2) Increase in economic social service demand (unemployment, etc.)
3) Inequitable tax structure
4) Change in property values, increase in housing demand
5) Increase in prices for goods and service
6) Increase in crime

The main method of mitigating for economic and social impacts is to make the developer financially responsible for added infrastructure and social services costs. This could probably be attained by the county and/or city negotiating realistic tax structures based on these impacts that would not leave the cities with large infrastructure and social service bills. Stabilization of property values and decreases in temporary housing demand may be attained by the developer providing housing for workers involved in the construction phase of development.

Increase in crime may be partially mitigated by the development interests financial responsibility for increased infrastructure costs, e.g. police protection.

4. Transportation and Transportation Facilities

-Oil transshipment. Mitigation strategies for impacts related to oil transshipment are well developed. Specific mitigation plans for the Columbia River, as well cleanup capacity and a Columbia River case study are contained in references 69-71.

-LNG and LPG transshipment. Potential for siting LNG or LPG transshipment facilities in the CRE area is seen as near zero. Mitigation of LNG or LPG transshipment impacts are references 64 and 65.

-Coal transshipment.

Identified impacts

-Dredging and dredged material disposal; coal export channel
-Water Quality
-Air Quality
-Noise
-Adjacent and nearby use
-Hazards

-Project site and coal export channel dredging and disposal impact mitigation strategies are described in Section 6.1.

-Water quality impact mitigation is relatively simple, and contains two parts. The first part is to reduce the amount of fugitive dust from the handling site. This in turn would reduce the amount of dust entering the aquatic ecosystem, mitigating impacts to water quality from coal particle deposition on the water's surface. The second part involves treatment of site wastewater runoff. The use of settling ponds, flow regulators, filter systems, and continual periodic water quality sampling would mitigate water quality impacts from wastewater runoff.

-Air quality impact mitigation is a little more complex. Fugitive coal dust is the main concern, and control must take place at several points. 90% of all fugitive dust from a coal facility occurs at 3 transfer points: Unit car dumping, loading out from storage piles, and loading into ships.[75]

Mitigation for fugitive dust from unit car dumping may be achieved through the use of "baghouses" used in conjunction with an enclosed air sweep system surrounding the dumping area, drawing the dust to a filter mechanism, and water jet systems to wet the coal and reduce the generation of dust.

Transfer dust control at storage pile transfer points is more difficult. The rotary scoop that picks up the coal generates most of the dust. Water jets can be used, but are inadequate to suppress the dust from the large quantities moved. This is the main area of dust control that needs improvement. Perhaps some sort of small air sweep attachment could be constructed for the rotary scoop.

Dust control at the ship loading transfer point may be the easiest to achieve. Chute extensions attached to the coal conveyer channel could reduce the amount of free fall for the coal to the surface of the pile in the ship's hold. Air sweeps could draw off dust from the tube and filter it. Alternately, "caps" could be placed over the top of the hold to draw off and filter the dust that way.

-Noise. The most cost efficient method of noise mitigation is to berm the perimenter of the facility, and plant shrubs and trees to absorb most of the sound energy. This would probably not protect residential areas on the hillside of Astoria if a terminal operated at the Port Docks. There is no effective mitigation strategy for reducing noise from unit train traffic through towns along the rail route, except possibly through installation of noise barriers to dampen noise generated by rail cars.

-Adjacent and nearby use

Impacts to adjacent and nearby uses are related to visual and noise impacts, and coal train movement through downtown Astoria. Visual and noise impacts are mitigated in the same way, and are addressed above. Coal train movement is an unavoidable impact. Relocating the rail line does not solve the problem, but merely shifts the impacts to another location. With the high frequency of train movement and single track capacity between Portland and Astoria, there is no way to schedule train traffic for non-business hours.

Mitigation for disruption of waterfront businesses could involve:

1) noise dampening structures along the track

2) pedestrian overpasses

3) financial aid for relocation of businesses

4) locating the coal terminal east of Astoria

It is not believed possible to substantially mitigate for coal train traffic through cities along the route from Portland to Astoria other than relocating the tracks outside of the urban areas.

-Hazards.

Mitigation for hazards associated with shipping damp coal centers on keeping the coal relatively dry. It is not possible to keep the coal totally dry, as wetting is a primary means of dust control. However, large sheds over the coal storage piles would prevent the coal from being saturated by the heavy rains in Astoria. Covers over loading galleries would also reduce this problem. Voiding oxygen from ships holds with nitrogen gas, or drying the coal as it is loaded are not economically or technologically feasible options.

Monitors for heat and acid detection both in the coal storage piles and in the ship holds would provide early detection of potential problems.

5. Impacts from coal Port development upriver

Impacts identified with coal port development upriver from the Columbia River Estuary are incremental increases in oil pollution, and increases in shoreline erosion and fish strandings from ship wakes. Oil pollution is addressed in section 6.4.

Mitigation for stranding of fish caused by ship wakes could include the imposition of channel speed limits for vessels over a certain tonnage. Such speed limits do not now exist. Such limits could be enforced by the U.S. Coast Guard.

Mitigation for shoreline erosion caused by ship wakes could consist of two parts. Photo comparisons of pre-development erosion rates and post development erosion rates could be used to determine what (if any) amount of erosion increase can be attributed to ship wakes. Second, if this amount is determined significant, shoreline protective measures funded in part by the coal shipping consortium could be instigated. This could include riprapping, or some structure to lessen the wave energy striking the shoreline. Dredge spoiling on existing dike structures is also considered a good method of mitigating erosion and disposing of dredged material.

APPENDIX A

New Work Cost Calculations

Mouth:

12 mcy x $1.07 dredging cost
12 mcy x $0.36 transportation cost to open ocean
12 mcy x $1.43 = 17.2 million dollars - 1.43/cy

Desdemona Shoals:

.7 mcy x $1.07 dredging cost
.7 mcy x $0.72 transportation cost to open ocean
07 mcy x $1.79 = 1.3 million dollars = $1.79/cy

Flavel/Astoria Shoals:

11.3 mcy x $1.07 dredging cost
3.2 mcy x $0.40 transportation to area D
2.0 mcy x $0.10 transportation to area 36-E
6.0 mcy x $1.02 transportation cost to open ocean
*8.0 mcy x $1.02 transportation cost to open ocean
= 19.7 million dollars = $1.74/cy

* 21.5 million dollars if area 36-E unavailable.

Upper Sands Shoals:

2.0 mcy x $1.07 dredging costs
2.0 mcy x $1.07 transportation to 39-E
*2.0 mcy x $0.30 transportation to Harrington Sump
- 2.3 million dollars - $1.15/cy
* 2.8 million dollars if area 39-E unavailable

Operations and Maintenance Cost Calculations

Mouth:

7.5 mcy x $1.07 dredging cost
7.5 mcy x $0.35 transportation cost to open ocean
= 10.7 million dollars

Desdemona Shoals:

.55 mcy x $1.07 dredging cost
.55 mcy x $0.72 transportation cost to open ocean
= 1.0 million dollars

Flavel/Astoria Shoals:

8.8 mcy x $1.07 dredging cost
3.5 mcy x $0.40 transportation cost to area D
.8 mcy x $0.10 transportation cost to area 36-E
4.5 mcy x $1.02 transportation cost to open ocean
= 15.5 million dollars

Upper Sands Shoals:

1.5 mcy x $1.07 dredging cost
1.5 mcy x $0.30 transportation to Harrington Sump
= 2.1 million dollars

REFERENCES

1. U.S. Army Corps of Engineers. Senate Committee Testimony on the Status of Federal Navigation Development in the Portland District. Astoria, Oregon; August 1981.

2. Johnson, Ken. Corps of Engineers, Portland District. Personal Comm., September 22, 1982.

3. Roy, E.H. et al. "An Investigation to Determine Sedimentary Environments Near the Entrance to the Columbia River Estuary." Final Report to the Army Corp of Engineers. School of Oceanography, University of Washington, Seattle. 15 June 1982

4. U.S. Army Corps of Engineers. Oregon Coastal Hopper Dredge Operation Areas. Draft. Portland, Oregon: Portland District USCOE; January, 1978.

5. Columbia River Estuary Regional Management Plan. Ian McColgin, Ed. Astoria, Oregon: CREST; June 1979.

6. Moore, Pam. Corps of Engineers, Portland District. Personal Comm. 8 September 1982.

7. Heiser, David. Washington State Parks, Olympia, WA. Personal Comm. 8 September 1982.

8. Bartl, Rainmar, Mike Morgan and Jeanne Robbinette. An Economic Evaluation of the Columbia River Estuary. Astoria, Oregon: CREST; November 1981.

9. State of Oregon, Division of State Lands and Department of Energy. Feasibility Study for Coal Export Facility at Tongue Point. Portland, Oregon: Swan-Wooster Engineering, Inc.; September 1981.

10. CREST Calculation.

11. Clatsop County Department of Planning and Development. Background report, Goal 6: Air, Water and Land Quality in Clatsop County. Astoria, Oregon; 1980.

12. Garcia, John, et. al. Energy Related Use Conflicts for the Columbia River Estuary. Portland, Oregon: U.S. Fish and Wildlife Service; September 1982.

13. City of Astoria. Application for preliminary FERC permit. March 15, 1982.

14. Zieglar, D.L. and S.K. Cassell. "A Synthesis of OCS Well Information, Offshore Central and Northern California, Oregon, and Washington". Paper presented at the 53rd Annual meeting of Amer. Assoc. Pet. Geol. Pacific Section, Sacremento calif. April 28-29, 1978

15. State of Oregon, Lower Columbia River Development Task Force. Opportunities for Export of Coal From the Lower Columbia River. Salem, Oregon: August, 1980.

16. Interagency Coal Export Task Force. Interim Report, U.S. Department of Energy; January 1981.

17. Central Puget Sound Economic Development District. Puget Sound Coal Export Opportunities and Issués. Bellevue, Washington: CH2MHill; February 1982.

18. Meadows, Bob. Economist, CH2M/Hill, Seattle Office. Personnal Comm. 21 September 1982.

19. Howe, Charles W. Benefit-Cost Analysis for Water System Planning American Geophysics Union Water Resources Monograph 2, Washington D.C. 1971.

20. Power, Garrett, Karen H. Edgecomb, and William J. Bellows. The Real Beneficiaries of Federal Dredging. University of Maryland Sea Grant Pub. UM-SG-TS-81-10. October, 1981.

21. Beeman, Ogden, quoted in Oregon Journal, January 5, 1981. "Expert agures against deeper Columbia." Portland, Oregon.

22. Price, Joel. Rotan Mosle Inc. Statement before the Water Resources Subcommittee of the Senate Environment and Public Works Committee. June, 1981.

23. Columbia River Estuary Element, Pacific County Shoreline Master Program. Resolution 80-9. South Bend, Washington; January 1980.

24. Final CREST Mediation Panel Agreements. Astoria, Oregon: CREST; July 7, 1981.

25. Port of Astoria. Port of Astoria Channel. Vol. 1, #1. February 1982.

26. Pearce, B.C. and J. McBride. A Preliminary Study on the Occurrence of Coal Dust in Roberts Bank Sediments and the Effect of Coal Dust on Selected Fauna. Technical Report Series No. PAC/7-77-17.

27. State of Oregon, Division of State Lands. Tongue Point: Highest and Best Use Study. Redwood City, California. Williams-Kuebelbeck and Associates. October 1981.

28. Case, Nancy. Navigation Division, Corps of Engineers, Portland District. Personal comm. 29 September, 1982.

29. Corps of Engineers, Portland District. Coastal Projects Operation and Maintenance. Navigation Division, July 1982.

30. Holstein, Michael. Asst. Regional Supervisor, Portland, Office, Burlington Northern. Personal comm. 28 September, 1982.

31. Jenks, Greg. Senator Packwoods Office, Portland, OR. Personal. comm. 8 October 1982.

32. Daily Astorian. January 16, 1980. "Port okays bulk cargo yard lease option". Astoria, Oregon.

33. Washington State Department of Commerce and Economic Development. Coal/bulk commodity/transportation issue paper. Seattle, Washington; May 1981.

34. Shelton, Floyd. Director, Port of Astoria. Testimony before Senate Commerce Committee, Port of Astoria, OR. September 1, 1982.

35. Baker, Greg. Economist, Port of Astoria. Personal Communication. 19 October 1982.

36. DeLapa, Michael D. Letter to Colonel Robert Friedenwald, Portland District Army Corp of Engineers. 2 September 1982

37. Ellifrit, Nancy. Navigation Channel Deepening - Columbia River at the Mouth. U.S. Fish and Wildlife Service, Portland, Oregon August, 1982.

38. CREST, Columbia River Estuary Inventory. Astoria, OR. June 1977.

39. Fox, D.S. A Review of Recent Scientific Literature on the Columbia River Estuary, Emphasizing Aspects Important to Resource Managers. CREST, Astoria, Oregon. 1981.

40. Albright, Richard, and Patricia K. Borithilette. Benthic Invertebrate Studies in Grays Harbor, Washington. U.S. Army Corp of Engineers, Seattle District. April, 1982.

41. Swartz, R.C., W.A. DeBen, F.A. Cole, and L.C. Bentson. Chapter 20, Contaminants and Sediments, Volume 2. Robert A. Baker, Ed. Ann Arbor Science Publishers, Inc. Ann Arbor, MI. 1980

42. Kaplan, E.H., J.R. Welker, M.G. Krause, and S. McCourt "Some Factors Affecting the Colonization of a Dredged Channel". Marine Biology 32, pp 193-204. 1975

43. Smith, John M et al. Grays Harbor Ocean Disposal Study. U.S. Army Corp of Engineers, Seattle District. May 1980

44. Durkin, J.T. An Investigation of Fish and Decapod Shellfish Found at Four Spoil Sites and Two Dredge Sites Adjacent to the Mouth of the Columbia River. National Marine Fisheries Service, Astoria, OR. Nov. 1974

45. Boone, Charles G., Mitchell a. Granat, and Michael P. Farrell Aquatic Disposal Field Investigations, Columbia River Disposal Site, Oregon. (Evaluative Summary, 5 appendices published under separate covers.) Dredged Material Research Program, U.S. Army Engineer Waterways Experiment Station, Vicksburg Miss. May 1978

46. Grassle, J. Frederick and Howard L. Sanders. "Life Histories and the Role of Disturbances". Deep Sea Research, Vol. 20 pp 643-659. 1973

47. Oliver, John S. et al. Patterns of Succession in Benthic Infaunal Communities Following Dredging and Dredged Material Disposal in Monterey Bay. Dredged Material Research Program, U.S. Army corp of Engineers, Tech. Rep. D-77-27 October 1977

48. Berkshire County Regional Planning Commission, Evaluation of Power Facilities: A Reviewers Handbook Pittsfield, Mass. 377 pages April 1974

49. Craddock, Donovan R. "Impact of Cooling Waters on the Aquatic Resources of the Pacific Northwest". Marine Fisheries Review, Paper 1220 November, 1976

50. E.P.A. Columbia River Thermal Effects Study, Vol.I, Biological Effects Studies U.S. Env. Prot. Agency 1971.

51. Olson, P.A., and R.F. Faster, "Temperature Tolerance of Eggs and Young of Columbia River Chinook Salmon." Trans. Amer. Fish Soc. 85: 203-207, 1955

52. Ebel, Wesley J. "Supersaturation of Nitrogen in the Columbia River and its Effects on Salmon and Steelhead Trout." Bureau Comm. Fish., Fish. Bull. 68 vol. 1: 1-11. (1970)

53. Major, Richard L, and James L. Mighell, "Influence of Rock Reach Dam and the Temperature of the Okanagon River on the Upstream Migration of Sockeye Salmon". U.S. Fish and Wildlife Service Fish. Bull. 66: 131-147 (1967)

54. Baxter, R.M. and Pierre Glaude. Environmental Effects of Dams and Impoundments in Canada. Department of fisheries and Oceans. Ottowa, 1980.

55. Brett, J.R., "Temperature Tolerance in Young Pacific Salmon Genus Oncorhynchus" Jour. Fish. Res. Brd. Can. 9(6) 265-270. 1952

56. Swisher, Randall, Director, energy policy for National Assoc. of Counties Quoted in the Wall Street Journal, "Utah County Gets Skeptical About Growth." October 7, 1982 page 40.

57. Johanson, Scott, County Attorney, Emery County, Utah. Ibid.

58. Council on Environmental Quality. Tenth Annual Report; Environmental Quality, 1979. Washington D.C. December, 1979.

59. Daily Astorian. "Muddied Walluski River 'running clear' again." Astoria, OR: August 10, 1982, page 11.

60. Baldwin, Pamela L. and Malcolm F. Baldwin. Onshore Planning for Offshore Oil. The Conservation Foundation, Washington D.C. 183 pages. 1975

61. U.S. Army Corp of Engineers. Draft EIS. Construction and Operation of Pacific Fabricators Steel Structure Fabrications Yard at Warrenton, Oregon. Portland District COE. Dec. 1977

62. O.S.U. Sea Grant. Oregon and Offshore Oil. OSU Sea Grant College Program, Corvallis, OR. Sept. 1978

63. Longley, William L., Rodney Jackson, and Bruce Snyder. Managing Oil and Gas Activities in Coastal Environments. U.S. Fish and Wildlife Service, FWS/OBS 78/54. June, 1978

64. Oceanographic Institute of Washington. "LNG and LPG Hazards Management in Washington State". Report to 46th Legislature, State of Washington by the Oceanographic Commission of Washington. 1978

65. Oceanographic Institute of Washington. LNG and LPG Hazards Management: A Bibliography. Technical Report No. 3, 1979.

66. Boesch, Donald F., Carl H. Hershner, and Jerome H. Milgram. Oil Spills and the Marine Environment. Ballinger Publishing co., Cambridge Mass. 114 pp 1974.

67. U.S. Environmental Protection Agency. Oil Spills and Spills of Hazardous Substances. Office of Water Program Operations. March, 1977

68. Evans, Dale R., and Stanley D. Rice. "Effects of Oil on Marine Ecosystems: A Review for Administrators and Policy Makers". Fishery Bulletin Vol. 72, No.3. 1974

69. Oceanographic Institute of Washington. Oil Spill Cleanup Capacity on the Columbia River Basin. Executive Summary Nov. 1978

70. Sutherland, G. Bruce. Oil Spill Protection Plan for the Natural Resources of the Lower Columbia and Willamette Rivers. Oregon Department of Environmental Quality, Salem, OR. Nov, 1979

71. Blahm, Theodore H. et al. Columbia River Oil Spill Study: June-July 1978. U.S. Environmental Protection Agency. Dec. 1980

72. Time. "Antipollution Pillows". Vol. 120, No. 10. Sept. 6, 1982 p. 60.

73. Halstead, Robert J. "Air Quality Impacts of Coal Terminal Operation: Actual Problems." Revision of presentation at the Symposium on Coal Ports and Environmental Considerations, University of Washington, Seattle, Washington. June 4, 1982.

74. Port of Astoria. Clatsop County Airport Master Plan 1979-2000(preliminary) Environmental Impact Assessment Report. Astoria, Oregon. 1979

75. U.S. Army Corp of Engineers. Draft EIS. Port of Kalama Marine Industrial Park and Bulk-Handling Facility. Portland District USCOE Portland, OR. May, 1981

76. Oregon Journal. "Coal Terminal Also Means Pollution" Aug 18, 1982 p 15.

77. Waterfront World. "Hot Coal Ships Trouble Ports" Vol. 1, No.5. September/October 1982

78. Leach, Don. Soil Conservation Service, Astoria, Or. Personal Communication, 19 October 1982

79. Port of Vancouver. Final Environmental Impact Statement, Vancouver Coal Terminal. Vancouver, WA. May, 1982.

80. CREST. CREST Mitigation Policy Paper: Final Draft. Astoria, Or. June, 1982

81. Durkin, J. T. "Migration Characteristics of Coho Salmon (Onchorhynchus kisutch) Smolts in the Columbia River and its Estuary"In: Estuarine Comparisons, Victor S. Kennedy, Ed. Academic Press, New York. 709 pp. p. 365 - 376 1982.

82. Rhoads, Donald C., Peter L. McCall, Josephine Y. Yingst. "Disturbance and Production on the Estuarine Seafloor." American Scientist, Volume 66, pp 577-586. Sept.-Oct., 1978.

83. Browning, Rober J. Fisheries of the North Pacific, Revised ed. Alaska Northwest Publishing Co., Anchorage, Alaska. 423 pp. 1980

84. Collins, Gerald B. et al. The Snake River Salmon and Steelhead Crisis. Its Relation to Dams and the National Energy Crisis. National Marine Fisheries Service, Seattle, WA Feb. 1975

85. B.P.A. U.S.D.O.E. Columbia River Power For the People. Portland, OR 1981

86. Northwest Power Planning Council. Fish and Wildlife Program. Draft, Portland, Or. September 1982

DATE: NOVEMBER 23, 1982

MEMORANDUM FOR: ROBERT STOCKMAN
OFFICE OF POLICY AND PLANNING

FROM: PETER TWEEDT
OFFICE OF COASTAL ZONE MANAGEMENT

SUBJECT: END OF THE MONTH REPORT

DATE	EVENT DESCRIPTION	CONTACT
11/1/82	THE MARINE SANCTUARY SITE EVALUATION PROCESS (SEL) IN ALASKA HAS BEEN TERMINATED DUE TO CONGRESSIONAL CONCERN OVER PUBLIC MISUNDERSTANDING OF THE PROCESS. THE SEL IS A PRELIMINARY STEP IN IDENTIFYING POSSIBLE SITES FOR MARINE SANCTUARY DESIGNATION. NOAA IS PRESENTLY EVALUATING THE INITIAL LIST OF SITES PROPOSED FOR THE SEVEN OTHER COASTAL REGIONS. A LIST OF PROPOSED SITES IS SCHEDULED FOR PUBLICATION IN THE FEDERAL REGISTER IN EARLY JANUARY.	BYRNE
11/1/82	GRANTS WERE MADE TO CALIFORNIA: $95,100 UNDER THE MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT FOR MANAGEMENT OF THE POINT REYES AND CHANNEL ISLANDS NATIONAL MARINE SANCTUARIES; $400,000 UNDER SECTION 315(1) OF THE CZM ACT TO PROVIDE FOR A THIRD YEAR OF OPERATING AND MAINTAINING THE ELKHORN SLOUGH NATIONAL ESTUARINE SANCTUARY AND FOR LAND ACQUISITION, MARSH RESTORATION, AND CONSTRUCTION OF ACCESS FACILITIES AND AN INTERPRETIVE CENTER.	BYRNE
11/4/82	MEETINGS BETWEEN OCZM AND VIRGINIA OFFICIALS WERE HELD TO DISCUSS THE DEVELOPMENT OF A FEDERALLY APPROVABLE VIRGINIA COASTAL MANAGEMENT PROGRAM. SINCE BEING DROPPED FROM THE FEDERAL PROGRAM IN 1979, THE STATE HAS PASSED LEGISLATION WHICH INCREASES ITS AUTHORITY OVER COASTAL RESOURCES, AND, THUS, ENHANCES ITS ABILITY TO DEVELOP AN APPROVABLE PROGRAM. A DRAFT PROGRAM IS PRESENTLY BEING REVIEWED BY THE STATE ATTORNEY GENERAL.	BYRNE
11/7-10/82	AN OCEAN STUDIES SYMPOSIUM WAS HELD IN ASILOMAR, CALIFORNIA, SPONSORED IN PART BY THE CALIFORNIA COASTAL COMMISSION UNDER A GRANT FROM THE WILLIAM F. DONNER FOUNDATION. A RANGE OF OCEAN MANAGEMENT ISSUES WERE DISCUSSED AND PROCEEDINGS ARE BEING PREPARED. IN ADDITION, A REPORT WILL BE ISSUED RECOMMENDING ACTIONS THE STATE SHOULD TAKE OVER THE NEXT FEW YEARS TO MANAGE BETTER ITS NEARSHORE OCEAN RESOURCES.	BYRNE

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