4.7 Cumulative Effects

4.7.1 Introduction

4.7.1.1 Approach

Cumulative Effects

These effects constitute the impact on the environment that results from the incremental impact of the action under consideration when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions (40 CFR 1508.7).

Cumulative effects result from the incremental impact of the proposed action and alternatives when added to other past, present, and reasonably foreseeable future actions, regardless of what government agency or private entity undertakes such actions. Cumulative effects can result from individually minor impacts that when viewed collectively over space and time can produce significant impacts.

For clarity in presenting the issues related to TAPS operation under renewal, the proposed action has been carefully defined. This was done to focus attention on the conditions under which the TAPS might continue to operate. Nevertheless, there are a number of other actions, significant in geographic extent and economic scope, that directly or indirectly depend on or take advantage of the operations of the TAPS. These actions include, but are not limited to, petroleum development and production, petroleum refining, and petroleum transportation beyond the boundaries of the TAPS. For this EIS, such actions are assessed and included in this section on cumulative impacts, together with other actions that may have similar impacts to continued TAPS operations. This approach was used to allow the decision maker to view the overall environmental impacts of all actions in the cases where TAPS operations continued and in the case of the no-action alternative.

The approach used in this cumulative impact assessment is to first evaluate the cumulative impacts of all actions, including the proposed action and other reasonably foreseeable future actions. Then the degree to which the proposed action contributes to those impacts is presented. Finally, the cumulative impacts of the alternatives (less-than-30-year renewal and no action), together with other reasonably foreseeable actions, are discussed. Comparisons are then made between cumulative impacts including the proposed action and cumulative impacts, including the alternatives.

For this EIS, the relationship between the proposed action (30-year renewal) and the less-than-30-year renewal alternative is primarily one of time dependency. Because the other actions evaluated for cumulative impacts with the proposed action could also all occur within the next 10 to 15 years, they were included in assessing cumulative impacts with the less-than-30-year alternative. The less-than-30-year alternative differs somewhat from the proposed action in that, for a short renewal period, uncertainities associated with future renewals might result in some reductions in investments in future North Slope oil exploration and development. For the cumulative analysis, this time-dependent effect is considered highly speculative and could vary widely under different economic conditions, including projected future demand for petroleum products. The cumulative impact analysis assumes that, for the life of TAPS renewal, North Slope activities would remain within the upper and lower bounds necessary to sustatin the range of TAPS oil transport assessed elsewhere in this EIS for the proposed action. For the cumulative analysis it was also assumed that at the end of a less-than-30-year renewal period, either an additional renewal period would be granted or the TAPS operation would be terminated and pipeline facilities removed.

For this EIS, the relationship of the proposed action to the no action alternative is reversed from the usual situation found in NEPA analyses of proposed actions for new facilities or new plans. For this EIS, the proposed action is reauthorization, and the potential impacts would be largely related to forecasts of future continuing operations of an existing system. At the time of grant expiration, this system will have been in operation for 30 years following 3 years of construction, and its impacts have received continuous study. For this EIS, the no-action alternative (the alternative in which the responsible agency takes no action on the proposal to reauthorize continued operations) could trigger a new action, which is to cease operating and remove the existing system. The no-action alternative has not received detailed engineering and environmental study, and its description is less well developed than the proposed action description. Nevertheless, the major steps triggered by the no-action alternative are known and can be analyzed sufficiently to provide a comparison with the proposed action. The no-action alternative involves many major activities, including construction-like activities; removal of facilities would require a large workforce and generate large amounts of wastes. In addition, other actions, including industries that depend upon the TAPS operation, would be affected. The assessment of the no-action alternative in Section 4.6 concludes that in most cases, the environmental impacts of the no-action alternative would result in a greater change in impacts to the existing environment than the impacts of the proposed action. Where this cumulative impact assessment (Section 4.7) differs from the earlier impact sections, is that the resultant effect of no action on other reasonably foreseeable future actions is also considered in the impact assessment. The operation of the TAPS supports and is a requirement for other ongoing activities, and is an integral part of the Alaskan economy.

4.7.1.2 Method

The analysis of cumulative impacts focuses on specific human resources or environmental receptors that can be affected by the incremental impacts. Generally, the geographic area for a cumulative impact analysis is defined by the specific resource or receptor of concern and the spatial extent of the interacting (cumulative) impact generators. The temporal extent of the cumulative analysis extends from the past history of impacts to each receptor through the anticipated life of the project, including additional time necessary for decommissioning and restoration, if appropriate. In many cases, the past history of impacts of human activities are reflected in the description of the existing environment in Chapter 3.

Cumulative impact analysis, by definition, incorporates an extensive range of potential stressors and thus provides a decision maker and the public with an overview of the condition (past, present, future) of a receptor or resource within a regional or landscape context. A broader overview of the set of potential impacts to a resource allows the decision maker to place the direct and indirect impacts of the proposed action within the context of other potential stressors.

The Council on Environmental Quality discussed the assessment of cumulative effects in detail in its report entitled *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997). Although it is not formal guidance, the handbook provides assistance in developing an analysis. The handbook identifies 10 steps for assessing cumulative impacts prior to implementation of a proposal. These steps are listed here and in Figure 4.7-1.

1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.

2. Establish the geographic scope for the analysis.

3. Establish the time frame for the analysis.

4. Identify other actions affecting the resources, ecosystems, and human communities of concern.

5. Characterize the resources, ecosystems, and human communities

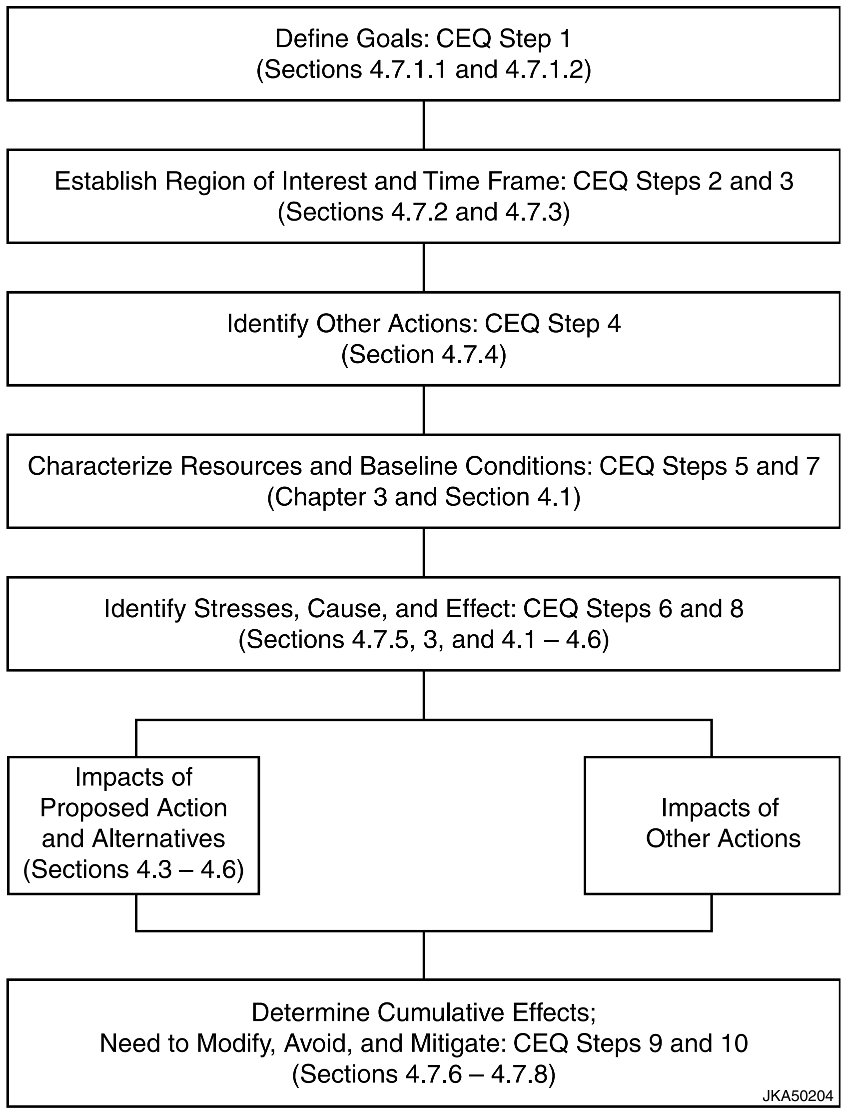

FIGURE 4.7-1 Cumulative Assessment Approach for This EIS

identified during scoping in terms of their response to change and capacity to withstand stresses.

6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds.

7. Define baseline conditions for the resources, ecosystems, and human communities.

8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.

9. Determine the magnitude and significance of cumulative effects.

10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.

The approach used for the cumulative impact assessment discussed in this EIS includes the 10 steps identified in the CEQ approach (Figure 4.7-1). Cumulative effect issues were initially identified during scoping and in consultations with Alaska Native groups (Step 1), as discussed in Chapters 1 and 2. Additional issues and actions were added later as they were identified. Next in the analysis, the region of interest (Step 2) and the time frame (Step 3) were established. Then other actions that previously had, now have, or would have similar impacts to those of the proposed action were identified (Step 4). The affected environment described in Chapter 3 was used to characterize the resources, ecosystems, and human communities of concern (Step 5); characterize the past and present stresses affecting these elements (Step 6); and establish baseline conditions (Step 7). Both the proposed action and other actions would generate similar factors that could cause impacts to the physical, ecological, human, and/or economic environment. These individual contributions were evaluated (Step 8) and aggregated, and it is this aggregate (the total contributions from all actions to the impacting factor) that was used to assess the cumulative effect (Step 9).

Cumulative impacts can be additive, less than additive, or more than additive (synergistic). In cases where the contributions of individual actions to an impacting factor were uncertain or not well known, a qualitative evaluation of cumulative impacts was necessary. A qualitative evaluation of cumulative effects covered the locations of actions, times they would occur, degrees to which the impacted resource is at risk, and potential for long-term and/or synergistic effects. Recommendations for future modifications to the alternatives and the means for future monitoring or mitigation of effects were identified if needed (Step 10). A further discussion of the approach used for cumulative effects analysis is found in Appendix A, Section A.16.

4.7.2 Regions of Interest

In order to determine which actions should be included in a cumulative effects analysis in this EIS, the region of interest must first be defined. This region should not be limited to just the location of the proposed action but should also take into account the distance that effects may travel and the regional characteristics of the affected resources.

The cumulative impact analysis in this EIS considers past, present, and future actions that previously occurred, occur now, or are expected to occur near the TAPS or within the areas affected by the TAPS. Table 4.7-1 summarizes the regions of interest examined for cumulative effects for different subjects. For the purposes of the physical and ecological environment analyses in this EIS, these areas include the (1) Beaufort Sea, (2) North Slope, (3) Interior Alaska, and (4) Prince William Sound, and (5) the Gulf of Alaska and Pacific Ocean tanker routes to west coast and Asian ports (Volume 7, Map 4.7-1).

Actions and impacts in the Beaufort Sea and North Slope are described for an area extending from Barrow in the west to the U.S./Canadian border (east of the Arctic National Wildlife Refuge [ANWR]) in the east and from the Beaufort Sea in the north to the crest of the Brooks Range in the south. This area includes the ranges of migratory mammal species that could be impacted by the TAPS and by North Slope petroleum development activities, and it also includes communities that would be affected by impacts to these important subsistence resources and by employment impacts (Map 4.7-2).

Interior Alaska includes areas adjacent to the TAPS, from the crest of the Brooks Range in the north to Thompson Pass near Valdez in the south. It also includes nearby portions of the Yukon River drainage west of the TAPS and the Copper River drainage east of the TAPS because they might be affected by a petroleum spill (Map 4.7-3).

With regard to Prince William Sound and Copper River delta and adjacent lands, this area is affected by activities at the end of the TAPS, including activities associated with the Valdez Marine Terminal and tanker transport of oil through the sound. Tanker routes through the Gulf of Alaska to the U.S. West Coast and to the Eastern Pacific are included for the purpose of addressing the potential impacts of oil

TABLE 4.7-1 Regions of Interest for the Cumulative Assessment

	Beaufort Sea/ Alaska North Slope	Interior/ TAPS ROW	Prince William Sound/Valdez	Gulf of Alaska/ Pacific Ocean	State of Alaska
Soils and permafrost	X	X			
Sand, gravel, and quarry resources	X	X			
Paleontology	X	X	X		
Surface water resources	X	X	X		
Groundwater resources	X	X	X		
Physical marine environment			X	X	
Air quality	X	X	X		
Noise	X	X	X		
Transportation	X	X			
Wastes	X	X	X		
Human health and safety	X	X	X		
Terrestrial vegetation and wetlands	X	X	X		
Fish	X	X	X		
Birds and mammals	X	X	X	X	
Threatened and endangered species	X	X	X	X	
Subsistence	X	X	X	X	
Sociocultural systems	X	X	X		
Economics					X
Cultural resources	X	X	X		
Land use and coastal zone management	X	X	X		
Recreation, wilderness, and aesthetics	X	X	X		
Environmental justice	X	X	X	X	

transportation on marine and coastal resources (Map 4.7-4).

For the purposes of the economic analysis in this EIS, the region of interest for cumulative impact analysis is considered to be the entire State of Alaska. This is because the economic implications of the TAPS and North Slope petroleum development are statewide. In addition, a natural gas transportation pipeline would also have impacts on the state's economy through employment, expenditures, and fees.

4.7.3 Time Frames of Actions

4.7.3.1 Reasonably Foreseeable Future Actions

A cumulative impact analysis should incorporate the sum of the effects of past, present, and future actions, because the past influences the future, and impacts may accumulate or develop over time. The future actions specifically and generally described in this cumulative analysis are those that are "reasonably foreseeable." As a general rule, time frames for these actions fall within a planning horizon of less than the proposed action. These actions have either already occurred, are ongoing, are currently being implemented, are funded for future implementation, or are included in firm near-term plans. They are discussed further in Section 4.7.4. Types of proposals with firm near-term plans include these:

1. Proposals for which NEPA documents are in preparation or finalized;
2. Proposals in a detailed design phase;
3. Proposals listed in formal Notices of Intent published in the *Federal Register* or state publications;
4. Proposals that are funded;
5. Proposals for which enabling legislation has been passed; and
6. Proposals that have been submitted to federal and state regulators to begin the permitting process.

4.7.3.2 Proposals Considered but Excluded

Proposals that are in early stages of development and potential projects described in long-range planning documents are considered uncertain and speculative. These include the high-visibility and controversial proposal currently being discussed in Alaska and throughout North America for oil and gas production in the ANWR. The proposal to develop oil and gas production in ANWR, while it has strong proponents, is currently not feasible under existing regulations and laws. This proposal has not reached a state of development where legislative approval, regulatory review, funding, or permitting has begun. Another such proposal is for the construction and operation of a natural gas pipeline along a northern route through the Beaufort Sea into the Mackenzie Delta and from there to southern Canada and the United States. The proposal for a natural gas pipeline from the North Slope oil fields into the Mackenzie Delta would not be permitted under existing Alaska regulations dealing with rights-of-way through state lands. Neither of these proposals is considered in this cumulative effects analysis.

One proposal, which would otherwise have been included in this cumulative effect analysis because environmental analysis has been completed, is also considered uncertain and speculative at this time. This is the Liberty Project, designed to develop offshore oil reserves in the Beaufort Sea. It no longer has the support of its proponent.

Another speculative proposal by the State of Alaska for a permanent road west of Prudhoe Bay to the Village of Nuisqut on the Coville River has been talked about, but does not now have legislative or administrative approval or funding. This action is also considered uncertain and speculative and it is not included in the cumulative analysis.

4.7.4 Types of Actions

Table 4.7-2 lists the potential cumulative actions considered in this TAPS EIS. These actions include those of various federal and state agencies, communities, and individuals. The actions listed in the table include past, present, and future actions in the region of interest. Both actions related to the TAPS and actions unrelated to TAPS are described. Uncertain or speculative actions are not required to be included. Cumulative effects are not limited to the actions of one agency, one type of organization, or individuals. Because several agencies or individuals can create a similar type of environmental effect, all agencies and individuals having the same effect are included.

The actions listed in Table 4.7-2 are listed by region. Because actions in the Beaufort Sea, on the coast, or in upland North Slope areas might affect more than one of these areas, they are listed together. Actions related to petroleum transportation through the Gulf of Alaska and on to destination ports are also listed together. However, when appropriate, certain cumulative impact analyses may consider impacts in the

TABLE 4.7-2 Potential Contributions to Cumulative Effects in the Beaufort Sea, North Slope, Interior Alaska, and Prince William Sound

Type of Action	Beaufort Sea/North Slope			Interior	Prince William Sound; Pacific Region Transportation Routes
Oil and gas exploration, development, and production	• Locations (producing and undeveloped) - Alpine - Badami - Burger - Cascade - Colville Delta-North (Nanuq) - Colville Delta-South (fiord) - East Barrow - East Kurupa - East Umiat - Eider - Endicott - Fish Creek - Flaxman - Gubik - Gwydyr Bay - Hammerhead	- Hemi Springs - Kavik - Kalubik - Kuvlum - Kuparuk River - Lisburne - Meade - Mikkelson - Midnight Sun - Milne Point - Niakuk - North Prudhoe Bay - Northstar - Prudhoe Bay - Pt. McIntyre - Pt. Thomson - Sag Delta - Sag Delta North	- Sagavanirktok River - Sandpiper - Schrader Bluff - Sikulik - Simpson - South Barrow - Sourdough - Square Lake - Stinson - Tabasco - Tarn - Thetis Island - Ugnu - Umiat - Walakpa - West Beach - West Sak - Wolf Creek	• Locations (undeveloped) - Copper River - Mid-Tanana	• None
	• Facilities and infrastructure - Central production facilities (CPFs) - Gas processing plants - Seawater treatment plants - Carrier pipelines - Power plants - Service industries at Deadhorse - Gravel sources - Roads - Landing strips - Waste treatment				

TABLE 4.7-2 (Cont.)

Type of Action	Beaufort Sea/North Slope	Interior	Prince William Sound; Pacific Region Transportation Routes
Oil refining	• Prudhoe Bay • Kuparuk	• Williams Alaska Petroleum (North Pole) • Petro Star (North Pole)	• Petro Star (Valdez)
Oil and refined product storage	• TAPS pump stations • Prudhoe Bay • Kuparuk • Communities	• Williams Terminal (Fairbanks International Airport) • TAPS Pump Stations • Communities	• Valdez Marine Terminal • Communities
Oil and gas transportation	• TAPS • Natural gas pipeline • Carrier pipelines • Fuel transfer from barges and other vessels	• TAPS • Natural gas pipeline • Interconnections of the TAPS to Williams and Petro Star Refineries (North Pole)	• TAPS • Interconnection of the TAPS to Petro Star Refinery • Valdez Marine Terminal • Oil tanker operations • Natural gas pipeline
Methane hydrates research	• Prudhoe Bay • Kuparuk		
Human habitation and development	• Towns and villages - Anaktuvuk Pass - Atqasuk - Barrow - Deadhorse - Kaktovik - Nuiqsut • North Slope Borough	• Cities, towns, villages - Arctic Village - Beaver - Chalkyitsik Chicken - Chistochina - Chitina - Coldfoot and Wiseman - Copper Center - Delta Junction - Eagle - Evansville/Bettles - Fort Yukon - Gakona	• Cities, towns, villages - Chenega Bay - Cordova - Eyak - Tatitlek - Tonsina - Valdez - Whittier • Kenai Peninsula - Borough

TABLE 4.7-2 (Cont.)

Type of Action	Beaufort Sea/North Slope	Interior	Prince William Sound; Pacific Region Transportation Routes
Human habitation and development (Cont.)		- Glennallen - Gulkana - Livengood - Manley Hot Springs - McCarthy - Paxson - Rampart - Slana - Stevens Village - Tanana - Venetie • Fairbanks-North Star Borough	
Transportation	• Air fields and strips • Dalton Highway • Private and commercial watercraft	• Air fields and strips • Railroads • Alaska Highway • Dalton Highway • Richardson Highway • Other roads • Private and commercial watercraft	• Air fields and strips • Railroads • Roads • Marine Terminals • Alaska Marine Highway • Personal and commercial - Watercraft - Fishing vessels - Tour boats - Container and bulk carriers

TABLE 4.7-2 (Cont.)

Type of Action	Beaufort Sea/North Slope	Interior	Prince William Sound; Pacific Region Transportation Routes
Legislative actions related to land use	• Alaska Native Claims Settlement Act • Alaska National Interest Lands Conservation Act • Federal Coastal Zone Management Act • Alaska Coastal Zone Management Act	• Alaska Native Claims Settlement Act • Alaska National Interest Lands Conservation Act	• Alaska Native Claims Settlement Act • Alaska National Interest Lands Conservation Act • Federal Coastal Zone Management Act • Alaska Coastal Zone Management Act • Prince William Sound Regional Advisory Board
Land management	• U.S. Department of the Interior • North Slope Borough (Coastal Zone Management Program and Comprehensive Plan) • Native corporations	• U.S. Department of the Interior • U.S. Department of Agriculture • Alaska Department of Natural Resources • Dalton Highway Advisory Board • Military - Ft. Greely (Delta Junction) - Ft. Wainwright (Fairbanks) - Eielson Air Force Base (near Fairbanks) • North Star Borough • Native corporations	• U.S. Department of the Interior • U.S. Department of Agriculture • Alaska Department of Natural Resources • Military • City of Valdez • Native corporations

TABLE 4.7-2 (Cont.)

Type of Action	Beaufort Sea/North Slope	Interior	Prince William Sound; Pacific Region Transportation Routes
Natural resource use	• Subsistence • Recreational development - Tourism - Hunting and fishing • Mining (gravel)	• Subsistence • Recreational development - Tourism - Hunting, fishing - Pipeline viewing areas - Campgrounds - Boat launches - Visitor centers • Commercial development • Commercial fishing • Mining (minerals, gravel) • Logging	• Subsistence • Recreational development - Tourism - Hunting, fishing - Pipeline viewing areas - Campgrounds - Boat launches, harbors - Visitor centers • Commercial development • Commercial fishing • Mining (minerals) • Logging
Petroleum spills	• Production and exploration • Transportation	• Transportation	• Transportation

Beaufort Sea and the North Slope separately, depending on the distribution of the affected resources. Similar actions have been grouped together and listed by type in Table 4.7-2. Included are various actions associated with the petroleum industry, human habitation (these actions include various human and industrial activities), transportation, legislation affecting land control and use, land management activities and plans, natural resource use, and petroleum spills.

4.7.4.1 Oil and Gas Exploration, Development, and Production

4.7.4.1.1 Resources. Oil and gas exploration, development, and production have been ongoing for a number of years on the North Slope (see Map 4.7-5). The state of Alaska currently estimates that the North Slope oil reserves contain 12.8 billion bbl (ADNR 2000a). The federal government estimates that an additional 22.5 billion bbl of oil and 22.5 trillion ft^3 of natural gas are contained in the Arctic Outer Continental Shelf. An estimated 2.1 billion bbl of oil and 8.5 trillion ft^3 of gas are contained in NPR-A, and between 5.7 and 16 billion bbl of oil are contained in structures under the coastal plain of ANWR. While development within ANWR cannot be assumed, it is likely that oil and gas exploration, development, and production will continue on the North Slope, including NPR-A and offshore.

Current and projected oil and gas exploration, development and production are summarized in Table 4.7-3 (National Energy Policy Development Group 2001). In addition to the areas listed in the table, the Mid-Tanana and Copper River Basins in the Interior Alaska are being studied to determine their oil and gas potential, and lease sales are planned. Research is also ongoing on the North Slope to characterize methane hydrate deposits.

4.7.4.1.2 Facilities and Infrastructure. Petroleum production involves a number of ancillary facilities and supporting infrastructures, including well pads, gas processing plants, seawater treatment plants, carrier pipelines, power plants, gravel sources, roads, landing strips, and service industries. Oil development and production sites on the North Slope and in the Beaufort Sea use different technologies as a function of the time they were constructed and their remoteness from existing logistics sites. However, a generalized diagram is presented in Figure 4.7-2. Over the 35-year interval since the first wells were drilled at Prudhoe Bay, the technology and operating practices have changed considerably, resulting in a reduction in the size of the sites (details can be found in the web site presentation, “Arctic Energy”) (BP 2002a). Facilities enabled in remote locations, such as offshore, vary in configuration from those closer to principal infrastructure centers.

Future producing sites would be connected via a pipeline to the oil transfer network linked with the TAPS. The fields in the Prudhoe Bay area are serviced via the road network in that area. Nearshore operations, such as Endicott, are connected to the road network via causeways. Offshore operations, such as North Star, and potential new fields in the Beaufort Sea are or would be connected to shore only by air and marine transport. The newer onshore fields outside the existing road network, such as Alpine, are not connected to other oil fields by a permanent gravel road; instead, winter ice roads are used to move heavy equipment and materials. Aircraft and marine transport, where practical, are used to transport changing crews and lighter cargo items.

Well pads are gravel pads containing the wellheads and the equipment and personnel required to get oil out of the ground into gathering lines, to processing facilities, then into carrier pipelines. Drill sites (or production stations) are both individually smaller and fewer in number to produce a given deposit. Well spacing is tighter, both because drilling technology has improved and because earlier concerns about potential well damage caused by permafrost melting have been resolved. A wider subsurface area can now be reached from a smaller, single surface location through directional drilling, and multilateral and horizontal drilling techniques expand the oil reservoir that can be reached by a single well. Theoretically, a single drill site of 8 acres which

TABLE 4.7-3 Oil Fields Located in Alaska and the Arctic Outer Continental Shelf

Field	Unit	Product	Status	Operator	Began Production	Projected End of Production
Alpine	Colville River	Oil	Producing	Phillips Alaska, Inc.	2000	
Badami	Badami	Oil and gas	Producing	BP Exploration (Alaska), Inc.	1998	2008
Burger	Outer Continental Shelf	Oil and gas	Undeveloped	Shell		
Cascade	Milne Point	Oil	Producing	BP Exploration (Alaska), Inc.	1996	
Colville Delta	Colville	Oil	Undeveloped	Phillips Alaska, Inc.		
East Barrow		Gas	Producing	North Slope Borough	1981	
East Kurupa		Gas	Undeveloped			
East Umiat		Gas	Shut	UMC Petroleum		
Eider	Duck Island	Oil	Producing	BP Exploration (Alaska), Inc.	1998	
Endicott	Duck Island	Oil	Producing	BP Exploration (Alaska), Inc.	1987	
Fiord	Colville River	Oil	Undeveloped	Phillips Alaska, Inc.		
Fish Creek	NPR-A	Oil	Undeveloped			
Flaxman	Point Thomson	Oil	Undeveloped	ExxonMobil		
Gubik		Gas	Undeveloped			
Gwydyr Bay		Oil	Undeveloped	BP Exploration (Alaska), Inc.		
Hammerhead	Outer Continental Shelf	Oil	Undeveloped	Chevron		
Hemi Springs		Oil	Undeveloped			
Kalubik		Oil	Undeveloped	Phillips Alaska, Inc.		
Kavik		Gas	Undeveloped	Phillips Alaska, Inc.		
Kuparuk River	Kuparuk River (Greater Kurak Area) Kura	Oil and gas	Producing	Phillips Alaska, Inc.	1981	
Kuukpik	Kuukpik	Oil and gas	Exploration	Phillips Alaska, Inc.		
Kuvlum	Outer Continental Shelf	Oil	Undeveloped	Chevron		
Liberty	Outer Continental Shelf	Oil	Undeveloped	BP Exploration (Alaska), Inc.		
Lisburne	Prudhoe Bay	Oil and gas	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.	1986	
Meade	NPR-A	Gas	Undeveloped			
Midnight Sun	Prudhoe Bay	Oil	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.		
Mikkelson		Oil	Undeveloped	ExxonMobil; Phillips Alaska, Inc.		

TABLE 4.7-3 (Cont.)

Field	Unit	Product	Status	Operator	Began Production	Projected End of Production
Milne Point	Milne Point	Oil and gas	Producing	BP Exploration (Alaska), Inc;	1985	
Niakuk	Prudhoe Bay	Oil	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.	1994	
North Prudhoe Bay	Prudhoe Bay	Oil and gas	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.	1993	2006
Northstar	Northstar	Oil and gas	Producing	BP Exploration (Alaska), Inc;	2001	2015
Point McIntyre	Prudhoe Bay	Oil and gas	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.	1993	
Point Thomson		Oil and gas	Undeveloped	ExxonMobil		
Prudhoe Bay	Prudhoe Bay	Oil	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.	1977	
Sag Delta North	Duck Island	Oil	Producing	BP Exploration (Alaska), Inc.	1989	
Sagavanirktok River	Milne Point	Oil	Producing	BP Exploration (Alaska), Inc.	1994	
Sandpiper	Outer Continental Shelf	Oil	Undeveloped	Murphy		
Schrader Bluff	Milne Point	Oil and gas	Producing	BP Exploration (Alaska), Inc.	1991	
Sikulik		Gas	Undeveloped	North Slope Borough		
Simpson	NPR-A	Oil	Undeveloped			
Sourdough	Point Thomson	Oil	Undeveloped	BP Exploration (Alaska), Inc.		
South Barrow		Gas	Producing	North Slope Borough		
Square Lake	NPR-A	Gas	Undeveloped			
Stinson		Oil	Undeveloped	Phillips Alaska, Inc.		
Tabasco	Kaparuk River (Greater Kurak Area) Kura	Oil and gas	Producing	Phillips Alaska, Inc.	1999	
Tarn	Kaparuk River (Greater Kurak Area) Kura	Oil and gas	Producing	Phillips Alaska, Inc.	1999	
Thetis Island		Oil	Undeveloped	Anardarko		
Ugnu	Kaparuk River (Greater Kurak Area) Kura	Oil	Undeveloped	Phillips Alaska, Inc.		

TABLE 4.7-3 (Cont.)

Field	Unit	Product	Status	Operator	Began Production	Projected End of Production
Umiat		Oil	Producing	U.S. Department of the Interior		
Walakpa		Oil	Producing	North Slope Borough	1992	
West Beach	Prudhoe Bay	Oil and gas	Producing	BP Exploration (Alaska), Inc.; Phillips Alaska, Inc.	1994	2016
West Sak	Kuparuk River (Greater Kurak Area) Kura	Oil	Producing	Phillips Alaska, Inc.	1998	
Wolf Creek	NPR-A	Gas	Undeveloped			

Source: ADNR (2000a).

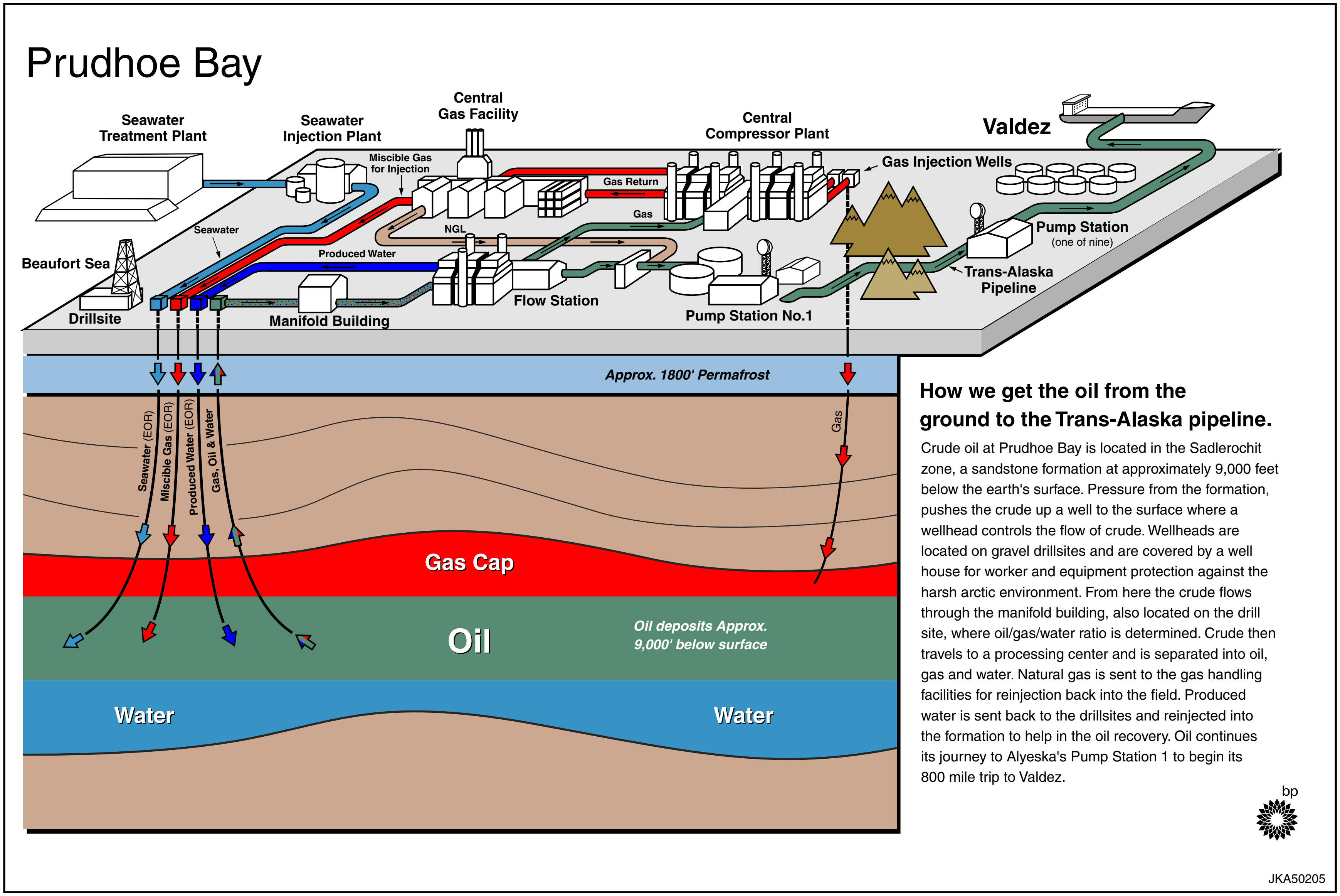

FIGURE 4.7-2 Generalized Schematic of Prudhoe Bay Oil Production (Source: BP 2002b)

is large even by Prudhoe Bay standards could cover a subsurface area that is 8 mi in diameter (more than 32,000 acres) (BP 2002a).

Site-specific conditions and available technology dictate the facilities' requirements and the size of the site footprint. Small fields with a single production pad and airstrip could have a footprint of approximately 50 acres. Larger fields with multiple pads and service roads could have footprints of up 200 acres. The newer production sites have well spacings of 10 to 20 ft on a pad (well spacings for older sites were 120 to 160 ft). Some of these wells are needed for reinjecting gas, water, or other fluids into the oil reservoir to improve oil recovery or for disposal of produced water into other authorized formations. The number of wellheads per production pad is determined by the economics and geology associated with developing the oil reservoir.

The number of pads needed depends on the methods of drilling and the depth to the oil reservoir. Conventional, vertically drilled wells have a horizontal distance (reach)-to-depth ratio of 1:1. Thus, for a reservoir at a depth of 8,000 ft, the reach for each pad would be 8,000 ft, so the production pads would be separated by roughly 16,000 ft. Currently, the greatest reach-to-depth ratio on the North Slope is 2:1. It occurs at a well in the Niakuk field (ratio of 18,098-ft reach to an oil reservoir depth of 9,445 ft) (BLM 1998).

A central production center (CPF) (also known as a flow station [Prudhoe Bay] or fathering center [western operating area]) manages well production and produces sales-quality crude oil by separating oil, water, and gas. In addition to oil production equipment, the CPF or nearby areas commonly include living quarters, eating and recreational areas, administrative areas, maintenance shops, vehicle parking, fuel and water storage tanks, power generators, wastewater management facilities, and a communications center. The types of services provided at a CPF, its crew size, and the size of its facilities depend on the size of the operations and the CPF's proximity to existing logistical support. Buildings are supported on pilings to mitigate ground settling or frost heaving. Production equipment includes oil, gas, and water separators and other equipment that condition and transport the oil and that manage the water and gas that have separated from the oil. Each oil-gas-water separation facility is equipped with gas detection, fire, and trouble alarm systems; several fire suppression systems; and fire water storage tanks. Each facility can also flare natural gas when the need arises to rapidly shut down a facility (BLM 1998).

The maintenance of existing oil fields and the development of new fields require continued support activities, including the extraction of gravel from borrow areas and the use of local water supplies, except where salt water can be used. To maintain existing facilities, these resources would likely be used at the current rate. The pace of new development would determine if additional personnel and logistics support beyond the current levels would be needed on the North Slope. However, new development would require the transport of additional equipment and materials to, and within, the North Slope and Beaufort Sea areas.

It is possible that sources of gravel for the development of new fields in the NPR-A may be limited to existing sources, although gravel requirements for NPR-A development have not been established. Gravel might have to be transported from borrow pits used by the existing oil fields, roadways, and the TAPS. However, the gravel need within the NPR-A has not been quantified, and the possibility exists that locally generated crushed rock and other materials could substitute for gravel (BLM 1998). In the vicinity of Prudhoe Bay and along the TAPS, numerous material sites provide gravel. Gravel sources include state-permitted deposits near the rivers and stream that parallel the TAPS (e.g., Sagavanirktok River, Atigun River, and Kuparuk River.

The reservoirs tapped by the North Slope wells are under pressure. To increase the oil recovered, other wells are drilled to inject water or gas into the field to maintain the pressure within the reservoirs. Gas is produced from the well with the oil and is reinjected into the reservoir. Water is obtained from the water extracted with the oil and from water wells and surface sources. Seawater may be used as a water source for sites where it is practical to construct a seawater intake, treatment plant, and insulated pipeline delivery system. A Prudhoe Bay pressure maintenance program that included seawater injection into the reservoir was initiated in 1984. The scope of the $2 billion program includes a distribution system, seawater treatment plant, and pumping systems. Today, produced water has increased in volume and has largely replaced seawater as a secondary recovery fluid.

The need for water for new development and production would be met from local freshwater supplies or seawater. The water supplies currently used by the existing oil fields and TAPS would not be affected. However, wastewater would likely be placed in existing EPA-approved injection wells that are used by the existing oil fields and TAPS facilities.

Similarly, solid waste management facilities used by existing oil fields and TAPS would likely be used in new development and production (BLM 1998). Waste generation rates would likely be similar to the rates of existing facilities. Today, for existing fields as well as new development, grinding and subsurface injection are used to dispose of drilling muds and cuttings after sand and gravel have been reclaimed for reuse (BLM 1998). This practice reduces the amount of oil field waste. The total quantities of wastes generated from new oil fields cannot currently be predicted because the extent of the new development and production cannot be predicted.

BP operates a Central Compression Plant and Central Gas Facility on the North Slope. This facility is devoted primarily to processing and handling the enormous quantities of natural gas produced by oil wells in Prudhoe Bay. This gas is then reinjected into the reservoir. In addition, this facility provides compressed natural gas (CNG) for fueling trucks and other vehicles. The facility is designed to fuel 20 vehicles per hour. A total of 70 CNG vehicles have already been added to BP's Prudhoe Bay fleet, and plans are to convert the entire 450-vehicle fleet from diesel fuel to CNG over the next 3 years (BP 2000b).

Carrier pipelines are used to transfer oil from the production stations at the oil fields to the TAPS. Elevated pipelines are typically used in the North Slope oil fields to prevent heat transfer from the hot oil in the pipeline to frozen soils, since heat would degrade the permafrost. Carrier pipelines from offshore production facilities are on the sea floor. Elevated pipelines are relatively easy to maintain and are visually inspected for leaks. Because they can restrict the movements of caribou and other wildlife, both TAPS and North Slope producers have implemented resources to allow for safe passage of caribou and other large mammals. Buried pipelines are feasible in the Arctic provided that the integrity of the frozen soils is maintained. Such pipeline configurations have been used in the Milne Point area. Buried pipe is more difficult to monitor and maintain and must be insulated and operated so that the oil temperature will ensure that thaw settlement will be within tolerable limits. According to State of Alaska regulations, pipelines must be located to enable the containment and cleanup of spills, avoid significant changes in the migration patterns of herd animals, and allow fish passage (ADNR 1999).

Power is supplied to the oil fields by natural-gas-fueled turbines. Natural gas is obtained from the oil production wells. Diesel fuel is also used for some purposes and is supplied either by small refineries at the oil fields or by truck from Fairbanks.

Exploration is now generally limited to winter in order to minimize the impact of moving equipment over exposed tundra to avoid interference with animals, and avoid the need to build permanent roads. Ice roads and drilling pads spread the weight of the equipment over the ground surface and minimize the contact of the equipment with the soil surface. Their locations are almost undetectable when they melt. Production areas remote from permanent roads may be built and maintained by using only ice roads in the winter and access by air strip or water during the summer.

Major aviation facilities are located at Barrow, Deadhorse, and Kuparuk. In addition, there is a gravel airstrip at Nuiqsut. Smaller airstrips link remote oil sites with the larger aviation facilities. These airstrips are typically made of gravel, measure 150 to 200 ft wide and 5,000 to 6,000 ft long, and are built to serve the needs of the site and not the local area.

Deadhorse was established to support oil development at Prudhoe Bay and is not a community in the traditional sense. It is not controlled or managed by the North Slope producers. The private support companies are located on state-leased land. Services include three hotels that offer meals, a general store that doubles as a post office, and two gas stations. Tire and vehicle repair facilities are also available, as are an auto parts store and hardware store. The North Slope Borough operates a solid waste facility at Deadhorse.

Public access is restricted beyond Deadhorse. Areas to the north, including the Arctic Ocean, can only be accessed via commercial tours, which operate from the hotels (Morris Communications Corporation 2001).

4.7.4.2 Oil Refining

Alaska has four merchant refineries and two smaller crude oil tapping plants in North Slope fields dedicated to producing oil for field use. Three of the merchant refineries are in the region of interest: two are at North Pole (near Fairbanks), and one is at Valdez. Most of the petroleum products produced by these refineries are used within Alaska. Williams Alaska Petroleum, Inc., owns and operates one of the petroleum refineries at North Pole. The refinery produces approximately 62,000 bbl/d of various petroleum products, including motor gasoline, naphtha, jet fuel, heating fuels, diesel fuels, gas, oil, and asphalt for both local supply and export. Approximately 60% of the refinery's product is jet fuel, which is supplied to various domestic and international airlines as well as to the U.S. military (Williams Energy 2002).

Petro Star operates the other refinery at North Pole. It produces 3,750 bbl/d of product, including kerosene, diesel fuel, and jet fuel for use in interior and northern Alaska (Petro Star 2002a). Petro Star also operates a refinery at Valdez that produces 10,000 bbl/d of refined product (ADNR 2000a). The refinery produces jet fuel, marine diesel and heating fuel for use in south-central and south coastal Alaska. The majority of the products are shipped out of the Valdez Petroleum Terminal, located approximately 6 mi from the refinery. The products are shipped to Anchorage, Kodiak, Dutch Harbor, and coastal Alaska by a leased barge (Petro Star 2002b).

These refineries obtain oil acquired by spur pipelines from the TAPS. Each extracts the lighter fractions from the crude oil to produce an array of refined products. The heavier fractions are returned to the TAPS via pipeline.

4.7.4.3 Oil Storage

Williams Energy operates a 20,000-bbl jet-fuel terminal at Fairbanks International Airport (Williams Energy 2002). Commercial fuel sales in Alaska increased from 1,507 million gal in 1995 to 1,788 million gal in 1999. Most of this increase was due to the increase in sales of jet fuel, which account for more than half of the total fuel sales in the state (900 million gal in 1999) (ADNR 2000a). Other storage facilities exist at the TAPS pump stations at Kuparuk and Prudhoe Bay and in communities throughout the region of interest.

4.7.4.4 Oil and Natural Gas Transportation

In addition to the major systems described below, refined products are shipped by truck from the three refineries to various end points.

4.7.4.4.1 Trans-Alaska Pipeline System. The TAPS has been described in detail in the earlier sections of this DEIS. It is listed here for completeness. The TAPS system assessed here includes the pipeline, pump stations, access roads, and the Valdez Marine Terminal.

4.7.4.4.2 Alaska North Slope Natural Gas Commercialization. This DEIS assumes that it is reasonably foreseeable that sometime in the next 30 years natural gas will be transported from the North Slope to market in Canada and the United States. At this time, it is premature to guess which proposal would ultimately be selected and implemented. There is a large quantity of natural gas within the Prudhoe Bay reservoir. In addition, there are undeveloped discoveries of natural gas in the area with projections for the discovery of substantially more gas if it were marketable. Since the discovery of the Prudhoe Bay field in

1968, planning for the commercialization of these gas deposits has been under way. A number of projects to market the gas have been proposed or conceptualized. These include several pipeline routes from the North Slope to the lower 48 states through Canada, a liquefied natural gas (LNG) project at Valdez, and a gas-to-liquids project on the North Slope. Although each of these projects has been studied, some extensively, none has been financed or built, principally because long-term natural gas prices in the target markets have not justified the cost and risk of the project. While it is not entirely clear that this gas will be commercialized, two possible gas commercialization projects are described in some detail below for purposes of this analysis to be the surrogate for whatever project might eventually be built.

A “southern” pipeline has been proposed to carry natural gas into Canada. One possible proposed route would parallel the TAPS until it reaches the Delta vicinity southeast of Fairbanks, then it would run roughly parallel to the Alaska Highway through the Yukon Territory and British Columbia into Alberta (Map 4.7-6). This proposal has been the subject of detailed study by the TAPS Owners, and legislation has been proposed for development of this proposal. Another proposal is for a northern route from Prudhoe Bay through the Beaufort Sea to the MacKenzie Delta then south through Canada. As already discussed, this proposal was not considered reasonably foreseeable. A third proposal is for a pipeline parallel to the TAPS into Valdez, where the natural gas would be liquefied for shipment. Although it is not clear which proposal might eventually be developed, it was considered reasonably foreseeable that sometime in the next 30 years a natural gas pipeline might be constructed. For the sake of analysis a hypothetical description of such a system follows.

A natural gas pipeline could consist of a large-diameter, 735-mi-long buried pipeline. It would run parallel to the TAPS from Prudhoe Bay to the vicinity of Fairbanks near Delta Junction, and from there, it would turn east, and of the TAPS region of interest. Key elements of such a project would be (1) a large CO_2 treatment plant on the North Slope, (2) the pipeline itself, (3) valve stations and compressor stations along the route, and (4) a possible natural gas liquid (NGL) recovery plant.

The gas treatment facility would remove acid gases (CO_2, H_2S) and compress and chill the gas to make it ready for transport. The pipeline would be 48 in. in diameter and constructed of high-strength steel. Compressor stations, valve stations, and intermediate pigging facilities would maintain gas pressure (about 2,500 psi), allow maintenance and pigging of the line, and provide safety features. Because the gas would contain ethane, propane, and other gas liquids, a NGL recovery plant might be needed to remove the heavier hydrocarbons (C_2+) for sale.

Construction of a natural gas pipeline could involve about 600 mi of buried pipeline in Alaska. The total project cost could be approximately $10 billion, of which $1 billion could be for the gas treatment facility and $2.5 billion could be for actual pipeline construction. Construction of the gas treatment facility could require about 3,000 person-years of labor, while construction of the pipeline could require about 7,500 person-years of labor. It is anticipated that the main construction effort could occur over a period of 3 to 5 years. The facilities could be labor-efficient and capital-efficient to operate, and could create direct employment of 300 to 400 permanent jobs (Goldsmith 2001; McGraw 2002).

Alternatively, conditioned natural gas could be transported by pipeline from the North Slope to Valdez, where the gas would be liquefied by a cryogenic process. The LNG would then be transported to various countries in specially designed cryogenic LNG tankers. Likely markets would include Japan, Korea, Taiwan, and possibly Mainland China (TAPS Owners 2001a).

This proposal could involve the construction of an 800-mi-long, 36- to 42-in. diameter, chilled pipeline, which could be buried adjacent to the TAPS. A 300-acre gas-conditioning facility could be built on the North Slope, and 10 main line compressor stations could be constructed along the pipeline route to maintain required operating pressures. The gas could be liquefied for shipment at an LNG plant that could be constructed at Anderson Bay, 3.5 mi west of the Valdez Marine Terminal. Additional construction at Anderson Bay could include storage tanks for the LNG and a marine terminal with two berths and loading facilities to accommodate LNG tankers with a capacity of 165,000 m^3.

It is projected that the gas volume would be about 2 billion ft^3/d for both the LNG and the pipeline export project. The capacity of the liquefaction facilities could be compatible, at 14 million tons/yr (29.3 m^3/yr). Fifteen tankers, each with a capacity of 125,000 m^3, would make about 275 loaded voyages per year to the Pacific Rim.

It is estimated that construction of this system would cost $4 billion for the pipeline and $8–10 billion for the other elements, including the tanker fleet. The estimated construction period would be 10 years. Public revenue, including property taxes, severance taxes, and royalties, would amount to about $377 million annually, depending on future energy prices. The economic life of the project is estimated to be 30 years.

4.7.4.4.3 Valdez Container Terminal Dock. The Valdez Container Terminal Dock is a 700-ft concrete floating dock, extending to 1,200 ft. The container dock is tied to a 21-acre marshalling yard by two 200-ft ramps. The dock is designed as a multipurpose berth to handle containerized, roll-on/roll-off and lift-on/lift-off operations. The marshalling yard contains a total area of 21 acres of land. A grain terminal consisting of nine concrete silos that are 112 ft tall and 33 ft in diameter and have a total capacity of 522,000 bushels is also located on the container terminal grounds (Valdez 2002).

4.7.4.4.4 Oil Tanker Operations. Oil tankers with cargo capacities ranging from 660,000 to 2,000,000 bbl are loaded with North Slope crude oil at the Valdez Marine Terminal which is controlled by the U.S. Coast Guard. North Slope crude oil is transported primarily to the west coast of the United States, with other shipments to Kenai, Alaska; the Hawaiian Islands; and the Asia Pacific market (TAPS Owners 2001a). In 1999, an average of 37 tankers per month were loaded at the Valdez Marine Terminal.

Tankers approach the Valdez Marine Terminal from the Gulf of Alaska via Hinchinbrook Entrance, and they follow dedicated traffic lanes to Valdez Arm and Valdez Narrows. The Prince William Sound Vessel Traffic System (VTS) controls the movement of tanker traffic into and out of the area. VTS closes Valdez to tanker traffic if conditions are hazardous.

Currently, the fleet serving the Valdez Marine Terminal consists of 26 tankers, including three with double hulls and 13 with double sides. However, the composition of the fleet will change to comply with the Oil Pollution Act of 1990, which requires that all tankers calling on U.S. ports have double hulls (double bottoms and sides) by the year 2015. According to the planned phaseout schedule for Prince William Sound tankers, the fleet will consist exclusively of double-hulled tankers beginning in 2014. The number of tankers will be reduced to 8 to 10 by 2020 (TAPS Owners 2001a).

APSC's SERVS is responsible for the safe transit of oil tankers from the Valdez Marine Terminal to international waters. Nine SERVS vessels have escort, docking, and response duties. At least two escort vessels are required for each laden tanker exiting Prince William Sound, and an additional escort may be added in inclement weather (TAPS Owners 2001a).

Map 4.7-7 shows the probable route that tankers bound from Valdez to the Far East would travel. They could carry up to 1.8 million bbl each; however, such estimates are highly speculative, because they depend on opportunities for short-term contracts (MMS 2002). The routing shown in Map 4.7-7 would bring the tankers more than 200 mi offshore of the Aleutian Islands. At a distance of 200 mi, oil spills are unlikely to significantly affect the Aleutian Islands.

Potential crude oil (and possibly liquefied natural gas tankerage from Valdez to the Far East will join existing liquefied natural gas tanker traffic from the liquefied natural gas plant in Nikiski, Alaska. Every 10 days, the Nikiski plant loads a tanker with 80,000 m^3 of liquefied natural gas for a round trip to Tokyo, which it has been doing since 1968 without significant spillage. Because liquefied gas would boil off and disperse quickly when exposed to normal air temperatures and winds in the North Pacific, it is not a major environmental threat along the tanker route (MMS 2002).

4.7.4.5 Habitation and Development

4.7.4.5.1 Beaufort Sea and North Slope. The North Slope Borough is the largest borough in Alaska, making up more than 15% of the state's total land area. It consists primarily of the north and northeastern coast of Alaska, including the Brooks Range, north of the Arctic Circle. Communities or areas of development located within the Borough within the region of interest include Anaktuvuk Pass, Atqasuk, Deadhorse/Prudhoe Bay, Kaktovik, and Nuiqsut (Map 4.7-2). With the exception of Deadhorse/ Prudhoe Bay, these communities are composed of primarily Alaska Natives or part Natives, and most inhabitants maintain lifestyles that rely heavily on subsistence activities. The oil and gas industry is also an important source of employment. The populations within these communities range from 200 to 500 people. The Borough population is about 4,600.

Deadhorse at Prudhoe Bay is a town dedicated to supporting the oil industry. Although it has only six permanent residents, more than 5,000 oil petroleum industry workers pass through Deadhorse on rotating work shifts. Development in Deadhorse is almost entirely related to the petroleum industry.
See Section 4.7.4.1.2 for more information on Deadhorse.

4.7.4.5.2 Interior. Interior Alaska has a number of communities that could contribute to cumulative impacts (Map 4.7-3). However, with the exception of Delta Junction/Big Delta, Fairbanks, and Glennallen/Copper Center, these communities are small, with populations of fewer than 200 people and no major industrial or commercial activities.

Delta Junction and Big Delta (no organized borough). Delta Junction is located at the convergence of the Richardson and Alaska Highways, approximately 95 mi southeast of Fairbanks. The city developed along the east bank of the Delta River, south of its junction with the Tanana River. Big Delta is located on the Richardson Highway at the junction of the Delta and Tanana Rivers. Delta Junction and Big Delta businesses provide services to traffic along the Richardson Highway. Fort Greely is located nearby. The surrounding area supports agriculture. The populations of Delta Junction and Big Delta in 2000 were 880 and 749, respectively.

Fairbanks North Star Borough. The Fairbanks North Star Borough is located in central Alaska and includes the cities of Fairbanks and North Pole. According to the 2000 census, the Borough's population was 82,840. The main campus of the University of Alaska is located at College in Fairbanks. Currently the Fort Knox and True North Gold Mines are expanding operations. The International Air Cargo landings at the Fairbanks International Airport have also expanded. The Fairbanks area serves as a regional service and supply center. The Alaska Railroad provides service to Fairbanks from Anchorage and Seward in the south and Eielson AFB in the east. The Borough is developing a plan for future growth and for an increase in population to 98,000 by 2018. Eielson AFB and Fort Wainwright are located nearby.

Glennallen/Copper Center. The communities of Glennallen and Copper Center are along the Richardson Highway, 189 mi (by road) east of Anchorage. The visitor's center and park headquarters for Wrangell-St. Elias NPP is located in Copper Center. Glennallen is the business hub of the Copper River region. Local businesses serve area communities and highway traffic, providing gasoline, supplies and services, schools, and medical care. State highway maintenance and federal offices are in Glennallen. The Wrangell-St. Elias Visitor Center and National Park Headquarters were recently completed (ADCED 2001).

4.7.4.5.3 Prince William Sound. Most of the communities bordering Prince William Sound are small (fewer than 200 people), with limited commercial and industrial activities (Map 4.7-4). In general, people in these communities have lifestyles that rely on subsistence or commercial fishing. Cordova, Kenai Pennisula Borough, and Valdez are larger areas of human habitation and thus have the potential to make a greater contribution to cumulative impacts.

Cordova is located on the southeastern end of Prince William Sound and is readily accessible to other communities only by air and water routes. Cordova serves as a fishing port and a tourist and recreational sports center. The population of Cordova in 2001 was about 2,500, including Eyak, a federally recognized Native village within the City of Cordova.

The Kenai Peninsula Borough lies directly south of Anchorage and is bordered by the Gulf of Alaska and Prince William Sound on the south and east. Cook Inlet divides the borough into two land masses. Cities within the Kenai Peninsula Borough include Homer, Kachemak, Kenai, Seldovia, Seward, and Soldotna. All communities are expanding in population and development. The population in 2000 was about 41,000.

Valdez is located on the north shore of Prince William Sound. In addition to being the southern terminus of the TAPS and Valdez Marine Terminal, the city is host to commercial fishing and shipping operations and is a port for commercial shipping, cruise ships, tour boat operations, and fishing. Valdez serves as a tourist and recreational sports center. Richardson Highway connects Valdez to Anchorage, Fairbanks, and Canada. The population in 2002 was estimated to be about 4,500 (Valdez 2002).

4.7.4.6 Transportation

4.7.4.6.1 Highways and Public Airstrips. In the areas traversed by the TAPS, the Richardson Highway connects Valdez with Fairbanks and the Dalton Highway connects Fairbanks with the North Slope. The Dalton Highway was formerly known as the “Haul Road” and was originally built and maintained by the TAPS Owners; it was closed to the public. It is now a state highway, is open to the public, and is maintained by Alaska’s Department of Transportation and Public Facilities.

4.7.4.6.2 Railroads. The state-owned Alaska Railroad and ferry system transports passengers and freight between Anchorage, Seward, and Whittier and Interior Alaska. Future expansion will be made to link the existing lines to the Ted Stevens Anchorage International Airport. The Alaska Railroad is also constructing a new depot and passenger facilities in Fairbanks and Whittier; realigning its track in the Fairbanks and North Pole area to minimize the number of railroad crossings; repairing bridges in the Kenai Peninsula; and repairing maintenance facilities in Seward and Whittier. The railroad operations employ nearly 700 people (Alaska Railroad 2002).

4.7.4.6.3 Marine Terminals. Marine shipments to the North Slope are limited to the ice-free period between late July and early September. Dock facilities for unloading barges are located at Prudhoe Bay and Oliktok Point. One dock head, which is no longer used, is at East Dock of Prudhoe Bay. Two others are located at West Dock, with drafts ranging from 4 to 10 ft. The dock at Oliktok Point extends 750 ft from shore, with a depth of about 10 ft at the dock face. Because of the lack of deep-water ports, cargo is usually off-loaded to shallow- or medium-draft ships for transport to shore or for transport upriver to communities such as Nuiqsut.

No port facilities exist in Barrow. Cargo is transported to the area by barges and cargo ships and off-loaded to smaller vessels for transport to the shore north of Barrow.

On Prince William Sound, oil is shipped from the Valdez Marine Terminal at Port Valdez. Deep-water cargo ports are located at Valdez, Seward, and Whittier. Rail links exist at Seward and Whittier.

4.7.4.6.4 Alaska Marine Highway. The state-owned Alaska Railroad and ferry system is constructing two docks in Whittier to accommodate the unloading of barges. Seward and Valdez serve as cargo and cruise ship ports. The Alaska Railroad is also constructing a new freight dock and overhauling an existing dock to serve passengers in Seward (Alaska Railroad 2002). The Alaska Marine Highway System connects the communities of Chenega Cordova, Tatitlek Valdez, and Whittier along the Prince William Sound with ferry services.

4.7.4.6.5 Personal and Commercial Watercraft (fishing vessels, tour boats). Commercial fishing vessels use ports at Valdez and Cordova. Private and charter vessels also use the ports for recreational boating, which includes wildlife and sightseeing cruises and sport fishing excursions. Alaska state ferries stop at Valdez, Cordova, Seward, and Whittier. Cruise ships use ports at Valdez and Seward (Morris Communications Corporation 2001). Section 4.7.4.9.2 on tourism and Section 4.7.4.9.4 on commercial fishing have more details.

4.7.4.7 Legislative Actions Related to Land Use

4.7.4.7.1 Alaska Native Claims Settlement Act. Shortly after its purchase of the territory of Alaska, the U.S. Congress abandoned its policy of establishing treaties with Native Americans (Alaska Commission on Rural Governance and Empowerment 1999). The Organic Act of 1884 and the Alaska Statehood Act of 1958 acknowledged, but postponed to future action by Congress, any settlement of Alaska Native aboriginal title to land. As a result, Alaska Native land claims were never resolved until the Alaska Native Claims Settlement Act (ANCSA) (PL 92-203; 43 USC 1601) was passed in 1971. The act extinguished all prior aboriginal land claims and conveyed 44 million acres and nearly $1 billion in compensation funds to the 12 regional corporations established under the act.

The passage of ANCSA cleared land titles and facilitated granting of the TAPS ROW. It also established, through the for-profit regional corporations, the contemporary structure for Alaska Native economic and political affairs (Alaska Commission on Rural Governance and Empowerment 1999). ANCSA did not affect Alaska Native governments nor terminate eligibility for federal programs serving Native Americans.

4.7.4.7.2 Alaska National Interest Lands Conservation Act. The Alaska National Interest Lands Conservation Act (ANILCA) (PL 96-487; 16 USC 3101) was passed in 1980 to provide for the designation and conservation of certain public lands in the State of Alaska. ANILCA establishes more than 100 million acres of federal land in Alaska as conservation system units (CSUs) in order to preserve these lands and their resources for the national interest. The CSUs include National Parks, Preserves, Monuments, Wildlife Refuges, Wilderness Areas, and Wild and Scenic Rivers and are managed by federal agencies. Thirty-four CSUs are within a few miles of the TAPS ROW. Title VIII of ANILCA established the rural subsistence priority and in Section 810 required an analysis of impacts on subsistence due to federal land use decisions.

4.7.4.7.3 Federal and Alaska Coastal Zone Management Acts. The Federal Coastal Zone Management Act (CZMA) was enacted in 1972 and last amended in 2001. The Alaska Coastal Management Act (ACMA) was enacted in 1977 as Alaska's version of coastal zone management as envisioned in the national CZMA, and it was last amended in 1994. Both statutes guide land use in coastal zones to provide a balance between development and protection of coastal resources (BLM 1998; State of Alaska 2001).

ACMP, approved in 1979, was developed to implement the ACMA. The ACMP encourages coastal districts to develop and adopt district coastal management programs (CMPs) that become part of the ACMP once they are fully approved. CMPs include enforceable policies, and all activities that occur within a coastal zone or that may affect coastal resources must be consistent with an approved CMP. The Alaska Department of Governmental Coordination and State of Alaska resource agencies conduct consistency reviews on proposed and existing projects within coastal zones (BLM 1998; State of Alaska 2001).

4.7.4.7.4 Prince William Sound Regional Citizens' Advisory Council. The Prince William Sound Regional Citizens' Advisory Council is an independent, nonprofit corporation dedicated to the environmentally safe operation of the Valdez Marine Terminal and oil tankers within Prince William Sound. The council reviews and comments on APSC's operations, oil spill response and prevention plans and capabilities, and the design of mitigation measures. The advisory council helps monitor and assess the environmental impacts of terminal and tanker operations of oil-related accidents (Prince William Sound Regional Citizens' Advisory Council 2002).

The council also works to increase the public's awareness of the actual and potential environmental impacts from terminal and tanker operations and of the APSC's environmental protection capabilities, which include oil spill prevention and response. Citizens organized the council after the Exxon Valdez oil spill in 1989 to increase public involvement in decision making in the Prince William Sound, Gulf of Alaska, and Lower Cook Inlet regions of Alaska. The Oil Pollution Act of 1990 later required citizen oversight councils for Prince William Sound and Cook Inlet. Although APSC funds the advisory council, it has no control over its operation (Prince William Sound Regional Citizens' Advisory Council 2002).

4.7.4.8 Land Management

4.7.4.8.1 National Parks, Preserves, Monuments, and Other Land Units

Arctic National Wildlife Refuge (ANWR). This refuge ranges from south of the Brooks Range to the Beaufort Sea. A small portion of the refuge comes within 1/4 mi of the TAPS, but the vast majority lies 60 mi or more east of TAPS. The ANWR encompasses more than 19 million acres and is the northernmost refuge in the United States. It contains the 8-million-acre federally designated Mollie Beattie Wilderness, which is the second largest Wilderness Area in the United States. The refuge contains part of the migration routes and calving grounds of the Porcupine caribou herds. Visitors are allowed in the refuge. Arctic Village — an Alaska Native community — is located on the south side of the refuge (Alaska Internet Travel Guide 2000a; Patterson 2001).

Chugach National Forest. The 5.5-million-acre Chugach NF occurs as two noncontiguous components. A portion of the forest is located south/southwest of the Valdez Marine Terminal and comes within 1/4 mi of the Valdez Marine Terminal at its closest point. Another portion is located on the Kenai Peninsula. The area near the Valdez Marine Terminal is used primarily for recreation and for subsistence hunting, fishing, and logging. Some commercial logging occurs on the Kenai. The Chugach NF is the northernmost national forest in the United States and is administered by the USDA Forest Service (Behrends 2002; USFS 2002).

Gates of the Arctic National Park and Preserve. Gates of the Arctic NPP is located in the Brooks Range west of the TAPS and comes within 2 to 3 mi of the pipeline at the closest point. It is composed primarily of federal lands and encompasses a 7.2-million-acre federally designated Wilderness Area — the third largest in the United States. The park is accessible by air and is open year round. There are no roads to or within the park, and it contains no established trails or facilities. Gates of the Arctic NPP receives about 4,000 visitors per year. A park ranger station is located in Coldfoot. No major construction is planned in the park (Uhler 2001; Ulvi 2001).

Kanuti National Wildlife Refuge. The 1.6-million-acre Kanuti NWR is located about 150 mi northwest of Fairbanks. It is about 8 mi west of the TAPS at its closest point, but most of the refuge is more than 24 mi away. The refuge is undeveloped but contains no federally designated or proposed wilderness. Kanuti receives few visitors, and most visits are made by subsistence hunters and fisherman. Some river floating and hiking are done in the park (Alaska Internet Travel Guide 2000b; Schultz 2001).

White Mountains National Recreation Area (NRA). This NRA is administered by the BLM and is located about 30 mi north of Fairbanks between Elliott and

Steese Highways. It encompasses about 1 million acres and is the largest NRA in the United States. The recreation area offers an abundance of year-round recreation opportunities (Great Outdoor Recreation Pages 2002).

Wrangell-St. Elias National Park and Preserve. The headquarters of Wrangell-St. Elias National Park and Preserve is situated near Copper Center, Alaska. Wrangell-St. Elias National Park is the largest park in the national park system, and Wrangell-St. Elias National Preserve is the second largest preserve in the system. The 9.6-million-acre Wrangell-St. Elias Wilderness represents nearly 10% of the entire National Wilderness Preservation System. The park and preserve complex is within a mile of the TAPS at its closest point. Ahina Corporation (Regional Native Corporation) owns about 1 million acres of land within the authorized boundary. The park and preserve complex is open year-round, and visitation averages about 30,000 people a year. A majority of visits are in the summer season (Uhler 2002; Ulvi 2001). No major construction is planned for Wrangell-St. Elias National Park and Preserve.

Yukon Flats National Wildlife Refuge. This 8.6-million-acre NWR is located east of the Dalton Highway and about 100 mi north of Fairbanks and is bisected by the Yukon River. The refuge is about 2 mi east of the TAPS at its closest point, but most of it is more than 6 mi away. Yukon Flats is undeveloped but contains no federally designated wilderness. A portion of the refuge has been proposed as a federal wilderness area. The refuge is visited primarily by subsistence hunters and fishermen. Summer use is mainly confined to the major waterways (Alaska Internet Travel Guide 2000c; Huer 2001).

4.7.4.8.2 Alaska Department of Natural Resources

Alaska Interior. Several small parks and recreation areas are in the Delta Junction and Fairbanks area. These parks provide access to lakes, rivers, and streams; camping; and limited facilities. No state-designated wilderness exists within 100 mi of the TAPS (ADNR 2001a). The Chena River State Recreation Area east of Fairbanks is a quarter of a million acres in size and draws more than 150,000 visitors a year. The park has limited facilities, and most of the area is closed to vehicles. The Chena River State Recreation Site is within the city of Fairbanks on the banks of the Chena River and is a popular recreation spot (ADNR 2001b).

Prince William Sound. There are several state marine parks in the Prince William Sound and Resurrection Bay area. Most of these parks can be accessed only by floatplane or boat, except for Shoup Bay, which can be entered by a foot trail. Seven parks are near Whittier, six are near Seward, three are near Valdez, and three are near Cordova. These parks are undeveloped but contain no state-designated wilderness (ADNR 2001c).

4.7.4.8.3 Military

Fort Greely. Fort Greely, near Delta Junction, is currently being closed and transferred to other uses by the Department of the Army under Base Realignment and Closure (BRAC). However, Fort Greely is the preferred alternative for the deployment of the ground-based interceptors and for deployment of the battle management, command, and control system of the National Defense Missile System. The former are guided missiles designed to intercept and destroy intercontinental ballistic missiles. The latter is the control and control system for the interceptors (U.S. Army Space and Missile Defense Command 2000).

Fort Wainwright. Fort Wainwright, located near Fairbanks, has nearly 4,600 soldiers and 6,100 family members. Its mission is to provide the services, facilities, and infrastructure needed to support the rapid deployment of the 172nd Separate Infantry Brigade and elements of the Arctic Support Brigade. These include field training exercises in Alaska, which involve the use of aviation, all-terrain, and winter vehicles and thus require facilities for refueling operations.

Eielson Air Force Base. This Air Force installation is located south of Fairbanks. The base mission includes support of combat aircraft, mid-air refueling, logistics support, and arctic survival training (Eielson AFB 2002).

Army Proposed Projects in the Region of Interest. Projects currently under construction at Fort Wainwright include central vehicle wash facilities, barracks renewals, central heat and power plant repairs, an ammunition surveillance facility, and a collective training facility for military operations in urban terrain. Other Army projects that were recently built at Fort Wainwright include barracks upgrades, several phases of housing projects, a new ski chalet, a coal car preheat facility, and a missile test facility. A munitions storage facility was recently built at Fort Greely. The Alaska District Corps of Engineers solicited requests for proposals in October 2001 for a new hospital to replace the existing Bassett Army Community Hospital at Fort Wainwright. The proposed project is a 259,000-ft^2, 32-bed facility.

Air Force Proposed Projects in the Region of Interest. Eielson AFB (354th Wing) projects include a repair runway, a parking ramp, a weapons and release systems facility, consolidated munitions, and an A-10 squad/ops facility. Projects in design for fiscal year 2000 at Eielson AFB included a hazardous materials storage facility, dormitory, joint mobility complex, and utility upgrade Phase I and II (USACE 2001).

4.7.4.9 Natural Resource Use

4.7.4.9.1 Subsistence. Subsistence means the customary and traditional uses by rural Alaskans of wild, renewable resources for personal or family consumption. A person living in a rural area (as defined by the Federal Subsistence Board) is eligible for a priority for subsistence hunting and fishing on federal lands under federal law. In 1999, about 123,000 (20%) of Alaskans lived in rural areas. Since 1989 under the Alaska Constitution, all Alaskan residents are legally entitled to share in fish and game on state and private lands, providing all the right to pursue subsistence. Therefore, under state law there is no rural priority. To help avoid confusion, this document has consistently employed the federal definition of subsistence. Although both Alaska Natives and non-Natives may subsistence hunt and fish, only Alaska Natives may hunt marine mammals, such as seals, whales, polar bears, and sea otters. Food is one of the most important subsistence uses of wild resources. Other subsistence uses include clothing, fuel, transportation (food for dogs), construction, home goods, sharing, customary trade, ceremony, and arts and crafts. In rural Alaska, about 75–98% of sampled rural households harvest fish and 48–70% harvest wildlife; actual use is probably higher, since harvested resources are often shared. Items harvested by weight included fish (60%), land mammals (20%), marine mammals (14%), birds (2%), shellfish (2%), and plants (2%). Although wild food harvests are high (up to 613 lb per person in the rural interior in the region of interest), subsistence harvest represents only 2% of the fish and game harvested annually in Alaska. Commercial fisheries harvest about 97%, while the sport harvest is only about 1%. In the region of interest, wild food harvests in the late 1980s through the 1990s were estimated at about 16 lb per person in the Fairbanks-Delta Area, 153 lb per person in the rural south central, 516 lb per person in the Arctic, and 613 lb per person in the rural Interior Alaska (ADF&G 2002c).

4.7.4.9.2 Tourism. Tourism is Alaska's second largest industry in terms of employment. The basis for much of Alaska's tourism industry is its natural resources. In 1999, more than 1.4 million people traveled to Alaska, and they spent about $1 billion in the state. Natural-resource-based tourism includes visits to national and state parks, viewing wildlife and scenery, back country travel, rafting and boating, skiing and winter sports, ship cruises, photography, fishing, and hunting. In addition, Alaska's cultural diversity and history help make it a major tourist attraction. In 1999, 53% of visitors to Alaska came by air, 31% came by cruise ship, and the balance came by highway, Alaska Marine Highway or international air (Alaska Travel Industry Association undated).

4.7.4.9.3 Hunting, Fishing, and Trapping. Hunting occurs for both subsistence and sport, while fishing and trapping occur for subsistence, sport, and commerce. In 2001, more than 565,000 sport fishing (178,251 resident; 274,968 nonresident), hunting (86,115 resident; 13,343 nonresident), and trapping (26,257 resident; 28 nonresident) licenses were sold. Of these, 51% were issued to nonresidents (ADF&G 2002c). Hunting, fishing, and trapping occur throughout the region of interest. Hunting seasons vary according to the region, species, sex of the animal, and classification of the hunter as resident or nonresident. In some cases, the issuance of a permit to hunt is based on a lottery. The situation for trapping is similar. The season and limits are adjusted by the ADF&G. In general, sport fishing is allowed year round in the Prince William Sound area and on the Tanana River, Yukon River drainage, and North Slope. Catch limits are placed on most species and typically do not exceed 10 per day. The season and limits are adjusted by the ADF&G. These regulations also apply on federal lands. However, the federal government controls fishing and hunting on federal lands.

Since 1990, the Federal Subsistence Board has managed subsistence harvests by rural Alaskans on federal lands. Seasons and harvest limits are regulated to ensure a rural subsistence priority. In most cases, hunting and fishing by Alaskans, under state regulations, is also permitted on federal lands. However, federal lands can be closed to such uses, if necessary, to ensure the rural subsistence priority.

4.7.4.9.4 Commercial Fishing. In the Prince William Sound area, commercial fishing is mainly composed of sole operators. In Prince William Sound and the Copper River District, the salmon season runs from mid-May to mid-October, and during this time, specific dates are set for each species and method of fishing. Herring season is in January for seine nets and from April into May for other methods. Shellfish season runs from April through December, with the specific dates set for each species and method of fishing. Groundfish, pollock, and cod fisheries operate year round. Six hatcheries operate in the area (ADF&G 2002d). Commercial fishing operations for salmon involve the use of purse seines, drift gillnets, and set gillnets. During the 1999 season, 523 drift gillnet permit holders, 21 set gillnet permit holders, and 139 seine permit holders participated in the fishery. However, three of the four seasons for herring and the fall season for food/bait fish were cancelled. Commercial fishing is a highly regulated industry; strict controls are placed on the days and hours fished, fishing locations, and methods.

4.7.4.9.5 Mining. Mining for gold and other minerals has been an important industry in Alaska, and this activity would continue throughout the period of TAPS operation. Mineral exploration, development, and production occur in a number of mining districts throughout the area traversed by the TAPS. In 1998, mining (except for oil and gas) was valued at about $900 million, with an annual employment of 3,452 (Szumigala and Swainbank 1999). The major new exploration activity was in the interior near Goodpasture and the Pogo Prospect, and exploration continued in the Fairbanks mining district. Exploration activities also concentrated on the north flank of the Alaska Range. During 1998, up to 12,000 new claims totaling 480,000 acres were staked on state land, while 5,800 claims were abandoned. The number of active claims on state land in 1998 was 41,157 on 1.65 million acres. Coal, copper, gemstones, gold, lead, sand and gravel, silver, stone, zinc, and other minerals were mined. The State of Alaska and several federal agencies regulate the mineral industry with regard to safety and environmental protection.

On the North Slope, mining of sand and gravel from river floodplains and stone from the Brooks Range support road construction and maintenance, river training, pipeline maintenance, and oil exploration and development. The Red Dog Mine (zinc, lead, and silver) in the Kotzebue area is several hundred miles from the TAPS and outside the region of interest for this cumulative assessment.

In Interior Alaska, coal is mined, and lode and placer are mined for gold and other metals and coal. In the Brooks Range, the Middle Fork Koyukuk River near Wiseman and Coldfoot was an important gold mining area, and mining still occurs there today. Numerous placer gold mining operations (i.e., the removal of gold from stream-bed gravel deposits) occur throughout the region around Fairbanks, and exploration is ongoing. The Fort Knox Mine, an open pit mine about 25 mi northeast of Fairbanks, is the largest operating gold mine in the state. The mine employs 260 people and produces 1,000 oz of gold per day. Probable reserves are estimated at 3,686,000 oz. In addition, gold-bearing sand and gravel are taken from the True North Mine, which is about 8 mi from the Fort Knox Mine and being developed. At the projected rate of production, this mine will be in operation for at least nine more years. The Teck-Sumitomo Pogo gold mine site is being developed northeast of Delta Junction. Once in production, it is estimated that the mine will operate for 12 years. Three medium-sized placer mines and about 50 smaller operations operate in the 10 interior mining districts. Small placer gold operations occur between Fairbanks and the North Slope and between Fairbanks and Valdez. These operations are widely scattered, and sites tend to shift depending on the potential for new discoveries of gold and the price of gold (Szumigala and Swainbank 1999).

In addition to gold mines, several small mining pits produce peat for local use in the Fairbanks and Palmer-Anchorage area. Several sand and gravel pits are located in the Fairbanks area, to the east of Delta Junction, in the Palmer area, and in the Kenai area. These materials are primarily used for roadwork. About 100 mi south of Fairbanks, the Usibella Coal Mine in Healy produces about 1.5 million tons of coal per year. Coal mining operations are also expected to begin at a location just north of the existing mine site. A portion of the coal removed at the mine is exported out of Alaska. A portion was also used in the Healy Clean Coal Project; it was enough to potentially generate 50 MW of baseload electric power (Szumigala et al. 2000).

In the early 1900s, copper was mined near McCarthy and transported by railroad along the Chitina and Copper Rivers to ships at Cordova. During that period, gold was also extracted from the area. Today, mining still occurs on private lands within the region.

Mineral exploration and mining occurred historically in the Prince William Sound area. Mineral resources in the Prince William Sound area include placer and lode gold deposits, chromium, copper, oil, and coal.

4.7.4.9.6 Logging. Both commercial logging and harvesting for personal use occur in Alaskan forests. In the vicinity of the TAPS, most commercial logging occurs on state lands; minimal logging occurs on federal lands. Logging on state lands is regulated by the Alaska Division of Forestry, and logging on federal lands is regulated by the agency administering the land where the timber sale occurs. Both state and federal land management agencies develop forest/land management plans that (1) identify areas suitable for harvesting, (2) determine appropriate harvest levels, and (3) ensure that commercial operations comply with harvest management practices that protect resources, such as soils and surface water.

Commercial logging occurs throughout state lands near the TAPS. However, most logging occurs in Tanana Valley State Forest, which lies north, northeast, and southeast of Delta Junction in several separate parcels. Logging on federal lands occurs in the Chugach National Forest and in BLM lands in the Copper River Basin.

Harvesting for personal use occurs throughout forests on public lands in the vicinity of the TAPS. Wood is harvested for both fuel and housing.

4.7.4.10 Petroleum and Hazardous Materials Spills

For the purposes of this EIS, petroleum spills are identified as an “action,” although they do not occur independently of other actions. Petroleum spills can occur during any action involving petroleum and its products, including exploration and development, transportation, and refining. These actions can be the responsibility of any industry, agency, or individual that is carrying them out. Petroleum spills may be large, such as those resulting from a pipeline or tanker accident, or they may be very small, such as a diesel fuel or oil spill during refueling or equipment maintenance. Because of the nature of the proposed action addressed in this EIS, this cumulative impact analysis emphasizes petroleum spills resulting from the exploration, development, and transportation of North Slope oil resources. The following text emphasizes spills on the North Slope and in Prince William Sound. Petroleum spills related to TAP operations are described elsewhere in this EIS, as part of the assessment of the proposed action and no-action alternative.

4.7.4.10.1 North Slope Petroleum Spill Scenarios. Twelve crude oil, diesel fuel, and saltwater spill scenarios were developed for the North Slope (Table 4.7-4). The first seven spills would be similar to spills that have occurred historically over the 25 years of TAPS operations, as logged in the TAPS ROW Renewal Oil Spill Database (TAPS Owners 2001a). More than 1,500 North Slope crude oil spills, about 2,300 diesel fuel spills, and more than 70 saltwater spills are cataloged in the database. The "moderate" spill of saltwater (Scenario 6) occurred on March 17, 1997, at Arco's Drill Site 4 in East Prudhoe Bay. The cause of the spill is unknown. Between 750,000 and 1,000,000 gal of seawater were released from six to nine wellheads, each at 10 to 20 bbl/min (ADEC 1997). Information on saltwater spills on the North Slope is limited. Information is available from ADEC for the period from July 1995 to June 2001 (6 years). The largest recorded saltwater spill volume (on the order of 1 million gal) is used as a surrogate for the maximum spill that could be encountered during 30 years of TAPS operations in the North Slope.

The next three spills (Scenarios 8, 9, and 10) were taken from environmental assessments associated with the Alpine crude oil pipeline and the Northstar well field. The Alpine crude oil field is located in the western Colville River Delta, about 34 mi west of the Kuparuk River oil field. The Alpine field is connected to the Kuparuk River delta via three 34-mi crude oil, diesel, and water transport pipelines. At the Colville River crossing, the depth of the pipeline is about 100 ft. The Alpine pipeline spill (Scenario 8) is an "extreme worst-case" scenario involving a rupture of the pipeline transporting crude oil. A fracture of the 14-in. Alpine pipeline is assumed to occur approximately 300 ft from the Colville River, causing crude oil to spill on the ground and then migrate into the river. The next two spills in the Northstar Field (Scenarios 9 and 10) would result from a leak on the drilling well platform and in the pipeline that transports crude oil from the Beaufort Sea to shore terminal.

4.7.4.10.2 Catastrophic Events Considered in the North Slope Spill Analysis. Two spill scenarios (a spill of crude oil due to a well blowout; a rupture of a pipeline over open water) have the potential to release catastrophic amounts of hazardous materials on the North Slope.

The first catastrophic scenario (Scenario 11; crude oil from a well blowout) was previously assessed as a "reasonable worst-case" spill at Alpine Pad 1 (Alpine 1997). It is assumed that the plume fallout and oil would spread from the wellhead and drill pad, flow over snow and ice surfaces that are breaking up, and deposit on them. Oil flowing from the drill pad would initially spread downslope following the terrain, then flow into adjacent lakes, the Sakoonang Channel, and eventually Harrison Bay. The frequency of this postulated spill scenario was estimated by using information from BLM (1998), which indicates that one well blowout occurred in the 9-year period from 1987 to 1996, a time when 2,933 wells were drilled. Ice breakup generally occurs on 10 to 21 days per year.

The last event in Table 4.7-4 (Scenario 12) is a crude oil pipeline rupture over Kuparuk River to open water. The rupture occurs where the Kuparuk 24-in. pipeline crosses the Kuparuk River. It instantaneously releases more than 10,000 bbl of crude oil into open water. The spilled oil moves downstream under the influence of the current and impacts the shoreline.

4.7.4.10.3 Transportation Spill Scenarios. Cumulative impacts associated with transportation accidents involving spills of hazardous material were evaluated for truck shipments from the North Pole Refinery to the North Slope (Deadhorse) and for rail shipments from the North Pole Refinery to Stevens International Airport. Three scenarios were assessed; frequencies and spill volumes are summarized in Table 4.7-5. The frequencies of all three scenarios would be considered likely, except for Scenario 2b (a fire variant of 2a), which would be considered unlikely. All scenarios, including the variant, involve the shipment of refined petroleum products, except for Scenario 3, which involves of a shipment of hydrochloric acid (HCl). Acid stimulation is one

TABLE 4.7-4 Spill Scenarios for the North Slope

No.	Description/Location[a]	Spill Material	Frequency (1/yr)	Frequency Range: Anticipated (> 0.5/yr)	Frequency Range: Likely (0.03 to 0.5/yr)	Frequency Range: Unlikely (10^{-3} to 0.03/yr)	Frequency Range: Very Unlikely (10^{-6} to 10^{-3}/yr)	Spill Volume Range (bbl)	Release Duration	Release Point	Does Spill Reach Water?
1	Small spill in the North Slope (NLS)	Crude oil	5.0×10^{-1}	X				~0 to 500	Short	Land	No
2	Small spill in the North Slope (NLS)	Diesel	5.0×10^{-1}	X				~0 to 170	Short	Land	No
3	Small spill in the North Slope (NLS)[b]	Saltwater	5.0×10^{-1}	X				~0 to 500	Short	Land (65–80% of crude oil spills on pad)	No
4	Moderate spill in the North Slope (NLS)	Crude oil	3.0×10^{-2}		X			501 to 925	Short	Land (65–80% of crude oil spills on pad)	No
5	Moderate spill in the North Slope (NLS)	Diesel	3.0×10^{-2}		X			171 to 450	Short	Land	No
6	Moderate spill in the North Slope (NLS)[b]	Saltwater	3.0×10^{-2}		X			501 to 23,810	Short	Land	No
7	Rupture of aboveground water-flood pipeline (saltwater spill)[b]	Saltwater	2.0×10^{-1}		X			2,400 to 82,000	Prolonged	Land	No

TABLE 4.7-4 (Cont.)

No.	Description/Location[a]	Spill Material	Frequency (1/yr)	Frequency Range: Anticipated (> 0.5/yr)	Frequency Range: Likely (0.03 to 0.5/yr)	Frequency Range: Unlikely (10^{-3} to 0.03/yr)	Frequency Range: Very Unlikely (10^{-6} to 10^{-3}/yr)	Spill Volume Range (bbl)	Release Duration	Release Point	Does Spill Reach Water?
8	Rupture of alpine pipeline near the Colville River	Crude oil	1.4×10^{-3}			X		50 to 2,800	Prolonged	Land, water	Yes
9	Platform spill in the Beaufort Sea (proposed Northstar field as a surrogate)	Crude oil	$2.3–2.7 \times 10^{-2}$			X		1,500	Instantaneous	Water	Yes
10	Pipeline spill in the Beaufort Sea (proposed Northstar field as a surrogate)	Crude oil	$2.3–2.7 \times 10^{-2}$			X		4,600	Instantaneous	Water	Yes
11	Well blowout at Phillips Alaska's Alpine Pad 1 during breakup	Crude oil	$1.8–3.8 \times 10^{-3}$			X		3,000 to 34,000	Prolonged	Land, water	Yes
12	Rupture of Kuparuk pipeline over Kuparuk River to open water	Crude oil	1.0×10^{-3}			X		10,516	Instantaneous	Land, water	Yes

a NLS = scenario is not location-specific.

b Because ADEC information covers only the period from July 1, 1995, to June 29, 2001 (6 years), extrapolation to a 30-year return period was necessary. The largest recorded saltwater spill volume (on the order of 1 million gal) is used as a surrogate for the maximum spill that would be encountered during 30 years of operations in the North Slope.

TABLE 4.7-5 Transportation Spill Scenarios[a]

No.	Description/Location	Spill Material	Frequency (1/yr)	Frequency Range: Anticipated (> 0.5/yr)	Frequency Range: Likely (0.03 to 0.5/yr)	Frequency Range: Unlikely (10^{-3} to 0.03/yr)	Frequency Range: Very Unlikely (10^{-6} to 10^{-3}/yr)	Spill Volume (bbl): Low	Spill Volume (bbl): High	Release Duration
1	Rollover of tanker truck on the Dalton Highway	HCl (37%)	1.7×10^{-1}		X			17	17	Short
2a	Overturn of fuel truck between North Pole Refinery and Deadhorse (Prudhoe Bay)	Arctic grade diesel	2.2 to 3.9×10^{-2}		X			119	190	Instantaneous
2b	Overturn of fuel truck *with subsequent fire* between North Pole Refinery and Deadhorse (Prudhoe Bay)	Arctic grade diesel	2.4 to 4.3×10^{-3}			X		119	190	Instantaneous
3	Derailment of freight train between North Pole Refinery and Stevens International Airport	Aviation jet fuel A	1.3 to 1.6×10^{-1}		X			195	488	Short (hours)

[a] All release points are aboveground, on land.

of the primary methods for improving productivity of oil, gas, injection, and disposal wells in the North Slope. The HCl acid is pumped down the well and into the producing fields to increase oil flow.

Scenario 1. In this event, a tanker truck that is transporting an HCl solution (37% concentration of HCl) overturns on the Dalton Highway while en-route to Prudhoe Bay (Deadhorse). The tanker's liquid cargo tank (MC 312/412)[1] contains approximately 4,500 gal of HCl. The incident occurs near MP 280 on the Dalton Highway. The TAPS pipeline is located less than 1/2 mi from the accident site. It is estimated that the accident would result in a spill of approximately 700 gal of HCl, released over a period of about 30 min.

This event is considered likely, with an occurrence frequency of once in every 6 years (0.17/yr). The accident frequency is based on a single event that occurred near Fairbanks on December 6, 1995, when 90 gal of 35%-HCl solution (muriatic acid) spilled when a drum fell off a truck and split because of the cold temperature (ADEC 2001a).

Scenarios 2a and 2b. A fuel truck carrying arctic-grade diesel from the Williams North Pole Refinery to Deadhorse leaves the highway and overturns on Dalton Highway. A large spill of diesel fuel (between 5,000 and 8,000 gal) (USFS and WEFSEC 1998) without a fire would be considered a likely event, occurring at a frequency of about 2.2 to 3.9×10^{-2}/yr. A variant of this scenario would involve a fire in addition to the spill and would have a probability of occurring about 2.4 to 4.3×10^{-3}/yr, based on adjustments to national HAZMAT transportation statistics (Brown et al. 2000).

Scenario 3. A freight train towing an average of 50 loaded petroleum tank cars filled with aviation jet fuel A (turbine jet fuel) partially derails. Up to two railcars are damaged and leak aviation jet fuel at a rate of 2 to 3 gal/min. A large railcar spill ranging from about 200 to 500 bbl of jet fuel would be considered a likely event, with a frequency of occurrence of once in 6 to 8 years (based on frequencies taken from USFS and WEFSEC [1998]). The spill magnitude was estimated on the basis of 30,000-gal railcar spill size scenario (AIChE 1989), adjusted for frequency data based on railcar tanker capacities of 20,000 to 25,000 gal and Alaska railroad accident statistics that indicate that two hazardous material (HAZMAT) railcars are damaged for each train derailment over a 5-year period (ADEC 2001b).

4.7.4.10.4 Prince William Sound and North Slope Spill Scenarios.

Prince William Sound Spill Scenarios. A total of 33 crude oil and diesel fuel spill scenarios were developed for the Prince William Sound (Table 4.7-6). They rely primarily on data from previous risk assessments prepared in support of crude oil spill emergency response planning in the sound (Det Norske Veritas et al. 1996; Merrick et al. 2000). It is expected that most pollution incidents in Prince William Sound would be minor, involving spills of diesel oil, lubricating oil, crude oil, and waste bilge oil. The probability of a hazardous substance discharge is low.

The first four spill scenarios listed in Table 4.7-6 represent small to moderate spills that are anticipated or likely to occur in Prince William Sound during the TAPS renewal period. The scenarios cover spills of North-Slope-produced crude oil and diesel fuel as a crude oil refined petroleum product. The scenarios were developed by considering more than 180 documented crude oil spills into the Prince William Sound during the first 25 years of operation of the pipeline (TAPS Owners 2001b). In addition, 70 diesel fuel spills are also documented in the database for Prince William Sound for a similar period. Spill initiators or causes ranged from small fuel line ruptures to very large storage tank failures. The spill volumes for these scenarios ranged from less than 1 gal to 60 bbl of crude oil and 12 bbl of diesel fuel. All of these spills were of short duration (a few hours to about a day).

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[1] MC (motor carrier) 312 or 412 cargo tanks are cylindrical tanks designed to carry high-density corrosive liquids and are typically constructed of stainless steel or aluminum and lined with material to resist degradation or reaction with its contents.

TABLE 4.7-6 Spill Scenarios for Tanker Accidents in the Prince William Sound[a]

						Frequency Range						
				Frequency (1/yr)						Spill Volume (bbl)		
No.	Spill Scenario	Material Spilled	Location	Low	High	Anticipated (> 0.5/yr)	Likely (0.03 to 0.5/yr)	Unlikely (10^{-3} to 0.03/yr)	Very Unlikely (10^{-6} to 10^{-6}/yr)	Low	High	Release Duration
1	Small spill	Crude oil	NLS[b]	5×10^{-1}		X				~0	10	Short
2	Moderate spill	Crude oil	NLS	3×10^{-2}			X			11	60	Short
3	Small spill	Diesel	NLS	5×10^{-1}		X				~0	1	Short
4	Moderate spill	Diesel	NLS	3×10^{-2}			X			2	12	Short
5	Collision	Crude oil	Arm	4×10^{-4}	8×10^{-3}			X		110,000	170,000	Prolonged
6	Drift grounding	Crude oil	Arm	2×10^{-5}	1×10^{-3}			X		50,000	190,000	Prolonged
7	Fire and explosion	Crude oil	Arm	2×10^{-5}	1×10^{-4}				X	270,000	320,000	Prolonged
8	Powered grounding	Crude oil	Arm	1×10^{-4}	9×10^{-4}			X		80,000	200,000	Prolonged
9	Structural and foundering	Crude oil	Arm	3×10^{-5}	2×10^{-4}			X		100,000	260,000	Prolonged
10	Collision	Crude oil	Central Sound	4×10^{-4}	3×10^{-3}			X		110,000	180,000	Prolonged
11	Drift grounding	Crude oil	Central Sound	6×10^{-6}	6×10^{-4}			X		0	190,000	Prolonged
12	Fire and explosion	Crude oil	Central Sound	4×10^{-5}	2×10^{-4}			X		250,000	300,000	Prolonged
13	Powered grounding	Crude oil	Central Sound	1×10^{-8}	7×10^{-4}			X		0	190,000	Prolonged
14	Structural and foundering	Crude oil	Central Sound	5×10^{-5}	4×10^{-4}			X		130,000	210,000	Prolonged
15	Collision	Crude oil	Gulf	6×10^{-5}	5×10^{-4}			X		170,000	190,000	Prolonged
16	Drift grounding	Crude oil	Gulf	2×10^{-5}	6×10^{-4}			X		150,000	320,000	Prolonged
17	Fire and explosion	Crude oil	Gulf	2×10^{-5}	1×10^{-4}				X	230,000	280,000	Prolonged
18	Structural and foundering	Crude oil	Gulf	4×10^{-5}	2×10^{-4}			X		100,000	210,000	Prolonged
19	Collision	Crude oil	Hinchinbrook	1×10^{-4}	1×10^{-3}			X		100,000	270,000	Prolonged
20	Drift grounding	Crude oil	Hinchinbrook	3×10^{-4}	3×10^{-3}			X		150,000	180,000	Prolonged
21	Fire and explosion	Crude oil	Hinchinbrook	2×10^{-5}	1×10^{-4}				X	280,000	330,000	Prolonged
22	Powered grounding	Crude oil	Hinchinbrook	1×10^{-4}	1×10^{-3}			X		190,000	160,000	Prolonged
23	Structural and foundering	Crude oil	Hinchinbrook	3×10^{-5}	2×10^{-4}			X		130,000	200,000	Prolonged
24	Collision	Crude oil	Narrows	3×10^{-4}	8×10^{-3}			X		120,000	80,000	Prolonged
25	Drift grounding	Crude oil	Narrows	1×10^{-8}	2×10^{-6}					0	0	Prolonged
26	Fire and explosion	Crude oil	Narrows	1×10^{-5}	6×10^{-5}				X	290,000	340,000	Prolonged
27	Powered grounding	Crude oil	Narrows	2×10^{-4}	2×10^{-3}			X		70,000	180,000	Prolonged

TABLE 4.7-6 (Cont.)

				Frequency (1/yr)		Frequency Range				Spill Volume (bbl)		
No.	Spill Scenario	Material Spilled	Location	Low	High	Anticipated (> 0.5/yr)	Likely (0.03 to 0.5/yr)	Unlikely (10^{-3} to 0.03/yr)	Very Unlikely (10^{-6} to 10^{-6}/yr)	Low	High	Release Duration
28	Structural and foundering	Crude oil	Narrows	1×10^{-5}	8×10^{-5}				X	110,000	280,000	Prolonged
29	Collision	Crude oil	Port	6×10^{-4}	9×10^{-3}			X		110,000	90,000	Prolonged
30	Drift grounding	Crude oil	Port	9×10^{-5}	7×10^{-4}			X		70,000	180,000	Prolonged
31	Fire and explosion	Crude oil	Port	1×10^{-5}	7×10^{-5}				X	250,000	300,000	Prolonged
32	Powered grounding	Crude oil	Port	1×10^{-8}	7×10^{-4}			X		0	190,000	Prolonged
33	Structural and foundering	Crude oil	Port	2×10^{-5}	2×10^{-4}				X	100,000	240,000	Prolonged

[a] All release points are on the water, and all spills reach the water.

[b] NLS = scenario is not location specific; it could occur anywhere in Prince William Sound.

The tanker Exxon Valdez went aground on Bligh Reef, Prince William Sound, on March 24, 1999, spilling 257,143 barrels of North Slope crude oil. Numerous improvements have been made since that spill (on the basis of lessons learned as a result of the spill, new legislation, new regulations, and numerous technology advances) that will reduce the likelihood of a major marine transportation accident and/or the expected outflow given such an accident. The report *Prince William Sound, Alaska Risk Assessment Study* by Det Norske Veritas et al. (1996), which did not consider future benefits of double-hulled tankers, estimated that the risks of a large oil spill were reduced by 75% with the creation of SERVS and related measures. These measures have been reflected in the frequency and spill volumes of the postulated spill scenarios in Table 4.7-6.

Controlling Tankers in Prince William Sound

The Oil Pollution Act of 1990, as well as Alaska regulations, have established numerous controls on tanker traffic as part of Prince William Sound spill contingency planning. These include a Coast Guard escort for ladened tankers, maneuvering support by SERVS, established tanker lanes, minimal weather limitations, and maximum tanker speed.

Gulf of Alaska/Pacific Ocean Spill Scenarios. The cumulative analysis in the Liberty FEIS (MMS 2002) considered future potential spills along the TAPS tanker route. For purposes of quantitative analysis of oil spills, the document focused on the past, present, and reasonably foreseeable activities, such as crude oil production. This information is current through 2001.

Table 4.7-7 lists the actual tanker spills greater than or equal to 1,000 bbl that have occurred along the TAPS tanker route; a total of 11 such spills occurred from 1977 to 1998. The most significant (in terms of spill volume) was the Exxon Valdez oil spill (240,500 bbl). This information is current through 2001.

Information from Table 4.7-7 was used in the Liberty FEIS to estimate the size and location (in port or at sea) of the potential future spills associated with movement of TAPS tankers.

The Liberty FEIS assumed very conservatively that nine tanker spills greater than or equal to 1,000 bbl could potentially occur during the 15- to 20-year life of the Liberty project. This approach does not take into account various measures such as the creation of SERVS and the increasing use of double-hulled tankers that are intended to decrease both the frequency and the magnitude of large tanker spills. It also does not take into account the decreasing production of North Slope crude oil with time, which would decrease the number of tanker calls at the Valdez Marine Terminal and thus the frequency of a potential large tanker spill.

Table 4.7-8 lists the estimated sizes of the nine spills that were postulated to occur during Liberty production.

The Liberty FEIS estimated six spills — four in port and two at sea — with an average size of 4,000 bbl; two spills at sea with an average size of 13,000 bbl; and one spill at sea with a size ranging from 200,000 to 260,000 bbl. For purposes of analysis, a value of 250,000 bbl was assumed for the size category of greater than 200,000 bbl. The maximum spill volume of 250,000 bbl assumed in the Liberty FEIS is consistent with that assumed in the TAPS Renewal EIS.

Information on the estimated frequency of a large tanker spill was not explicitly provided in the Liberty FEIS. A value of 3% was quoted for the probability of one or more spills occurring and contacting land along the U.S. coast adjacent to the TAPS tanker route, based on previous studies. However, it can be reasonably assumed from Table 4.7-8 that the Liberty FEIS estimated one catastrophic tanker spill per 15- to 20-year life of the Liberty project, for a frequency of 0.05 to 0.067 per year. This frequency is orders of magnitude greater than that estimated in the TAPS Renewal EIS for tanker transport in the Prince William Sound. This apparent discrepancy may be attributed to the fact that the TAPS Renewal EIS takes into account factors such as the increasing use of

TABLE 4.7-7 Trans-Alaska Pipeline System Tanker Spills Greater than or Equal to 1,000 Barrels: 1977 through 1998

Date	Vessel	Location	Destination	Spill Amount (bbl)
8/29/1978	Overseas Joyce	Balboa Channel	Perth Amboy, New Jersey	1,816
6/7/1980	Texaco Connecticut	Panama Canal Zone	Port Neches, Texas	4,047
12/12/1981	Stuyvesant	Gulf of Tehuantepec	Panama	3,600
12/21/1985	ARCO Anchorage	Puget Sound	Cherry Point, Washington	5,690
1/9/1987	Stuyvesant	Gulf of Alaska, British Columbia	Puerto Armuelles, Panama	15,000
7/2/1987	Glacier Bay	Cook Inlet, Alaska	Nikiski, Alaska	4,900
10/4/1987	Stuyvesant	Gulf of Alaska, British Columbia	Puerto Armuelles, Panama	14,286
1/3/1989	Thompson Pass	Port of Valdez	Panama	1,700
3/24/1989	Exxon Valdez	Prince William Sound, Alaska	Long Beach, California	240,500
2/7/1990	American Trader	Huntington Beach, California	Long Beach, California	9,929
2/22/1991	Exxon San Francisco	Fidalgo Bay, Washington	Anacortes, Washington	5,000

TABLE 4.7-8 Sizes of Tanker Spills Assumed in the Cumulative Analysis for the Liberty FEIS

Size Category (bbl)	Number	Average Size (bbl)	Total Volume (bbl)
≤6,000	6	4,000	24,000
>6,001-≤15,000	2	13,000	26,000
>200,000	1	250,000	250,000
Total	9	–	294,000

Source: MMS (2002).

double-hulled tankers, decreasing North Slope crude oil production, development of the SERVS, and other measures that would decrease the frequency of a catastrophic tanker spill within the Prince William Sound.

4.7.4.10.5 Catastrophic Events Considered in the Prince William Sound Spill Analysis. The source of a medium or major oil spill would most likely be a tank vessel laden with crude oil. An incident involving a tank vessel has the most potential to be catastrophic (ARRT 1999). The last 29 scenarios (5 through 33) represent unlikely or very unlikely spill events. The analysis considers accident types or initiators. The Prince William Sound subareas, identified in a risk assessment study by Merrick et al. (2000), are as follows:[2]

- Port of Valdez,
- Valdez Narrows,
- Valdez Arm,
- Central Sound,
- Anchorage,
- Hinchinbrook Entrance, and
- Gulf of Alaska.

2 This Prince William Sound risk assessment study had three primary objectives: to (1) identify and evaluate the risks of oil transportation in Prince William Sound; (2) identify, evaluate, and rank proposed risk reduction measures; and (3) develop a risk management plan and tools that could be used to support a risk management program.

The five types of tanker accidents considered are: (1) collision, (2) drift grounding, (3) fire and explosion, (4) powered grounding, and (5) structural and foundering. The potential for a catastrophic release of crude oil is identified with regard to the spill scenario initiators as follows (Det Norske Veritas et al. 1996):

- Collision occurs when an underway tanker and another underway vessel collide into each other or strike each other as a result of human error or mechanical failure and lack of vigilance (intervessel collision) or when a floating object is struck by an underway tanker (e.g., ice collision).
- Drift grounding occurs when a drifting tanker contacts the shore or bottom because it is not under control as the result of a propulsion or steering failure.
- Fire and explosion occurs either when there is a fire in the machinery, hotel, navigational, or cargo space of a tanker or when there is an explosion in the machinery or cargo spaces.
- Powered grounding occurs when an underway tanker contacts the shore or bottom because of navigational error or steering failure and lack of vigilance.
- Structural failure and foundering occurs when a structural failure due to the hull or frame cracking or erosion is serious enough to affect the structural integrity of the tanker. It is then assumed that the tanker will founder or sink as a result of water ingress or loss of stability.

As Garrick (1984) notes, an accident is not a single event, but the culmination of a series of events. A triggering incident is defined to be the immediate precursor of an accident. In the Prince William Sound Risk Assessment (Det Norske Veritas et al. 1996), triggering incidents were separated into mechanical failures and human errors. The mechanical failures that were considered to be triggering incidents were propulsion failures, steering failures, electrical power failures, and hull failures. Human errors were classified as diminished ability; hazardous shipboard environment; lack of knowledge, skills or experience; poor management practices; or faulty perceptions or understanding.

The volume of crude oil spilled for a given scenario identified in Table 4.7-6 was estimated on the basis of the methodology in Det Norske Veritas et al. (1996) and by taking into account the decreasing number of crude oil tanker shipments due to depletion of North Slope crude oil and the mandatory phase-out of single hull tankers on or before 2015 (FR 1998).

4.7.5 Impacting Factors of Reasonably Foreseeable Actions

Section 4.7.4 describes past, present, and reasonably foreseeable actions for each of the regions of interest (Beaufort Sea and the North Slope, Interior Alaska, Prince William Sound and Pacific transportation routes) that are the focus of the cumulative analysis (see Table 4.7-2). Table 4.7-9 translates these major actions in each region of interest into sets of activities relevant to each environmental attribute considered in the cumulative impact analysis. For example, surface water resources (an environmental attribute) could be affected by oil development (an action) through permitted discharges, construction, land disturbance, water use, or spills (the activities). The activities, in turn, can be further translated into impacting factors (e.g., chemical pollutants, sedimentation, reduced flow) that can be used to evaluate the impacts of the action on the environmental attribute. The sum of these effects, then, represents the cumulative impacts on the specific environmental attribute in the region. Thus, impacting factors constitute the mechanism by which cumulative effects are analyzed and presented. While each activity in Table 4.7-9 has one or more corresponding impacting factors, each impacting factor can also be a component of more than one activity. For example, sedimentation can be an impacting factor for surface water resources for both construction and land disturbance.

TABLE 4.7-9 Activities and Impacting Factors Associated with the Reasonably Foreseeable Actions That Would Contribute to a Cumulative Effect

Key to actions: A = Oil and gas exploration, development, and production; B = Oil refining; C = Oil and refined product storage; D = Oil and gas transportation; E = Human habitation and development; F = Transportation (other than oil and gas); G = Legislative actions; H = Land management; I= Natural resource use; and J = Petroleum spills.

		Major Contributing Actions, by Region[a]			
Environmental Attribute and Associated Activities	Impacting Factor	Beaufort Sea and North Slope	Interior Alaska	Prince William Sound	Gulf of Alaska/ Pacific Transportation Routes
PHYSICAL					
Soils and Permafrost					
Construction	Disturbance	A, D	A, D, E, F, I	E, F, I	
Spill/site cleanup	Disturbance	J	J	J	
Vehicular traffic	Dusts	A, D	A, D, E, F, I	--	
Sand, Gravel, and Stone					
Construction	Resource use	A, D, E	A, D, E, F	--	
Paleontology					
Excavation	Disturbance	--	--	--	
Collecting	Removal	E	E	E	
Surface Water Resources					
Permitted discharges	Pollutants	A	A, B, E	B, D, E	
Construction	Sedimentation	A, D, E, F	A, D, E, F	D, E, F	
Land disturbance	Sedimentation	--	E, I	E, I	
Bank/shore modification	Sedimentation; channel/flow changes	A, D, F	D, E, F, I	D, E, I	
Water use	Reduced flow	A	A, E, I	A, E, I	
Site remediation	Sedimentation; elimination or reduction of pollution source	J	I, J	I, J	
Petroleum spills	Pollutants	A, D, F	A, B, C, D, E, F, I	B, C, D, E, F, I, J	D

TABLE 4.7-9 (Cont.)

Environmental Attribute and Associated Activities	Impacting Factor	Major Contributing Actions, by Region[a]: Beaufort Sea and North Slope	Interior Alaska	Prince William Sound	Gulf of Alaska/ Pacific Transportation Routes
Groundwater Resources					
Permitted discharges	Pollutants	A	--	--	
Site remediation	Elimination or reduction of source pollution	J	I, J	I, J	
Petroleum spills	Pollutants	A, D, F	A, B, C, D, E, F, I	B, C, D, E, F, I, J	
Marine Environment					
Noise		--	--	E, F, I, J	
Oil/fuel spills		--	--	E, F, I, J	D
Air Quality					
Facility and equipment operations	Emissions from fuel combustion	A, D, E	A, B, D, E, I	B, C, D, E	
	Fugitive emissions	A, C, F	A, C, F	C, F	
Construction	Exhaust emissions	A, D, E	A, D, E, I	D, E, I	
	Fugitive dust	A, D, E	A, D, E, I	D, E, I	
Vehicles	Exhaust emissions	D, F	D, F	D, F	
	Fugitive dust	D, F	D, F	D, F	
Accidental spills	Evaporative emissions from crude oil, petroleum products, hazardous chemicals	J	J	J	
Noise					
Construction activities	Equipment, blasting	A, D, E, F	A, D, E, F, I	D, E, F, I	
Operations	Equipment, blasting	A, D, E, F	A, D, E, F, I	D, E, F, I	
Transportation					
Marine railway	Materials, equipment, supplies	A, D	A, D, E, I	E, I	
Dalton/Alaska highways	Materials, equipment, supplies	A, D	A, B, D, E, H, I	B, D, E, I	
	Workers	--	A, D, E, H, I	B, C, D, E, H, I	
	Residents	--	E	E	
	Tourists	E, H, I	E, H, I	E, H, I	

TABLE 4.7-9 (Cont.)

Environmental Attribute and Associated Activities	Impacting Factor	Major Contributing Actions, by Region[a]: Beaufort Sea and North Slope	Interior Alaska	Prince William Sound	Gulf of Alaska/ Pacific Transportation Routes
Airports/airstrips	Workers, supplies	A, H	E, H, I	E, H, I	
	Residents	E	E	E	
	Tourists	E, H, I	E, H, I	E, H, I	
Permanent/seasonal roads	Materials, equipment, supplies, workers	A	A, D, E, H, I	E, H, I	
Ice/winter roads	Materials, equipment, supplies	A	A, D, E, H, I	--	
Human Health and Safety					
Exploration	Occupational hazards	A	A	--	
Construction	Occupational hazards	A, D, E, I,	D, E, I	E	
Operations	Occupational hazards	A, D, H, J	B, C, D, E, H, I	B, C, D, E, H, I	
	Toxic releases	A, D	B, C, D, E, I	B, C, D, E, I	
Transportation	Vehicle emissions	F	F	F	
	Accidents	F	F	F	
Persistent environmental contaminants	Persistent organic pollutants (POPs)	A, D, E, F, H, I, global sources	B, C, D, E, F H, I, global sources	B, C, D, E, F H, I, global sources	
	Heavy metals	A, E, F, J, natural sources	E, F, I, natural sources	E, F, I, natural sources	
	Radionuclides	A, natural sources	B, E, I, natural sources	B, E, I, natural sources	
BIOLOGICAL					
Vegetation and Wetlands					
Construction	Disturbance	A, D, E	D, E, F, I	E, I	
	Dusts	A, D, F	D, E, F, I	E, I	
	Erosion	A, D, E	D, E, F, I	E, I	
Transportation	Dusts	A, D, F	B, C, D, E, F, I	C, E, F, H, I	
Restoration	Disturbance	A, D	B, C, D, I	B, C, D, I	
	Nonnative species	A, D	B, C, D, I	B, C, D, I	
Petroleum spills	Spills	A, D, F	B, C, D, E, F, I	B, C, D, E, F, I	D
Permafrost changes	Habitat loss/alteration	F	F	-.-	

TABLE 4.7-9 (Cont.)

Environmental Attribute and Associated Activities	Impacting Factor	Major Contributing Actions, by Region[a]: Beaufort Sea and North Slope	Interior Alaska	Prince William Sound	Gulf of Alaska/ Pacific Transportation Routes
Fish					
Construction	Habitat loss/alternation	A, D, E	D, E, F, I	E, I	
	Obstruction	A, D, F	D, F	I	
Transportation	Harvest	A, D, F	D, E, F, H, I	D, E, F, H, I	
Petroleum spills	Habitat loss/alteration	A, D, E	B, C, D, E, F, I	B, C, D, E, I	D
Birds and Mammals					
Construction	Habitat loss/alteration	A, D, E	D, E, F, I	E, I	
	Displacement	A, D, E	D, E, F, I	E, I	
Operations	Obstruction	A, D	D, E, F, I	I	
	Disturbance	A, D, E	D, E, F, H, I	B, C, D, E, I	
Petroleum spills	Habitat loss/alteration	A, D, E	B, C, D, E, F, I	B, C, D, E, F, I	
	Mortality	A, D, E	B, C, D, E, F, I	B, C, D, E, F, I	D
Transportation	Mortality	A, D, F	B, C, D, E, F, I	B, C, D, E, I	
HUMAN					
Subsistence					
Construction/operation	Employment	A, D, E, H	B, C, D, E, F, H, I	B, C, D, E, F, H, I	
	Permanent Fund Dividend	A, D	D	D	
	Effects on resources	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	D
	Nonsubsistence use	H, I	E, H, I	E, H, I	
Petroleum spills	Effects on resources	A, D, F	J	J	
Sociocultural Systems					
Taxes and revenues	Public services and education	All actions	All actions	All actions	
	Roads, airports, infrastructure	All actions	All actions	All actions	
Employment	Cash economy	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	
	Acculturation	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	
	Fragmentation	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	

TABLE 4.7-9 (Cont.)

Environmental Attribute and Associated Activities	Impacting Factor	Major Contributing Actions, by Region[a]: Beaufort Sea and North Slope	Interior Alaska	Prince William Sound	Gulf of Alaska/ Pacific Transportation Routes
Economics					
Construction/operations	Expenditures	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	
	Employment	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	
	Taxes/revenues	A, D, E, H, I	B, C, D, E, F, H, I	B, C, D, E, F, H, I	
Petroleum spills	Expenditures	A, D, F	B, C, D, E, F, I	B, C, D, E, F, I	D
	Employment	A, D, F	B, C, D, E, F, I	B, C, D, E, F, I	D
Land Use					
Construction/operations	Use conflicts	A, D, G, H	D, G, H	G, H	
Petroleum spills	Fire	A, D	B, C, D	B, C, D	D
Coastal Zone Management					
Construction/operations	Visual changes	A, D	--	B, C, D	
	Use conflicts	A, D, G, H	--	B, C, D, E, F, G, H, I	
	Subsistence impacts	A, D, G, H	--	B, C, D, E, F, G, H, I	
Petroleum spills		D		D	D
Recreation					
Construction/operations	Increased demand	--	D, E, I	--	
	Conflict with use	--	E, I	--	
Petroleum spills			D	D	D
Aesthetics					
Construction/operations	Visible effects	A, D	B, C, D, E, F, I	B, C, D, E, F, I	
	Noise	A, D	B, C, D, E, F, I	B, C, D, E, F, I	
Petroleum spills	Fire	A, D	B, C, D	B, C, D	D

[a] See Table 4.7-2 for further details.

[b] A hyphen indicates not applicable.

4.7.6 Physical Environment

4.7.6.1 Soils and Permafrost

Activities associated with oil and gas exploration, development, and production and the construction of a natural gas pipeline could disturb vegetative cover and affect soils and permafrost in the North Slope and Beaufort Sea areas and Interior Alaska. These activities could include constructing roads, drilling pads, and pipeline; delivering heavy equipment; logging; and building support facilities. As the vegetative cover would be disturbed, the permafrost below the ground surface could be degraded, causing changes in the local hydrology, slope stability problems, and surface subsidence (see Section 4.3.2 on soils and permafrost). The current warming trend in Alaska would contribute to continued thawing in the vicinity of all actions in permafrost areas.

The impacts would vary by location, since they would depend on the local geology, hydrology, and permafrost conditions. The impacts on the soil and permafrost would primarily occur in the local areas where the activities occurred. Therefore, since other activities in the Beaufort Sea and North Slope areas would affect local areas, there would be a negligible cumulative impact with any similar localized impacts of TAPS operations.

Construction of a gas pipeline from the North Slope either to Delta Junction in Interior Alaska or on to Valdez would require excavation in the vicinity of the TAPS ROW. Activities associated with TAPS and natural gas pipeline construction and operation would therefore act cumulatively to disturb vegetative cover and affect soils and permafrost. The disturbance caused by construction of the natural gas pipeline would be substantially larger than that caused by maintaining the TAPS; the contribution of the TAPS to cumulative impacts of soil disturbance in the region is expected to be small.

Under the less-than-30 year renewal alternative, cumulative impacts would be as stated above for the proposed action, but of shorter duration for the TAPS renewal period. TAPS contributions to cumulative effects would be small. For the no-action alternative, the cumulative impacts on soil disturbance from oil exploration and development on the North Slope would decline as these activities declined, pending development of an alternative means of oil transportation. However, the combined effects of shutting down TAPS operations, removing facilities, and construction of a natural gas pipeline would have cumulative effects greater than those for the proposed action. This is because the activities involve extensive excavation and movement of heavy equipment. In summary, the cumulative impact on soil and permafrost caused by physical disturbance on the ground surface would be smaller under the proposed action than under the no-action alternative.

Permafrost is affected by road dust generated by traffic on unpaved roads; snow melt due to dust deposition can lead to flooding, ponding, and hydrological changes in soil (see Section 3.3.2.2 on permafrost degradation and aggradation). Where roads on the North Slope and in Interior Alaska are not paved, all activities that generate vehicle traffic on roadways generate dust. (The Dalton Highway is currently being improved to reduce generation of dust.) Thus, continuing oil and gas exploration, development, and production; construction of a natural gas pipeline; the operation of the TAPS; and other activities requiring road travel would add cumulatively to the volume of road dust generated. The quantitative increase in the settled dust layer, as well as increases in the frequency of dusting may increase effects on vegetation and snow cover, thus ultimately affecting soils and permafrost.

The road dust generated from TAPS activities alone in the long term would be about the same or larger under the proposed action than under the no-action alternative because expected traffic volumes would be less under no action (Section 4.6.2.11). Under the no-action cumulative case, the amount of traffic due to oil exploration, development, and production would also decline after the initial phase of TAPS renewal. Depending on the balance of the other transportation changes, the cumulative impact of road dust on soil and permafrost could be smaller, the same, or larger in the proposed action case than in the no-action case, while the contribution of the gas line construction to the total impact caused by the road dust in both alternatives would be the same.

If oil and gas exploration, development, and production in the North Slope and Beaufort Sea areas were expanded, or a gas pipeline parallel to the TAPS is constructed, the amount of road traffic caused by these activities would increase greatly over the traffic caused by regular maintenance operations for the TAPS. The cumulative impact of road dust on soil and permafrost would be smaller in the proposed action case than in the no-action case. Similarly, the cumulative impact on soil and permafrost caused by physical disturbance on the ground surface would be smaller under the proposed action than under the no-action alternative. In the years following completion of dismantlement of the pipeline, impacts from all activities could be less than, the same, or greater than the annual impacts under the proposed action, depending on the level of activity in any area. No synergistic impacts were found.

In summary, if oil and gas exploration, development, and production in the North Slope and Beaufort Sea areas continued and if the natural gas pipeline were constructed, the amount of road traffic caused by these activities could be greater than the traffic caused by regular maintenance operations for the TAPS. It is likely that the TAPS contribution to the total dust load would be smaller than that from the other activities in the North Slope area.

4.7.6.2 Sand, Gravel, and Quarry Resources

Sand, gravel, and quarry stones are needed to build the access roads, air strips, workpads, drilling pads, and gravel islands needed for oil and gas exploration, development, and production. These materials are mined in quarries in the Brooks Range and in floodplains throughout the region.

To reduce construction costs, most of the mining sites, to the maximum extent possible, would be located near areas where the materials would be needed. With continuing oil and gas exploration, development and production in the Beaufort Sea, North Slope, and Interior Alaska, and with development of the natural gas pipeline and with other industrial and community development, additional quantities of sands, gravels, and quarry stones would be needed. Other actions in Interior Alaska, such as mineral development, logging, and urban development, would require roads and other facilities, which, in turn, would require sand and gravel. The sand and gravel requirements for the natural gas pipeline on the North Slope and in the Interior Alaska are not known, but these resources might be required along the ROWs and access points. Rip rap might be needed at river crossings. The majority of these materials would be mined and impact areas would be outside the areas where the TAPS is located. However, some of the materials could be extracted in areas near the TAPS or from the same quarries or gravel pits as those used by the TAPS. The latter actions would contribute to a cumulative impact. However, taken as a whole, sand, gravel, and stone resources are abundant, and all requirements are unlikely to deplete these resources.

The requirement designed to protect the tundra environment — to use ice roads in winter and ice pads in exploratory drilling pads — reduces the quantity of gravel that would otherwise be used for roads to reach remote areas. However, ice roads or ice pads might not be used in places where continued access during summer (for maintenance) or operational access is required. Sands and gravels would be required at remote locations for pad construction, production facilities, and associated infrastructure. On the North Slope, the source for rock for rip rap and river framing is limited to quarries in the Brooks Range. The contribution of the TAPS to the total impact would likely be much smaller than that of the other continuing and new activities in the North Slope area. No synergistic impacts were found.

Under the less-than-30-year renewal alternative, cumulative impacts would be as stated above for the proposed action but of shorter duration. If at the end of this period a further request for renewal was granted, cumulative impacts would continue as stated for the proposed action. If a further request for renewal was not granted, cumulative impacts would continue as stated for no action, below.

Under the no-action alternative, sand, gravel, and quarry stone requirements might increase while TAPS facilities were dismantled and removed. However, sand, gravel, and quarry stones would no longer be needed for the TAPS after early phases of the termination activities were completed, and requirements for oil exploration, development, and production would decline. However, the natural gas pipeline would require sand, gravel, and quarry stone resources. The cumulative impact of all activities on these resources would be smaller under the no-action alternative than under either the 30-year proposed action or the less-than-30-year renewal alternatives.

4.7.6.3 Paleontology

Any action that involves ground disturbance, either from routine operations or from cleanup after accidents, creates a potential for impacts to paleontological resources existing in the affected area. Synergistic effects are unlikely. Paleontological resources may also be impacted by collecting and disturbance by the presence of people associated with these actions. However, given the variability of the scientific importance of paleontological resources, there is the potential for significant adverse cumulative impacts when all other actions are considered together. Mitigating this cumulative impact would require addressing protection of paleontological resources for these other actions on a case-by-case basis. Impacts to paleontological resources from continuing operations of the TAPS will be avoided according to provisions in the Federal Grant that address paleontological materials, and continued operation of TAPS would not add to any significant impact on paleontological resources.

Under the no-action alternative and the less-than-30-year renewal alternative, the cumulative impacts would be similar to cumulative impacts under the proposed action. Construction of a natural gas pipeline would be a major ground disturbing activity of a few years' duration. These impacts would be offset by declining oil and gas development activities on the North Slope. In summary, any ground disturbing activity involves the potential for impacts to paleontological resources requiring mitigation on a case-by-case basis.

4.7.6.4 Surface Water Resources

A number of foreseeable actions have been identified (Section 4.7.3) that could produce impacts to surface water resources in three regions associated with the TAPS ROW: the North Slope, Interior Alaska (along the TAPS ROW), and Prince William Sound. These actions could interact cumulatively with impacts from the proposed action and the no-action alternative. Impacting factors related to these foreseeable activities include permitted discharges; erosion; sedimentation; bank, channel, and shore modifications; water use; site remediation; and spills. Potential impacts of these factors on surface water resources include reduced quantities of water and degraded water quality.

Oil and gas exploration, development, and production require the use of large quantities of water. Maximum bounding estimates for one project are that construction of 1 mi of ice road requires about 1 million gal of water; an ice pad that is square and 600 ft on a side requires about 21 million gal of water; and construction of an ice airstrip requires about 8 million gal of water (BP Exploration 2000). For the same project, drill rig use would require about 9 million gal of water annually, rig-camp use for 120 people would be about 2 million gal of water annually; mobile camp water use for 60 people would be about 0.5 million gal of water per year; and ice pad, road, and airstrip maintenance would use another 9 million gal of water per year. For the North Slope as a whole, the typical annual water use for oil exploration is about 27 billion gal (ADNR 2001e). This value represents about 0.27% of the total water available on the North Slope in any given year.

Water requirements on the North Slope in summer would be met by using water from lakes, river pools, and flooded gravel mine sites. Water from taliks (unfrozen layers of ground located on top, underneath, or within masses of permafrost, often occurring beneath deep pools below the surface of rivers and lakes) would be used in winter when the surface water was frozen (BLM 1983c). Water withdrawals from taliks could be limited by permit to no more than 15% of the available water (ADNR 2001e). For the town of Barrow, the Barrow Utilidor System, which is owned and operated by the North Slope Borough, provides about 200,000 gal/d of water from the Isatkoak Reservoir (AWWA 2001).

Impacts to the quantity of surface water from foreseeable activities would be cumulative if the water withdrawals occurred in the same watershed. These impacts potentially could act synergistically on aquatic life due to the action of biological processes if the withdrawals used a large portion of the available water. However, because the total water use for the North Slope is about 0.27% of the available water, and because withdrawal from any one source is limited, impacts from the foreseeable actions could be small in magnitude and local, and synergistic effects are not expected. Impacts from continued operation of the TAPS would be cumulative with other activities on the North Slope only if the same source area was used. Some major water users, such as oil and gas development, are not located along the TAPS ROW. However, water for construction of a natural gas pipeline may affect surface waters in the TAPS ROW, however, these effects would be small in magnitude and local. By following the guidelines on the permissible levels of water withdrawal specified in Alaska water-use permits, impacts of surface water use on the quantity of surface water could be minimized.

The quality of surface water resources (dissolved constituents and sediment) could also be affected by water withdrawals and oil and gas exploration, development, and production; oil and gas transportation; and human habitation and development in the North Slope and Beaufort Sea area. Since water would be withdrawn from taliks during winter, oxygen demand by sediments and water could reduce the concentration of oxygen in the water needed by overwintering fish. However, only 15% of water under the ice sheet may be withdrawn (ADNR 2001e), which would reduce the potential for oxygen reduction or loss and the release of harmful substances from the sediments. The quality of surface water in other areas could be affected by discharges during drilling, sedimentation and runoff from road construction, discharges from homes and developments, and spills. Impacts of these activities would be cumulative if the surface discharges or spills occurred in the same watershed. Impacts from the foreseeable actions could be small in magnitude and local. Impacts from continued operation of the TAPS would be similarly small in magnitude and local on the North Slope. However, the effects on water quality if a large spill was released directly to surface water could be large and extensive, and the magnitude of the effects would depend on the speed of cleanup response teams and the local conditions affecting oil dispersion. The probability of this type of spill occurring is very small. Impacts from anticipated or likely small spills would produce small and local impacts on surface water quality. By following guidelines established for appropriate Alaska discharge permits, limits on the volume of water that can be withdrawn under ice cover, meeting restrictions on the storage of toxic construction and operations materials, and meeting requirements for cleanup of all toxic materials as part of construction and normal operations, cumulative impacts on water quality could be minimized.

In Interior Alaska (i.e., along the TAPS ROW), quantity and quality of surface water could be cumulatively affected by oil and gas exploration, development, and production; oil and gas transportation; oil refining; and human habitation and development. Surface water would be used for activities such as drilling, oil refining, construction (including a natural gas pipeline), dust control, and human consumption. Water requirements would be met by using water from lakes, river pools, taliks (during the winter; BLM 1983c), and groundwater wells (see Section 4.7.6.5). Large construction projects, such as the natural gas pipeline, would probably obtain water from nearby rivers and streams. Impacts of these activities on surface water would be cumulative with those from the proposed action, if the water withdrawals occurred in the same watershed. As discussed in Section 4.3.6, impacts of the proposed action on surface water would be negligible in magnitude, local, and temporary because most water needs are met by using groundwater wells along the TAPS ROW. It is anticipated that the cumulative impacts of the foreseeable actions would be minimized as much as possible by using good engineering practices. Implementation of the foreseeable actions would require compliance with all applicable permit restrictions, laws, and regulations.

The quality of surface water resources in Interior Alaska could also be affected by oil and gas exploration, development, and production; oil refining; and human habitation and development. Surface water quality is affected by both dissolved constituents and sediment. Similar to withdrawal from taliks on the North Slope, water withdrawal from taliks in Interior Alaska could affect overwintering fish if a large proportion of liquid water were withdrawn. However, this potential effect is limited by water withdrawal permit conditions. Similarly, the quality of surface water could be affected by discharges during drilling, sedimentation and runoff from road construction (particularly during construction of a natural gas pipeline), refinery construction and operation, human habitation and development, and spills. Impacts of these activities would be cumulative with those from the proposed action if the surface discharges or spills occurred in the same watershed. Depending on the quantities of pollutants released, impacts from the foreseeable actions could be large in magnitude and local. Impacts from continued operation of the TAPS would, in general, be small and local because of existing permit conditions. However, impacts from a large spill could be major in magnitude and extensive, depending on the speed of cleanup response and the conditions affecting dispersal. (For example, a guillotine break caused by a helicopter or fixed-wing aircraft crash could spill oil directly into a river or stream at an elevated crossing.) In the case of smaller spills, cleanup response would limit the extent of contamination and effect on water quality. By following guidelines established for appropriate Alaska discharge permits, meeting restrictions on the storage of toxic construction and operations materials, and meeting requirements for cleanup of all toxic materials as part of construction and normal operations, cumulative impacts on water quality would be minimized and synergistic effects are not expected.

In the area of Prince William Sound, oil refining; oil and gas transportation; and human habitation and development could affect both the quantity and quality of available surface water. The quantity of surface water available could be reduced by activities such as road construction and dust control, building construction, and human habitation and development, however, water in the Valdez area is supplied by four primary groundwater wells (Vacation Alaska 1999). If the foreseeable project water needs were met by using groundwater from these wells or other new wells, there would be no impact to surface water quantities. Impacts from anticipated or likely small spills would produce small and local impacts because of the small volumes of oil released. (Cumulative impacts to groundwater are discussed in Section 4.7.6.5). Impacts from continued operation of the TAPS for the proposed action would, then, be the only component of the cumulative impact to surface water quantities in the Prince William Sound area. These impacts, as previously discussed, would be small in magnitude, local, and regulated by applicable permits for water use at the Valdez Marine Terminal.

The quality of surface water resources in the area of Prince William Sound could also be affected by oil refining; oil and gas transportation; and human habitation and development. Surface water quality is affected by both dissolved constituents and sediment. The quality of surface water could be affected by runoff from road construction, refinery construction and operation, human habitation and development, and spills. Impacts of these activities would be cumulative with those from the proposed action if the surface discharges or spills occurred in the same watershed. Impacts from the foreseeable actions could be large in magnitude and local. Impacts from continued operation of the TAPS would, in general, be small in magnitude and local, except for impacts from spills, which could be major and extensive (e.g., a catastrophic failure of an oil storage tank at the Valdez Marine Terminal). For anticipated or likely small spills, impacts to surface water quality would be small and local because of the small volumes of oil released. The recipients of most of these impacts would be marine waters (see Section 4.7.6.7) rather than freshwater rivers or streams, which are limited in number and size in the vicinity of the Valdez Marine Terminal. By following guidelines established for appropriate Alaska discharge permits, meeting restrictions on the storage of toxic construction and operations materials, and meeting requirements for cleanup of all toxic materials as part of construction and normal operations, cumulative impacts on water quality would be minimized.

For the less-than-30-year renewal alternative, cumulative impacts would be as stated above for the proposed action but of a shorter duration. Impacts from routine TAPS operations would be small in magnitude and local. However, for a large spill into a major system, impacts on surface waters could be large in magnitude and extensive, depending on the speed of cleanup and the conditions affecting dispersal. If at the end of this period a further request for renewal was granted, cumulative impacts would continue as stated for the proposed action. If a further request for renewal was not granted, cumulative impacts would continue as stated for no action, below.

Under the no-action alternative, the Federal Grant of ROW would not be renewed, and oil would no longer flow through the pipeline to the Valdez Marine Terminal. Oil production on the North Slope would cease, and there would be no exploratory drilling for oil. However, it is assumed gas production on the North Slope would continue, as would exploratory drilling for gas. Because oil production and exploratory drilling for oil would cease, water use on the North Slope would be greatly reduced, and impacts to surface water quality from activities (e.g., ice road construction, other construction, and camp use), discharges from homes and developments, and spills would also be greatly reduced.

In Interior Alaska, cumulative impacts along the TAPS ROW would be temporarily increased during removal of the oil pipeline and associated structures. These impacts would include water use and modification of the existing water quality. Impacts from TAPS removal would be cumulative with those from construction of a new gas pipeline. Although construction and removal impacts would only occur for a short time, the cumulative impacts along the TAPS ROW would be large in magnitude and extensive (occurring along a substantial portion of the 800-mi length of the pipeline). Once the pipeline was removed, impacts from any TAPS-related spills would no longer be possible, and impacts to surface water quality would be limited to other non-TAPS-related projects.

In the Prince Williams Sound area, impacts to surface water quantity and quality would be initially high as TAPS facilities were removed; however, these impacts would be temporary. Once removal activities were completed, impacts would be produced by other non-TAPS related projects. Because surface water would not be used for these other activities, impacts to the quantity of surface water available would be negligible. Impacts to water quality would be minimized, to the extent possible, by following good engineering practices and provisions in appropriate Alaska discharge permits.

In summary, the cumulative impacts of all activities would have small, local, and additive impacts on surface water quantity and quality. Permit requirements related to water withdrawals and discharges to surface waters, as well as cleanup of small petroleum spills, would protect surface water resources. The impacts of TAPS operations on surface water resources would be small in comparison to other actions such as oil exploration and development, water requirements for construction of a natural gas transportation system, and the requirements of other industrial and municipal systems.

4.7.6.5 Groundwater Resources

A number of foreseeable actions have been identified that could produce impacts to groundwater resources in three regions associated with the TAPS ROW: the North Slope, Interior Alaska (along the TAPS ROW), and Prince William Sound. These actions could interact cumulatively with impacts from the proposed action. Specific impacting factors for these foreseeable activities include water use, permitted discharges, site remediation, and spills. Impacts to groundwater resources include reduced quantities of water available and degraded water quality.

In the North Slope area, oil and gas exploration, development, and production; oil and gas transportation; and human habitation and development could affect the quantity and quality of groundwater directly or indirectly. While groundwater resources could be used for such activities as drilling, road construction (particularly ice roads), construction, dust control, and human consumption, water needs on the North Slope are typically met by using surface water resources (BLM 1983c) (see Section 4.7.6.4) because of the presence of a thick layer (thousands of feet) of permafrost. Therefore, cumulative impacts to the available groundwater from the foreseeable actions, together with the proposed action would be none to negligible.

The quality of groundwater resources could also be affected by oil and gas exploration, development, and production; oil and gas transportation; and human habitation and development in the North Slope. Both direct and indirect impacts could occur. Direct impacts on water quality would result from direct discharges to the groundwater from drilling operations (e.g., disposal of production water in deep formations beneath the permafrost layer) and septic systems that discharge to very shallow water above the permafrost (suprapermafrost). However, disposal of production water in deep formations would not impact water available for human consumption. Indirect impacts on water quality would result from the infiltration of contaminated surface water derived from petroleum spills. Impacts from these sources would be cumulative with the proposed action only if contaminants reached the same aquifers. However, these impacts would be controlled and minimized by prompt cleanup actions. Impacts on water quality from the foreseeable actions would be small in magnitude and local because of the presence of the permafrost in this region. Synergistic effects are not expected. Impacts from spills from all actions could be large and extensive if contamination from unlikely or very unlikely large spill events were allowed to reach the groundwater. Impacts to water quality from continued operation of the TAPS would be small in magnitude and local on the North Slope (no cumulative impacts along the TAPS ROW would be derived from North Slope actions), except for spills, which could produce large and extensive impacts if allowed to reach the groundwater. The cumulative impact of foreseeable actions and the proposed action would be small in magnitude and local. Impacts from anticipated spills would be small and local because of the small volumes released. By following guidelines established for appropriate Alaska discharge permits, meeting restrictions on the storage of toxic construction and operations materials, and meeting requirements for cleanup of all toxic materials as part of construction and normal operations, cumulative impacts on water quality would be minimized.

In Interior Alaska (i.e., along the TAPS ROW), groundwater quantity and quality could be cumulatively impacted by oil and gas exploration, development, and production; oil and gas transportation; oil refining; and human habitation and development. The quantity of groundwater available may be locally reduced because water would be used for industrial activities such as drilling, oil refining, construction; dust control, and human consumption. Within Interior Alaska, water needs are usually met by using groundwater wells. For example, the City of Fairbanks acquires all of its water from wells. In 1996, the monthly mean water withdrawal was about 6 million gal/d (USGS 2002b).

For the foreseeable actions in Interior Alaska, water requirements would be met by using groundwater wells, although surface water resources could be used to meet natural gas pipeline construction needs. Impacts of these activities on groundwater resources would be cumulative with those from the proposed action, if the water withdrawals were from the same aquifer. Impacts produced by the foreseeable actions could be large in magnitude and local if withdrawals were a substantial proportion of the available resource. As discussed in Section 4.3.6, impacts of the proposed action on groundwater quantities would be negligible and would be a small component of the cumulative impact. The cumulative impacts of the foreseeable actions would be minimized as much as possible by using good engineering practices. Implementation of the foreseeable actions would require compliance with all applicable permit restrictions, laws, and regulations.

The quality of groundwater resources in Interior Alaska could also be affected by oil and gas exploration, development, and production; oil refining; and human habitation and development. Both direct and indirect impacts could occur. Direct impacts could result from direct discharges to the groundwater from industrial activities and septic fields. Indirect impacts could result from the infiltration of contaminated surface water from industrial and municipal sources and from spills which were not cleaned up. Impacts of these activities would be cumulative with those from the proposed action, if the direct discharges were to the same aquifer or if contaminated surface water infiltrated the same aquifer. Impacts from the foreseeable actions could be large in magnitude and local if any wastewaters were disposed of by deep well injection. Impacts from continued operation of the TAPS would, in general, be small and local, except for impacts from unlikely or very unlikely large spills, which could be large and extensive (e.g., a very unlikely underground guillotine break caused by seismic activity or a landslide). The cumulative impact of foreseeable actions and the proposed action would be large in magnitude and local, with the contribution from continued TAPS operation being negligible to small in magnitude, except for the impacts from spills. In the case of spills, the cumulative impacts could be very large in magnitude and extensive, particularly if a large unlikely spill was released directly to groundwater. For anticipated spills, impacts would be small and local because of the small volumes of contaminants released and because they would be promptly cleaned up. By following guidelines established for appropriate Alaska discharge permits, meeting restrictions on the storage of toxic construction and operations materials, and meeting requirements for cleanup of all toxic materials as part of construction and normal operations, cumulative impacts on water quality could be minimized.

In the area of Prince William Sound, oil and gas transportation, and human habitation and development could affect both the quantity and quality of groundwater. The quantity of groundwater could be reduced because water would be used for activities such as industrial requirements, road construction and dust control, building construction, and human consumption and development. Water in the Valdez area is supplied by four primary groundwater wells (Vacation Alaska 1999). Water is stored in two 750,000-gal reservoirs before it is piped throughout Valdez. If foreseeable project water needs were met by using groundwater from these wells or other new wells, the impacts on the groundwater system could be large, and the water table would be lowered. Water for operation of the Valdez Marine Terminal is obtained from surface water resources. Impacts from continued operation of the TAPS under the proposed action would thus be a negligible component of the cumulative impact to groundwater quantities in the Prince William Sound area.

The quality of groundwater resources in the area of Prince William Sound could also be affected by oil refining; oil and gas transportation; and human habitation and development. Both direct and indirect impacts could occur. Direct impacts would result from direct discharges to the groundwater from septic fields. Indirect impacts would result from the infiltration of contaminated surface water. Impacts from continued operation of the TAPS would, in general, be small in magnitude and local, except for impacts from spills, which could be larger and more extensive (e.g., a very unlikely catastrophic failure of an oil storage tank at the Valdez Marine Terminal). The cumulative impact of foreseeable actions and the proposed action would be large in magnitude and local, with the contribution from continued TAPS operation being small in magnitude, except for the impacts from spills. In the case of spills, the cumulative impacts could be very large and extensive for unlikely to very unlikely spill scenarios. For anticipated spills, impacts could be small and local because of the small volumes of contaminants released. By following guidelines established for appropriate Alaska discharge permits, meeting restrictions on the storage of toxic construction and operations materials, and meeting requirements for cleanup of all toxic materials as part of construction and normal operations, cumulative impacts on groundwater quality would be minimized.

Under the less-than-30-year renewal alternative, cumulative impacts would be the same as the cumulative impacts under the proposed action but of shorter duration. Cumulative impacts on groundwater could be large and local; however, the contribution of routine TAPS operations to these impacts would be small in magnitude. Impacts to groundwater could be large in the case of a large, but very unlikely oil spill. If at the end of this period a further request for renewal was granted, cumulative impacts would continue as stated for the proposed action. If a further request for renewal was not granted, cumulative impacts would continue as stated for no action, below.

Under the no-action alternative, the Federal Grant of ROW would not be renewed, and oil would no longer flow through the pipeline to the Valdez Marine Terminal. Oil production on the North Slope would cease, and there would be no exploratory drilling for oil. However, it is assumed gas production on the North Slope would continue, as would exploratory drilling for gas. Because oil production and exploratory drilling for oil would cease, water use on the North Slope would be greatly reduced. Because this water is normally supplied from surface water resources, there would be no effect on the groundwater resources. However, groundwater quality could still be impacted by such activities as exploratory drilling for gas (e.g., brine disposal), discharges from septic fields, and spills. With the curtailment of oil field drilling, impacts from normal operations to groundwater quality would be greatly reduced. Although the impacts of spills could still be high, the occurrence of spills would be reduced with the curtailment of oil production and exploratory drilling for oil.

In Interior Alaska, cumulative impacts along the TAPS ROW would be increased during removal of the oil pipeline and associated structures and construction of a natural gas pipeline. These impacts include water use and modification of the existing water quality. Impacts from TAPS removal would be less than those from construction of a new natural gas pipeline. Because construction and removal impacts would only occur for a short time, the cumulative impacts along the TAPS ROW would be extensive in area (occurring along a substantial portion of the 800-mi length of the pipeline) and temporary. Once the TAPS pipeline was removed, impacts from any TAPS-related spills would no longer be possible, and impacts to groundwater quality would be limited to those produced by other non-TAPS-related projects.

In the Prince William Sound area, impacts to groundwater quantity and quality would be initially high as TAPS facilities were removed; these impacts would be temporary, however. Once removal activities were completed, impacts would be produced by other non-TAPS-related projects. Because groundwater is the primary source of water in the area, impacts to the resource could be large. Impacts to groundwater resources could be minimized, to the extent possible, by following good engineering practices and provisions in appropriate Alaska discharge permits.

In summary, cumulative impacts on groundwater would be small and local. These impacts would be related to oil and gas exploration, development, and production, and by other industry and community withdrawals. In the event of an unlikely or very unlikely large spill, groundwater could also be affected if contamination was allowed to reach the groundwater. Continued operation of the TAPS would be a small contributor to the cumulative impacts on groundwater resources. No synergistic effects were found.

4.7.6.6 Physical Marine Environment

Potential cumulative impacts to the physical marine environment associated with the TAPS would include those from tankers traveling from the Valdez Marine Terminal through Prince William Sound to the Hinchinbrook Entrance and on to the Gulf of Alaska, Pacific Ocean, and receiving ports. These transits would create noise and involve the risks of petroleum spills or other accidents. Other actions that would be cumulative with the impacts from tanker traffic are commercial fishing, recreational fishing/sightseeing, commercial sightseeing/tours, and other commercial cargo operations in Port Valdez, Prince William Sound, and other ports. With the exception of the risks from larger oil spills, these cumulative impacts on the physical marine environment would be small and short-lived. Small spills from all vessels are rapidly responded to and cleaned up by the spill response infrastructure supporting the oil transportation industry. However, a vessel could sink in deep water and release oil over a longer time period.

Section 4.7.4.10.5 discusses potential spills and accidents that could impact Port Valdez and Prince William Sound, Gulf of Alaska, and

Pacific Ocean coastal areas, including Oregon and California. The GNOME computer program (NOAA 2000) was used to estimate the spread of oil from the various release points identified in Table 4.7-4 GNOME uses location files to specify local conditions; this analysis used the Prince William Sound location file compiled by NOAA (2002). The Prince William Sound location file includes the effects of five current patterns to simulate the circulation and tides in Prince William Sound and Port Valdez. NOAA (2002) states:

> "The tides at Hinchinbrook Strait, Port Wells, Montague Strait, and Valdez Arm are each simulated with separate current patterns. The tidal circulation of Latouche Passage, Elrington Passage and Prince of Wales Passage are all simulated with two current patterns: (1) a modified portion of the Montague Strait current pattern and (2) a background current pattern. The background current pattern models the net surface currents through each of these passages: Latouche Passage (–0.3 knots); Elrington Passage (0.3 knots); and Prince of Wales Passage (–0.9 knots). The tidal current pattern for Montague Strait was extended to each of these passages with relative amplitudes that approximate the residual tides. Since the phase differences between these areas were on the order of an hour, this approximation was considered acceptable."

The spill scenarios assume that a volume of North Slope crude oil ranging from 50,000 to 290,000 bbl would be released instantaneously at various locations in Port Valdez, the Valdez Narrows, and Prince William Sound, and that it would spread for 6 hours before response and containment. This is the range of oil spill volumes that would be expected to be released from a tanker accident (see Table 4.7-4). The actual response time might be significantly different (either higher or lower) from the assumed 6-hour value, depending on weather conditions, the location of the spill, and other factors. If the spills occurred under extreme weather conditions in which the winds and currents were different from those used in the model, response times could be longer, and the released oil could travel more rapidly, so a much larger area would be impacted by the potential oil spills than the area estimated here.

Prevailing winds in Port Valdez and Prince William Sound are generally from the northeast, with speeds up to 15 knots. The other prevalent wind direction in Port Valdez is from the southwest at about 12 knots (TAPS Owners 2001a). Both of these prevailing winds were used in the model runs to estimate the impacts of the various spill scenarios. Because specific locations for these spills were not known, a number of locations from Port Valdez to the Hinchinbrook Entrance were evaluated. In addition to the effects of wind variability, the differences in currents at different times of the day were also incorporated into the calculations.

For all the release scenarios modeled, the oil slick moved out from the release point and expanded radially, except the expansion was larger in the direction of the prevailing winds and currents. The general direction of the oil movement depended on the wind direction.

The best estimate of the shape of the area in which 99% of the oil would be in the water within 6 hours after the release is that it would be an almost-circular ellipse, if the spill could not reach the shoreline. This area would extend about 4-1/2 mi in diameter from the release point. The general shape of this estimated area would be different for different release points, since it would be influenced by winds and currents in the spill location.

The GNOME program also has the capability to evaluate the relative uncertainties of various parameters used in the model projections. These calculations are implemented by using a "minimum regret" approach (see Section 4.4.4.5.2). The estimated areas that would contain the oil spill plume after 6 hours would be ellipses about 10 mi in diameter, approximately centered on the release point, in an almost circular shape.

Spills starting at locations near the center of Prince William Sound would not reach the shoreline within the assumed 6-hour response time; spills starting at locations within 5 mi of the shore could potentially reach the shoreline within the 6-hour assumed time limit. Potential oil spill locations within Port Valdez and the Valdez Narrows would release oil over large portions of the shoreline, up to 10 mi (5 mi on each side of Port Valdez or the narrows) in the assumed 6-hour response window. Potential oil spill locations near the Hinchinbrook Entrance would also release oil over large amounts of shoreline, up to 6 mi or more, depending on prevailing wind directions at the time of the spill.

All spills within the range of spill volumes evaluated would behave in a similar manner, and the oil would be transported over comparable distances. The only difference would be in the concentration of oil within the plume.

It is assumed that at the 6-hour point, the spill would be contained, and further spreading of the oil would stop. However, it is possible that some oil would escape the initial containment and could impact other areas in Port Valdez and Prince William Sound. The impacts outside the containment area would be small and localized. Within the containment area, the impacts would be significant.

It is assumed that once the oil was contained, removal actions would begin. As noted in Section 4.4.4.5.4, North Slope crude oil does not significantly dissolve into the water column during the first 24 hours after a spill; however, some dissolution does take place. Dissolved constituents resulting from the spill could have minor local impacts, but dilution effects would limit the impacts away from the spill areas. As noted in Section 3.9.3 on affected marine environment, the waters of Port Valdez and Prince William Sound are well-mixed and would dilute dissolved constituents from the spill.

Releases near the shore would heavily oil the shoreline, and the waters immediately around the area would also be affected. The oiled shoreline could also continue to affect the waters of Port Valdez and Prince William Sound in the immediate area of the spill for a long time after the initial release. However, because of dilution and the existing hydrocarbon background concentrations, changes in seawater hydrocarbon concentrations would be minimal and localized. Impacts could also occur in other areas of Port Valdez and Prince William Sound away from the release point or oiled shoreline; these impacts on seawater hydrocarbon concentrations would also be small and localized. As noted in Section 3.11.3, significant hydrocarbon background concentrations already exist in Port Valdez waters. Low concentrations resulting from long-term releases from an oiled shoreline would not be distinguishable from background concentrations at any locations except the areas very near the source location.

Mitigation for spills occurring during tanker transit from Port Valdez and in Prince William Sound would include (1) minimizing the time for response and the time required to contain a release, (2) deploying containment systems quickly, and (3) starting removal actions before weather or other adverse conditions could make containment difficult.

Oil spilled in the Gulf of Alaska, Pacific Ocean, or mainland coastal areas would be transported away from the spill site by prevailing winds and currents. The drifting oil would form a water-in-oil emulsion (mousse) that breaks into bands and stringers and could reach areas hundreds of miles away from the spill site. Where shore is reached, impacts would be similar to those for the proposed action. For oil remaining in the water column, the concentration of hydrocarbons in the water column would be high, hundreds of parts per million, during the first several days following the spill. Over some period of time, perhaps as long as several months in heavily oiled areas, the concentration of hydrocarbons in the water would decrease to background levels. This decrease would result from a number of processes, including evaporation of the volatile components, dispersion through horizontal and vertical mixing, weathering, biodegradation, deposition along shorelines and in seafloor sediments, and photolysis (MMS 2002).

Under the less-than-30-year renewal alternative, the consequences from oil spills would be the same as those discussed for oil spills under the proposed action. However, the overall probability of a spill (which is the product of the spill frequency multiplied by the number of years) will be lower with the less-than-30-year renewal period.

Under the no-action alternative, oil shipments from the TAPS would cease, and there would be no risk of an oil spill from a TAPS-related tanker. However, risks from an oil spill from other marine traffic would remain. If the spill emergency response infrastructure was not maintained, the environmental effects of fuel or oil spilled by non-TAPS-related vessels could be larger than those under the proposed action.

4.7.6.7 Air Quality

Reasonably foreseeable actions that might impact air quality and air quality-related valves (AQRVs), such as visibility and acid deposition, include exploration, development, production, storage, refining, and transportation of oil and gas; human habitation and development; land management activities; and natural resource uses. Specific factors inherent to these actions impacting air quality and AQRVs include emissions from (1) the operation of facilities and equipment (exhaust emissions from fuel-burning equipment and fugitive emissions of dust and VOCs); (2) construction activities (exhaust emissions from heavy equipment and vehicles and fugitive emissions of dust from land disturbance); (3) accidental spills of crude oil, petroleum products, and hazardous chemicals (evaporative emissions); and (4) transportation activities (exhaust and road dust emissions from vehicles).

Emissions associated with the operation of industrial facilities and equipment are usually continuous and long-term, while those associated with construction activities or spills are usually intermittent and short-term. Emissions from transportation activities can be either short-term or long-term, depending on whether they are associated with facility construction or operational activities. Potential impacts on air quality (and AQRVs) from operational, construction, and transportation activities and those from accidental spills under the proposed action are described in Sections 4.3.9 and 4.4.4.6, respectively. Results of air quality impact modeling of emissions from TAPS facilities, including pump stations and the Valdez Marine Terminal, show that ambient air quality in the vicinity of the TAPS ROW would remain in compliance with applicable ambient air quality standards under the proposed action. In addition, available ambient air quality monitoring data in the vicinity of the TAPS ROW indicate that cumulative air quality impacts from the TAPS and other existing industrial facilities as well as from other human activities would not result in ambient air quality exceeding applicable ambient air quality standards (Table 3.13-10). Potential impacts on air quality (and AQRVs) from termination activities under the no-action alternative are estimated to be less than those under the proposed action (Section 4.6.2.9).

Twelve TAPS facilities are located along the 800 mi of the TAPS ROW. They include 11 pump stations (4 are currently in ramp-down mode) and the Valdez Marine Terminal. Therefore, it is likely that many locations of reasonably foreseeable actions would be spatially separated from the TAPS facilities by considerable distances. In these cases, there would be little long-term cumulative impacts due to the potential long-term emissions from reasonably foreseeable actions in combination with the proposed action. In cases where reasonably foreseeable actions would be located close to TAPS facilities, there could be observable cumulative impacts. However, all new or modified industrial facilities that would have a significant amount of new emissions or emission increases (major new source or modification) would have to comply with the Prevention of Significant Deterioration of Air Quality regulations (18 AAC 50.020), which limit the maximum allowable incremental increases in ambient concentrations above established baseline levels (Table 3.13-8). Therefore, any potential long-term cumulative air quality impacts due to reasonably foreseeable actions in combination with various activities under the proposed action would be limited and would not result in deterioration that would exceed applicable ambient air quality standards.

It is also likely that many locations of construction activities or spills associated with the reasonably foreseeable actions would be separated spatially from the TAPS facilities or temporally from the TAPS-related construction activities or spills under the proposed action, or from termination activities under the no-action alternative. In these cases, there would be little or no short-term cumulative impacts due to the potential emissions from construction activities or spills associated with the reasonably foreseeable actions in combination with the proposed action or the no-action alternative. In cases where construction activities or spills associated with the reasonably foreseeable actions would be located close to TAPS facilities or occur simultaneously and in close proximity to TAPS-related construction or termination activities, there could be observable cumulative impacts. However, the potential air quality impacts of emissions from these construction activities or spills would be short-term and localized to the immediate vicinity of construction or spill sites. Mitigation measures, such as watering to control fugitive dust at construction sites and containment and recovery of spilled materials by spill response teams, would minimize the potential impacts on ambient air quality. Thus, any potential short-term cumulative air quality impacts due to construction activities or spills associated with the reasonably foreseeable actions in combination with the proposed action or the no-action alternative would be limited and would not result in deterioration that would cause ambient air quality to exceed applicable standards.

Transportation of personnel, equipment, materials, and supplies for construction activities associated with reasonably foreseeable actions, such as the natural gas pipeline, would result in increased traffic volumes on the roadways near the TAPS. Potential increases in traffic volume along Dalton Highway due to the natural gas pipeline construction and operation would be expected to be small (see Section 4.7.6.9). Existing traffic volumes on these highways are also low.[3] Thus, it is estimated that potential cumulative air quality impacts due to the emissions from small increases in traffic volumes in combination with the proposed action, less-than-30-year alternative, or the no-action alternative would be limited and would not result in deterioration of ambient air quality along these highways that would cause ambient air quality to exceed applicable standards.

The transportation of crude oil to market by tankers would result in air emissions from the tankers' engines during loading operations, transit, and during unloading at the destination ports. These emissions would consist primarily of nitrogen oxides, sulfur dioxide, and particulate matter. Emissions of volatile organic compounds would also occur during tanker loading and unloading operations. Emissions of nitrogen oxides and volatile organic compounds would be of concern in ports located within ozone nonattainment areas because of their potential to contribute to tropospheric ozone levels. In these areas, local regulations commonly require the use of vapor balance systems to reduce volatile organic compound emissions substantially. For any particular port, the emissions would be intermittent, and nitrogen dioxide, sulfur dioxide, and particulate matter concentrations would be within ambient air quality standards. Impacts from emissions during transit would be very small because emissions would be dispersed over a large area.

In summary, little or no potential long-term and short-term impacts on air quality (and AQRVs), including synergistic effects, are estimated to result from reasonably foreseeable actions in combination with the proposed action or the no-action alternative. Such impacts would not result in deterioration of air quality that would cause ambient air quality to exceed applicable standards.

4.7.6.8 Noise

The construction and operation of industrial facilities and equipment, transportation, and mining can produce annoying or harmful levels of noise. Potential noise impacts due to operational and construction activities under the proposed action are described in Section 4.3.10. It is estimated that there would be no adverse noise impacts beyond TAPS facility site boundaries from the noise emitted during TAPS facility operations. Potential noise impacts due to any construction activities under the proposed action or termination activities under the no-action alternative would also be limited to within the TAPS facility site boundaries or the immediate vicinity of construction sites. Therefore, any cumulative noise impacts due to noise emitted from the reasonably foreseeable

[3] Annual average daily traffic volumes along Dalton Highway range from about 200 to 300 vehicles per day, and those along the Alaska Highway range from about 400 to 3,000 vehicles per day. These values can be compared with tends of thousands to more than 100,000 vehicles per day for a busy urban highway.

actions, in combination with noise emitted from TAPS operational or construction activities under the proposed action or termination activities under the no-action alternative, would be limited to within the facility site boundaries or the immediate vicinity of construction sites.

4.7.6.9 Transportation

The transportation network currently plays a key role in North Slope oil and gas exploration, development, and production. One major route by which equipment, materials, and supplies enter Alaska is via the rail marine service between Seattle and Whittier. From Whittier, the cargo is shipped by rail to Fairbanks. The cargo is then shipped by truck from Fairbanks via Dalton Highway to the North Slope for use. The Deadhorse Airport also plays an important role in North Slope operations as a terminus for personnel and some cargo.

Aside from the existing road network, some roads and workpads need to be constructed on the North Slope for oil and gas exploration. Ice roads and pads are employed when possible to reduce impacts to water, soil, and vegetation. Oil and gas exploration and development on the North Slope is an ongoing process in which a relatively constant number of contractors move from area to area to locate more producing well fields. Over time, the number of production wells does not change significantly because older well fields eventually become uneconomical. The older wells are taken off-line, while new producing wells are brought on-line as a result of the exploration and development. Thus, North Slope activities would not be expected to change significantly in the foreseeable future, and the associated demands on the area's transportation infrastructure from oil and gas exploration, development, and production could be readily accommodated.

The construction of a natural gas pipeline might impact the transportation corridor that is also used by the TAPS. The existing transportation network is expected to be capable of transporting personnel, equipment, materials, and supplies for natural gas pipeline construction. This infrastructure has been incrementally upgraded over the years since the construction of the TAPS. (Transportation of material, goods, and services for the natural gas pipeline construction might temporarily increase use on the roadways.) It is expected that any natural gas pipeline would follow existing roadways to facilitate construction and maintenance. The most noticeable impacts would occur in the immediate vicinity of the current focus of construction along the affected highways as a result of the entry and exit of workers and construction equipment. However, proper staging of equipment and gas pipeline components along the affected highways would minimize delays along the routes associated with deliveries to the current construction site.

In general, any impacts to travel along the affected highways would be expected to be small and additive because daily traffic volumes are relatively low. Annual average daily traffic volumes along Dalton Highway range from about 200 to 300 vehicles per day. Traffic volumes along the major highways south of Fairbanks vary significantly and fall into the range of approximately 300 to 2,000 vehicles per day away from the larger communities such as Anchorage, Delta Junction, Fairbanks, Glennallen, and Valdez (ADTPF 2001; Richards 2002). Commercial truck traffic constitutes approximately 10% to 40% of these volumes. Traffic in mid-summer is close to double the annual averages in some locations. Because of these relatively low traffic volumes, additional traffic from natural gas pipeline construction would not be expected to cause significant impacts, such as traffic delays.

Under the less-than-30-year renewal alternative, the impacts discussed above for the proposed action also would apply. However, should the TAPS ROW renewal not be granted, a number of changes might occur. Without the pipeline, an alternative means of transporting oil from the North Slope to the refineries and Prince William Sound would need to be identified. Should further transportation of oil from the North Slope prove to be infeasible, railroad transport of petroleum products from the North Pole refinery to Anchorage would cease, resulting in approximately a one-third cut in the railroad's annual revenue. A decrease or cessation of oil exploration and production on the North Slope would also decrease the need for rail shipments of materials and supplies to

Fairbanks and subsequent shipment by truck up the Dalton Highway. In addition, personnel and supply transport into the Deadhorse Airport would also decrease.

4.7.6.10 Wastes

Waste impacts would result from many of the past, present, and reasonably foreseeable activities that contribute to the cumulative impact. In most instances, the majority of waste impacts from those activities would result from human habitation or presence (i.e., the generation of domestic solid wastes and domestic and sanitary wastewaters). With the exception of North Slope activities, human habitation related to these cumulative actions (i.e., the workforce engaged in those actions) would likely occur at or near population centers or established communities. It is therefore assumed that solid wastes and domestic and sanitary wastewaters attributable to that workforce would be managed in existing municipal treatment or disposal facilities. It is further assumed that the (1) relative sizes of the workforces engaged in most cumulative actions would be small relative to the sizes of the communities in which they would reside or work and (2) cumulative actions would thus have only small incremental and additive impacts on existing waste management systems. Consequently, those waste impacts were not analyzed further, and no discussion is included here. Such assumptions are only partially correct for the North Slope, however, thus waste impacts from the presence of a workforce in the North Slope are discussed in this analysis. Among the potential cumulative actions identified in Table 4.7-2, three ongoing actions have substantial waste impacts: North Slope oil exploration, development, and production (including maintaining the North Slope workforce); oil refining at three of the four operating refineries in Alaska; and tanker loading activities at the Valdez Marine Terminal. One proposed action, the construction of a natural gas pipeline, could also have substantial waste impacts.

The potential cumulative actions for each of the ongoing actions identified above are discussed briefly below. For a more detailed discussion of these actions and their impacts, see Appendix C.

4.7.6.10.1 Waste Impacts Associated with Oil Exploration, Development, and Production. Impacts associated with oil exploration, development, and production on the North Slope result from the management and disposal of production waters, domestic and sanitary wastewaters, other wastes from North Slope operations (e.g., wastes containing naturally occurring radioactive materials, commonly called NORM wastes) and solid wastes.

Production water recovered from each wellhead is either reinjected into the production well from which it was removed or injected into any of the underground injection wells located throughout the North Slope. More than 20 such Class II underground injection wells are in operation on the North Slope. Thus, water is returned to the geologic formation from which it originated or into a formation of similar depth and characteristics. Other industrial wastewaters, such as drilling muds, well development solutions, snow meltwater removed from impoundment structures, and nonhazardous industrial wastewaters associated with activities at the central processing facility, are also routinely disposed of through deep well injection. TAPS operations do not have any impacts on any of the formations that receive production water or well development wastes that are disposed of through deep well injection.

Some wastes associated with oil exploration and production on the North Slope exhibit hazardous waste characteristics. These wastes are transported to out-of-state permitted treatment storage and disposal facilities (TSDFs). Hazardous wastes associated with TAPS operations are also delivered to out-of-state TSDFs. Thus, there might be some cumulative impacts at those out-of-state TSDFs that receive hazardous waste from both TAPS and North Slope operators. However, these impacts are governed by the permit limitations under which such facilities operate.

Domestic and sanitary wastewaters associated with North Slope operations are managed by (1) biological treatment followed by discharge of treated effluents to area lakes or the Beaufort Sea or (2) injection into Class II underground injection wells located on the North Slope. Domestic and sanitary wastewaters from PS 1 are managed by stack injection. However, currently the TAPS PS 1 workforce lives in North Slope dormitories maintained by the North Slope companies; therefore, the domestic and sanitary wastewater resulting from TAPS workforce residents is combined with similar wastewater from the North Slope workforce. Thus, TAPS and North Slope operations have a cumulative impact on the area lakes and the Beaufort Sea and on underground formations as a result of the discharge of treated sanitary wastewater. These impacts are, however, limited by the conditions of the NPDES and Class II injection well permits, respectively, under which discharges to surface water or underground injection occur.

Other waste associated with North Slope operations includes retired well production and oil handling equipment that is contaminated with scale that may contain NORM precipitates that were present in production waters. This NORM waste is generated by all North Slope drillers to varying degrees that depend on the characteristics of the formations from which oil and water are being recovered. However, all such waste is centrally managed at the Mukluk Storage Yard and then transported to commercial firms in Louisiana for treatment. Surveys conducted by those responsible for the Mukluk Yard have demonstrated that NORM contamination of surrounding soils has not occurred during storage. Thus, impacts associated with NORM generation and management do not occur at the North Slope. Because acceptance criteria for oil delivered to PS 1 limit the amount of water allowed and thus the accumulation of contaminated scales, TAPS operations do not contribute to the generation of NORM wastes.

Finally, solid wastes are generated in association with North Slope activities. While some nonhazardous solid *industrial* waste is generated, the majority of solid waste is nonhazardous solid *domestic* waste from activities that support the workforce. All nonhazardous solid domestic and industrial wastes from North Slope operations are delivered to the Oxbow Landfill for disposal. Combustible solid wastes delivered to the Oxbow landfill are incinerated there before land disposal. Similarly, solid wastes from TAPS operations at PS 1 are also delivered to the Oxbow Landfill. TAPS solid waste that is combustible is incinerated at PS 1, and the ash is delivered to the Oxbow Landfill. Thus, impacts to the environment from the operation of the Oxbow Landfill are cumulative, resulting from the management of wastes from both North Slope operations and TAPS operations. However, TAPS solid waste volumes are estimated to be only a minor portion of all the wastes delivered to Oxbow.

Under the no-action alternative, oil exploration, development, and production would cease, pending development of another transportation means. Consequently, there would be a dramatic decrease in the North Slope oil company workforce and a proportional decrease in wastes associated with the support of that workforce (e.g., domestic solid waste, domestic and sanitary wastewaters). Maintaining oil production facilities until an alternative oil transportation option is established would result in small amounts of maintenance-related wastes; a small fraction of which might be hazardous waste. However, no production water, industrial wastewaters, or other wastes associated with oil exploration and production (e.g., retired well production and oil handling equipment) would be generated.

4.7.6.10.2 Waste Impacts Associated with Oil Refining Operations. Petroleum refining is the physical, thermal, and chemical separation of crude oil into its major distillation fractions, which are then processed through a series of separation and conversion steps into finished petroleum products. Currently, four petroleum refineries operate in Alaska: Petro Star Refinery on the Kenai peninsula, Petro Star Valdez Refinery, Petro Star North Pole Refinery, and Williams Alaska Petroleum Co. North Pole Refinery (formerly the MAPCO Refinery). Only the last three receive crude oil from the TAPS. Consequently, for the purposes of this EIS, only activities at the three refineries in North Pole and Valdez are considered to be within the area of interest and to result in cumulative impacts.

The nature and volumes of wastes generated at refineries are functions of the quality and throughput of the raw materials (crude oil) as well as the products being generated. The petroleum refining industry uses relatively large volumes of water. Four types of wastewater are produced: surface water runoff (precipitation draining from industrialized land areas), cooling water, process water, and domestic/sanitary wastewaters. Federal regulations governing the discharge of storm water from industrial areas require the capture and treatment of storm water at all petroleum refineries, including the removal of a large fraction of both conventional pollutants (e.g., suspended solids and constituents that contribute to the water's biological oxygen demand) and toxic pollutants (e.g., certain metals and organic compounds).

Most cooling water is recycled. Any discharge of cooling water, even though it does not come into direct contact with the oil, is treated to remove any oil residues that might have resulted from leaks and to remove any chemicals that were added to the cooling water (e.g., descalers). Process waters require primary and secondary wastewater treatment. Primary wastewater treatment is the separation of oil, water, and solids. After primary treatment, wastewater can be discharged to a publicly owned treatment works (POTW) or undergo secondary treatment before being discharged directly to surface waters under an appropriate NPDES permit. For example, Williams North Pole Refinery holds an NPDES permit, issued by EPA Region 10, for the discharge of treated wastewater into a former gravel pit located on the Williams property. In addition, treated process wastewater is discharged to the City of North Pole's municipal sewage treatment plant (EPA 2002b). Domestic/sanitary wastewaters and industrial wastewaters (including process waters and cooling waters) from the oil refining operations are not discharged to the same watercourses or publicly owned treatment facilities as TAPS wastewaters. Surface water runoff discharged from the North Pole Refinery may impact the same watercourses as storm waters discharged from the TAPS North Pole metering station and from segments of the ROW in the immediate vicinity.

Hazardous wastes, including oily wastes that may contain hazardous constituents (e.g., benzene), are generated during refinery operations. In addition, certain EPA-listed wastes are associated with oil refinery processes, including slop oil emulsion solids (EPA Hazardous Waste No. K049), dissolved air flotation floats (EPA Hazardous Waste No. K048), and heat exchanger bundle sludge (EPA Hazardous Waste No. K050). As discussed above, all hazardous wastes generated in Alaska are transported to out-of-state TSDFs for ultimate treatment and disposal. For example, Williams North Pole Refinery is a large-quantity generator of RCRA hazardous wastes. In 1997, Williams North Pole Refinery generated 17.6 tons of hazardous waste, all of which was shipped off site to out-of-state TSDFs (EPA 2002b). There could be some cumulative impacts at out-of-state TSDFs that receive hazardous wastes from both TAPS operations and from oil refining operations. However, permit conditions would limit the extent of those impacts to acceptable levels.

Solid, nonhazardous wastes are also generated during refinery operations. (They include packing materials and nonhazardous sludge). These can be disposed of in on-site landfills; disposed of in off-site, local solid waste landfills; or shipped out of state to appropriately permitted landfills. If local disposal is selected, there may be a cumulative impact to the area sanitary landfills also being used by the TAPS. However, these landfills also serve their respective communities and the percentages of input to the landfills from either the TAPS or any of the refineries are expected to be small. Some outputs, such as sulfur, acetic acid, phosphoric acid, and recovered metals, are sold as by-products and transported off site.

Under the no-action alternative, although there are other sources of Alaska crude oil that could be processed at these oil refineries, transportation via other transportation modes (e.g., truck) would be costly, and it is assumed oil refinery production would dramatically decline at the three refineries that rely on TAPS oil as their primary feedstocks. There would be a comparative decline in oil refining wastes (including waste related to workforce support).

4.7.6.10.3 Waste Impacts Associated with Tanker Operations at the Valdez Marine Terminal. Wastes associated with oil tanker visits to the Valdez Marine Terminal include tanker ballast and bilge water and domestic solid wastes generated on board (which could include some medical wastes) during the ship's voyage to the Valdez Marine Terminal. Oil tankers berthing at the Valdez Marine Terminal discharge their ballast and bilge waters to the Ballast Water Treatment Facility (BWTF) at the Valdez Marine Terminal for treatment before discharge to Prince William Sound (e.g., removal of oil). Appendix C provides a detailed description of wastes associated with TAPS operations. Section C.5 provides details regarding the operation of the BWTF.

Conversion of the Valdez Marine Terminal tanker fleet to comply with double-hull requirements will dramatically reduce but not completely eliminate the volume of ballast water treated in the BWTF. It can be reliably assumed that the maximum reduction in ballast water volumes will be realized by January 2015. However, a schedule for reductions in the interim period is difficult to predict, since many vessel owners are reconfiguring their fleet or purchasing new vessels on more aggressive schedules than those required by the statute. Regardless of their hull design, tankers visiting the Valdez Marine Terminal will still have bilge water that will require treatment before discharge. Under the no-action alternative, oil tanker visits to the Valdez Marine Terminal would decline to zero, and no bilge water or ballast water would be treated at the BWTF.

Domestic solid wastes generated on board are managed as "international wastes" or "regulated wastes" and are treated as potentially biohazardous. As a service to the berthing tankers, upon request, the Valdez Marine Terminal accepts domestic solid wastes, separately bags those wastes, and delivers them to a commercial firm for sterilization and ultimate disposal in a municipal landfill. Under the no-action alternative, oil tanker visits would decline to zero and the solid waste generated from the tankers also would cease.

Valdez Marine Terminal personnel report that the Valdez Marine Terminal does not treat domestic and sanitary wastewaters generated by the tankers. These wastewaters are treated under existing US Coast Guard and ADEC regulations and discharged to the ocean. None of the tankers commingle domestic or sanitary wastewaters with ballast waters or other TAPS wastewater (Edwards 2002). Finally, wastes generated during the vessel's trip to Prince William Sound as a result of maintenance or repair of on-board mechanical systems are not off-loaded at Valdez (Edwards 2002).

4.7.6.10.4 Waste Impacts Associated with Natural Gas Pipelines. The construction and operation of the proposed natural gas pipeline would generate wastes. In addition to the pipeline, the system would include construction of a natural gas separation and treatment facility on the North Slope and compressor stations along the pipeline route. If natural gas was transported to Valdez, a gas liquefication facility and marine terminal might be located at Anderson Bay in Prince William Sound. Waste impacts would be both short term (associated with initial construction) and long term (associated with subsequent operation). During construction, substantial amounts of domestic solid waste and domestic and sanitary wastewaters would be generated in support of the construction workforce.

Wastes associated with operation of the natural gas pipeline would include wastes resulting from the support of a workforce and wastes associated with pipeline maintenance. Although less complex in its design than the TAPS, the natural gas pipeline would still require maintenance, and related activities would also generate wastes, many of which would be similar to those resulting from maintenance of the TAPS. Because the natural gas pipeline project is only at a preliminary conceptual development stage, no additional details can be provided regarding the amounts or types of operation wastes that would result or their ultimate disposal.

The LNG plant would generate industrial wastewater related to plant operations as well as domestic and sanitary wastewater from support of the workforce. In addition, LNG tankers visiting the LNG plant could generate bilge/ballast wastewaters that would have to be treated and discharged under the auspices of appropriate NPDES permits. Prince William Sound would then receive treated wastewaters from both the Valdez Marine Terminal and any new LNG plant.

In addition, the LNG plant would generate solid waste that could be disposed of in the City of Valdez municipal landfill. This would be cumulative to any solid waste generated at the Valdez Marine Terminal and disposed of at the municipal landfill. Under the no-action alternative, solid wastes from the LNG plant could continue to be disposed of at the municipal landfill, even though Valdez Marine Terminal operations would have ceased. However, under the no-action alternative, solid wastes generated during pipeline and Valdez Marine Terminal closure and dismantlement could also be disposed of at the municipal landfill.

Finally, the construction and operation of the LNG plant might cause increases in the populations of Valdez and other nearby communities, together with increases in domestic solid wastes and domestic and sanitary wastewaters, the management of which would represent cumulative impacts to those already resulting from other activities, including those associated with the Valdez Marine Terminal operational workforces. Under the no-action alternative, these cumulative impacts would be less, since employment related to the Valdez Marine Terminal would decline.

4.7.6.11 Human Health and Safety

Actions considered, which, together with the proposed action, could have cumulative impacts on human health and safety include oil and gas exploration, development, and production on the North Slope; construction and operation of natural gas pipelines; land management activities; human habitation and development; and natural resource use. Possible cumulative impacts of these actions (in conjunction with the proposed action, the less-than-30-year renewal alternative, or the no-action alternative) to workers and the general public are considered in this section.

4.7.6.11.1 Occupational Hazards.

Physical Hazards. Unintentional (including accidental) injuries are the fifth leading cause of death in the United States, primarily from motor vehicle crashes, falls, poisonings, and drownings (NSC 2001). While unintentional injuries, as a whole, are the third leading cause of death in Alaska (43.4 per 100,000 population), in 1998, Alaska had the second greatest decrease (−19%) in unintentional injury death rates to the general public (NSC 2001). A National Institute for Occupational Safety and Health study of death certificate surveillance data collected for the period 1980–1995 showed that Alaska was the state with the highest overall occupational injury fatality rate of 24.3 per 100,000 workers (Marsh and Layne 2001). While Alaska still has the highest worker death rate in the nation, occupation-related fatalities have been decreasing in recent years (20.5 to 13.4 during 1996–2000) (ADHSS 2002). Nationwide, the highest average annual fatality rates during the same period 1980–1995 were for workers in the mining industry (30.4) and for farmers/foresters/fishers (21.9) (Marsh and Layne 2001). However, the rates of traumatic occupational fatalities from 1980–1995 were much higher in Alaska, with the highest rates in agriculture/forestry/fishing (295.4 per 100,000 workers) and in associated farming/forestry/fishing occupations (383.2 per 100,000 workers). Other hazardous industries in Alaska include manufacturing and mining, which had 64.0 and 18.7 fatalities per 100,000 workers, respectively, in 1983–1995 (Marsh and Layne 2001).

The two industry divisions of transportation/communications/public utilities and construction, which were found to have occupational fatality rates of 39.0 and 31.5 per 100,000 workers, respectively, over the same period, are probably the most inclusive of pipeline-related activities and many of the associated cumulative actions. (The total number of fatalities from incidents directly related to TAPS pipeline construction and operations-related incidents are 31 and 9, respectively [APSC 2001i; Elleven 2002b].) It is apparent that the risk faced by workers, as defined by traumatic occupational fatality rates, is already considerably elevated in Alaska, particularly as a result of the water and air transport required for various hazardous occupations there (e.g., fishing, farming, logging, mining, and manufacturing). With the exception of workers involved in the proposed natural gas pipeline, relatively small numbers of workers will be involved in other cumulative actions (e.g., oil refining, oil and gas exploration, oil storage), and their risks of injuries and fatalities from physical hazards are expected to be in line with the historical rates, especially for the transportation/communications/public utilities-related and construction-related cumulative activities. The use of best management practices for occupational health and safety compliance is recommended to reduce statewide fatality and injury incidence rates in all of these sectors in the future.

Of the actions considered (e.g., oil and gas exploration, development and production and oil refining, storage, and transportation [see Section 4.7.4]), the natural gas pipeline could employ the most workers during the construction phase. Key components of the project would be construction of a large CO_2 treatment plant, a large-diameter pipeline, high-efficiency compressor stations, and a natural gas liquid (NGL) recovery plant. Multiple construction projects would be spread out over 2 to 3 years. At the peak of construction, the pipeline project could employ as many as 10,000 workers. After construction, the project could directly employ 600 permanent employees. Similar to the TAPS, potential fatalities and injuries from a natural gas pipeline would be expected on the basis of incidence rates in the construction and pipeline industries, the number of full-time equivalents (FTEs), and the number of years of construction and operation. While such occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment, fatalities and injuries from on-the-job accidents can still occur. The use of best management practices for occupational health and safety compliance is recommended to reduce statewide fatality and injury incidence rates from all of the actions in combination (i.e., the proposed action, less-than-30-year renewal alternative, and the no-action alternative). The rates of occupational fatalities and injuries are expected to be similar for all alternatives.

Radiation Hazards. Another concern with respect to occupational exposures is NORM. NORM may be deposited in oil production pipes and vessels as the temperature and pressure of oil and water brought to the surface decreases. When equipment is taken out of production, actions are taken to avoid hazards from NORM exposure (BP Amoco Alaska 2001). The equipment is surveyed for the presence of NORM, and any pieces with contamination greater than a minimal level (50 microroentgens per hour, μR/h) are segregated, labeled, sealed in plastic, and secured in a special storage area. Such equipment is shipped off site for cleaning by a specifically licensed NORM contractor. With such procedures in place, there is little potential for any NORM exposure from oil production operations on the North Slope or during pipeline dismantlement. NORM is not an issue for the no-action alternative because it is assumed that oil production would cease.

Petroleum Spills. The cumulative assessment of human health and safety impacts from environmental releases is limited to the general public and does not include occupational exposures for cleanup workers or employees at the plants or compression facilities. Protection of these workers is regulated under the Occupational Health and Safety Act and is beyond the scope of this assessment.

4.7.6.11.2 Hazards to the Public.

As stated above, cumulative impacts of concern with respect to public impacts include cumulative air emissions and uptake of persistent, bioaccumulative, and toxic (PBT) substances from multiple sources into the food chain. Potential cumulative impacts in these categories are discussed below both for normal operations and accidents and spills.

Cumulative Impacts of Emissions to Air.

Volatile Organic Compounds. Table 4.7-10 summarizes 1999 Alaska statewide emissions of chemicals to air as reported under EPA's Toxics Release Inventory (TRI) (EPA 2002). The TRI contains information on releases of nearly 650 chemicals and chemical categories from many industries, mainly manufacturing (including petroleum refining), metal and coal

TABLE 4.7-10 Toxics Release Inventory Reportable Emissions for the State of Alaska in 1999[a]

Chemical Name	Number of Sources	Total 1999 Statewide Emissions (tons)	Cities Where Emissions Occurred (% of total)	Industry Sectors (in order of emissions amount contributed)
1,2,4-Trimethyl-benzene	6	3.1	Anchorage (14), Fairbanks (<1), Kenai (67), North Pole (18)	Manufacturing (petroleum refining); wholesale trade-petroleum products (bulk stations and terminals)
Ammonia	3	684	Fairbanks (<1), Kenai (99)	Mining-gold and silver ores; manufacturing-petroleum refining and chemicals
Antimony compounds	1	0.008	Juneau	Mining-lead and zinc ores
Arsenic compounds	1	0.25	Juneau	Mining-lead and zinc ores
Barium compounds	2	172	Healy (>99), Juneau (<1)	Electric services (power plant); mining-lead and zinc ores
Benzene	7	13	Anchorage (4), Kenai (68), North Pole (28)	Wholesale trade-petroleum products (bulk stations and terminals); manufacturing (petroleum refining)
Cadmium compounds	2	1.5	Kivilina (95), Kotzebue (5)	Mining-lead and zinc ores
Chromium compounds	3	0.046	Fairbanks(30), Juneau (1), Kotzebue (69)	Mining-lead and zinc ores; manufacturing (chemicals)
Cobalt compounds	1	0.013	Kotzebue	Mining-lead and zinc ores
Copper compounds	3	0.21	Fairbanks (<1), Juneau (<1), Kotzebue (99)	Mining-lead and zinc ores
Cyclohexane	5	11	Anchorage (3), Kenai (80), North Pole (17)	Wholesale trade-petroleum products (bulk stations and terminals); manufacturing (petroleum refining)
Ethylbenzene	6	3.7	Anchorage (4), Fairbanks (1), Kenai (77), North Pole (21)	Wholesale trade-chemical and allied products; wholesale trade-petroleum products (bulk stations and terminals); manufacturing (petroleum refining)
Ethylene glycol	2	0.35	Anchorage (11), Kenai (89)	Wholesale trade-petroleum products (bulk stations and terminals); manufacturing (chemicals)
Formaldehyde	1	0.078	Kenai	Manufacturing (chemicals)
Hydrochloric acid	1	20	Healy	Electric services (power plant)
Hydrogen cyanide	1	1.8	Fairbanks	Mining-gold and silver ores
Hydrogen fluoride	1	23	Healy	Electric services (power plant)

TABLE 4.7-10 (Cont.)

Chemical Name	Number of Sources	Total 1999 Statewide Emissions (tons)	Cities Where Emissions Occurred (% of total)	Industry Sectors (in order of emissions amount contributed)
Lead compounds	3	5	Juneau (<1), Kivalina (2), Kotzebue (84)	Mining-lead and zinc ores
Manganese compounds	3	37	Juneau (<1), Kotzebue (<1), Healy (>99)	Mining-lead and zinc ores; electric services (power plant)
Mercury compounds	1	0.047	Healy	Electric services (power plant)
Methanol	2	248	Kenai (15), Kotzebue (85)	Manufacturing (chemicals); mining-lead and zinc ores
n-Hexane	6	18	Anchorage (6), North Pole (19), Kenai (75)	Wholesale trade-petroleum products (bulk stations and terminals)
Nickel compounds	3	0.026	Juneau (2), Fairbanks (6), Kotzebue (92)	Mining-lead and zinc ores, gold and silver ores
Toluene	6	24	Anchorage (2), Kenai (80), North Pole (18)	Wholesale trade-petroleum products (bulk stations and terminals), manufacturing-petroleum refining
Xylene (mixed isomers)	8	18	Anchorage (3), Fairbanks (1), Kenai (79), North Pole (17)	Wholesale trade-petroleum products (bulk stations and terminals), manufacturing-petroleum refining
Zinc compounds	4	28	Fairbanks (<1), Kivalina (11), Juneau (32), Kotzebue (57)	Mining-gold and silver ores, lead and zinc ores

[a] TAPS and North Slope producer facilities do not have to report their toxic pollutant emissions to the EPA Toxic Release Inventory (because of the SIC code exemption) and, as a result, they are explicitly excluded from the table.

Source: EPA (2002).

mining, electric utilities, and commercial hazardous waste treatment. Although the TRI data are informative about emissions from many sources, the emissions inventory is not exhaustive because not all industrial emitters are required to report. For example, APSC has a standard industrial classification (SIC) of 4612 (transportation — crude petroleum pipelines) and is not required to report emissions. The North Slope oil producer facilities (SIC of 1311) are also not required to report emissions. For perspective, note that industrial sources are estimated to contribute only about 14% of all benzene emissions in the United States (Ott and Roberts 1998).

Of the TRI-reported emitted chemicals listed in Table 4.7-10, benzene, ethylbenzene, formaldehyde, n-hexane, toluene, and xylene are also emitted from TAPS facility sources (i.e., pump stations or the Valdez Marine Terminal, see Table 3.13-6). For each of these chemicals, emissions from TAPS facilities (assuming maximum throughput) exceed those from the TRI-reported sources, with the majority of emissions from the Valdez Marine Terminal at

Valdez. The TRI-reported emissions are generally quite distant from the Valdez Marine Terminal and the pump stations and, with the exception of some emissions in Fairbanks and North Pole, are mostly from petroleum refineries. Note that for an unknown reason, emissions from the Petro Star refinery at Valdez were not included in the reported TRI data. It is estimated that this refinery would emit about 0.65 ton/yr of benzene and 2 ton/yr of the other VOCs (in comparison with 43 tons/yr of benzene and 69 tons/yr of the other VOCs from the Valdez Marine Terminal only and Ballast Water Treatment Facility).

An assessment of potential health impacts from Valdez Marine Terminal air toxics emissions was provided in Section 4.3.13.2.2. It concluded that no adverse health impacts would be expected in association with inhalation of those emissions throughout the authorization period. A tracer study also concluded that only 10% of the ambient VOC level in the city of Valdez was attributable to Valdez Marine Terminal emissions. Some possible future projects in the regions of interest (e.g., new natural gas pipelines and perhaps a gas liquefication facility at Valdez, should a natural gas pipeline be routed there) could result in additional VOC emissions, presumably with maximum emissions similar to or less than those associated with TAPS facilities. Even with these facilities, there should be no adverse health impacts from inhalation of VOCs from all the industrial sources combined (under the proposed action, less-than-30-year renewal alternative, and no-action alternative).

Another important source of some of the same VOCs that are emitted from TAPS facilities is motor vehicle emissions. For example, in the United States, automobile emissions are estimated to account for approximately 82% of all the benzene emitted to the atmosphere (although auto emissions contribute only 18% of total benzene *exposures*; cigarette smoking contributes about 45% to exposures [Ott and Roberts 1998]). The average benzene concentration in the city of Valdez in 1991 was approximately 5 $\mu g/m^3$ (Goldstein et al. 1992). This value is on the high side compared with the 2001 values of ambient benzene in five major U.S. cities, which ranged from 1 to 5 $\mu g/m^3$ (EPA 2002). Auto emissions would be expected to increase over the renewal period as the state population and automobile transportation increase (the annual increase in population is estimated to be 1.5%, resulting in a 60% population increase by 2034; see Section 4.3.19.3.1). On the basis of the 1991 benzene concentrations, a cancer risk of about 3×10^{-5} was estimated for residents of Valdez from benzene inhalation from all sources (Section 4.3.13.2.2). As sources such as motor vehicle emissions increase over the next 30 years, additional emission controls on mobile and/or point sources might be needed to minimize increasing cancer risks under any of the alternatives.

Criteria Pollutants. During construction of a natural gas pipeline, the main type of emission of concern during the 2- to 3-year construction period would most likely be criteria pollutants generated from excavation, heavy equipment operation, and vehicles used for transporting workers and raw materials. Unless residential areas were located in close proximity to the pipeline or related facilities, adverse health impacts due to limited-duration increases in criteria air pollutant levels from future construction actions in conjunction with the proposed action, the less-than-30-year renewal alternative, or the no-action alternative would not be expected.

Because the population of Alaska is expected to substantially increase during the next 30 years (at an annual rate of about 1.5%), traffic and vehicular emissions of criteria pollutants would also be expected to increase. This increase might be problematic in the Fairbanks/North Pole area, which is an air quality nonattainment area with respect to CO. Inhalation of increased levels of CO could aggravate cardiovascular conditions existing in the general population. Although change in human habitation and development is an issue considered in this cumulative impacts assessment, none of the TAPS emissions of CO under the proposed action, the less-than-30-year renewal alternative, or the no-action alternative would cause a measurable increase in CO levels in the Fairbanks nonattainment area (see Sections 4.3.9.1 and 4.6.2.9.1). Therefore, although the CO levels might become more problematic as the population increased, such an increase in CO levels does not constitute a cumulative impact with respect to the action being considered.

Air Emissions, Accidents, and Spills. Under the proposed action and the no action alternative, it was determined that the potential for serious adverse health impacts exists from inhalation of contaminants emitted from spills or fires for people who remain within maximum impact distance areas (0.02, 0.4, and 4 km; and 0.2 km, respectively). Numerous hazardous materials would be used and stored in association with some of the actions considered in this cumulative impacts assessment, especially oil and gas exploration, development, and production; oil refining; and oil and gas transportation. Human health and safety impacts from accidental releases of hazardous materials could result in exposures to contaminated air, soils, groundwater, or food. However, the potential for additional cumulative adverse impacts from accidental releases is small for the following reasons. First, it is unlikely that accidental releases would occur at the same time and in close proximity to each other. Second, existing regulations require timely cleanup of environmental media contaminated by spills, so that the possibility of prolonged human exposure would be limited.

The potential for ingestion or dermal exposure of the general public to soils and groundwater contaminated due to spills of hazardous materials is very low, because there is extensive regulation with regard to the containment and cleanup of spill sites. Because spills onto gravel or soil surfaces must be cleaned up according to the ADEC requirements, there should be no complete exposure pathways or elevated concentrations remaining after remediation of these types of spill sites and, therefore, no long-term health impacts from exposure to contaminants in soil.

The cumulative assessment of human health and safety impacts from environmental releases is limited to the general public and does not include occupational exposures for cleanup workers or employees at the various plants and facilities. Protection of these workers is regulated under the Occupational Health and Safety Act and is beyond the scope of this assessment.

Potential for Exposure to Persistent, Bioaccumulative, and Toxic Chemicals. An extensive discussion of the sources and toxicity of PBT chemicals of concern is provided in Section 3.17. There is evidence that under certain circumstances there may be interactions between chemicals in complex mixtures of PBTs. However, it is difficult to say whether a cumulative effect would be less than or greater than the combined individual effects because the health consequences of exposure to most chemicals have not been tested and effects vary according to specific conditions. Thus, the overall effects are considered to be additive. The PBT contaminants include persistent organic pollutants (POPs) such as certain pesticides, PCBs, some PAHs, and the heavy metal mercury. (Radionuclides are not listed as PBTs by the EPA but are also of some concern.) These persistent contaminants generally originate outside of Alaska but are deposited there as a result of long-range transport. They may persist longer in the Arctic environment than in other locations because of the lower temperatures. In the Arctic ecosystem, the PBTs accumulate and are concentrated in the fat and organ meats of animals at upper levels of the food chain. Traditional use of these animals as part of the diet is a pathway of exposure to these contaminants, especially for Alaska Natives.

As discussed in Section 3.17, levels of PCBs and mercury in tissues of Alaska Natives and others regularly consuming contaminated game may be elevated, and these exposures could cause a variety of adverse health impacts. The major source of these contaminants is long-range atmospheric transport from industrialized areas in many countries. PCB production has been stopped in most countries, but poor disposal practices may result in continued releases to the atmosphere. The major sources of mercury in the atmosphere are burning of coal, municipal waste, medical waste, and hazardous waste; operation of motor vehicles; and production of chlorine (EPA 2001a). The operation of the TAPS is not known to result in any emissions of PCBs or mercury; these chemicals are also not expected to be associated with the no-action alternative nor would the no action or less-than-30-year renewal alternatives reduce the cumulative emissions, PCBs, or mercury. Similarly, the other foreseeable actions considered in this cumulative impact assessment (i.e., oil and gas exploration, development, and production on the North Slope; construction and operation of fuel gas pipelines; land management activities; human habitation and development; and natural resource use) would not be expected to result in emissions of PCBs or mercury. Therefore, additional cumulative adverse health impacts from exposure to these contaminants would not be likely.

The PAH benzo[a]pyrene has also been designated as a PBT (EPA 2001b). PAHs are a constituent of crude oil and refined oil products and were a major contaminant of concern with respect to food pathways after the Exxon Valdez oil spill (Field et al. 1999). There is also an ongoing debate about the sources of PAHs in PWS, including past anthropogenic sources and natural background from oil seeps, oily shales, and coal (see Section 3.11.3). Oil spills in the marine environment have the most potential for foodchain impacts, because of bioaccumulation in shellfish (see Section 4.4.4.7.3). Of the actions assessed in this cumulative impacts evaluation, oil and gas exploration, development, production, and transportation involve risk of a spill in either the North Slope or Prince William Sound marine environment. On the basis of an analysis of the data from the Exxon Valdez Oil Spill (see Section 4.4.4.7.4), uptake of PAHs in the foodchain after a spill could result in somewhat increased cancer risks among individuals consuming high amounts of shellfish (especially mussels) from highly contaminated areas. The increased risk would likely be less than that from ingestion of smoked meats and fish. It is possible that increased digestive cancer incidence rates among Alaska Natives (see Section 3.17) are associated with dietary PAH exposures, but this speculation has not been confirmed with data.

4.7.6.11.3 Summary. Possible cumulative human health impacts of reasonably foreseeable actions, in conjunction with the proposed action, the less-than-30-year renewal alternative, or the no-action alternative, to workers and the general public were considered in this section. The types of actions that could have cumulative impacts on human health and safety include oil and gas exploration, development, and production on the North Slope; construction and operation of fuel gas pipelines (e.g., the natural gas pipeline); land management activities; human habitation and development; and natural resource use.

Occupational. The risk faced by workers, as defined by traumatic occupational fatality rates, is already considerably elevated in Alaska, particularly as a result of the water and air transport required for various hazardous occupations there (e.g., fishing, farming, logging, mining, and manufacturing). With the exception of workers involved in the construction of proposed natural gas project, relatively small numbers of workers would be involved in other cumulative actions (e.g., oil refining, oil and gas exploration, oil storage), and their risks of injuries and fatalities from physical hazards are expected to be in line with the historical rates, especially for the transportation/ communications/public utilities-related and construction-related cumulative activities. Similar to the TAPS, potential fatalities and injuries from a natural gas pipeline would be expected on the basis of construction and pipeline industry incidence rates, the number of FTEs, and the number of years of construction and operation. While such occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment, fatalities and injuries from on-the-job accidents can still occur. The use of best management practices for occupational health and safety compliance is recommended to reduce statewide fatality and injury incidence rates from all of the actions in combination.

Another concern with respect to occupational exposures is NORM. However, with standard operating procedures in place, there is little potential for any NORM exposure from oil production operations on the North Slope or during pipeline dismantlement.

The cumulative assessment of human health and safety impacts from environmental releases is limited to the general public and does not include occupational exposures for cleanup workers or employees at the plants or compression facilities. Protection of these workers is regulated under the Occupational Health and Safety Act and is beyond the scope of this assessment.

Public. An assessment of potential health impacts from Valdez Marine Terminal air toxics emissions was provided in Section 4.3.13.2.2. It was concluded that no adverse health impacts would be expected in association with the inhalation of those emissions throughout the renewal period. Some planned future projects in the regions of interest (e.g., new natural gas pipelines) could result in additional VOC emissions, presumably with maximum emissions similar to or less than those associated with TAPS facilities. Unless a large new source of VOC emissions is placed in the Valdez area (none currently planned), there should be no adverse health impacts from inhalation of VOCs from all the industrial sources combined.

Another important source of some of the same VOCs that are emitted from TAPS facilities is motor vehicle emissions. Auto emissions would be expected to increase over the renewal period as the state population and automobile transportation increased. An increased cancer risk of about 3×10^{-5} has been estimated for residents of Valdez from benzene inhalation from all sources. As sources such as motor vehicle emissions increase over the next 30 years, additional emission controls on mobile and point sources might be needed to minimize increasing cancer risks, under any of the alternatives.

During construction of a natural gas pipeline, the main type of emission of concern during the 2- to 3-year construction period would most likely be criteria pollutants generated from excavation, heavy equipment operation, and vehicles used for transporting workers and raw materials. Unless residential areas were located in close proximity to the pipeline or related facilities, adverse health impacts due to limited-duration increases in criteria air pollutant levels from future construction actions in conjunction with the proposed action or the no-action alternative would not be expected.

The projected increase in the population of Alaska over the next 30 years might be problematic in the Fairbanks/North Pole area, which is an air quality nonattainment area with respect to CO. However, none of the TAPS emissions of CO under the proposed action or alternatives would cause a measurable increase in CO levels in the Fairbanks nonattainment area (see Sections 4.3.9.1 and 4.6.2.9.1). Therefore, although the CO levels might become more problematic as the population increased, such an increase in CO levels does not constitute a cumulative impact with respect to the action being considered.

Numerous hazardous materials would be used and stored in association with some of the actions considered in this cumulative impacts assessment, especially oil and gas exploration, development, and production; oil refining; and oil and gas transportation. Human health and safety impacts from accidental releases of hazardous materials could result in exposures to contaminated air, soils, groundwater, or food. However, the potential for additional cumulative adverse impacts from accidental releases is relatively small.

The potential for ingestion or dermal exposure of the general public to soils and groundwater contaminated due to spills of hazardous materials is very low, because there is extensive regulation with regard to the containment and cleanup of spill sites. Because spills onto gravel or soil surfaces must be cleaned up according to these ADEC requirements, there should be no complete exposure pathways or elevated concentrations remaining after remediation of these types of spill sites and, therefore, no long-term health impacts from exposure to contaminants in soil.

Levels of two PBT contaminants (PCBs and mercury) in tissues of Alaska Natives and others regularly consuming contaminated game may be elevated, and these exposures could cause a variety of adverse health impacts. The operation of the TAPS is not known to result in any emissions of PCBs or mercury. Similarly, the other foreseeable actions considered in this cumulative impact assessment would not be expected to result in emissions of PCBs or mercury. Therefore, additional cumulative adverse health impacts from exposure to these contaminants would not be likely.

Oil spills in the marine environment have the most potential for foodchain impacts, because of bioaccumulation of PAHs in shellfish (see Section 4.4.4.7.3). However, the increased risk would likely be less than that from ingestion of smoked meats and fish.

4.7.7 Biological Resources

4.7.7.1 Terrestrial Vegetation and Wetlands

This section evaluates the cumulative effects of the proposed action, in combination with other past, present, and foreseeable future actions, on terrestrial vegetation and wetlands communities. This cumulative effects assessment evaluates impacts in and along the Beaufort Sea, North Slope, Interior Alaska, and Prince William Sound.

The cumulative effects of past actions have resulted in the existing conditions described in Section 3.18. In general, the greatest overall effects within the region of TAPS influence have been caused by oil and gas production and transportation. However, the cumulative effects on the major vegetative zones through which the TAPS passes have generally been minor. Future actions that have the potential to affect terrestrial and wetland vegetative communities are presented in Table 4.7-2 and include oil and gas exploration, development, and production; oil refining; oil and gas transport; oil storage; human habitation and development; transportation; land management activities and plans; natural resource use; and petroleum spills.

These actions could impact vegetation by means of a number of impacting factors. Table 4.7-9 identifies the activities and impacting factors associated with these actions. Construction activities would disturb soil and probably involve physical injury to vegetation or removal of vegetation within the disturbed area. In areas with a high proportion of wetlands, such as the Arctic Coastal Plain, or during construction of large projects, such as a natural gas pipeline, wetlands could be filled in. The placement of gravel to construct drilling pads, workpads, or service roads would eliminate local vegetation and alter local hydrologic regimes, which could adversely affect terrestrial and wetland communities. These activities would also produce fugitive dust, which could injure or kill vegetation and alter vegetative communities by reducing vegetative cover, altering local soil and permafrost conditions, and changing species composition. Erosion from construction sites could result in the sedimentation of vegetative communities, particularly wetland communities. Sediments could injure or kill vegetation and alter vegetative communities.

Disturbances to vegetative communities would generally require restoration of the affected site and revegetation efforts. Vegetative communities that would then become established might not represent local natural community types and might include non-native species, which could become dominant or invade undisturbed natural areas. Activities that disturbed the soil or remove vegetation could result in changes to the underlying permafrost, causing thermokarst. Terrestrial vegetative communities and some wetland communities might be eliminated by thermokarst-induced inundation.

Spills of crude oil, diesel oil, or other fluids might result from activities associated with any of the major actions contributing to cumulative effects. Spills could injure or kill vegetation, potentially leaving affected areas unvegetated or sparsely vegetated. Impacted soils might require extended periods of time to revegetate. Small spills, however, which would be considered likely or anticipated events (see Section 4.4.1 for spill frequency definitions) would be cleaned up and would generally have negligible to minor cumulative effects on the terrestrial vegetation and wetland communities of the four major vegetation zones. Large spills, which would be considered unlikely or very unlikely events, would have greater effects but would not be considered reasonably foreseeable future events. (See Section 4.4.4.9 for a discussion of the effects of spills on terrestrial vegetation and wetlands.)

Activities associated with transportation might result in impacts to terrestrial vegetation and wetlands from the generation of fugitive dust, particularly along unpaved highways, such as the Dalton Highway. However, ongoing improvements to the Dalton Highway road surface have resulted in reduced airborne dust along treated road segments. Oil and gas transportation might also involve the construction of pipelines. The elimination of terrestrial and wetland communities might occur on a large scale during the construction of an extensive pipeline system, such as a natural gas pipeline, resulting in major impacts to vegetation. Large-scale restoration and revegetation activities might be required. Past construction projects, such as TAPS and the construction of drilling pads on the North Slope, have involved extensive vegetation restoration. Pipeline construction and operation might also result in permafrost changes and accidental petroleum spills. The loading and transport of oil tankers might also result in accidental spills of crude oil.

Other than oil and gas production, mining and logging are the primary activities that use resources. Mining includes the extraction of minerals (such as gold, silver, lead, and zinc) and sand and gravel mining for construction materials, primarily for oil field development. Mining operations for sand and gravel and placer gold mining might remove large quantities of stream bed deposits and also riparian vegetative communities. The alteration of hydrologic regimes or surface water drainage patterns could adversely affect vegetation by increasing or decreasing soil moisture or inundation. Mining activities might result in soil disturbance, dust, erosion, and sedimentation. Logging operations would remove or alter existing vegetation on logged sites and could also result in soil disturbance, dust, erosion, and sedimentation. Logged sites generally progress through successional stages to mature forest over time. Harvesting of plant material from natural vegetative communities is often associated with human settlements. The acquisition of firewood, building materials, and edible plants or fruit might result in local impacts to vegetative communities.

Certain large-scale or global phenomena can also impact terrestrial and wetland vegetation. For example, global warming might result in changes to permafrost and alter many vegetative communities throughout the state of Alaska. Natural pests, such as the spruce bark beetle, might also cause changes in the structure or composition of forest communities.

While the combined effect of these large-scale impacts with local project-specific impacts may be greater than additive, data do not exist to support such a conclusion.

4.7.7.1.1 Beaufort Sea. The construction and operation of facilities for oil exploration and production would include offshore gravel islands, Beaufort Sea shore modifications, new access roads, and pipelines. Losses of vegetative communities might result from direct removal, sedimentation, or spills and might include marine vegetative communities or coastal marshes. The cumulative impacts of these actions on the Beaufort Sea would be expected to be minor. For cumulative impacts under both the proposed action and the less-than-30-year renewal alternative, there would be a negligible effect on vegetation near the Beaufort Sea, unless there was a large oil spill (see Section 4.4.4.9). The contribution to cumulative effects from TAPS to impact vegetation near the Beaufort Sea would be negligible because TAPS does not occur in that area. Under the no-action alternative, structures for oil exploration and drilling in the Beaufort Sea would not be constructed, and associated impacts to vegetation would not occur. Impacts to the Beaufort Sea from TAPS termination activities would not be expected, since the system does not extend into this region.

4.7.7.1.2 North Slope. Impacts to vegetation would result from the construction and use of drilling pads, modifications of stream banks and channels, new access roads, pipelines, and use of sand and gravel mining sites. Although oil and gas exploration, development, and production are expected to continue on the North Slope, the area of impact from individual drilling or production sites has become considerably smaller over the past 30 years as advances in technology have reduced the area required for well pads. Losses of vegetative communities might result from direct removal, sedimentation, or spills; these communities might include lowland and upland tundra. However, less than 1% of the vegetation of the Arctic Coastal Plain would likely be impacted by oil development (BLM 1998). Construction of a natural gas transportation system would also impact vegetation on the North Slope in the vicinity of existing oil production facilities and near the TAPS ROW. The cumulative effects of these activities on North Slope terrestrial vegetation and wetlands would be expected to be minor. Very little new construction or other major disturbance of vegetation on the North Slope is anticipated for continued operation of the TAPS. The contribution to cumulative impacts from the continued operation of the TAPS would be minor, unless there was a large oil spill (see Section 4.4.4.9). Under the no-action alternative, impacts to vegetation from the construction of oil exploration and drilling structures would not occur. Impacts to the North Slope vegetation communities from TAPS termination activities would result in a small temporary contribution to cumulative impacts and an increase in North Slope communities over the long-term, although the increase would be very small relative to the total area of upland and lowland tundra vegetation zones.

4.7.7.1.3 Interior Alaska. Impacts to vegetation would result from the construction and use of new access roads, a natural gas pipeline, modifications of stream banks and channels, use of sand and gravel mining sites land development, logging, and other natural resource use. Losses of vegetative communities might result from direct removal, sedimentation, or spills; these communities might include upland tundra, boreal forest, and coastal forest. The cumulative effects of these activities on the interior terrestrial vegetation and wetlands would be expected to be minor. Very little new construction or other major disturbance of vegetation in Interior Alaska is anticipated for continued operation of the TAPS. The contribution to cumulative impacts from the continued operation of the TAPS, under both the proposed action and the less-than-30-year renewal alternative, would be minor, unless there was a large oil spill (see Section 4.4.4.9). Impacts to boreal forest, coastal forest, and upland tundra communities from termination activities under the no-action alternative would result in a small temporary contribution to cumulative impacts and a long-term increase in vegetation communities, although the increase would be very small relative to the boreal forest, coastal forest, and upland tundra vegetation zones.

4.7.7.1.4 Prince William Sound. Loss of vegetative communities might result from direct removal, sedimentation, or spills; these communities might include marine vegetative communities or coastal marshes. The cumulative effects of future activities affecting these resources, such as oil storage and transportation, land development, logging, and natural resource use on the terrestrial vegetation and wetlands would be expected to be minor, unless there was a large oil spill. The largest contribution to the cumulative impact to the terrestrial vegetation and wetlands of Prince William Sound results from past and existing impacts, such as the Exxon Valdez oil spill, which impacted many miles of shoreline. The continued operation of the TAPS would have a negligible effect on Prince William Sound, under the proposed action and less-than-30-year renewal alternative, unless there was a large oil spill (see Section 4.4.4.9). Thus, the contribution to cumulative effects from the TAPS would be negligible. Under the no-action alternative, oil storage and transportation would cease and associated impacts to terrestrial vegetation and wetlands would not occur. Impacts to Prince William Sound communities from TAPS termination activities would make a very small contribution to cumulative impacts. Cumulative impacts to vegetation would continue from all other activities not related to oil transportation.

4.7.7.1.5 Summary. The cumulative effects on terrestrial vegetation and wetlands would be minor, relative to the extent of the four major vegetation zones (lowland tundra, upland tundra, boreal forest, coastal forest) within the TAPS region of influence, and the Beaufort Sea and Prince William Sound.

The contribution to cumulative effects on terrestrial vegetation and wetlands from the continued operation of the TAPS under the proposed action, under the less-than-30-year renewal alternative, and under the no-action alternative would be small and additive.

4.7.7.2 Fish

This section evaluates the cumulative impacts of the proposed action (Section 4.3.16) in combination with other past, present, and foreseeable future activities on fish. Thus, impacts associated with actions in the Beaufort Sea, the North Slope, Interior Alaska, and in Prince William Sound are considered for anadromous, diadromous (freshwater fish that overwinter in freshwater but disperse into low-salinity coastal waters during the summer to feed) and strictly freshwater fishes. The “other actions” that are considered in this cumulative impacts evaluation include (1) oil and gas exploration, development, and production; (2) oil and gas transportation; (3) human habitation and development; (4) legislative actions; (5) land management activities; (6) natural resource use; and (7) spills (Table 4.7-2). Additional information on the scopes of these activities is presented in Section 4.7.4. As for the proposed action (Section 4.3.16), these other actions can affect fish in a variety of ways that can be broadly categorized into impacts that result from:

- Alteration and loss of fish habitat;
- Obstructions to fish passage;
- Increased human access; and
- Effects of oil, fuel, and chemical spills.

4.7.7.2.1 Alteration and Loss of Habitat. Actions on the North Slope, in the Beaufort Sea, and in Prince William Sound might all cumulatively contribute to the alteration and loss of resources and habitat for fish that occur there and use habitats along the TAPS ROW. Oil exploration activities, offshore construction discharges, and offshore dredging or trenching might alter marine habitats and influence planktonic and benthic marine invertebrates and fish (USACE 1984, 1999) that serve as food for anadromous and diadromous fish. Similar impacts to anadromous fish could occur in Prince William Sound as a result of construction activities, dredging, or runoff from industrial sites. Affected areas would probably be more turbid than normal, and this turbidity could affect visual distances for feeding fish. Because most North Slope construction occurs in the winter when there is prolonged darkness and thick ice cover, phytoplankton photosynthesis would not likely be substantially affected. Heavy downstream sedimentation from construction or oil production activities could smother the benthos in localized areas, but effects would probably not to be widespread. In general, species occupying these areas have adapted to dynamic conditions, and they react to short-term fluctuations in water quality and habitat by either enduring and functioning under those conditions or moving out of the impact zone. Recolonization of affected areas by benthic organisms in surrounding areas would probably occur relatively rapidly in most cases. An exception would be the Boulder Patch community that lies about 6 mi seaward of the Sagavanirktok River delta. This community of epilithic flora and fauna inhabits an isolated area of rock substrate in Stefansson Sound (Dunton and Schonberg 2000). Organisms occupying the Boulder Patch are at risk from localized impacts because they are immobile, occupy a relatively small geographic area, and are an isolated community that cannot easily be repopulated from surrounding stocks. Offshore construction and trenching in this area may require special consideration.

Another habitat alteration that may affect fish resources in Prince William Sound is the introduction of nonnative organisms from the ballast water of oil tankers. Some inbound tankers, especially the newer double-hulled tankers that are expected to become prevalent within the next 10 years, carry segregated ballast water (i.e., ballast water is separated from the oil cargo compartments) that is discharged directly into Port Valdez. The segregated ballast water can contain organisms that are not native to Prince William Sound. Organisms introduced from other areas of the world may become a nuisance in the absence of predator species to control population growth. Once established, nonindigenous species may also ecologically displace native species or some species in the food chain upon which fish or other native aquatic organisms depend for survival. Hines and Ruiz (2000) investigated the numbers and types of nonindigenous organisms transported into Prince William Sound in ballast water. They concluded that large numbers of planktonic organisms are released into Prince

William Sound with segregated ballast water and that there is a high potential for the types of organisms observed to survive in the water conditions in Prince William Sound. On average, they found about 360 organisms per cubic foot of water in segregated ballast water samples. Although not all of these organisms were nonnative species, 14 nonnative species were recorded (13 crustacean species and 1 fish species) from the 169 tankers sampled. A previous study (Ruiz and Hines 1997) found that when nonsegregated ballast water (i.e., the ballast water that is carried in oil-holding compartments) was introduced, it contained very few viable nonindigenous organisms. In addition, such water is processed in the BWTF before being discharged into Port Valdez, making it unlikely that nonindigenous organisms would be introduced. The tanker traffic used in support of the gas pipeline may be about 275/yr (TAPS Owners 2001a). This could add incrementally to the potential to introduce nonnative species into Prince William Sound. However, ballast water treatment would minimize this impact.

Oil and gas exploration and development can affect fish, if ground- or vegetation-disturbing activities occur in or near waterways or if chemicals or wastes are discharged into waterways. Loss of habitat in freshwater systems can result from bank hardening, draining of water bodies, changes or temporary diversions in river or stream channels, excavations of streambed materials, removal of riparian vegetation, and changes in water quality parameters. Permits are required under Alaska Title 16 for activities in or near streams that could affect anadromous fish and their freshwater habitat or the free and efficient migrations of resident fish. Discharges of wastes and treated water from oil facilities must also comply with the Clean Water Act and NPDES permits. Compliance minimizes the cumulative effects from the described actions on aquatic habitats.

Removal of freshwater from lakes to construct ice roads and pads and for other operations could also affect fish in these water bodies. Withdrawal of water can reduce water depth in overwintering areas, thereby reducing their ability to support fish, and it can entrain fish through the pumps. Design considerations and mitigation are incorporated into these operations to minimize impacts on fish. Water withdrawals would continue to be required for future North Slope oil field developments, but efficient and appropriate regulation, compliance, and enforcement would reduce the potential impacts. Use of other options for obtaining water for ice roads and pads (e.g., desalination, use of snowmelt water, and water from flooding abandoned mine sites) may also limit potential impacts.

Construction of and maintenance operations for a gas pipeline would have impacts on freshwater habitats similar to those of the TAPS. Inspection, monitoring, and prompt corrective action would be required to limit impacts. Increased public access as a result of new pipeline construction or development would probably have only small impacts on fish habitat, primarily due to the increased erosion of stream banks by off-road vehicles and the increased amount of dust deposited by vehicles traveling on unpaved roads. The development of other industries in the vicinity of the TAPS could also have impacts on freshwater habitats, depending on the location and operational needs.

Alterations to freshwater habitats could reduce fish survival and potentially affect fish populations. The Interior column of Table 4.7-2 lists the activities that may impact freshwater habitats. These impacts would more likely occur if the alterations were allowed to persist for multiple years and if overwintering habitat was affected. However, such alterations would typically be minor in scope and would not substantially affect fish populations. In addition, many potential impacts would probably be identified and corrected before impacts to populations ever occurred. Overall, cumulative impacts from alterations of freshwater habitats in the vicinity of the TAPS would be low to moderate under the proposed action. Synergistic effects on the population as a whole are not anticipated.

Overall, the magnitude and geographic scope of impacts to fish habitats are likely to be low. However, it is difficult to predict the potential impacts associated with biological organisms that could be introduced via ballast water.

4.7.7.2.2 Obstructions to Fish Passage. Drainage structures, such as culverts and low water crossings can impede fish migration and obstruct fish passage (Section 4.3.16). Generally, such impacts may occur intermittently at some, but not all, stream crossings that require drainage structures or that require vehicles to cross streams. Impacts at stream crossings are typically addressed through proper design and maintenance of roads, pipeline river crossings, and culverts, coupled with regulation, monitoring, and corrective actions.

Little or no discernable impact to fish passage in freshwater habitats has occurred in North Slope oil fields as a result of past activities, and it is anticipated that this will also be the case for future North Slope oil fields. Construction and operation of a natural gas pipeline would likely have impacts similar to those from the TAPS. For example, new roads, workpads, and buried pipeline crossings for a natural gas pipeline could impact new areas outside the TAPS ROW. Construction of additional roads and increased numbers of workers could result in more stream crossings and more vehicles crossing streams in the vicinity of the TAPS. This may increase the frequency of impacts to fish from obstructed passage at disturbed stream crossing areas. Other activities that may be developed on the North Slope or in Interior Alaska (Table 4.7-2) could further increase such impacts, depending on the applicable location, extent of development, level of mitigation, and regulatory control.

Inhibiting fish movement in streams can reduce access to spawning areas and potentially affect fish populations. These results are more likely if the obstructions are allowed to persist for multiple years. Fish passage in freshwater habitats has been a continuous maintenance issue along the TAPS ROW, and it is also likely to be an issue relatively frequently as a result of the cumulative actions described above. However, obstructions to fish passage would probably be identified and corrected before impacts to populations would occur. Given the geographic extent and the large number of streams that could be affected by existing and proposed activities, fish populations in some freshwater habitats may be affected over the renewal period. Overall, cumulative impacts from blocking fish passage in freshwater habitats in the vicinity of the TAPS would be low to moderate under the proposed action, and synergistic effects with other factors are not anticipated.

Cumulative impacts to anadromous or diadromous species may occur as a result of activities that obstruct fish movement in marine environments. Under certain meteorological conditions, structures along the Beaufort Sea mainland coast can also block the movements of diadromous fishes, particularly juveniles (Gallaway and Fechhelm 2000 and references cited therein). Because many of these species avoid high-salinity, marine conditions, they tend to remain nearshore, where they forage up and down the coast within a narrow band of warm, low-salinity water (Craig 1984). Causeways can impede coastal movement either by directly blocking fish or by modifying nearshore water conditions to the point where they might become too cold and saline for these species. On the North Slope, this impact was identified as a concern at West Dock and the Endicott Causeway, although actual impacts were identified only at West Dock. However, current construction practices and mitigation efforts have shown that breaching can alleviate blockage (Gallaway and Fechhelm 2000 and references cited therein).

The locations of causeways relative to coastal topography, local bathymetry, and freshwater drainages also is critical in determining their impact on the nearshore migration corridor (Niedoroda and Colonell 1990). For example, West Dock was constructed at the eastern end of an extensive brackish-water lagoon system (Simpson Lagoon) through which fish disperse and migrate. The causeway extends seaward into the marine environment enough beyond the 6-ft isobath to exacerbate coastal mixing processes that sometimes block the movements of those fish. In contrast, the entire Endicott Causeway was constructed inside the 6-ft isobath and does not protrude into deeper marine waters. The onshore encroachment of marine water is further impeded by the freshwater discharge of the Sagavanirktok River (Niedoroda and Colonell

1990). As a result, cells of upwelled marine water that develop at the Endicott Causeway are restricted to the seaward tip of the causeway's western leg and do not reach the mainland shore, where the water might otherwise disrupt fish migrations (Hachmeister et al. 1991; Gallaway et al. 1991).

The proper siting of any future causeway to be constructed along the Beaufort Sea is the most important consideration with regard to fish movements. In many cases, breaching might be appropriate, depending on the site location and hydrography. Other structures constructed at offshore facilities and artificial islands would not affect diadromous fish habitat and would have a limited influence on anadromous species.

Although the impact from docks or causeways may occur in the marine environment of the Beaufort Sea, it is believed that there has been little or no impact on fish movements from docks or causeways at the Valdez Marine Terminal or in Prince William Sound. Because of the extensive distributions and coastal movements of marine and anadromous species, any additional terminal structures would probably affect only an insignificant number of individuals and a small geographic area.

4.7.7.2.3 Effects on Fish Populations from Increased Human Access. With an increase in human population associated with foreseeable future activities (Table 4.7-2), there would likely be additional recreational fishing pressure on fish populations. Currently, recreational fisheries are regulated to maintain adequate stocks and are adjusted to compensate for changes in fishing pressure. However, increased access could result in overharvest if regulations and enforcement were inadequate. The BLM and USACE (1988) reported that individuals of the species preferred for harvest were smaller and less numerous after the construction of the TAPS in areas accessible to anglers. While developments in remote areas have allowed access to previously unavailable harvest opportunities, large increases in fishing effort and catches of desirable species such as Arctic char, Arctic grayling, and lake trout were not reflected in statewide harvest surveys (Burr 2001) after the entire length of the Dalton Highway was opened in 1994. The potential for overharvest is expected to be greater in northern areas because fish productivity is low.

In the North Slope oil fields and Beaufort Sea, increased human access, with its accompanying increased fishing pressure, has not affected fish populations, although some subsistence, sport, and very limited commercial fishing occur. Public access into Prince William Sound is increasing, and the combined effects of commercial, subsistence/personal use, and sport fishing could impact populations. Fishing activities are managed by the ADF&G and the National Marine Fisheries Service within federal conservation units. The Federal Subsistence Board manages subsistence fishing by rural Alaska residents. Maintenance of fish at the desired sizes and population levels has been largely accomplished by regulations established by the Alaska Board of Fish and enforced by ADF&G and the Alaska Department of Public Safety. In the vicinity of Prince William Sound, a number of anadromous fish hatcheries are also utilized to produce enough fish to increase harvest above natural levels and to manage stocks. Consequently, the cumulative impact of increased human access to fish populations is expected to be minor and additive.

4.7.7.2.4 Effects of Oil, Fuel, and Chemical Spills on Fish. Oil, fuel, and chemical spills are a primary concern with regard to oil and gas development, production, and transportation. The potential impacts of freshwater spills (see Section 4.4.4.12) are primarily localized and restricted to gravel pads at facilities or roads. Large spills into freshwater have not occurred. However, should one occur in the future, it could have substantial impacts on fish in the impacted area.

Large marine spills, such as the Exxon Valdez oil spill, could potentially have large impacts on fish. Such spills could cause mortality and injury to plankton, marine invertebrates, and fish (USACE 1999). While direct mortality of fish due to open water marine oil spills has seldom been documented, impacts on fish in natural environments have been inferred on the basis of laboratory studies. The Exxon Valdez oil spill had some impacts on fish, including pink salmon and herring (see Sections 3.19.1.3 and 4.4.10.2). While some populations and habitats appear to have recovered from the effects of the spill, other habitats and populations have not yet recovered or their status is not certain (Section 3.19.1.3).

Past oil spills along the TAPS and in the North Slope oil fields have been mainly confined to land, but future leaks could reach watersheds and impact fish. The future operation of the TAPS, a gas pipeline, and other industrial activity carry the risk of small-scale spills of oil, fuel, and chemicals from vehicles and machinery. Present and future North Slope oil field developments might have an impact on fish, particularly in the marine environment. The potential for spills from subsea pipelines and other sources for offshore developments in the Beaufort Sea was assessed previously (USACE 1999). Impacts of spills in solid ice or broken ice in this region may be particularly difficult to clean up.

Gas production activities could increase the risk of impacts as a result of the increased volume of liquids transported through the gas pipeline and in tankers. The magnitude of the risk of such impacts would partly depend on facility locations. Increased public access could result in some small spills from highway vehicles, off-road vehicles, and boats.

Although there is a potential for large impacts to fish from large oil spills, the risk of such spills is relatively small (Section 4.4.1). The probability of smaller spills is higher, but the impacts from such spills if they entered freshwater or marine habitats would probably be small, temporary, and additive and unlikely to severely affect fish populations; especially in light of spill response activities that are undertaken when spill events occur.

4.7.7.2.5 Summary. On the North Slope and Beaufort Sea, the most important future activities that could contribute to cumulative impacts on fish would be planned oil and gas development activities, oil and gas transportation, and natural resource use (e.g., subsistence). In Interior Alaska, future actions that could contribute to cumulative impacts on fishes include oil and gas transport, other transportation activities, human habitation and development, and land management actions. In Prince William Sound and the Gulf of Alaska, future actions contributing to cumulative impacts on fish include oil transport, other transportation activities, (e.g., barging and cruise ships), human habitation, natural resource use (e.g., commercial, subsistence, and recreational fishing), and land management activities. However, none of these activities are expected to significantly increase cumulative impacts, including any synergistic effects, on fish or affect the viability of species' populations. Oil spills would not significantly add to cumulative impacts, except for an unlikely large spill to aquatic habitats, in which case impacts similar to the Exxon Valdez oil spill could occur (see Section 4.4.4.10).

TAPS operations are only a small component of the cumulative impacts associated with the activities listed in Table 4.7-2. However, the indirect effects of the TAPS are a significant contribution to cumulative impacts to fish, because of the interdependence of current and foreseeable future oil development, production, and transportation activities with the TAPS.

Cumulative impacts of the less-than-30-year renewal alternative on fish would be similar to cumulative impacts described above under the proposed action but of shorter duration. During the renewal periods, TAPS operations, monitoring, and maintenance activities; and other present and foreseeable actions would essentially be the same for both alternatives. The shorter renewal period would not preclude any other current or foreseeable actions listed in Table 4.7-2 from occurring. The differences in cumulative impacts between the two renewal alternatives likely would be negligible during the renewal periods. If at the end of the less-than-30-year renewal period a further request for renewal was granted, cumulative impacts would continue as stated for the proposed action. If a further request for renewal was not granted, cumulative impacts would continue as stated for no action, below.

Differences in cumulative impacts between the no-action and the proposed-action alternatives on fish would be more evident than those between the less-than-30-year renewal alternative and the proposed action, particularly within the North Slope. While activities associated with gas production and transportation would occur under both alternatives; oil production and transportation would be reduced to very low levels for the no-action alternative. Thus, most oil production facilities would be idled. Also, the incremental changes that would have occurred from future oil field developments would not occur. Therefore, the level of impacts to fish within the North Slope would be less for the no-action alternative, except for subsistence harvest levels that may increase. The potential for accidental oil spills would also decline within the North Slope, along the TAPS ROW, and within Prince William Sound and the Gulf of Alaska. However, the infrastructure required to promptly clean up any spills that might occur within these areas might not be available (e.g., response equipment and teams associated with the TAPS would not be present). The potential for introduction of nonnative organisms within Prince William Sound would decrease from the decrease or elimination of oil tanker traffic within Prince William Sound.

4.7.7.3 Birds and Mammals

This section evaluates the cumulative impacts of the proposed action in combination with other reasonably foreseeable actions on birds and terrestrial mammals. Past and present activities that contribute to cumulative impacts are part of the existing baseline and are discussed in Sections 3.20 (birds) and 3.21 (terrestrial mammals). Actions directly associated with the oil and gas industry that could contribute to cumulative impacts include ancillary facilities and infrastructure (e.g., pipelines, roads, landing strips, gravel mines, and pump stations), refineries, terminals, and tanker transport. Other actions within the region of influence that could contribute to cumulative impacts include human habitation and development, transportation systems, natural resource use (including subsistence and sport hunting), spills, and natural events (e.g., forest fires and insect infestations) (Section 4.7.4). Legislative actions and land management activities could also have a controlling influence on the environment.

It is expected that in general, the cumulative impacts on birds and terrestrial mammals would be similar to the impacts associated with the proposed action (Sections 4.3.17 and 4.4.4.11). Thus, cumulative actions could impact these wildlife resources by (1) habitat loss, alteration, or enhancement; (2) disturbance or displacement; (3) mortality; (4) obstruction to movement; and (5) spills. The effects that these actions may cause include (1) immediate physical injury or death; (2) increased energy expenditures or changes in physiological condition that may reduce survival or reproduction rates; or (3) long-term changes in behavior, including the traditional use of ranges (Calef et al. 1976). Possible differences between cumulative impacts and the impacts from the proposed action would depend on the intensity (magnitude), scale (geographic area), duration, timing and frequency, any synergies (impact interactions), and likelihood of the impacts associated with the cumulative actions (USACE 1999).

4.7.7.3.1 Habitat Loss, Alteration, or Enhancement. Within the North Slope, oil and gas exploration, development, and production, along with the construction and operation of ancillary facilities (e.g., gravel mines, roads, pipelines, and drill pads), could result in a cumulative reduction in habitat for wildlife. Future developments within the North Slope could result in continued habitat alteration, although new developments would have smaller footprints and result in a relatively smaller impact than in the past (TAPS Owners 2001a). The cumulative loss from all listed projects in the North Slope may have localized effects on the distribution or density of some wildlife species over the life of the oil fields (MMS 1998). Overall, fragmentation of the tundra by oil facilities has not been a major factor affecting bird use of the Prudhoe Bay oil field. There may have been a rearrangement of birds, but there was probably no net change in bird abundance (Troy and Carpenter 1990; TERA 1993). The potential effect on species such as caribou might not be measurable because of the natural variability, including productivity, of a large population (ADNR 1999).

Within the North Slope, more than 21,550 acres have been filled and covered by gravel for airstrips, drill pads, roads, and other structures. This total includes 10,653 acres distributed by mine sites and gravel placement within the oil fields and 10,900 acres occupied by the portion of TAPS within the North Slope (Ambrosius 2000; Gilders and Cronin 2000). However, this represents a very small portion (~0.02%) of the more than 56.8 million acres that occur within the Arctic Coastal Plain (Gilders and Cronin 2000).

The loss of wildlife habitat from the development projects represent a small decrease in the amount of available tundra habitat in the North Slope (MMS 1998). The avoidance by wildlife of areas near industrial developments that might otherwise be usable habitat (i.e., functional habitat loss) also contributes to the cumulative loss of habitat associated with facility development (Cameron et al. 1995; Nellemann and Cameron 1998; James and Stuart-Smith 2000). However, cumulative impacts would be negligible because the amount of habitat physically affected would be small compared to the amount available (ADNR 1999).

Gravel fill generally eliminates tundra habitat. However, it can provide habitat for some species. For example, it provides insect relief areas for caribou; denning habitat for arctic foxes and ground squirrels; and nesting sites for semipalmated plover, ruddy turnstone, and Baird's sandpiper; and feeding habitat for Lapland longspurs (Pollard et al. 1990; Truett et al. 1994 and references cited therein). Arctic fox den density was found to be greater within developed areas than on adjacent undeveloped tundra; using culverts and road embankments as den sites (Ballard et al. 2000).

Although structures may occasionally be a barrier to wildlife movements, they can provide a haven from predators, pests, or weather, or a platform for feeding, hunting, or nesting (Truett et al. 1994). In general, birds use gravel pads more for feeding and resting than for nesting; while mammals rest and, less often, feed on the gravel pads (Pollard et al. 1990). Caribou use gravel pads and roads as insect relief habitat during the mosquito season (June to mid-July) and use the shade of oil field structures (pipelines and buildings) and parked vehicles when oestrid flies are abundant (mid-July to early August) (Lawhead and Prichard 2002; Pollard et al. 1996a). The availability of man-made insect-relief habitats may allow caribou to remain near preferred foraging habitats, thereby lessening the energy demands normally imposed upon caribou during the insect season (Pollard et al. 1996a).

Shorebirds and waterfowl commonly feed and rest on impoundments associated with gravel pads (Pollard et al. 1990). Pacific loons nest and rear their young in impoundments created by oil field developments (Kertell 1996).

Dust shadows might be increased by the addition of roads, facility pads, and greater traffic loads associated with gas commercialization on the North Slope. Construction of the natural gas pipeline would increase traffic loads on the Dalton Highway, contributing to the effect in the TAPS study area. The dust shadows affect a limited amount of habitat but will continue as long as heavy traffic occurs on gravel roads. Cumulative impacts of dust shadows on wildlife would be similar to those addressed in Section 4.3.17.1.

A new North Slope oil field could require permanent gravel roads and pads for production facilities, which would incrementally increase the area affected by changes in drainage patterns. However, the footprint for new developments would require less area than in the past. For example, the "P" Pad built in the Prudhoe Bay Oil Field is 70% smaller than the "A" Pad built in the 1970s (Gilders and Cronin 2000). The construction of a natural gas pipeline would also contribute to these types of effects on wetlands, because trenching for the pipeline, burial of the pipeline, and placement of gravel for compressor stations and access roads would cover wetland sites and affect natural drainage patterns. If the gas pipeline was routed approximately parallel to the TAPS alignment, impacts could be minimized if the existing TAPS workpad, access roads, stream crossings, and material sites were used when feasible (TAPS Owners 2001a).

Construction of natural gas pipeline would disturb up to 23,216 acres of habitat (TAPS Owners 2001a). Because the gas pipeline would be buried, impacts would be short term, lasting during the construction period and time required for revegetation. However, to allow access to the pipeline, the overlying ROW would be maintained in an early stage of succession (i.e., in boreal forest areas), similar to that of the

TAPS ROW. This could total up to about 8,425 acres during the period of gas pipeline operation (TAPS Owners 2001a). The gas condition facility would require an area of about 300 acres (TAPS Owners 2001a) within the 56.8 million acre North Slope. A further 390 acres of habitat may be disturbed for construction of a gas liquefication plant at Valdez, if this option were selected (TAPS Owners 2001a).

Several studies have documented that birds such as raptors perch and nest on oil field and pipeline structures and that swallows and other birds nest on structures at several TAPS pump stations (see Section 4.3.17.1). Similarly, Pollard et al. (1990) and Rodrigues (1992) documented extensive use of gravel pads and adjacent disturbed sites in the North Slope oil fields by birds. Offshore artificial drilling islands would provide new artificial habitats that would attract birds (USACE 1999). This situation was documented on the Endicott Causeway, which was colonized by common eiders. In addition, molting long-tailed ducks aggregate on the leeward side of the causeway (TAPS Owners 2001a). Present and future oil and gas development on the North Slope, particularly offshore in the Beaufort Sea, might involve the construction of more offshore islands, which would likely provide more nesting and molting habitat for birds.

4.7.7.3.2 Disturbance or Displacement. High levels of air and vehicle traffic are associated with the petroleum industry in the North Slope. For example, up to 1,200 helicopter trips per year have taken place just to support offshore development. Such activities could cause short-term displacement of nesting, feeding, and/or molting birds (MMS 1998). Traffic and human activity associated with the TAPS and the Dalton Highway can disturb female caribou with young calves (Cameron and Whitten 1980); while roads, pipelines, and human activity may block, delay, or deflect individual caribou as they move through the Prudhoe Bay oil field (Pollard et al. 1996a). Nevertheless, movements of large groups of caribou do occur through the oil fields (Murphy and Lawhead 2000). Pregnant and maternal cows are sensitive to human activities within the North Slope (Cameron et al. 1985). Some will avoid roads with relatively low traffic levels (e.g., < 100 vehicles/day) for about two weeks following parturition and tend to remain > 0.6 mi from roads (Cameron et al. 1992; Cronin et al. 1994). Caribou, including cows with calves, do not avoid developments during the post-calving period (Pollard et al. 1996b; Cronin et al. 1998a). Cameron et al. (1992) observed that the calving caribou of the Central Arctic caribou herd were displaced outward after construction of the Milne Point road system; relative densities within 1.2 mi of the road system decreased by over two-thirds. Similarly, Nellemann and Cameron (1998) observed that increasing density of roads in the Kuparuk Development Area near Prudhoe Bay decreased caribou density. Caribou densities declined by 63% when there were 0.0 to 0.5 mi of roads/mi^2 and declined by 86% when there were more than 1.9 to 2.8 mi of roads/mi^2. The higher road densities virtually excluded cow-calf pairs (Nellemann and Cameron 1998). In contrast, Carruthers and Jakimchuk (1987) did not observe traditional migration of the Nelchina caribou herd (in the Gulkana River area) to be affected by the TAPS and the Richardson Highway.

During the post-calving season, caribou distribution is largely unrelated to distance from infrastructure; they regularly occur within the oil fields, and they often occur close to infrastructure (Cronin et al. 1998a). Although some level of cumulative effect to caribou is likely from petroleum development, clear separation of the cumulative effects from natural variation in caribou habitat use and demography is difficult (Wolfe et al. 2000). No population-level impacts to any wildlife species have been documented (reviewed in Truett and Johnson 2000).

Several factors influence caribou populations, including winter weather, oil field disturbances and developments, hunting, predation, intersegment or interherd movements, and insect harassment (Cronin et al. 1997; Klein 1991). All major caribou herds on the North Slope have increased in size, independent of oil field development (Klein 1991). These higher population densities may cause dispersal or range changes among caribou herds. Thus, no single cause-and-effect explanation can be made regarding changes over time in caribou herd size and distribution (Cronin et al. 1997).

Helicopter and fixed-wing aircraft flights associated with the multitude of North Slope projects could result in combined or repeated disturbances to wildlife. Such impacts could be effectively reduced by restricting flight paths to avoid sensitive nesting areas during active breeding and brood-rearing periods and by establishing minimum flight altitudes to reduce ground-level noise (USACE 1999). While a few species, such as wolves and foxes, habituate to human presence, they are nevertheless disturbed by aircraft and other vehicles (ADNR 1999). Brant react to aircraft by alert posturing, running, or entering water. Interruptions of feeding may have deleterious effects on body reserves; and molting birds that move to undisturbed areas would be exposed to predators within the open tundra. A single aircraft could disturb birds from dozens of lakes in its flight path (Simpson et al. 1982). Repeated exposure of caribou to low-level military jet overflights, especially during sensitive periods, may reduce calf survival and increase daily activities (Calef et al. 1976; Maier et al. 1998; Wolfe et al. 2000). Females of the Delta caribou herd with newborn calves apparently move away from areas where they are disturbed by jet aircraft overflights (Murphy et al. 1993). However, Valkenburg and Davis (1984) believe that the effects of disturbance from hunters on snowmobiles may be more important than aircraft overflights.

Traffic along hundreds of miles of existing and future pipeline roads could disturb and displace wildlife. Disturbance to caribou would be generally short-term (e.g., a few hours or less). Less time spent lying and more time moving about are the two consistent reactions by caribou to disturbance. Disruption of the feeding and resting cycle, accompanied by increased energy expenditures by running may contribute to energetic stress (Murphy and Curatolo 1987). If calving caribou are displaced from a high-quality forage area, there is a potential for lowered calf survival (ADNR 1999). To date, the cumulative impacts of North Slope oil and gas developments have caused minor displacement of the Central Arctic caribou herd from a small portion of its calving range without an apparent adverse effect on herd abundance or overall productivity.

Future North Slope oil field developments may contribute to the disturbance and displacement of wildlife. However, mitigation measures, such as restricting the timing of the activity and locating facilities away from nesting or calving areas, could minimize impacts. Operation of the gas pipeline project would have a negligible impact. Localized disturbances to wildlife would occur during its construction.

In Prince William Sound, the cumulative effect of aircraft and vessel traffic associated with the oil industry, commercial and recreational fishing, tourism, and other commercial and recreational activities could result in long-term displacement of birds from nesting and feeding habitats (MMS 1995). However, most effects of disturbance and displacement would be local and minor at the population level because most species have relatively low density (BLM 1998).

4.7.7.3.3 Mortality. The Dalton Highway has provided access to previously remote areas north of the Yukon River. Concern exists that this increased access has adversely affected moose, caribou, wolf, and bear populations as a result of increased harvests (McLellan 1989; Yokel 1999). The increase in Alaska's human population since TAPS construction has also increased the hunting pressure on the state's wildlife. ADF&G has responded to this pressure where necessary by restricting seasons and bag limits and by implementing intensive management programs to achieve and maintain population objectives for ungulates available to hunters (see TAPS Owners 2001a).

Increased densities of predators and scavengers attracted to areas of human activity may result in increased predation pressure on prey populations. This situation has recently become a management issue, mainly for ground-nesting birds on the North Slope (Day 1998), but it is difficult to document. Increases in the abundance of foxes are well-documented in the North Slope oil fields (Burgess 2000). However, because pipeline facilities are more dispersed than are oil field facilities, this problem would be small south of PS 1. Within the North Slope, losses of birds due to elevated levels of predators would be in addition to losses associated with habitat loss, displacement, and so forth (BLM 1998).

Similarly, increased densities of predators and scavengers might increase the occurrence and rate of transmission of wildlife diseases, including rabies (Follmann et al. 1988). The primary reservoir of rabies in the North Slope area is the arctic fox, whereas south of the Brooks Range, the red fox and other carnivores are sources of greater concern (Winkler 1975).

Other causes of wildlife mortality in Alaska include intentional mortality (i.e., sport and subsistence harvest, management and research mortality) and unintentional mortality (i.e., railroad and road kills; unreported harvests; defense of life and property mortality) (TAPS Owners 2001a). Vehicle collisions with terrestrial mammals, particularly moose, are an issue of public safety as well as a source of wildlife mortality (TAPS Owners 2001a). Black bears continue to be a problem in Valdez as a result of city garbage management and lack of fencing at the Valdez Marine Terminal (Schmidt 1999; Lawlor 1999; Shoulders 1999; Brown 1999).

Mortality of predators such as bears occurs primarily from sport and subsistence hunting. Overall, only about 5% of brown bear mortality and 3% of black bear mortality are related to defense of life and property. However, within urban areas, these percentages are about 22% and 6% for brown and black bear, respectively (Miller and Tutterow 1997). Oil and other resource extraction industries have indirectly contributed to brown bear mortality by the construction of roads that have increased access by hunters, poachers, and settlers (McLellan 1989). The oil industry, in cooperation with ADF&G, has implemented management activities to reduce impacts to wildlife. These measures have included the closing of the developed areas to big game hunting, prohibiting firearms within the oil fields proper, educating workers on wildlife safety, and training security personnel on proper techniques for hazing problem animals (Shideler and Hechtel 2000).

Birds, especially those using early green-up areas in dust shadows along the TAPS ROW, could be killed by vehicles (Shoulders 1999; Schmidt 1999). Road kills have not been a problem in the North Slope oil fields, although there have been occasional mortalities of caribou and bears. The same trend would be likely during present and future North Slope oil field developments and a gas transmission line project. A gas pipeline might increase traffic on highways, particularly during construction. This situation would be unlikely to impact large numbers of animals. Increased public access might increase the numbers of road kills from Valdez to the North Slope, while the National Missile Defense System is unlikely to have an impact. Traffic associated with other industrial activities might result in road kills, depending on the location and extent of developments.

Birds might also fly into structures, particularly offshore structures during periods of fog. Also, some birds (e.g., cliff swallows) that nest at the TAPS pump stations might fly into the pump station structures. Structures and bright lights at the Valdez Marine Terminal might attract birds during inclement weather (Senner 1999). Collisions normally occur during spring and fall when birds are migrating through the area. Although they could result in the loss of individual birds, the cumulative effect would not be considered significant (USACE 1999).

In the North Slope oil fields, there is some anecdotal evidence for bird mortality at nearshore structures such as Endicott and at the seawater treatment plant at the end of the West Dock causeway. Bird mortality at such structures, however, has been intermittent and local and has involved only a few individuals. Present and future North Slope oil and gas developments could also cause some bird mortalities. It has been postulated that lights at offshore facilities such as Northstar might attract migrating birds that could then collide with structures (USACE 1999).

High predator populations in the North Slope oil fields are associated with natural factors such as high prey availability and natural den sites. However, because of the availability of supplemental food at the North Slope Borough Landfill and in dumpsters throughout the North Slope oil fields, populations of predators, such as bears, foxes, gulls, and ravens, have increased over the past three decades. Although there is no definite cause-and-effect relationship between human food and predator numbers, predators have adversely affected nesting success of birds that nest on the ground, especially colonial nesting snow geese, and possibly some ducks and shorebirds (TAPS Owners 2001a).

The introduction of exotic animals (mostly foxes, but also rats, voles, ground squirrels, and rabbits) has been among the most damaging source of direct mortality to seabirds of all the factors associated with human activity (Bailey 1993). Unlike an oil spill or some other one-time catastrophe, predators have a continuing negative impact on seabird populations. Combined with this source of seabird loss is the detrimental impact of large fish harvests on seabirds (e.g., seabirds are accidentally killed in drift gill nets, major shifts in fish stocks have altered seabird food supplies, and possible effects of fish biomass) (Hatch and Piatt 2001). Disease, predation, fluctuations in prey, and severe weather are among the natural phenomena that also contribute to cumulative impacts on wildlife (MMS 1998).

The natural gas pipeline and other industrial developments could result in more workers within remote areas and could increase hunting pressure depending on location and extent of development. However, it is likely that firearms will be prohibited from gas-pipeline construction sites and facilities (as with APSC facilities today) and that hunting will be prohibited from the ROW of a gas pipeline, as with the TAPS ROW. Increased public access could result in the greatest impact to wildlife through sport hunting, while an NMDS may bring more military personnel who hunt, although hunting may be prohibited on the military site (TAPS Owners 2001a).

The Central Arctic caribou herd has increased in size since oil field development and operation began. Similar increases have occurred to all major caribou herds in northern Alaska and Canada, and are presumed to be independent from the effects of oil field development (Klein 1991). In fact, the populations of many wildlife populations that spend at least part of the year in the vicinity of oil fields are either stable or larger than when oil field development began. In addition to caribou, these include muskox, brown bear, polar bear, arctic fox, snow goose, brant, and other waterfowl and shorebirds (see Cronin et al. 1998b).

4.7.7.3.4 Obstruction to Movement. Present and future North Slope oil field developments could further obstruct wildlife movements. For example, during the brood-rearing period when species such as brant are flightless, roads, causeways, and other structures could present a barrier to movement (ADNR 1999). Roby (1978) reported that during summer, caribou with calves were the group most sensitive to the Dalton Highway. Caribou cows with calves may be underrepresented along the Dalton Highway during the calving season due to avoidance of the road, habitat selection, or predator avoidance. Roads (without adjacent pipelines) that have heavy traffic (e.g., >60 vehicles/h) appear to impede caribou movement. Pipeline-road combinations tend to have a synergistic effect on impeding caribou movements (Curatolo and Murphy 1986; Cronin et al. 1994). Regardless, the Central Arctic Herd of caribou has grown in numbers since the mid-1970s (i.e., from about 5,000 in 1975 to more than 27,000 in 2000) (ADF&G undated; Cronin et al. 1998b), and any redistribution of caribou in the spring has apparently not adversely affected population growth (TAPS Owners 2001a). The ADF&G management objectives for this herd (10,000 individuals) are being met, and herd-levels impacts due to the oil field are not apparent (Cronin et al. 1998b).

It is reasonable to expect that measures designed to provide caribou and other large mammals with unimpeded movement (e.g., pipelines at least 5 ft aboveground and minimizing permanent roads alongside pipelines) would also be used in the future. Therefore, cumulative impacts that would obstruct wildlife movements would be minor (USACE 1999), and synergistic effects at the herd level would not be anticipated.

The natural gas pipeline would have little or no impact on animal movements because only a few aboveground structures would be required on the North Slope and along the pipeline route. The gas pipeline would be buried and have no impact, except during construction. The NMDS would have very localized impacts in the area of development. Increased public access could result in more highway traffic and increased obstruction of wildlife movements. The impact from other industrial activity would depend on its extent and location (TAPS Owners 2001a).

4.7.7.3.5 Spills. About 400 spills of diesel, crude, and hydraulic oils and other substances (e.g., drilling wastes and seawater) occur yearly in the North Slope. Many of the oil spills occur as a result of corroded infrastructure (Schmidt 2002). Multiple spills could adversely affect wildlife if more disturbances occurred while populations were still recovering from the initial disturbance (USACE 1999). Potentially, tens of thousands of birds (e.g., long-tailed ducks, common eider, and other sea ducks) could be killed as a result of oil spills within the Beaufort Sea over the life of the oil fields. Other species, such as brant and snow geese, could be similarly affected by oil spills into coastal salt marshes or the Sagavanirktok River delta, respectively (MMS 1998). To date, there have been no significant offshore oil spills on the North Slope and, subsequently, no measurable mortality of seabirds and waterfowl, although such spills have occurred in other arctic regions. Based on experience, land-based spills of crude oil in the oil fields are uncommon and have only impacted tens of acres. Diesel spills have been more common and have affected hundreds of acres but mostly within gravel pads (Jorgenson 1997), and thus have had a negligible biological impact. Current management and cleanup techniques are effective in reducing the occurrence of spills and in removing spills when they occur (Jorgenson 1997).

Present and future North Slope oil field developments could include more offshore facilities, which would increase the potential for marine oil spills (USACE 1999). For example, oil pipelines will be used for the Northstar development in the Alaskan Beaufort Sea, and fuel barges will be used for supply. Depending on the time of year and the volume of the oil spill, several thousand birds could be affected by a spill in the Beaufort Sea (USACE 1999). Significant impacts could occur to post-nesting birds that concentrate along the coast for brood rearing, molting, premigratory staging, or migration (BLM 1998). Caribou could be impacted by a large oil spill in the North Slope if it occurred during the spring or insect-harassment period, when caribou are found in coastal waters or on beaches. Some individuals or groups of caribou might come in contact with oil and be adversely affected. However, impacts to the herd as a whole would be negligible.

As discussed in Section 4.4.4.11, a land-based oil spill can contaminate individual animals, their habitats, and their food resources. Species such as foxes may be attracted by dead oiled wildlife at a spill site or by human activity associated with spill cleanup. A large spill would probably disturb and displace most animals (other than foxes and other scavengers) from the area due to extensive activities associated with spill cleanup activities (ADNR 1999). Leaving some residual oil in place may be less damaging than the potential long-term effects of intensive cleanup activities (Jorgenson and Cater 1996).

A large oil spill (e.g., from a tanker spill) in Prince William Sound could have deleterious impacts similar to those that resulted from the Exxon Valdez oil spill (e.g., the loss of hundreds of thousands of marine and coastal birds and hundreds of eagles) (Ford et al. 1996; Exxon Valdez Oil Spill Trustee Council 2002). Smaller oil spills and contamination routinely occur (e.g., from natural crude oil seeps, and from bunker and diesel fuel spills) (Burger and Fry 1993). Small oil spills would have an additive effect, perhaps causing death to several thousand marine and coastal birds. Bird losses would be an incremental addition to the hundreds of thousands of birds that annually die in driftnets within the North Pacific, Bering Sea, and Gulf of Alaska (MMS 1998). However, present and future oil transport through Prince William Sound is now safer than before the Exxon Valdez oil spill because of the implementation of the SERVS vessel escort system. In addition, the use of double-hulled tankers in the future will add further protection against potential tanker spills (TAPS Owners 2001a).

An analysis of the cumulative impact of tanker spills in the Gulf of Alaska determined that normal operations would have no measurable impact on marine mammals, marine and coastal bird populations, and terrestrial mammals (MMS 2002). A worst case analysis of a large tanker spill in the Gulf of Alaska (200,000 bbl) would result in significant impacts to biological resources if the spill occurred in the summer under onshore wind conditions (MMS 2002). Full recovery of non-endangered marine mammals would vary from 5-10 years for sea otters, 1 year for northern fur seals, 2-5 years for harbor seals, and 10 years or more for cetaceans (assuming the complete loss of a pod of killer whales). Marine and coastal birds would also be significantly impacted by a large tanker spill with full recovery taking multiple generations of successful post-spill reproduction (MMS 2002). If the spill was to occur in late spring and the spill affected the Copper River Delta, a catastrophic loss of marine and coastal birds could occur with losses of up to 10,000-50,000 individual western sandpipers, dunlin, dusky Canada goose. The MMS (2002) also estimated that approximately 20-30 brown and black bears could ingest oil-covered food. Recovery of bear populations would take 1 year.

While a worst-case tanker spill in the Gulf of Alaska would significantly impact a number of biological resources, the likelihood of such an event is extremely small (see Section 4.7.4.10.6). Thus, the overall cumulative impact from tanker traffic is considered negligible over the lifetime of the proposed renewal period.

LaBelle and Marshall (1995) calculated simulated oil-spill trajectories for tanker routes off the U.S. West Coast. Oil-spill trajectories were mapped as "risk contours" (or oil-spill travel time at sea), showing the chance of contact to environmental resource areas, assuming an oil spill occurred (conditional probabilities). Off the California coast, an oil spill at 100 nautical miles offshore would have a 5% chance of contacting the shoreline within 30 days, while an oil spill at 80 nautical miles offshore would have a 10% chance of contacting the shoreline within 30 days. The contour lines are farther offshore off Washington and Oregon.

Spills of this size at sea have not been found to cause serious effects on bird, fish, or sea mammal populations when the effects have been studied. Additionally, at-sea spills of these average sizes are not expected to reach large areas of habitat critical to these species' survival until after the oil has been rendered less harmful by weathering and dispersion in the water. Recovery periods would be lengthened if more than one spill affected the same population within a short interval – a situation that is unlikely. Therefore, effects on species along the tanker-transportation route south of the Gulf of Alaska to the U.S. West Coast and California ports are expected to be about the same or less than those described above for the Gulf of Alaska (MMS 2002).

Ports receiving oil produced on the North Slope are sensitive areas in the unlikely event of a significant oil spill. For example, the area of the Los Angeles/Long Beach (LA/LB) marine terminal includes, in addition to terminal and port facilities, sand beaches, marinas, wetlands, and habitats of sensitive species. The most significant, sensitive, and important habitats and resources in the area are found in approximately 3,000 acres of remaining wetlands, including Anaheim Bay, Bolsa Chica, Huntington Beach, Talbert Marsh, and Santa Ana River mouth. Anaheim Bay is much reduced from its original size. Many shorebirds and migrating birds depend upon it for survival, and it receives a high priority for protection. Species that nest and/or feed in areas potentially affected by a spill in the region encompassing the terminal include the California brown pelican, the California least tern, western snowy plover, light footed clapper rail, and Belding's savannah sparrow. Also in the area, San Nicholas Island has an introduced population of the sea otter. A potential candidate for listing, the black skimmer, utilizes sand beaches in the area, particularly Seal Beach (California Department of Fish and Game 2002).

4.7.7.3.6 Summary. On the North Slope and in the Beaufort Sea, the most important future activities that could contribute to cumulative impacts on birds and terrestrial mammals would be planned oil and gas development activities, oil and gas transportation, and natural resource use (e.g., subsistence). In Interior Alaska, future actions that could contribute to the cumulative impacts on these species would include oil and gas transport, other transportation activities, human habitation and development, and land management actions. For example, timber harvests and post-harvest management may directly and indirectly affect winter habitat of caribou through loss of lichen (Wolfe, S.A., et al. 2000). In Prince William Sound, future actions that could contribute to cumulative impacts on birds and terrestrial mammals would include oil transport, other transportation activities (e.g., barging and cruise ships), human habitation, natural resource use (e.g., commercial and recreational fishing, hunting, and trapping), and land management activities. However, it is expected that none of these activities would significantly increase cumulative impacts or affect the viability of species' populations including from synergistic effects. Oil spills would not significantly add to cumulative impacts, except for an unlikely to very unlikely large spill to aquatic habitats; in this case, impacts similar to those from the Exxon Valdez oil spill could occur (see Section 4.4.4.11).

Impacts associated directly with the TAPS are only a small component of the cumulative impacts associated with the activities listed in Table 4.7-2. However, the indirect effects of the TAPS are a significant contributor to cumulative impacts to birds, and terrestrial mammals because of the interdependence of current and foreseeable oil development, production, and transportation activities with the TAPS.

Cumulative impacts of the less-than-30-year renewal alternative on birds and terrestrial mammals would be similar to the cumulative impacts of the proposed action. TAPS operations, monitoring, and maintenance activities; and other present and foreseeable actions would essentially be the same for both alternatives (except for the duration of the TAPS renewal period). The shorter renewal period would not coincide with any other current or foreseeable actions listed in Table 4.7-2. The differences in cumulative impacts between the two renewal alternatives would likely be within the same order of magnitude. If at the end of the less-than-30-year renewal period a further request for renewal was granted, cumulative impacts would continue as stated for the proposed action. If a further request for renewal was not granted, cumulative impacts would continue as stated for no action, below.

Differences in cumulative impacts between the no-action alternative and the proposed action on birds and terrestrial mammals would be more evident, particularly within the North Slope. While activities associated with gas production and transportation would occur under both alternatives, oil production and transportation would be reduced to very low levels for the no-action alternative. Thus, most oil production facilities would be idled. Also, the incremental changes that would have occurred from future oil field developments would not occur. Therefore, the level of disturbance to wildlife within the North Slope would be less for the no-action alternative as the level of vehicle use and human activity would reduced. For example, caribou using gravel pads during periods of insect harassment would not be disturbed on pads housing idled facilities. The potential for accidental oil spills would also decline within the North Slope, along the TAPS ROW, and within Prince William Sound, the Gulf of Alaska, and Pacific transportation routes. However, the infrastructure required to promptly clean up any spills that may occur within these areas may not be available in areas or ports where other oil transportation is not common (e.g., response equipment and teams associated with the TAPS would not be present).

4.7.7.4 Threatened, Endangered, and Protected Species

Cumulative impacts to threatened, endangered, and protected species result from past, present, and reasonably foreseeable future actions in the three regions crossed by the TAPS: (1) North Slope and Beaufort Sea; (2) Interior Alaska; and (3) Prince William Sound. In addition, spills of North Slope oil could impact listed species in the Gulf of Alaska and Pacific transportation routes. Cumulative impacts are considered separately for species in the three TAPS regions because there are few species that occur in more than one. Past and present activities that contribute to cumulative impacts are part of the existing baseline and are described in Section 3.22. Only past activities or events whose impacts still influence the status of listed or protected species are considered here. Factors contributing to the existing baseline for species are sometimes not well known, not restricted to TAPS or oil-related activities, and occur in other portions of the species' ranges. No critical habitat, as designated by the ESA, occurs in the area affected by TAPS operations; therefore, cumulative impacts on critical habitats are not discussed here.

Tables 4.7-11, 4.7-12, and 4.7-13 provide an overview of the relative contributions of the proposed action and past, present, and reasonably foreseeable future actions to cumulative impacts on listed and protected species. Five categories of impact are considered:

- *No effect:* Activity has not produced or is not expected to produce an effect on the species.
- *Negligible effect:* Activity has produced or is expected to produce an adverse effect, but the effect is or would not be distinguishable from natural variability in population size.
- *Minor effect:* Activity has produced or is expected to produce a small but measurable decrease (about 5% or less) in population size that does or would not affect the viability of the population.
- *Moderate effect:* Activity has produced or is expected to produce a moderate measurable decrease (more than about 5%) in population size that does or would not affect the viability of the population.
- *Large effect:* Activity has produced or is expected to produce a measurable decrease in population size that does or would affect the viability of the population.

The same five categories are used to describe the overall cumulative effect (i.e., the effect of all past, present, and future actions together on the species of concern). These designated levels of impact are consistent with the definitions of "threatened" and "endangered," as provided in the ESA and presented in Section 3.22.

For listed species (i.e., those listed as threatened or endangered by the federal government or the state or as depleted by the federal government under the MMPA), the effects of past and present activities (including TAPS and non-TAPS activities) as represented in the existing baseline are considered moderate if the species is threatened or depleted and large if the species is listed as endangered. The effects of past and present activities on state species of special concern are considered minor. The effects of past and present actions on other species were based on the current status of populations relative to predisturbance population estimates, as described in Section 3.22.

The relative impacts of future actions on listed and protected species were estimated on the basis of information presented in Section 4.7.4. The impacting factors associated with future actions that affect listed and protected species are similar to those described for the proposed action (see Section 4.3.14). The relative magnitude of impacts was determined from the area that would be affected by the future action and the nature of the impact (i.e., habitat alteration, noise, air emissions, changes in hydrology).

Only petroleum spills that are anticipated or likely to occur are considered in this cumulative impact evaluation. These include spills that result from vandalism or sabotage, because, on the basis of past frequencies of occurrence, these types of spills are likely to occur. Only large spills (which are considered unlikely or very unlikely to occur) would contribute substantially to the cumulative impact on listed and protected species. Since these spills are not "reasonably foreseeable," their effects are not described here. It is important to note that the proposed action would not affect the waters of the Beaufort Sea, except in the case of an unlikely or very unlikely catastrophic oil spill into the Sagavanirktok River that could not be contained before it entered the Beaufort Sea.

The proposed action would result in a negligible contribution to cumulative impacts on listed and protected species on the North Slope (spectacled eider, Steller's eider, and Arctic peregrine falcon) and no contribution to cumulative impacts on species in the Beaufort Sea because the proposed action would not affect the water of the Beaufort Sea (Table 4.7-11).

TABLE 4.7-11 Cumulative Impacts on Threatened, Endangered, and Protected Species That Occur on the North Slope and Beaufort Sea[a]

	Relative Contribution to Cumulative Effect									
Species	Existing Baseline[b]	Oil and Gas Exploration, Development, and Production	Oil and Gas Transportation	Human Habitation and Develop-ment	Transportation (other than oil and gas)	Land Manage-ment	Natural Resource Use	Petroleum Spills[c]	Proposed Action[d]	Overall Cumulative Effect
Arctic peregrine falcon	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible	Negligible	Negligible
Spectacled eider	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Moderate
Steller's eider	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Moderate
Bearded seal	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible
Beluga whale[e]	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible
Bowhead whale	Large	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Large
Gray whale	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible
Pacific walrus	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible
Polar bear	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible
Ribbon seal	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible
Ringed seal	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible
Spotted seal	Negligible	Negligible	Negligible	None	None	None	Negligible	Negligible	None	Negligible

a Impacts in all portions of the species' ranges are considered. None = activity has not produced or is not expected to produce any effect; negligible = activity has produced or is expected to produce an adverse effect, but the effect on population size would not be distinguishable from natural variability in population size; minor = activity has produced or is expected to produce a small but measurable (5% or less) decrease in population size that does not affect the viability of the population; moderate = activity has produced or is expected to produce a moderate measurable decrease (more than 5%) in population size that does not affect the viability of the population; large = activity has produced or is expected to produce a measurable decrease in population size that affects the viability of the population.

b Existing baseline incorporates the effects of all current ongoing activities and residual past effects (i.e., the effects of past activities that continue to influence baseline conditions) and both TAPS and non-TAPS activities. The effects of past and present activities are considered moderate for species listed as threatened or depleted and large for species listed as endangered. These effects are considered minor for state species of special concern.

c Only those petroleum spills that are considered anticipated or likely to occur are presented here. Very large spills that are unlikely or very unlikely to occur could have impacts ranging from no effect to large effect depending on the location and extent of the area affected.

d The direct and indirect effects of the proposed action are presented.

e Beaufort Sea and Chukchi stocks.

TABLE 4.7-12 Cumulative Impacts on Threatened, Endangered, and Protected Species That Occur in Interior Alaska[a]

Species	Existing Baseline[b]	Oil and Gas Exploration, Development, and Production	Oil and Gas Transportation	Human Habitation and Develop-ment	Transportation (other than oil and gas)	Land Manage-ment	Natural Resource Use	Petroleum Spills[c]	Proposed Action[d]	Overall Cumulative Effect
	Relative Contribution to Cumulative Effect									
American peregrine falcon	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible	Negligible	Negligible
Blackpoll warbler	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible	Negligible	Minor
Gray-cheeked thrush	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible	Negligible	Minor
Olive-sided flycatcher	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible	Negligible	Minor
Townsend's warbler	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	None	Negligible	Negligible	Minor

a Impacts in all portions of the species' ranges are considered. None = activity has not produced or is not expected to produce any effect; negligible = activity has produced or is expected to produce an adverse effect, but the effect on population size would not be distinguishable from natural variability in population size; minor = activity has produced or is expected to produce a small but measurable (5% or less) decrease in population size that does not affect the viability of the population; moderate = activity has produced or is expected to produce a moderate measurable decrease (more than 5%) in population size that does not affect the viability of the population; large = activity has produced or is expected to produce a measurable decrease in population size that affects the viability of the population.

b Existing baseline incorporates the effects of all current ongoing activities and residual past effects (i.e., the effects of past activities that continue to influence baseline conditions) and both TAPS and non-TAPS activities. The effects of past and present activities are considered moderate for species listed as threatened or depleted and large for species listed as endangered. These affects are considered minor for state species of special concern.

c Only those petroleum spills that are considered anticipated or likely to occur are presented here. Very large spills that are unlikely or very unlikely to occur could have impacts ranging from no effect to large effect depending on the location and extent of the area affected.

d The direct and indirect effects of the proposed action are presented.

TABLE 4.7-13 Cumulative Impacts on Threatened, Endangered, and Protected Species That Occur in Prince William Sound[a]

	Relative Contribution to Cumulative Effect								
Species	Existing Baseline[b]	Oil and Gas Transportation	Human Habitation and Develop-ment	Transportation (other than oil and gas)	Land Manage-ment	Natural Resource Use	Petroleum Spills[c]	Proposed Action[d]	Overall Cumulative Effect
Steller's eider	Moderate	None	None	None	None	Negligible	Negligible	Negligible	Moderate
Beluga whale[e]	Moderate	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	Moderate
Dall's porpoise	Negligible	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	None
Fin whale	Large	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	Large
Gray whale	Negligible	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	None
Harbor porpoise	Negligible	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	None
Harbor seal	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor
Humpback whale	Large	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	Large
Killer whale	Negligible	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	Negligible
Minke whale	Negligible	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	Negligible
Pacific white-sided dolphin	Negligible	Negligible	None	Negligible	None	Negligible	Negligible	Negligible	Negligible
Sea otter	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor
Steller sea lion	Large	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Large

a Impacts on all portions of the species' ranges are considered. None = activity has not produced or is not expected to produce any effect; negligible = activity has produced or is expected to produce an adverse effect, but the effect on population size would not be distinguishable from natural variability in population size; minor = activity has produced or is expected to produce a small but measurable (5% or less) decrease in population size that does not affect the viability of the population; moderate = activity has produced or is expected to produce a moderate measurable decrease (more than 5%) in population size that does not affect the viability of the population; large = activity has produced or is expected to produce a measurable decrease in population size that affects the viability of the population.

b Existing baseline incorporates the effects of all current ongoing activities and residual past effects (i.e., the effects of past activities that continue to influence baseline conditions) and both TAPS and non-TAPS activities. The effects of past and present activities are considered moderate for species listed as threatened or depleted and large for species listed as endangered. These affects are considered minor for state species of special concern.

c Only those petroleum spills that are considered anticipated or likely to occur are presented here. Very large spills that are unlikely or very unlikely to occur could have impacts ranging from no effect to large effect depending on the location and extent of the area affected.

d The direct and indirect effects of the proposed action are presented.

e Cook Inlet stock.

The largest contribution to cumulative impacts on species occupying the North Slope and Beaufort Sea would result from past and current activities, including activities and effects in other portions of the ranges of these species. For example, for the spectacled eider, the ingestion of lead shot and ecosystem-level changes elsewhere in its range might have been major contributors to the declines in the population of the species (USFWS 1999). Population status and factors affecting the status of listed and protected species are discussed in Section 3.22. The most important future activities that could contribute to cumulative impacts on the North Slope and Beaufort Sea are planned oil and gas development activities, oil and gas transportation, and natural resource use (subsistence harvests). However, on the basis of information available none of these activities are expected to noticeably increase the cumulative impact or affect the viability of species' populations.

Spectacled and Steller's eiders could be affected by future activities and facilities that would disturb their habitat, including the development of new production facilities and oil and gas transportation infrastructure. Increased predator abundance associated with human occupation and the subsequent increased mortality of eider eggs and young have been identified as a concern on the North Slope but could be mitigated with proper disposal and management of food waste (USFWS 2002). New development is expected to have relatively minor effects, given the overall availability of habitat across the North Slope; consequently, the overall cumulative impact on eiders would be relatively unchanged. Cumulative impacts are not expected to threaten the population viability of either the spectacled or Steller's eider.

Concern has been raised about the effect of underwater noise and disturbances associated with oil and gas development on whales inhabiting the Beaufort Sea. All whale species that have been examined show some aversion to underwater noise (see Section 3.22). A recent evaluation of the cumulative impacts of leasing and exploration activities on bowhead whales of the Outer Continental Shelf portion of the U.S. Beaufort Sea concluded that these activities were not likely to jeopardize the continued existence of this species, but that adverse effects of noise on whale behavior were possible (Knowles 2001).

None of the species in Interior Alaska are currently listed by the federal government as threatened or endangered. The American peregrine falcon has been de-listed because the population has recovered. Several neotropical migrant bird species are considered species of special concern by the state (blackpoll warbler, gray-cheeked thrush, olive-sided flycatcher, Townsend's warbler), but past and present actions affecting existing populations mostly result from impacts in other portions of the ranges of these species. Future actions in Interior Alaska that could contribute to the cumulative impact on these species include oil and gas transport, human habitation and development, other transportation activities, land management actions, and petroleum spills (Table 4.7-12). The contributions to the cumulative impact from all of these activities and from the proposed action are expected to be negligible given the area of habitat potentially affected compared to that available.

Future actions contributing to cumulative impacts on listed and protected species in Prince William Sound include oil transport (tankering), other transportation activities (e.g., barge traffic), human habitation, natural resource use (e.g., commercial and recreational fisheries), land management, and petroleum spills. The largest contribution to the cumulative impact results from past and existing impacts. The Exxon Valdez oil spill has affected several species in the Sound, including the sea otter and Steller sea lion (Section 3.22.3; Table 4.7-13). Past and present impacts to fin whale, humpback whale, beluga whale, and Steller's eider, for the most part, occur in other portions of the ranges of these species (see Section 3.22). Reasonably foreseeable future actions in the Sound, because of their nature and size (see Section 4.7.4), would contribute relatively minor increments to the overall cumulative impact, and these increments are not expected to reduce the viability of existing populations in Prince William Sound.

The proposed action would result in a negligible contribution to cumulative impacts on listed and protected species in Prince William

Sound (Table 4.7-13). Very minor amounts of water pollutants would be released as effluent to Port Valdez during normal operations of the TAPS. On the basis of past monitoring results, these permitted discharges would not affect overall water quality in the Sound. Similarly, anticipated or likely spills associated with the proposed action are expected to be relatively small, and, if existing oil spill contingency plans for response and cleanup are followed, any impacts from the spills should be short in duration. Large spills (not included in Table 4.7-13) that are considered unlikely or very unlikely could contribute substantially to the cumulative impacts on listed and protected species in Prince William Sound. The impacts of such a spill would depend on many factors including location, weather, time of year, and area affected.

The analysis of oil-spill risk on some species along transportation routes from Alaska to ports on the U.S. west coast can be found in the Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final EIS (MMS 1995). That EIS discusses potential effects of an oil spill on these species as a result of tankers transporting oil from the Cook Inlet sale area to California ports.

Sea lions are not expected to be adversely affected, because studies suggest there would be relatively low effects of an oil spill on sea lions. Northern sea otters likely would be at limited risk from a tanker oil spill, because oil spilled along the Far East tanker route would tend to be moved parallel to the Aleutian Islands by the Alaskan Stream rather than toward the coast where sea otters might be contacted. Critical habitat for Steller's eiders on the north side of the Alaska Peninsula also is unlikely to be at risk from a tanker spill along the Far East tanker route. Overall, the potential for an oil spill to affect salmonids and other fish species, including the tidewater goby, the Sacramento splittail, Pacific hake, white abalone, and black abalone, appears limited.

Implementation of the provisions of the Oil Pollution Act of 1990 should significantly reduce the frequency and magnitude of spills associated with oil tankers. If an oil spill coincided with the outmigration of smolt, some smolts could be exposed to spilled oil. An oil spill could cause slower growth for smolts, which could result in an incremental reduction in survival to adulthood but probably would not result in population-level effects. It is unlikely that any adverse effects would occur to either salmon or other fish species as a result of a tanker spill. It is unlikely that an oil spill would affect designated critical habitat for marbled murrelets, because the critical habitat is inland coniferous forests. It also is unlikely that an oil spill would affect proposed critical habitat for western snowy plovers. If an oil spill occurred from a tanker carrying oil from the North Slope and the spill contacted proposed critical habitat, the intertidal food sources for this species may be adversely affected, resulting in slow growth and development and/or death of the chicks. No significant mortality of short-tailed albatrosses is expected to result from a tanker spill along the transportation route. No adverse effects from any spill containing oil produced on the North Slope are expected to result to the following: the northern spotted owl, California freshwater shrimp, California tiger salamander, mission blue butterfly, San Bruno elfin butterfly, callippe silverspot butterfly, Behren's silverspot butterfly, Suisun thistle, soft bird's-beak, coastal dunes milk vetch, Hickmann's potentilla, La Graciosa thistle, yellow larkspur, Sonoma alopecurus, showy Indian clover, Presidio manzanita, marsh sandwort, robust spineflower, Sonoma spineflower, Presidio clarkia, Santa Cruz cypress, Baker's larkspur, Santa Cruz tarplant, clover lupine, and white-rayed pentachaeta.

The effects on marine mammals of underwater noise associated with boat and tanker traffic is a concern in Prince William Sound, much as it is in the Beaufort Sea. Unlike in the Beaufort Sea, however, no substantial increases in noise are anticipated in Prince William Sound, since tanker and boat traffic is not expected to increase substantially over the TAPS renewal period. Decreasing throughput during the renewal period could result in decreased tanker traffic and reduced noise levels.

The cumulative impact of the less-than-30-year renewal alternative on listed and protected species would be very similar to that of cumulative impacts under the proposed action. The only difference between the proposed action and this alternative is the length of the renewal period. As for the proposed action, a decision could be made to renew the Federal Grant at the end of the renewal period. Therefore, ultimately, the period of time during which the TAPS would operate under the less-than-30-year renewal alternative could be identical to that under the proposed action. A shorter renewal period would not preclude any other existing or foreseeable actions from occurring. Because large impacts on listed species are due to existing non-TAPS actions, and because a very unlikely major spill could occur for either alternative, the duration of the renewal period does not affect recovery from effects. Consequently, the cumulative impact of this alternative could be the same as that of the proposed action.

The cumulative impact of the no-action alternative on listed and protected species would be quite different from that of the proposed action. Differences result from the relationship between the TAPS and oil and gas production on the North Slope. For the no-action alternative it is assumed that oil exploration and production activities would cease pending development of another means of transporting the oil to market, but that gas production and transportation would occur via a natural gas pipeline. Thus, the cumulative impact of the no-action alternative would be less than that of the proposed action because of the reduction in impacts associated with oil exploration and production on the North Slope and oil transportation in Prince William Sound. Although there would be some potential for a short-term increase in impacts resulting from termination activities for production facilities on the North Slope and on Prince William Sound, the overall cumulative impact on listed and protected species of the no-action alternative would be minor and less than that of the proposed action.

In summary, the impacts of the proposed action would represent a small incremental contribution to the cumulative impact on listed and protected species. For all of these species, the largest contributions to cumulative impact would occur in other portions of the species' range. On the North Slope, past and present oil and gas production activities would be the largest contributors to cumulative impact, while important future contributors would include oil and gas exploration and development activities; oil and gas transportation; and use of natural resources (subsistence harvest). Activities in Interior Alaska, including the proposed action, would result in negligible contributions to the cumulative impact on species that occur there. In Prince William Sound and the Gulf of Alaska/Pacific Ocean, the largest contributors to cumulative impacts would be associated with past, present, and future oil and gas transportation (tankering) and use of natural resources (commercial fishing).

The cumulative impact of the less-than-30-year renewal alternative on listed and protected species would be very similar to that of the proposed action because TAPS operation and associated activities would continue and the impacts of other future activities would be similar. In contrast, the cumulative impact of the no-action alternative on listed and protected species would be quite different from that of the proposed action. Differences would result from the relationship between the TAPS and oil and gas production on the North Slope. Under the no-action alternative, the cumulative impact would be less than it would be under the proposed action because of the reduction in impacts associated with oil exploration and production on the North Slope and oil transportation in Prince William Sound. Although there would be some potential for a short-term increase in impacts resulting from termination activities for production facilities on the North Slope and Prince William Sound, the overall cumulative impact on listed and protected species under the no-action alternative would be minor and less than that under the proposed action.

4.7.8 Social Systems

4.7.8.1 Subsistence

As was the case when assessing subsistence impacts of the proposed action and other alternatives considered in this EIS, the evaluation of cumulative impacts on subsistence requires consideration of complex relationships among several variables — biological resource levels, human population, the economics of various components of Alaskan society, recreational hunter and angler practices and harvests, and subsistence practices and harvest levels. The evaluation of cumulative impacts on subsistence is particularly challenging in that it involves several past, present, and reasonably foreseeable actions, each potentially affecting the above variables. Of particular concern are North Slope oil field development and potential impacts from tanker transportation of oil (as occurred following the Exxon Valdez oil spill). Nevertheless, one would expect certain types of conditions to emerge under negative and positive impacts. Negative impacts would generate reduced subsistence harvest levels or efficiency, through smaller resource populations, changed resource locations, increased competition for resources, disrupted subsistence activities, reduced access to resources, or some combination of these factors resulting from the alternatives considered in this EIS in conjunction with other pertinent (past, present, or reasonably foreseeable) actions. Positive impacts, in turn, would be those leading to improved subsistence harvest levels or efficiency, through increased resource populations, resource relocation closer to subsistence users, improved access to resources, improved ability to acquire more efficient transportation or harvest technology, or some combination of these factors, again as a consequence of pertinent actions. The evaluation of cumulative impacts on subsistence that follows considered this large collection of interrelated factors for cumulative impacts associated with the proposed action, less-than-30-year renewal alternative, and no-action alternative. It concludes that negative impacts would be associated with the first two, with their magnitude low for all except those on the North Slope, which would be moderate.

Section 4.3.20 contains a description of anticipated impacts under the proposed action. That analysis was based on an evaluation of evidence for all possible impacts to subsistence as a result of the TAPS, either positive or negative. The evaluation of impacts under the less-than-30-year renewal alternative employed an identical approach, yielding a conclusion similar to that for the proposed action (the magnitude of the negative impacts likely less — see Section 4.5.2.20). Finally an assessment of likely subsistence impacts under the no-action alternative indicated a slight positive impact overall (see Section 4.6.2.20). The analysis of cumulative impacts to subsistence, discussed in this section, similarly considers all possible effects to arrive at an overall assessment.

The following evaluation focuses primarily on cumulative impacts associated with the proposed action. Cumulative impacts associated with the less-than-30-year renewal and no-action alternatives appear at the end of the section. This analysis evaluates cumulative impacts for three principal geographic areas associated with the TAPS: the North Slope, Interior Alaska, and Prince William Sound/Gulf of Alaska. This procedure differs slightly from other geographic treatments of subsistence in the EIS, essentially combining the Yukon River drainage and Copper River basin (used in subsistence impact evaluations in other parts of the document) into Interior Alaska.

For cumulative impacts, several effects on subsistence would be possible due to past, present, and reasonably foreseeable future actions. These effects would vary in importance depending on the geographic area being considered. The principal potential effects are as follows:

- More infrastructure and activity in support of this infrastructure would potentially increase disruption to the movement of various types of fish and game.
- Additional actions that would introduce more infrastructure, people, and activities would further limit the areas where subsistence is pursued.
- Improved access to rural Alaska may accompany the construction and maintenance of additional service roads associated with other current or potential activities, such as oil and gas exploration on the North Slope and construction, operation, and maintenance of a natural gas pipeline.
- The overall state population likely would grow in response to the direct and indirect economic effects of current and reasonably foreseeable actions; the increased number of residents may generate increased competition for fish and game resources.

- Increasing numbers of outsiders would be introduced to rural Alaska through their involvement in present and reasonably foreseeable actions, increasing the number of potential competitors for fish and game resources,

- Larger amounts of cash would probably be available to individuals pursuing recreational hunting and fishing, enabling them to obtain and operate improved sport harvest-related technologies.

- Larger amounts of cash would probably be available to individuals pursuing subsistence activities, enabling them to obtain and operate improved subsistence-related technologies.

On the North Slope, many of the current and reasonably foreseeable actions tend to involve the oil and gas oil industry — through exploration, development, production, support, and transportation. A second important future action there would be the construction and operation of a natural gas pipeline with facilities and activities present on the North Slope (and extending south). Finally, the northern part of Gates of the Arctic NPP is located on the North Slope, where it overlaps with portions of traditional subsistence harvest areas for Anaktuvuk Pass and Nuiqsut (see Maps 3.24-1, 3.27-2, D-3, and D-4). Likely cumulative impacts to subsistence in the North Slope would include the following:

- Increased disruption to the movement of subsistence resources;

- Increased restrictions against using certain areas traditionally used for subsistence;

- Increased number of potential competitors for fish and game in subsistence harvest areas;

- Improved sport harvests by enhanced travel to resources, increased harvest levels, increased harvest efficiency, increased opportunities for recreational hunting and fishing, or some combination of all four through access to additional cash to purchase pertinent technology or otherwise fund sport hunting and fishing; and

- Improved subsistence through enhanced travel to resources, increased harvest levels, increased harvest efficiency, or some combination of all three through access to cash to purchase modern transportation and harvest technology.

The North Slope communities of Anaktuvuk Pass and Nuiqsut both rely heavily on subsistence for economic, sociocultural, and ceremonial reasons. Because of their locations, the locations of their subsistence harvest areas, and their subsistence practices, each village likely would experience the above impacts to some degree. In part these impacts would be directly associated with various activities and land management strategies identified elsewhere in this EIS. The presence of infrastructure and crews associated with oil and gas exploration and development already restricts subsistence in areas traditionally used for that purpose (BLM 1998; Haynes and Pedersen 1989; Pedersen et al. 2000). Although the establishment of Gates of the Arctic NPP did not disallow subsistence activities in the park area, it did introduce certain restrictions (e.g., allowable modes of transportation) that increased the difficulty of subsistence in the park (Ned 1992; Reakoff 1992). Nevertheless, the traditional harvest areas of these villages are very large, both exceeding 11,000 mi^2, enabling the continued pursuit of subsistence in other locations outside the restricted areas. Additional travel likely would be necessary to harvest certain resources, reducing subsistence efficiency (see Pedersen et al. 2000). As a consequence, the magnitude of this impact is anticipated to be moderate.

The impact of the TAPS and human activities on subsistence resource movement continues to be debated. One of the main concerns is caribou, a key subsistence resource that migrates (in herds) in the spring and fall of each year (see Section 3). Scientific evidence indicates that human activities could change caribou movement patterns (Horejsi 1981; Lenart 2000; Murphy and Lawhead 2000; Tyler 1991; Wolfe, S.A., et al. 2000), and testimony from several of the rural communities in the vicinity of the TAPS associates the pipeline and related activity with changes in herd movement (ADF&G 2001; Moses 1993; see also

Section 3.24.1). However, disruption to movement patterns does not appear to have occurred at a large scale involving more than relatively few animals (see Section 4.7.7.3.2).

The modification of whale migration routes due to noise associated with North Slope oil activities has been asserted by Nuiqsut residents as causing failed whale harvests in the past (Pedersen et al. 2000). Although whales have been shown to be quite sensitive to underwater noise (see Section 3.22) and bowhead whales can exhibit adverse behavioral effects from such noise (Knowles 2001), specific effects on movement are unknown and oil development activities were not found to jeopardize continued survival of the species (see Section 4.7.7.4). Large numbers of caribou continue to be harvested in Anaktuvuk Pass and Nuiqsut (see Section 3.24.1), while whale harvests in Nuiqsut and elsewhere usually reach imposed limits, suggesting that any impacts due to relocation from noise on the North Slope are not serious or long-lasting.

Increased competition for subsistence resources could also occur from nonlocal hunters and fishermen as a result of introducing more individuals to the North Slope through employment-related activities. Residents from both Anaktuvuk Pass and Nuiqsut have identified competition for resources as key problems for subsistence (ADF&G 2001). However, of specific concern here are impacts that are a direct consequence of cumulative actions — that is, competition from personnel associated with these activities on the North Slope. There is no indication that personnel associated with oil and gas exploration and development, who tend to live elsewhere, are a serious source of competition for fish and game resources on the North Slope. Moreover, the number of people involved directly or indirectly in other current and foreseeable actions is not expected to be large and in many cases would be temporary (TAPS Owners 2001a).

Indirect impacts resulting from cumulative actions also are likely, mainly by further reducing the flexibility of subsistence users to pursue resources where and when they are available, and by reducing harvests in an area felt to be experiencing reduced subsistence resources (Ned 1992; Nelson 1992). Nevertheless, the large size of traditional subsistence harvest areas for Anaktuvuk Pass and Nuiqsut (see Map 3.24-1), coupled with evidence for substantially increased populations of certain key subsistence resources (namely caribou) in recent years (TAPS Owners 2001a) and the successful regulation of harvests by ADF&G (see Sections 4.7.7.2 and 4.7.7.3), suggests that the magnitude of impacts from reduced flexibility likely would be minimal.

Residents of the North Slope, including Anaktuvuk Pass and Nuiqsut, continue to be employed by the oil and gas industry in the region (ADCED 2001). The cash income generated by such employment can be used to obtain transportation and harvest technology that aids in subsistence. Cash income from these activities on the North Slope and cumulative actions elsewhere also can be used to improve sport harvests on the North Slope. Although such technological enhancement of recreational hunting and fishing no doubt occurs, available evidence from resource populations and harvest levels does not indicate the presence of severe cumulative impacts as a result (see Sections 3.19.1.1.1, 3.21, 3.24.3, 4.7.7.2.3, and 4.7.7.3.3).

Note that cumulative impacts on the North Slope also could involve the consequences of spills. Table 4.7-4 describes a number of spills and associated probability of occurring. For normal operations — that is, reasonably foreseeable — *anticipated* or *likely* spills could occur. Although releases as large as 82,000 bbl could occur within these probability ranges, they would be confined to terrestrial settings. As discussed in Sections 4.4.4.11 and 4.4.4.14, a terrestrial spill would have limited impacts on terrestrial mammals with large ranges. A similar conclusion holds for a spill on the North Slope under cumulative impacts.

For the cumulative impacts on subsistence anticipated on the North Slope, the TAPS contribution should be small.

Cumulative impacts to subsistence would also occur in Interior Alaska. Impacts here would relate in particular to oil and gas development and transportation, coupled with continued management of Gates of the Arctic NPP and Wrangell-St. Elias NPP. The most important cumulative impacts to subsistence associated with the proposed action would include:

- Disruption to the movement of subsistence resources;
- Restrictions against using certain areas traditionally used for subsistence;
- Increased number of potential competitors for fish and game in subsistence harvest areas;
- Improved sport harvests by enhanced travel to resources, increased harvest levels, increased harvest efficiency, increased opportunities for recreational hunting and fishing, or some combination of all four through access to additional cash to purchase pertinent technology or otherwise fund sport hunting and fishing; and
- Improved subsistence through enhanced travel to resources, increased harvest levels, increased harvest efficiency, or some combination of all three through access to cash to purchase modern transportation and harvest technology.

Several interior communities likely would experience cumulative impacts to subsistence: Alatna, Allakaket, Big Delta, Chitina, Coldfoot, Copperville, Copper Center, Delta Junction, Evansville, Gakona, Glennallen, Gulkana, Hughes, Kenny Lake, Livengood, Manley Hot Springs, Minto, Paxson, Rampart, Stevens Village, Tanana, Tazlina, Tonsina, and Wiseman (see Map 3.24-1). However, the magnitude of the impacts would vary, depending on the community's proximity to one or more activities included in the cumulative analysis. For instance, Alatna, Allakaket, Evansville, and Wiseman all have part of their respective subsistence harvest areas within Gates of the Arctic NPP (see Maps 3.24-1 and 3.27-2). Parts of the subsistence harvest areas of Chitina, Copper River, Gakona, Glennallen, Gulkana, Kenny Lake, Paxson, and Tonsina, in turn, lie within Wrangell-St. Elias NPP. Although subsistence for traditional and personal use is allowed within the parks, many subsistence practitioners feel that restrictions on subsistence in the parks makes that activity unduly difficult (e.g., Mekiana 1992; Moses 1993). However, because of the rural subsistence priority as applied to national parks, competition from nonrural hunters is eliminated in parks and reduced in preserves. Because the presence of the TAPS itself leads to little restriction on subsistence activities (see Section 4.3.20), this evaluation assumes that restrictions due to additional infrastructure (such as a gas pipeline) would be similarly limited.

In the interior, as on the North Slope, infrastructure and human activity could disrupt movements of certain subsistence resources in Interior Alaska. Again, a main concern is caribou — important to subsistence for several Interior rural communities and a migratory species whose movements are important to harvests. Subsistence users from Interior communities have expressed concerns that caribou migration patterns have changed in recent decades, occasionally citing the TAPS as the cause of such change (ADF&G 2001; Moses 1993). However, as for the North Slope, although caribou can be sensitive to human activity, there is no evidence that the impacts of the TAPS have affected more than a few animals temporarily (see Section 4.3.17.2). Cumulative impacts similarly are not expected to affect the behavior of many caribou or any other animal important for subsistence (see Sections 4.7.7.2, 4.7.7.3, and 4.7.7.4).

As discussed in Section 4.3.20, increased competition for subsistence resources likely will occur throughout Alaska with continued population growth. However, very little of this growth would be directly due to either the proposed action or other current and reasonably foreseeable future activities, beyond temporary local influxes of workers for construction of a gas pipeline and the NMDS (see Section 4.7.8.3). Certain subsistence resources have shown low population levels in recent years, including Yukon River salmon and the Delta caribou herd (see Section 4.3.20). The active management of sport harvests by ADF&G, particularly where these specific resources are concerned, undoubtedly would continue and would help to minimize that source of competition — although low resource populations likely are due primarily to other reasons (severity of winters, predation, environmental conditions, and commercial fishing).

Residents of Interior Alaska, including many of the villages mentioned above, continue to be employed by the oil and gas industry in the region, although at much lower levels than on the North Slope (ADCED 2001). Employment also is available in connection with the two national parks in the region. The cash income generated by such employment can be used to obtain transportation and harvest technology that aids in subsistence. Cash income from these activities in Interior Alaska and cumulative actions elsewhere (e.g., on the North Slope) also can help to improve sport harvests in the Interior. Technological enhancement of recreational hunting and fishing no doubt occurs, particularly in the rivers near Fairbanks and in the Copper River basin, which support particularly active sport fisheries, and in the game management units (GMUs) experiencing high amounts of hunting (see Section 3.19.1.1.2 and Table 3.21-2 [for GMUs 13, 20, and 24]). Once again, the heavy use of particular species in particular areas has resulted in careful management of all harvests by ADF&G to help maintain resources at sustainable levels.

For the cumulative impacts on subsistence anticipated in the Alaska Interior, the TAPS contribution once again should be small. Compared with the North Slope, cumulative impacts in the Interior should be smaller because of less concentration of infrastructure and activities (particularly within subsistence harvest areas).

In Prince William Sound and the Gulf of Alaska, cumulative impacts on subsistence would be possible as a result of past, current, and reasonably foreseeable future actions. These impacts could include those from anticipated and likely hazardous materials spills — that is, smaller-volume spills that are reasonably foreseeable (see Section 4.7.4.10). The most important possible cumulative impacts to subsistence in Prince William Sound would include the following:

- Disruption to the movement of subsistence resources;
- Increased number of potential competitors for fish and game in subsistence harvest areas;
- Improved sport harvests by enhanced travel to and from hunting and fishing areas, increased harvest levels, increased opportunities to pursue recreational hunting and fishing, or combinations of these consequences through the availability of additional cash; and
- Improved subsistence by enhanced travel to and from subsistence areas, increased harvest levels or efficiency, or both through the availability of additional cash.

The impacts of disrupting subsistence resource movements in Prince William Sound and Gulf of Alaska should be minimal. Most of the terrestrial subsistence resources relied upon by the three rural communities (Chenega Bay, Cordova, and Tatitlek) in Prince William Sound examined in this EIS are harvested well away from infrastructure and activities associated with either the TAPS or other current or reasonably foreseeable activities (see Maps D-20, D-21, and D-24). Marine resources similarly tend to be harvested well away from current and foreseeable infrastructure and activities.

As noted earlier, increased competition for subsistence resources likely will occur throughout Alaska with continued population growth. However, very little of the growth in Prince William Sound would be directly due to either the proposed action or other current and reasonably foreseeable future activities. Certain subsistence resources in this region have shown low population levels in recent years, including pink salmon and herring (see Sections 3.19.1.3 and 4.3.20). The active management of sport and commercial harvests by ADF&G, especially where these particular resources are concerned, undoubtedly will continue and would help to minimize that source of competition — although low resource populations likely are due primarily to other reasons (e.g., predation, environmental conditions, and commercial fishing).

The Eyak Tribe has asserted that the closure of oil tanker lanes in the Valdez Arm to Cape Hichinbrook waters, recently adopted for national security reasons, has restricted access to a traditional fishing area. The map of the traditional use area for Cordova residents does not show these lanes to be part of the traditional use area (see Maps 3.24-1 and D-23).

Residents of the Prince William Sound area continue to be employed by the oil and gas industry, primarily in the vicinity of Valdez (ADCED 2001). The cash income generated by such employment can be used to obtain transportation and harvest technology that aids in subsistence. Cash income from these activities in Prince William Sound and cumulative actions elsewhere also can be used to improve sport harvests. Technological enhancement of recreational hunting and fishing no doubt occurs (see Section 3.19.1.3 and Table 3.21-2 [for GMU 6]). Once again, the heavy use of particular species in particular areas has resulted in careful monitoring by ADF&G to help maintain resources at sustainable levels.

The impacts described above for Prince William Sound concern normal activities or spills under the *anticipated* or *likely* frequency categories. The distinction between spill categories is particularly important for Prince William Sound, which experienced severe subsistence impacts from the Exxon Valdez oil spill in 1989 (see Fall and Utermohle 1999). The spills thus far considered would involve the release of 60 barrels or less into the Sound (see Table 4.7.4-6). Although much less probable, larger spills are included in the spill scenarios considered — with maximum releases into some portion of Prince William Sound (as opposed to Hinchinbrook Entrance or beyond) of 300,000 bbl under an *unlikely* scenario and 320,000 bbl under a *very unlikely* scenario.

The release of a large volume of oil into Prince William Sound could have severe negative impacts on subsistence resources, notably certain species of fish, birds, and marine mammals. Impact magnitude would vary, depending on the location of the release point and the duration of the spill. Moreover, current contingency plans for oil spills in Prince William Sound, coupled with the SERVS tanker escort system (with accident prevention and spill containment capabilities), likely would help to limit the size of the area affected and thus the impacts. The location and size of traditional subsistence harvest areas in Prince William Sound (for Chenega Bay, Cordova, and Tatitlek) might enable avoidance of spill areas (see Maps D-20, D-21, and D-24). However, the potential for avoidance would depend on many other factors (such as spill location and subsequent dispersal). Also, the act of avoidance, harvesting subsistence resources elsewhere, in itself would be a negative impact in that it would likely involve greater travel and hence less efficiency and longer absences from the village.

Depending on the scale of the spill, impacts on subsistence could include large reductions in subsistence harvests. Associated consequences of such reductions would extend to the local economy, social organization, and ceremonial spheres. Intensive community survey data for the five rural communities examined in the EIS that experienced direct impacts from the Exxon Valdez oil spill (Chenega Bay, Cordova, Nanwalek, Port Graham, and Tatitlek) indicate that subsistence harvests dropped off drastically in the first two years of spill damage, the range of species harvested was reduced, sharing declined, and young people had fewer opportunities to participate and learn the cultural values associated with subsistence (Fall and Utermohle 1999; see Section 3.24.2.4.2). Fear of contamination was cited by subsistence users as a major factor in these changes (Fall 1999a).

In the following three years, harvest levels, sharing, and subsistence involvement by young people rebounded, although not uniformly across and within communities (Fall and Utermohle 1999). A study of psycho-social impacts noted that "fear" about resource safety and "alienation" from culturally valued activities were important in the early years (IAI 2001). By the late 1990s, nearly a decade after the spill, subsistence uses had largely recovered to pre-spill levels, but with some enduring changes. Fish species now make up a larger portion of subsistence harvests, while marine mammals, marine invertebrates, and birds constitute a smaller portion than before. Resource scarcity, rather than fear of contamination, is now cited as the primary factor influencing harvest patterns, and subsistence hunters report having to travel greater distances to meet their subsistence needs (Fall and Utermohle 1999). The likelihood of an accident releasing a large amount of oil into Prince William Sound is extremely low, but if such an event occurs, the impacts on subsistence could be severe for several years.

For the cumulative impacts on subsistence anticipated in Prince William Sound or the Gulf of Alaska, the TAPS contribution once again should be small under normal operations. This conclusion would hold where a large tanker spill is concerned, as such an event would technically not be reasonably foreseeable, although the ultimate impacts of such an event on subsistence could be severe.

Cumulative impacts for the cases of the other alternatives considered in this DEIS would vary from those just discussed for the proposed action. Under the less-than-30-year renewal alternative, impacts likely would be about as small as those outlined earlier in this section; if anything, they would be smaller because there would be less time for impacts to accumulate (see also Section 4.5.2.20).

Cumulative impacts of the no-action alternative on subsistence likely would change in comparison to those associated with the proposed action. This EIS assumes that closing down the TAPS would effectively cause North Slope oil production to cease. As discussed above, this activity has had an adverse impact on subsistence in that region through restrictions on use areas and effects on resource movement (notably of caribou) (see Haynes and Pedersen 1989; Pedersen et al. 2000). Although the EIS makes no assumption about removal of infrastructure on the North Slope associated with oil production, the dramatic reduction of personnel and termination of activities likely would remove many of the above impacts. Slight reductions in human activity also would occur in Interior Alaska and Prince William Sound as a result of cumulative actions, although impacts on subsistence would not be as great as on the North Slope. By the same token, cumulative impacts would include considerable changes in the Alaska economy, with mixed consequences on subsistence. On the one hand, slowing population growth in Alaska as a whole and providing less disposable income for sport hunting and fishing likely would reduce competition for subsistence resources. On the other hand, the substantial economic decline in Alaska that would accompany the no-action alternative likely would increase both the number of people pursuing subsistence and the intensity of subsistence activity in many places.

The main consequences of increased subsistence activity likely would be growing pressure on the resources harvested, although less access to cash (and hence less access to modern technology and the materials to operate it) may well mean that subsistence efficiency would decline. Considering positive and negative consequences together, the likely net effect on subsistence from the no-action cumulative case would be slightly positive — similar to that concluded for the no-action alternative alone (see Section 4.6.2.20), although slightly greater because of the anticipated improvements on the North Slope.

Cumulative impacts to subsistence also can occur outside of Alaska. The potential for an oil spill to affect subsistence fisheries and the small subsistence gray whale hunt of the Makah Tribe on the Washington coast along the tanker corridor appears to be limited. Any negative cumulative impacts associated with the less-than-30-year renewal alternative likely would be less than those associated with cumulative impacts under the proposed action. Cumulative impacts associated with the no-action alternative, in contrast, likely would be positive but very small outside of Alaska, removing possible negative impacts due to a tanker spill.

In summary, cumulative impacts to subsistence likely would vary for the three broad geographic regions — the North Slope, Interior Alaska, and Prince William Sound Gulf of Alaska area. In all cases, cumulative impacts to subsistence under past, present, and reasonably foreseeable actions should not be large. Those occurring in the North Slope likely would be the greatest, due primarily to the relatively large amount of oil and gas exploration, development, and production occurring there and the associated human activity and restrictions on subsistence in certain areas (see BLM 1998). However, the size of subsistence harvest areas in all three regions would leave much of these areas unaffected by cumulative impacts — that is, still available for subsistence, and outside the geographic influence of various cumulative activities that might cause minor disruptions to subsistence resource movements. Moreover, the increase in size of certain key subsistence resource populations over the past several years suggests that improved availability of certain species may help compensate for reduced access to certain subsistence areas.

4.7.8.2 Sociocultural Systems

Cumulative impacts on sociocultural systems take the form of changes to Alaska Native and rural non-Native sociocultural systems because of one of the alternative actions considered in conjunction with other past, present, and reasonably foreseeable actions. Although it is the nature of sociocultural systems to change in response to shifting challenges or surrounding conditions, rapid, large-scale change that often accompanies close interaction with other, more modern societies can be cause for concern. Large shifts and rapid changes prevent sociocultural systems from incrementally adjusting to conditions and discarding those adjustments that do not help them survive. Moreover, such large-scale changes place members of a sociocultural system under pressure, since they may face situations for which there are no established cultural guidelines to help them respond. With the consideration of cumulative impacts, one adds additional opportunities for adjustments by Alaska Native and rural non-Native sociocultural systems to shifting external conditions.

Similar to the analysis of impacts under the proposed action (see Section 4.3.21), this evaluation of cumulative impacts considers both positive and negative effects on sociocultural systems. This section focuses primarily on cumulative impacts associated with the proposed action. It begins by exploring positive and negative impacts in general, and then examines cumulative impacts specifically on the North Slope, in the Alaska Interior, and in Prince William Sound. The conclusion drawn here is that negative cumulative impacts on sociocultural systems due to the proposed action would be likely, but those impacts would be small in magnitude. Cumulative impacts associated with the less-than-30-year renewal alternative and the no-action alternative employ the same approach to evaluation as used for the cumulative-proposed action case. Conclusions for these last two cumulative cases appear at the end of this section.

As was the case with the individual alternatives assessed in this EIS, the basis for many of the cumulative impacts on sociocultural systems is the amount of revenue that these other actions generate. The effects of these revenues can be broad and positive. For example, although their association with sociocultural systems is indirect, many cumulative actions contribute (or will contribute) revenues that help support a variety of state programs, public services, and infrastructure construction and maintenance (see Section 4.3.21). Access to such public programs can have tangible positive effects. For instance, infant mortality among Alaska Natives decreased approximately 36% between 1988–1990 and 1996–1998, while overall mortality fell by more than 12% over the same time period (ADHSS 2001b). In 1998, nearly 76% of residents in the North Slope Borough had a minimum of a high school education in 1998, despite being one of the most geographically remote parts of the United States (North Slope Borough 1999).Moreover, beyond the obvious benefits of public expenditures, such programs and services are extremely important in providing a quality of life in rural settings that in many cases helps to maintain resident populations. For Alaska Native communities in particular, maintaining cohesive communities helps to strengthen sociocultural bonds and preserve working societies.

Despite their importance to Alaska Native and rural non-Native sociocultural systems, the future of many state programs is uncertain because of current state budget problems. The loss or substantial reduction of these programs would be keenly felt by much of rural Alaska, including many of the sociocultural systems examined in this EIS.

Another important consequence of cumulative actions is continued access to wage employment for many rural Alaskans. As discussed in Section 3.24, the foundation of rural communities in Alaska is a mixed subsistence-cash economy (Wolfe and Walker 1987). Subsistence continues to play an extremely important role in these communities, with its importance for Alaska Natives extending beyond economic considerations to sociocultural and ceremonial roles. But access to cash also is important, enabling the purchase of necessities that cannot be obtained through other means, including equipment and supplies used for subsistence. Beyond any convenience, security, or improved quality of life that cash might provide, in Alaska rural economies do not function without it. Access to more cash in such settings, in turn, often promotes increased subsistence involvement and productivity (Wolfe 1987).

Increased reliance on cash and increased involvement in a cash economy can also have negative consequences. Although money provides the means of purchasing goods and services necessary for survival and enhances subsistence activity, it also requires that rural Alaskans locate scarce jobs and participate in a job market for which they may not be fully prepared (Hudson 1985). This situation provides an additional source of pressure in sociocultural systems that have changed considerably (in the case of Alaska Natives). Participation in wage employment, in turn, can require behavior that is inconsistent with the normal functioning of rural sociocultural systems, such as extended absences from a community and important social activities (including subsistence; see Strohmeyer 1997). Access to cash can change status recognition, shifting influence to individuals with money who may not have attained the status normally associated with authority in Alaska Native and rural non-Native sociocultural systems. In addition, cash can provide the means of acquiring substances, such as drugs and alcohol, detrimental to a healthy existence (Kettl and Bixler 1991; Kraus and Buffler 1979). Indeed, the large amounts of money earned through employment on the TAPS construction in the 1970s were accompanied by the introduction of illegal drugs to many rural Alaskan communities (Strohmeyer 1997).

A final general consequence of the revenues generated by some of the cumulative actions considered here is the continued rapid modernization of Alaska. As has occurred throughout much of the United States in recent decades, information flows with increased freedom and people move with increased ease throughout virtually all of Alaska in 2002. Isolation from broad, frequent contact with other sociocultural systems is no longer a condition in most of the state, including rural settings. Accompanying this continued reduction in isolation is exposure to growing amounts of ideas and people from sociocultural systems very different from those of rural Alaska. Such exposure introduces the potential for increasingly rapid sociocultural change — and the potential displacement of both village residents lured by other opportunities and key components of sociocultural systems supplanted by constructs imported from elsewhere.

Despite indications of improved conditions and quality of life for many rural sociocultural systems in modern Alaska, certain measures of societal health and mental health for Alaska Natives indicate sociocultural systems that are out of balance. One of the most alarming is the high rate of suicide. For years suicide has been a source of concern, and by the late 1980s Alaska Natives took their own lives at a rate of 69 per 100,000, many times the rate found in the rest of American society (see Section 3.25.1.3). Concerted efforts to reduce suicides among Native peoples in Alaska, many conducted in rural villages, experienced some success. After a decade of fluctuating rates, by 1999 Alaska Native suicides occurred at a rate of 53 per 100,000 persons. This was a marked improvement over levels a decade earlier, but still more than five times the rate for the United States as a whole in 2000 (ADHSS 2001b).

Substance abuse similarly continues to be a problem among Alaska Natives. Alaska Natives are nearly two to three times more likely to have lifetime alcohol dependence, more likely than any ethnic group in Alaska to engage in binge drinking, more likely to have fetal alcohol syndrome than non-Natives, and four times more likely to be amphetamine dependent than Whites in Alaska (ADHSS 1999, 2001b). Although large-scale problems in the Native community with alcohol abuse can be traced to the onset of rapid change initiated by statehood (see Section 3.25.1.3), its persistence suggests the presence of conditions that would somehow generate such behavior into the 21st century.

Violence in Alaska Native society also remains a concern — occurring in much greater frequency among these sociocultural systems than for Alaska as a whole, with the rate of homicide among Alaska Natives nearly twice that of all Alaskans in 1998 (ADHSS 2001b).

In considering the rise of certain social problems challenging contemporary Alaska Native communities, it is also important to note the rapid development of Alaska Native self-determination and self-governance institutions in the last several decades. Building on traditional foundations of leadership and political organization during the 1960s, Alaska Natives created regional organizations and the state-wide Alaska Federation of Natives. Under the terms of the Indian Self-Determination Act (P.L. 93-638), the regional nonprofit corporations and new regional health corporations assumed responsibility for many federal programs. Tribal governments and the North Slope borough have also grown in exercising “civic capacity” on behalf of Alaska Native constituents. Alaska Native leaders in all of these entities have systematically focused on prevention and intervention to reduce the problems of suicide, substance abuse, and violence. Cultural renewal efforts, including culture camps for young people, the statewide sobriety movement, and development of culturally appropriate treatment models, all form part of this growing capacity within the Alaska Native community.

The citation of problems among Alaska Native sociocultural systems is in no way an attempt to belittle or otherwise disrespect these peoples. Rather, it is an attempt to provide a complete sense of the challenges that these sociocultural systems face. Although the Alaska of the late 20th century brought many improvements to Native life, it also provided a setting where many social problems could develop. Although one can argue for a link between certain social improvements and modern services and programs, such as improved health care and a widespread school system, the causes of social maladies are not as clear. However, in the case of suicide, many researchers have postulated that high rates among Alaska Natives are associated with the sudden introduction of money and modern American culture (Hlady and Middaugh 1988; Kettl and Bixler 1991, 1993; Kraus and Buffler 1979). Acculturation also has been linked to alcohol use as well (Kelso and DuBay 1989). This evaluation of cumulative impacts uses the possible association between rapid acculturation of Alaska Native (and, to a lesser extent, rural non-Native) sociocultural systems and persisting social problems as a possible indicator of cumulative impacts to those systems.

Cumulative impacts to sociocultural systems are expected to accompany additional oil and gas exploration, development, and production projected to occur on the North Slope in coming years. As discussed in Section 4.3.21, despite their remote location, the (largely) Alaska Native sociocultural systems of the North Slope interacted with outsiders throughout much of the 20th century, and particularly over the past three decades as a consequence of oil-related activities. Despite experience interacting with modern Western society, there are symptoms that the Nunamiut and Tareumiut sociocultural systems also have developed certain indications of sociocultural stress. More than two decades ago, research revealed the presence of violence and substance abuse in these sociocultural systems (e.g., Kruse et al. 1981) — problems which persist. In addition, over the last three decades, different types of problems have emerged with the enormous surge of income to the North Slope Borough, introducing authority structures, status differences, and in some instances corruption previously unknown in traditional Iñupiat society (see Strohmeyer 1997).

In addition to the two Iñupiat sociocultural systems noted above, cumulative impacts would also be likely to affect the communities of Anaktuvuk Pass and Nuiqsut (see Map 3.24-1) as well as other Iñupiat communities. As described in Section 3.24 and Appendix D, both of these communities have mixed economies, although they rely heavily on subsistence (ADCED 2001). The participation in wage employment outside the villages requires absence from the communities, introducing the possibility of fragmentation in sociocultural systems built on a heritage of interaction and collaboration. Moreover, such absence can compromise subsistence activities, such as caribou and whale hunting, that typically occur in groups and remain extremely important in both villages (see Section 3.24.1). Cumulative impacts to subsistence in these communities are discussed in Section 4.7.8.1, noting disruption via additional restrictions to subsistence harvest areas. Because of the key sociocultural and ceremonial roles of subsistence, further constraints on this activity are important to consider in the current context as well.

It appears that cumulative actions, in association with the proposed action, will bring mixed impacts to Alaska Native sociocultural systems on the North Slope. In addition to providing revenues to help continue various state-funded services and programs, the North Slope Borough’s ability to tax certain types of development will provide additional local revenues. A noted in Section 4.3.21, such revenues have enabled the borough to provide a number of improvements for residents of rural communities within its jurisdiction. But with development come certain possible challenges, including continued social disruption and subsistence impacts. The people of the North Slope have taken an aggressive approach to acquiring the financial resources necessary to adjust to increased interaction with modern American society, and this evaluation assumes that such adjustments will continue in the cumulative case. As a result, cumulative impacts likely will be small, although probably negative given continued modernization and the social ills that such change has introduced to the North Slope peoples. TAPS contributions to sociocultural impacts on the North Slope, both positive and negative, would be relatively small compared with the other changes occurring there.

Cumulative impacts to sociocultural systems would also be likely in Interior Alaska, to both the (largely) Athabascan Alaska Native sociocultural systems and to non-Native sociocultural systems located there. In Interior Alaska, other activities that occurred in the recent past, are currently under way, or are reasonably foreseeable would not be as geographically concentrated as on the North Slope. Thus, their potential impacts would also be dispersed geographically. As a result, in some cases, it is unlikely that the cumulative impacts on rural sociocultural systems would be as great in Interior Alaska as they would be on the North Slope. One exception likely would be positive impacts of public services, state-funded programs, and infrastructure, which Interior Alaska in particular relies upon.

The construction and operation of a natural gas pipeline would probably provide additional opportunities for wage employment for rural Interior Alaskans, with sociocultural impacts of the sort outlined in prior paragraphs (increased absence from communities, shifting authority structures, heavy interaction with members of other sociocultural systems, possible increases in social problems, additional state revenues for public programs, and an important source of cash). Construction of the NMDS would generate similar impacts, although these likely would serve to replace the current mission at Fort Greely.

Sociocultural systems of particular concern with regard to cumulative impacts to Interior Alaska would be those with members located near the TAPS and these other developments. Native systems of particular concern would be (north to south) the Gwich’in, Koyukon, Tanana, and Ahtna Athabascans. Alaska Native and rural non-Native communities of particular concern would include Alatna, Allakaket, Big Delta, Chitina, Coldfoot, Copperville, Copper Center, Delta Junction, Evansville, Gakona, Glennallen, Gulkana, Hughes, Kenny Lake, Livengood, Manley Hot Springs, Minto, Paxson, Rampart, Stevens Village, Tanana, Tazlina, Tonsina, and Wiseman (see Map 3.24-1). The extent of the cumulative impacts experienced in each village would likely vary with the degree to which it was affected by current and foreseeable future actions, in terms of the involvement of community members in these actions or in terms of the effects on the community itself from an increased influx of outsiders and increased exposure to the outsiders’ sociocultural systems. Negative cumulative impacts likely would be less to rural non-Native sociocultural systems, such as found in Wiseman, in part because many have their roots in American society. As described in Section 3.24.1 and Appendix D, all of these communities have mixed economies that combine subsistence and wage labor; those with larger non-Native populations located close to major roads tend to rely more on the latter (ADCED 2001).

In Interior Alaska, as with the North Slope, cumulative impacts associated with the proposed action likely will have mixed consequences. In addition to providing revenues to help continue various state-funded services and programs, the cumulative actions considered also will provide additional opportunities for wage employment. But once again, with development come certain possible challenges, including continued social disruption and the persistence of social problems. The people of Interior Alaska, particularly the Copper River Basin, have had a lengthy experience of interaction with, and adjustment to, modern American society. This evaluation assumes that such adjustments will continue in the cumulative case, and that they will be small because of the relatively limited actions occurring in a huge geographic area. As a result, cumulative impacts to Alaska Native and rural non-Native sociocultural systems in Interior Alaska likely will be small, although once again probably negative given continued modernization and the social ills that such change has introduced to this part of Alaska. TAPS contributions to sociocultural impacts in Interior Alaska, both positive and negative, would be relatively small compared with the other changes occurring there.

Cumulative sociocultural impacts also would affect the Alaska Native and rural non-Native sociocultural systems of Prince William Sound. Considering past, present, and reasonably foreseeable actions, impacts on these systems would probably be less extensive than those likely to occur in Interior Alaska or on the North Slope. The main reason for this conclusion is that there are generally fewer total actions taking place in Prince William Sound that would disrupt Alaska Native or rural non-Native sociocultural systems than there in the other two regions, especially the North Slope. It is also worth noting that the Native sociocultural systems in Prince William Sound — the Chugach Alutiiq and Eyak — have interacted with Western societies more than the Alaska Native sociocultural systems in the Interior and North Slope. This long history of interaction and adjustment to the presence and influence of Western society has produced Native sociocultural systems (including Tribal governments) in a sense more accustomed to introduced change (see Section 3.25). The communities expected to experience sociocultural impacts include three Alaska Native villages: Chenega Bay, Cordova (including Eyak), and Tatitlek (Map 3.24-1).

As discussed in Section 4.7.4.10.5, cumulative impacts also include tanker spills in Prince William Sound and beyond to destination ports. Because of the need to focus on reasonably foreseeable actions, the spills considered under normal operating conditions would those falling in *anticipated* or *likely* frequency categories. Such spills would be reasonably probable (between one every 30 years to two per year), but would generate minimal impacts due to the release of 60 barrels of oil or less (see Table 4.7-6). Despite concerns about another spill by people living near Prince William Sound, impacts (including sociocultural impacts) under normal operating conditions should be minimal. TAPS contributions to sociocultural impacts in the Prince William Sound area, both positive and negative, would be relatively small compared with the other activities occurring there.

In contrast, impacts on Alaska Native and rural non-Native sociocultural systems from a less probable tanker accident in Prince William Sound and beyond along transportation routes could be severe. Falling under the frequency categories of *unlikely* and *very unlikely*, oil releases into the Sound (i.e., within the Hinchinbrook Entrance) could total 320,000 bbl (see Table 4.7-6), and yield impacts to local naturally occurring resources similar to those experienced with the Exxon Valdez oil spill (see Sections 4.7.7.2, 4.7.7.3, 4.7.7.4, and 4.7.8.1).

Impacts to sociocultural systems from the Exxon Valdez spill were severe in terms of the short-term adjustments made, including major economic shifts, changes in community structure (e.g., extended absence to work on spill cleanup), and changes in authority recognition (IAI 2001). Some of the largest sociocultural impacts involved subsistence impacts, as this central component of rural Alaskan sociocultural systems was severely affected in Prince William Sound and beyond (Fall and Utermohle 1999; see Section 4.7.8.1).

Much of the economic shift that occurred represented a replacement of subsistence with wage labor. Exchange of subsistence resources declined, as did the presence of such resources in ceremonial activities of Native communities. Young persons received less instruction in subsistence activities traditionally passed from generation to generation, while older members of society saw their influence replaced by that of people more involved in spill-related activities. Ultimately, it is likely that sociocultural impacts as a result of the Exxon Valdez oil spill were short-term, representing adjustments to the consequences of this event rather than changes in the fundamental structural components of local sociocultural systems (Wooley 1995). Moreover, the improbability of a large tanker accident occurring again, coupled with dramatically improved spill prevention and cleanup contingency plans and the use of the SERVS system for tanker escort (TAPS Owners 2001a), likely would limit impacts to much less than those experienced from the Exxon Valdez spill. Nevertheless, should a large spill occur, the impacts on Alaska Native and rural non-Native sociocultural systems in Prince William Sound (at least in the short term) would be severe.

Sociocultural effects south of the Gulf of Alaska to the U.S. West Coast and California ports are expected to be less than those described above. This is primarily because Native subsistence cultures south of Alaska historically have been more greatly affected by Euro-American Society, although several Native communities in the Pacific northwest of the United States and the Pacific coast of southwestern Canada continue to practice subsistence. Ultimately, impacts likely to result from a tanker spill far offshore likely would have little impact on the resources used by these Native peoples, and little impact on their sociocultural systems.

Cumulative impacts associated with the less-than-30-year-renewal alternative likely would be similar to those just described for proposed action-associated cumulative impacts. Cumulative impacts associated with the no-action alternative, in turn, likely would be similar to those discussed under the no-action alternative by itself, although the magnitude likely would be greater both for positive and negative consequences, and ultimately the latter would dominate. Reduced negative impacts could result from a reduction in potential acculturation were the TAPS and certain key related activities (e.g., North Slope oil production) discontinued — removing some sources of interaction with personnel maintaining the pipeline and related facilities as well as sources of wage employment. Reduced positive impacts likely would be of particular concern. Not renewing the Federal Grant would remove a source of wage employment for rural Alaskans, which as noted can have positive as well as negative consequences. It would also remove a considerable amount of state and local (North Slope Borough) tax revenues used to fund public services, programs, and infrastructure (see Section 4.6.2.19). For sociocultural systems, cumulative actions under the no-action alternative would yield an Alaska quite different from that which currently exists. Alaska Native and rural non-Native sociocultural systems likely would face lessened acculturation than under current conditions, but also would face greater economic challenges in conjunction with reduced public services and programs — these negative consequences likely providing other challenges for rural sociocultural systems. Under the less-than-30-year renewal alternative, the TAPS contribution to cumulative sociocultural impacts would be relatively small compared with the likely effects of other cumulative actions. Under the no-action alternative, the relative contribution of discontinuing the TAPS would be quite large in the sense that North Slope oil production relies on the TAPS to transport oil to the market. As discussed in Section 4.7.8.3, discontinuing the TAPS would set several other events into motion, including the termination of oil production and the considerable revenues it provides.

Overall, cumulative impacts to sociocultural systems likely would be a mix of positive and negative consequences. Both probably are a consequence of continued acculturation and influence by modern American society, particularly affecting Alaska Native sociocultural systems but also influencing rural non-Native systems. As was the case when evaluating sociocultural impacts under the proposed action (see Section 4.3.21), clearly linking acculturation with the TAPS or any of the cumulative actions considered in this EIS is extremely difficult given the general modernization that continues to occur throughout Alaska for a variety of reasons.

4.7.8.3 Economics

The assessment of the cumulative economic impacts of the TAPS covers the impacts from continued operation (including renewal for less than 30 years) and no action, together with impacts from other existing and projected economic development activities likely to occur in the state during the proposed lease renewal period. The economic impacts of any spills that could potentially occur in Prince William Sound during tanker operations are also included. The analysis combines the impacts from the TAPS continued operation and no action with those from the most important major projects expected to occur during the period 2004 to 2034 and qualitatively assesses the resulting aggregate impact on the economy of the state and pipeline corridor region. Although numerous projects are slated for development in Alaska (see Section 4.7.4), the only projects potentially creating significant cumulative impacts in association with the continued operation of the TAPS and no action are the natural gas pipeline designed to transport gas from the North Slope to Canada and the proposed National Missile Defense System (NMDS) at Fort Greely and a large potential oil spill. The impacts of all oil field development considered likely to occur are included under the proposed action (Section 4.3.19). Other economic development activities, such as the Wrangell-St. Elias NPP and mining development near Fairbanks, although they would add to the overall level of economic activity in the state, would not be as significant as the pipeline project, NMDS, and a large potential oil spill.

The largest planned activity potentially occurring during the renewal period would be the construction and operation of the proposed natural gas pipeline from the North Slope. Gas would be transported through the pipeline to serve markets in both Canada and the United States. The total capital cost associated with the pipeline would be between $5 and $6 billion, and it would take up to 7 years to build (CERA 1999). The largest impact of the pipeline to the state and local economy would be the tax revenues it would generate. On the basis of the impact of the Trans Alaska Gas System (TAGS), a pipeline that was proposed to transport liquid petroleum gas from the North Slope to Valdez, which would have had a throughput rate (2 billion ft^3/d) similar to that of the proposed pipeline, it is estimated that revenues from the pipeline would amount to $189 million annually in royalties and severance taxes and $188 million annually in property taxes (TAPS Owners 2001a). The exact size of revenues would depend on tax rates, actual daily throughput rates, and the market price of natural gas. Additional benefits of the pipeline would be the possibility of further North Slope economic development, and the potential for reduction in the cost of natural gas throughout the state.

Employment that would be created by the pipeline is difficult to estimate, given the provisional status of the project. Since the length of time required for its construction is assumed to be less than that estimated for the TAGS, given that it would be a shorter pipeline and that there would be processing facilities (CERA 1999), it is likely that the employment impacts from the project would be less than those estimated from the TAGS. The TAGS employment impact is assumed to be 7,200 direct workers during the peak year of an 8- to 10-year construction period, with an additional 3,300 jobs created indirectly in the state as a whole. Annual operations jobs are estimated to be 550, with an additional 1,250 indirect jobs (TAPS Owners 2001a). It is likely that the pipeline would employ a large number of construction workers from outside the state, and while wages and salaries would produce local spending and state tax revenues, a significant portion of wages and salaries during construction would leave the state, used for families and other expenditures elsewhere in the United States. Deterioration in the provision of local public services might also occur in some communities along the proposed route in the short term as a large number of in-migrating workers arrive, especially if some are accompanied by their families.

The NMDS includes a facility to be located in Alaska to support an anti-ballistic missile system, most likely at Fort Greely, near Delta Junction. The system would cost $626 million and create 400 direct construction jobs over a five-year period and create an additional 620 jobs in the state (U.S. Army Space and Missile Defense Command 2000). A total of

360 direct operations jobs and an additional 110 indirect jobs would be created. Currently, 600 civilian and military jobs are under threat as part of the plan to close the base at Fort Greely (TAPS Owners 2001a). A large number of construction workers from outside the state could be expected as a result of the project, and depending on the where these workers live during construction, they could strain the ability of local governments to provide adequate public services to the local communities in the vicinity of the site.

In addition to new economic development activity projected for the state, oil spills in Prince William Sound could also result in additional spending in local communities and at the state level. For example, as a result of the Exxon Valdez oil spill in 1989, Exxon Corporation spent more than $2.6 billion on cleanup activities in the following three-year period (Etkin 1998), creating an average of 2,500 direct cleanup jobs and approximately 2,500 indirect jobs over the period (ADOL 1990). These jobs more than offset monetary losses in the fishing and tourism industries (IAI 1990). The local economy, in particular, was stimulated by income generated by the oil spill; income doubled and employment increased by 30% in the Valdez-Cordova Census Region in 1989 (TAPS Owners 2001a). Many of the cleanup jobs were filled by temporary in-migrants from outside the state, reducing the benefits to the state and local economy. In addition to the employment and income generated as a result of the spill, significant compensation was paid by Exxon to various parties in the state. Almost $300 million was paid to commercial fishermen, while $1,025 million was paid to the state and federal government in criminal and civil settlements for damage to the environment in Prince William Sound. In addition, APSC paid $98 million to commercial fishermen and has significantly increased its annual spill response expenditures to $60 million, primarily benefiting the Valdez local economy (TAPS Owners 2001a). The long-term effects of the spill on the environment in Price William Sound have yet to be fully established, and the potential costs of compensatory claims for additional environmental damages may still significantly increase the overall monetary cost of the spill.

While the Exxon Valdez oil spill resulted in significant economic benefits to the communities in Prince William Sound, there were numerous other social and psychological costs incurred by many of those directly and indirectly involved in the spill. These impacts include damage to fisheries resources and cultural, spiritual and community damages, many of which are long term and highly significant, possibly life-changing, to those involved. More information on the impact of the spill on communities in the Prince William Sound area, including intangible impacts outside the scope of this socioeconomics section (such as psychological stress) can be found in IAI (2001).

Improvements to tankers, shipping safety, and spill response capability in Prince William Sound developed after the Exxon Valdez incident means that it is unlikely that a spill of the same magnitude would occur again, and that the local and state economic impacts associated with spill response and clean-up activities for any spill would not be as significant as those following the Exxon Valdez incident. The possibility of compensatory and punitive damage resulting from a future spill, however, may still increase the monetary cost of even a relatively small spill, although there may be offsetting economic impacts, depending on the extent to which cash from compensation payments is spent inside the state.

It may be reasonable to assume that the economic impacts resulting from the Exxon Valdez oil spill, excluding those associated with compensation, represent the upper bound for any potential accidental spill. The local and state economic impacts from smaller spills that would be well within the capability of the spill response authorities would therefore probably be far less significant. The possibility of compensatory claims in the event of a spill might still remain, however, since the long-term effect of the Exxon Valdez oil spill on the environment of Prince William Sound has not been clearly established (TAPS Owners 2001a). Even in the absence of significant local employment and income impacts like those that occurred as a result of the Exxon Valdez spill, the ultimate distribution of compensation among parties (in the event of a lawsuit and settlement following a serious spill) would mean that local and state economic impacts might still be significant.

Although the natural gas pipeline would impact the economy of the state, the cumulative economic impacts of declining North Slope oil production and continued TAPS operations, together with the operation of the gas pipeline project, would probably not be significantly larger than the impacts of current North Slope and TAPS operations. The gas pipeline would probably be the most important new project for the state in the next decade, and its most significant impact would be on tax revenues from severance taxes, royalties and property taxes levied by the state, and from additional property taxes collected by local governments. It is likely that gas pipeline construction would not begin until after 2010 during a period of declining revenues from North Slope production and TAPS throughput that will begin in 2006 (see Section 4.3.19.1). Impacts from the gas pipeline might therefore merely partially offset the decline in state oil revenues over the renewal period. Employment impacts at the state level, while significant during construction, would be likely to impact the economy only in the short term; the longer-term overall impact on the state would probably be small, even though pipeline operations workers are likely to be relatively highly paid.

At the local level, impacts of continued TAPS operations and the gas pipeline in the short term would also probably be significant, with a major influx of workers expected during the construction period. Depending on where these workers reside during pipeline construction, there might be substantial impacts on local employment and income in the smaller communities as well as impacts on the ability of local governments to provide adequate public services, especially if many workers are accompanied by their families. There might also be major impacts at the local level if construction of the gas pipeline project and the NMDS occurred simultaneously in the Fairbanks/Delta Junction area, but such impacts are unlikely, given the proposed schedules for the two projects.

Additional cumulative impacts of continued TAPS operations would come from use of the Dalton Highway for general traffic. The road was built along the pipeline route during TAPS construction, and for many years use of the road was limited to oil development and pipeline support traffic. The road recently has been opened to the general public, which has created problems, especially in the North Slope Borough, where the provision of emergency and other public services to support the additional traffic has been costly and has placed strain on the financial resources of the Borough.

Cumulative employment and income impacts associated with NMDS and oil spills in Prince William Sound would probably be much less significant with regard to the economy of the state than they would be with regard to the local economies in which each is located. Employment and income impacts of the NMDS would only offset the decline in employment resulting from base realignment at Fort Greely, with no major impacts to local public service provision expected. Any major employment and income impacts resulting from a spill would be unlikely, given the significant upgrading of spill response capability since the Exxon Valdez accident. Any increases in activity would most likely be concentrated in Valdez. Any in-migrating workers would probably not have a major impact on the ability of local government to provide adequate local public services.

The impacts of continued TAPS operation for the less-than-30-year renewal alternative, together with the gas pipeline and NMDS, would be less than those for the proposed action as a function of the renewal period. Less oil-related investment could occur in the North Slope fields and other parts of the oil sector, and supporting industries, together with lower levels of private and public investment in the non-oil-related parts of the economy, would produce less employment, income, and tax revenues.

Construction and operation of the gas pipeline project and the NMDS under the no-action alternative would partially offset the losses in employment, income, and tax revenues that would occur at both the state and local levels with the end of TAPS operation and North Slope production (see Section 4.6.2.19). Construction of the pipeline project would not conflict with the latter stages of TAPS termination activities or the NMDS, and pipeline operation would likely provide an alternative basis of support for state and local revenue generation and continuing efforts toward diversifying the state's economy away from natural resource extraction activities.

4.7.8.4 Cultural Resources

Cumulative impacts on cultural resources have occurred in the recent past as a consequence of the Exxon Valdez oil spill. In addition to damage to coastal archaeological sites due to contact with oil, additional impacts occurred because of clean-up efforts and as a consequence of increased human traffic along a coast previously quite isolated (Bittner 1996; IAI 2001). Physical impacts from clean-up efforts resulted from soil removal at archaeological sites and operation of machinery near archaeological sites. The unauthorized removal of artifacts from archaeological sites by clean-up personnel was also reported. Based on experience from this spill, the SHPO determined that the involvement of cultural resource professionals and local tribal groups during the initial planning stages of an emergency is important to minimize impacts to cultural resources (Bittner 1996).

No cumulative impacts are anticipated for cultural resources under any of the alternatives considered in this EIS. Although other projects might adversely affect cultural resources, adherence to federal and state laws pertaining to cultural resources should mitigate adverse effects associated with the additional projects. As stated in Section 4.3.22, the renewal of the TAPS ROW could adversely affect known cultural resources, but these impacts could be mitigated on a project-by-project basis through avoidance, monitoring, data recovery, etc. Although the Exxon Valdez oil spill understandably had negative impacts on cultural resources, the likelihood of an event of similar magnitude occurring is quite low (see Table 4.7-6). This improbability, coupled with improved spill response capabilities and steps to restrict vandalism, should limit impacts to cultural resources from a similar event.

4.7.8.5 Land Use and Coastal Zone Management

4.7.8.5.1 Land Use. The TAPS and other actions in the vicinity of the pipeline have had cumulative effects on land ownership and use near the ROW during the past 25 years. Valid legal access for TAPS operation and maintenance has been acquired on the lands it crosses. Access to public and some private lands has increased in the vicinity of the pipeline due to construction of the Dalton Highway, TAPS access roads, and airstrips. Some trespassing and conflict of use issues have resulted on native lands. Some increases in recreational, residential, municipal, and commercial land uses have occurred; some of which can be attributed to the pipeline. Commercial development has occurred at three development nodes along the Dalton Highway. The existence of the pipeline has contributed to the increase in oil exploration, development, and transportation activities at the North Slope during the past 25 years.

Other actions unrelated to the TAPS have greatly affected land ownership and use in Alaska. The passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980 resulted in numerous designations of conservation system units. Lands have also been conveyed from federal to state government, and from state to local government and Native Alaskans.

The largest new development reasonably foreseeable in the vicinity of the TAPS is a natural gas pipeline project. In this project, a buried natural gas pipeline would run parallel to the TAPS ROW. A gas processing facility would be constructed on the North Slope, and compressor, pigging, and valve stations would be constructed intermittently along the pipeline.

The gas pipeline and its related infrastructure would have some effects on land use in the vicinity of the TAPS. Aesthetics would be affected along and/or within the TAPS ROW, with resulting effects on recreation likely (see Section 4.7.8.6). Noise from construction, operation, and maintenance of the gas pipeline and related structures would likely be audible from some recreation areas and could interfere with recreational activities. During construction, a temporary increase in noise might also occur on lands set aside for wildlife habitat conservation, disturbing wildlife. Effects on military, residential, municipal, commercial, or private land use could also occur, not only from increased noise, but from preclusion or interference of use from the gas pipeline and related structures. Conflicts with mining and other natural resource use would be possible, depending on the route of the pipeline and locations of structures.

Finally, although there would be an influx of personnel associated with the gas pipeline, it would be unlikely to result in an increase in residential, municipal, or commercial development. The new personnel associated with the project would probably just offset the workforce reductions that have recently resulted from the closure of Fort Greely and proposed APSC reorganization.

Additional recreational development and/or increased use of existing developed recreation areas would also be unlikely. However, increased access would likely result from construction of the gas pipeline and could contribute to an increase in recreational use of undeveloped public lands.

Spills (see Sections 4.4.4.17.1 and 4.6.2.23.1) could also occur as the result of a variety of actions, including oil exploration and development, oil refining, oil storage activities, and transportation. Small spills could disrupt other land uses, although a large spill would have the greatest impact. If there was a spill from the natural gas pipeline, resulting in volatilization of the gas, the potential for a fire would exist. A fire would result in temporary evacuation of nearby areas, long-term aesthetic impacts to the landscape, and potential long-term interference with land uses.

If there were no spills, renewal of the TAPS ROW for either 30 years or less than 30 years would continue to have only small impacts on land use in the vicinity of the pipeline. However, the anticipated construction of the natural gas pipeline and related infrastructure would have larger impacts on land use. The combined effects from both pipelines would increase the currently existing impacts on land use in the vicinity of the TAPS, depending in large part on the location of the natural gas pipeline and related structures. If the TAPS ROW were renewed for less than 30 years, the cumulative effects would be similar to the cumulative impacts under the proposed action but of shorter duration.

However, the cumulative effects under the no-action alternative would be much different from those under either the proposed action or the less-than-30-year renewal alternative. Less commercial, municipal, and residential development would be expected to occur due to a downturn in the state economy resulting from lost oil revenues. Use of state recreation areas, sites, and parks would decline because of closures resulting from state funding reductions. Oil exploration, development, and transportation activities at the North Slope would cease, although natural gas development at the North Slope and construction of a natural gas pipeline might still occur.

Cumulative effects on land use from the TAPS will continue to occur, whether the ROW is renewed for 30 years, less than 30 years, or not at all. Few, if any, additional effects on land ownership would be expected, regardless of renewal.

4.7.8.5.2 Coastal Zone Management. The TAPS and other actions in the vicinity of the pipeline have had cumulative effects on the North Slope Borough and Valdez coastal zones during the past 25 years. Aesthetic and land use impacts from the TAPS and other activities are evident in both zones. However, the operation and maintenance of the TAPS and related facilities, including the Valdez Marine Terminal are permitted activities in compliance with the enforceable policies in both the North Slope Borough CMP and the Valdez CMP. The TAPS is also a development activity consistent with both CMPs. (See Section 4.3.23.2 for effects on coastal zone management from the proposed action.) Other currently existing development in the coastal zones would be expected to be consistent and in compliance with the CMPs as would future development, and therefore would be unlikely to have a large cumulative impact on coastal zone management. Spills from the TAPS, a future natural gas pipeline, or oil and gas development represent actions that could have the greatest potential cumulative effect on coastal zone management with regard to either the North Slope Borough or Valdez CMP.

North Slope Borough Coastal Management Program. Oil and gas exploration, development, and production activities would be expected to continue within the North Slope Borough coastal zone. Construction of a natural gas processing facility has been proposed. The facility would service a gas pipeline that would parallel the TAPS, either within or adjacent to the ROW. The pipeline would be buried along most of its length.

The natural gas processing facility would add to the existing visual impact within the North Slope Borough. The gas pipeline would also represent a visual impact if any segment of it was above ground. However, the North Slope Borough CMP allows for development activities as long as they do not substantially interfere with subsistence activities in the borough or jeopardize the continued availability of subsistence resources. The additional processing facility, the natural gas pipeline, and ongoing oil and gas activities would not be expected to interfere with or jeopardize subsistence within the borough, although an impact would be expected to occur (see the cumulative effects discussion on subsistence).

Impacts to subsistence resources within the North Slope Borough coastal zone could occur from a land or water-based petroleum spill. The magnitude of the impacts would depend on the volume, location, duration of the spill, as well as the time of year it occurred. Aesthetic impacts would also occur, and cleanup activities could be substantial and long term. Potential effects to the North Slope Borough coastal zone from TAPS spills are discussed in Section 4.4.4.19.2. Similar impacts would result from petroleum spills from other resources. Spills could also occur from the natural gas pipeline if it was constructed, resulting in volatilization that could temporarily impair air quality. Volatilized gas could lead to a fire, resulting in damage to subsistence resources and temporary evacuation of areas within the borough, thereby disrupting subsistence activities. Disruption to other development activities within the borough would also be likely.

As discussed in Section 4.4.4.19.2, renewal of the Federal Grant would continue to be consistent with the North Slope Borough CMP and in compliance with enforceable policies. In the absence of spills, continued operation and maintenance of TAPS would have very little additional effect on coastal resources and activities within the borough. The cumulative effects from the renewal of the ROW for less than 30 years would be similar to the cumulative impacts under the proposed action, but of short duration. However, in the event of an unlikely spill, impacts would be the same for both renewal alternatives.

If the no-action alternative were implemented, TAPS-related activities would cease in the North Slope Borough coastal zone. Land occupied by the TAPS and related oil exploration, production, and transportation facilities would be available for other development activities, consistent with ACMP statewide standards and the North Slope Borough CMP. Some aesthetic and land use impacts would likely result.

Some cumulative effects on the North Slope Borough coastal zone from the TAPS will continue to occur, whether the ROW is renewed for 30 years, less than 30 years, or not at all. Because of required compliance with statewide ACMP standards and the North Slope Borough CMP, additional effects would likely be small.

Valdez Coastal Management Program. The Valdez CMP allows for a variety of activities within the coastal zone, including development, and those activities would be expected to continue. No major developments are currently planned within the Valdez coastal zone, but any additional development would add to the existing visual impact of the Valdez Marine Terminal.

Normal operation and maintenance of the TAPS and the Valdez Marine Terminal would not impact the Valdez coastal zone. However, impacts to other activities within the coastal zone could occur from small spills, although a major land- or water-based petroleum spill at the Valdez Marine Terminal, or from an oil tanker, other commercial vessel, or private vessel would be most disruptive. A spill at the Valdez Marine Terminal that erupted into fire or a spill to water within the coastal zone, especially to Prince William Sound, would likely damage coastal resources (including aesthetics) and interfere with other coastal zone activities. These impacts would be similar to the potential impacts on the Valdez coastal zone from TAPS spills discussed in Section 4.4.4.19.2.

As discussed in Section 4.4.4.19.2, renewal of the Federal Grant would continue to be in compliance with the enforceable policies in the Valdez CMP. In the absence of spills, continued operation and maintenance of the TAPS and the Valdez Marine Terminal would have very little additional effect on coastal resources and activities within the Valdez coastal zone. The cumulative effects under the less-than-30-year renewal alternative would be similar to those under the proposed action. Under the no-action alternative, TAPS and related activities would cease, and the Valdez Marine Terminal would be removed. Other permitted activities could then occur in those areas, which would likely have associated aesthetic and land use impacts.

Receiving Port Coastal Zone. Numerous significant economic resources have the potential to be impacted in the event of an oil spill in a harbor receiving North Slope oil shipments. For example, in the vicinity of the LA/LB terminal, there are large marinas in Marina Del Rey and Redondo Beach; inside the LA/LB Harbor complex; at the mouth of the Los Angeles River; inside Alamitos, Anaheim and Newport Bays; and at Dana Point. At all of these locations, private vessels are susceptible to oiling. There are many commercial fishing vessels throughout the various harbors. Recreation at all or a portion of the beaches in the area could be impacted during a response to a nearshore spill (California Department of Fish and Game 2002).

4.7.8.6 Recreation, Wilderness, and Aesthetics

4.7.8.6.1 Recreation. The TAPS and other actions have had some cumulative effects on recreation on federal and state lands in the vicinity of the pipeline. Access to public lands has increased since construction of the TAPS, particularly as a result of the construction of the Dalton Highway, resulting in an increase in recreational opportunities and use in some areas. The pipeline is visible from some recreation areas, sites, and parks. At some locations, noise from TAPS-related infrastructure (such as pump stations) is audible.

The passage of ANILCA in 1980, which created numerous conservation system units in Alaska, greatly increased recreational opportunities in the vicinity of the TAPS. The existence of these opportunities has increased recreational use of public lands near the TAPS. Oil revenues have allowed for greater funding of state recreational areas, sites, and parks, which has also increased recreational opportunities and use.

These impacts from the TAPS would continue with renewal of the ROW. The only large development — recreational or otherwise — reasonably foreseeable at or near recreation areas, sites, or parks in the vicinity of the TAPS is the potential construction of a buried natural gas pipeline within or adjacent to the TAPS ROW, beginning about the year 2010. The anticipated route of the pipeline would parallel the TAPS. A gas processing facility would be constructed on the North Slope, and compressor, pigging, and valve stations would be constructed intermittently along the pipeline.

The gas pipeline and its related infrastructure would substantially add to the currently existing visual impacts along, and within, the TAPS ROW. Only temporary visual impacts would occur from burying the gas pipeline but construction of the related infrastructure would represent long-term aesthetic impacts. Since sight-seeing is a very popular recreational activity in Alaska, these visual impacts would somewhat diminish the quality of that recreational experience for some people. Infrastructure visible from recreation areas, sites, or parks might also reduce the quality of other recreational experiences such as hiking or camping.

In addition, noise from construction of the gas pipeline and compressor, pigging, or valve stations could be audible from some recreation areas, sites, and parks, depending on the location of the pipeline and related infrastructure, which is currently uncertain. Additional vehicular and air traffic resulting from the construction, operation, and maintenance of the natural gas pipeline would also add to current noise audible from recreation areas, sites, or parks, particularly those in proximity to a highway. Lastly, increased access resulting from construction of the gas pipeline could contribute to an increase in recreational use of undeveloped public lands.

Recreation in the vicinity of the TAPS could also be affected in the future by a major land- or water-based TAPS spill, particularly a major spill. Visual and noise impacts could occur, especially from long-term cleanup activities. Both temporary evacuation and long-term closure of recreation areas would be possible. Potential effects to recreation from TAPS spills are discussed in Section 4.4.4.18.3.

Spills could also occur from the natural gas pipeline if it was constructed, resulting in volatilization that could temporarily impair air quality. Volatilized gas could lead to a fire, resulting in evacuation of recreation areas, long-term aesthetic impacts to the landscape, and potential closure of sites.

If a major spill occurred in Prince William Sound, it would create economic losses for the tourist and recreation industries. A major spill in the Gulf of Alaska would affect recreation and tourism, with major economic losses for the tourist industry. Small charter boat, lodge, and sportfishing operations in the Yakutat area would be the hardest hit. Tourist levels would be expected to rebound to prespill levels 1 year after the spill. A spill south of the Gulf of Alaska to the U.S. West Coast and California ports would affect the same types of tourist industries and resources. However, in coastal areas to the south, marine sanctuaries, shoreside beaches, parks, campgrounds, and recreation areas are more numerous and see more overall visitation. For this reason, economic losses to the tourism industry could be greater (MMS 2002).

In the absence of spills, renewal of the Federal Grant of ROW, either for 30 years or a lesser term, would continue to have only small impacts to recreation in the vicinity of the pipeline and the effects of the renewal alternatives would be similar. However, the anticipated construction of the natural gas pipeline and related infrastructure would also impact recreation. The combined effects from both pipelines would increase the currently existing impacts on recreation in the vicinity of the TAPS, depending in large part on the location of the natural gas pipeline and related structures.

The cumulative effects on recreation from the no-action alternative would likely be greater than those from either the proposed action or the less-than-30-year renewal alternative. The currently existing visual and noise impacts from the TAPS would end after termination activities were completed. Oil revenues would decline and eventually cease, resulting in decreased funding of state recreation areas, sites, and parks. The reduced funding would be expected to force closure of some state areas, sites, and parks, resulting in a decrease in recreational opportunities and use levels in the vicinity of the TAPS.

Cumulative effects on recreation from the TAPS and other actions would continue to occur, regardless of the length of the renewal, or even in the event of no action. In spite of some visual and noise impacts from TAPS infrastructure and increased traffic, the overall cumulative effects on recreation from the TAPS are generally favorable, since oil revenues generated by the TAPS help to fund state recreation areas, sites, and parks. However, decreased throughput during the renewal period would result in decreased state revenues, which could impact state recreational funding, although not as much as no action.

4.7.8.6.2 Wilderness. The Wilderness Area within the Gates of the Arctic NPP is the only federally designated Wilderness Area within a few miles of the TAPS or in the vicinity of the proposed gas pipeline. No state designated, or federal or state proposed, wilderness areas exist in the vicinity of the TAPS or the proposed gas pipeline.

The only large action that has occurred in the past near the eastern portion of the Gates of the Arctic NPP Wilderness Area is the construction of the TAPS. The pipeline continues to be the only large development in the vicinity.

The currently existing cumulative effects on the Wilderness Area are due to the TAPS.

The construction of a buried natural gas pipeline within or adjacent to the TAPS ROW as it passes the Gates of the Arctic NPP is a reasonably foreseeable future activity and would add to the indirect impacts of the TAPS. Temporary visual impacts would occur from burying the pipeline and would persist until revegetation occurred. Any compressor, pigging, or valve stations constructed along the pipeline and visible from the Gates of the Arctic Wilderness Area would add to the existing visual impact. Noise from construction could be audible within the wilderness, and the additional vehicular and air traffic resulting from the construction, operation, and maintenance of the natural gas pipeline would also add to current noise audible from the Wilderness Area. Lastly, an increase in personnel in the area due to the additional pipeline could potentially result in an increase in recreational use in the Gates of the Arctic Wilderness Area.

Spills in the vicinity of the Gates of the Arctic NPP could occur from the natural gas pipeline if it was constructed, and they could result in a fire that would impair air quality in the vicinity of the Wilderness Area. Long-term aesthetic impacts to the landscape could occur from a fire, and potentially be visible from the Gates of the Arctic NPP Wilderness Area. See Section 4.4.4.18.2 for a discussion of potential impacts on wilderness from TAPS spills.

In the absence of spills, renewal of the TAPS ROW would continue to have only small visual and noise impacts to the Wilderness Area. However, the anticipated construction of the natural gas pipeline and related infrastructure would also have indirect impacts to wilderness. The combined effects from both pipelines would likely have a more substantial impact on the Gates of the Arctic NPP Wilderness Area than the current impact, depending in large part on the location of the natural gas pipeline. The cumulative impacts would be similar under the proposed action and the less-than-30-year renewal alternative.

Cumulative effects on wilderness from the no-action alternative would result in elimination of the currently existing visual impact of the TAPS as well as some of the noise associated with the pipeline and related traffic on the Dalton Highway. Increased access and a small increase in use would be expected to continue.

4.7.8.6.3 Aesthetics. The TAPS and several other actions have resulted in a large cumulative visual impact in the vicinity of the pipeline. The TAPS and its related infrastructure represent one of the more substantial visual impacts on the landscape along much of its length. The highways that it parallels also represent major aesthetic impacts, as do the communities and other developments within the pipeline viewshed. Other existing visual impacts include additional pipelines and oil development infrastructure on the North Slope; commercial, industrial, residential, and recreational development along the Dalton and Richardson Highways; mining operations; pipeline viewing stations; and the Valdez Marine Terminal.

All of these visual impacts currently exist and have existed for many years or decades along the length of the pipeline. Development in the vicinity of the pipeline is expected to occur slowly, as it has in the past. No major municipal, commercial, industrial, recreational, or mining development has been identified adjacent to the TAPS, and no major additional TAPS-related construction is anticipated. However, a 200- to 300-acre residential development and an approximately 2,000-acre agricultural development have been proposed about 5 mi south of Copper Center.

In addition, the TAPS corridor has been proposed for the construction of a natural gas pipeline within the next decade. The anticipated route of the pipeline would parallel the TAPS. A gas processing facility would be constructed on the North Slope, and compressor, pigging, and valve stations would be constructed intermittently along the pipeline. These stations would add to the currently existing visual impacts along, and within, the TAPS ROW. Even though the gas pipeline would be buried, the ROW would be visible and would likely be maintained in a state visually different from surrounding areas. This would be similar to buried segments of the TAPS, which are visually different from surrounding areas.

Aesthetics could also be affected in the future by a land- or water-based petroleum spills from oil exploration, development, or production; oil storage; or oil transportation by tanker. Visual impacts, including cleanup activities, could be long-term and similar to the aesthetic impacts from a TAPS spill, as discussed in Section 4.4.4.18.3. Spills could also occur from the natural gas pipeline if it was constructed, resulting in volatilization that could temporarily impair air quality. Volatilized gas could lead to a fire, further degrading air quality until it was extinguished. Long-term aesthetic impacts to the landscape could occur from a fire, depending on its extent.

As discussed in Section 4.3.24.3, renewal of the TAPS ROW would continue to have mostly localized impacts to aesthetics in the vicinity of the pipeline. In the absence of spills, continued operation and maintenance of the TAPS would have very little additional aesthetic effect on the landscape. However, the anticipated construction of the natural gas pipeline and related infrastructure would have additional visual impacts on the landscape in the vicinity of the TAPS. That potential project, combined with existing aesthetic impacts from the TAPS, as well as other probable future development in the vicinity of the pipeline, would combine to create a major aesthetic impact in the vicinity of the TAPS ROW, under the proposed action or less-than-30-year renewal alternative.

The cumulative effects to aesthetics would be lessened somewhat under the no-action alternative because the TAPS and related infrastructure would be removed. The rate of development in the vicinity of the pipeline would also be expected to slow because of the economic impacts of lost oil revenues. However, the gas pipeline may still be built, and the residential and agricultural development near Copper Center may still occur. Overall, the aesthetic impacts would be less under the no-action alternative than under either of the renewal options.

4.7.8.7 Environmental Justice

The evaluation of cumulative impacts with implications for environmental justice depends first on the identification of high and adverse cumulative impacts in other impact areas (groundwater, human health, etc.) and then on whether these impacts would affect minority and low-income populations disproportionately. Disproportionate impacts can occur two ways: (1) because the environmental justice population under consideration is present at a percentage higher than that found in the state as a whole, or (2) because the environmental justice population under consideration is more susceptible to such impacts. In either case, it is a necessary precondition that the cumulative impacts have already been determined to be high and adverse. Analyses indicate that high and adverse impacts would not be anticipated for cumulative actions combined with the proposed action or less-than-30-year renewal alternative. Impacts associated with the no-action cumulative case, in contrast, are expected to produce high and adverse economic consequences. Both because minority and low-income populations occur in disproportionately high percentages in many parts of Alaska (the entire state economy likely to be affected; see Figures 3.29-1 and 3.29-2), and because these populations tend to be more susceptible to such impacts because of their financial status (see Section 3.29), environmental justice impacts would be anticipated.

4.7.9 Summary

Many activities in the TAPS region of interest (TAPS ROW, North Slope, and Prince William Sound) contribute to cumulative effects on the environment. If it were not for the construction of the TAPS, some of these activities would not take place, including oil exploration, development, and production on the North Slope; refinery operations; and oil transport from Valdez to market. However, other petroleum industry activity could still occur in the TAPS region of interest even in the absence of the TAPS, including the transport of petroleum products into and within Alaska and the storage of oil for industrial, transportation, and domestic use. It is also possible that natural gas exploration, development, and production would occur and that a natural gas pipeline would be constructed and operated, depending on economic conditions. The petroleum industry affects many segments of the Alaskan economy by creating jobs, providing revenue for government services, and providing income to support subsistence lifestyles. These secondary effects are most evident when economic and social issues are the subject of an assessment. However, some activities within the TAPS region of interest are independent of the oil industry. These include activities based on Alaska's other natural resources, such as mining, forestry, tourism, and fishing.

The cumulative impact assessments presented in Sections 4.7.6 through 4.7.8 integrate the effects of all actions taken together under three scenarios. The first scenario, which is analyzed in the most detail, considers the impacts from all actions, including the operation of the TAPS, for another 30 years. This is the proposed action. The second scenario considers all actions taken together with a less-than-30-year authorization of TAPS operations followed by either a further renewal or no action. The third scenario considers all actions taken together with no action, which would involve ending TAPS operation and removing TAPS facilities. The cumulative impacts associated with these three scenarios are summarized in Table 2.1.

Many of these impacts are secondary. Three major cross-cutting impacts are identified in this analysis. First, the generation of road dusts affects vegetation, soils, and permafrost; this impact, in turn, affects surface hydrology and snowmelt; and this impact affects birds and mammals. Second, activities associated with petroleum exploration and development use large quantities of water that are taken from surface water under ice, which constitutes an important habitat for overwintering fish. Third, developments in all areas affect fish and mammal populations, which are important subsistence resources for Alaskans; in addition, the income and access provided by these developments affect the ability of and need for people to utilize these subsistence resources. Although the cumulative impacts on these resources, as analyzed in Sections 4.6 through 4.8, are, in general, minor and local, knowledge about their relationships is still important to reach an understanding of the environmental consequences of the proposed action. No major synergistic effects were identified in the cumulative analysis.