APPENDICES

APPENDIX A

Exploration and Development Scenario

Maximum Case

North Aleutian Basin (Sale 92)

Prepared by

Minerals Management Service

Maximum Case
North Aleutian Basin (Sale 92)

A. Description and Resource Estimates: The hypothetical development strategy for the maximum case is based on a resource level of 759 MMbbls of oil and 5.250 TCF of gas (Table A-1). The resource estimates and the analysis of the maximum case are based on the following major assumptions.

- Increasing projected oil resources would be expected to double the number of oil spills (2 1,000-barrel-or-greater spills and 0.08 100,000-barrel-or-greater spills).

- Gas production from two offshore platforms would be transported by pipeline across the Port Moller/Balboa Bay transportation corridor to an LNG plant at Balboa Bay.

- Oil production from three offshore platforms would be transported by pipeline to the transshipment terminal at Balboa Bay via a pipeline across the proposed Port Moller/Balboa Bay transpeninsula transportation corridor (BBRMP, 1985).

- Hydrocarbons would be transported from the Balboa Bay transshipment terminal to markets by VLCC-type tankers.

- Marine support for offshore operations would be based out of Unalaska. Cold Bay could serve as the primary air-support site.

B. Developmental Timetable: The exploration period is expected to begin in 1986 and to end in 1993 (Table A-1). Eight exploration and twelve delineation wells are expected to be drilled. If commercial quantities of hydrocarbons are located during the exploration phase, planning and construction of the first oil platform would start around 1987. During this period, 76 production and service wells would be drilled from five platforms. Pipeline construction could begin in 1994 and end in 1997. Total pipeline mileage would vary according to the location of the production platforms; however, about 480 kilometers of oil and gas pipeline are anticipated. The pipeline would connect production wells to a transshipment terminal on Balboa Bay via the proposed Port Moller/Balboa Bay transpeninsula transportation corridor. The transshipment terminal should be completed in 1995.

Oil production is expected to begin in 1996, with a peak annual production of 64 MMbbls between 1997 and 2002. The volume of recoverable oil is expected to gradually decline after 2002, with oil output ceasing in the year 2015. Gas production is expected to begin in 1998, with a peak annual production of .252 TCF of gas between 1999 and 2016. The volume of recoverable gas is expected to decline after 2016, with output ceasing in the year 2021.

The level of preliminary seismic activity would depend on the number of exploratory and delineation wells drilled and the number of production platforms installed from which production wells would be drilled. These surveys would use high-resolution instruments to evaluate shallow geologic hazards for drilling clearance. This appendix uses the maximum-case resource estimate to

Table A-1
Estimated Schedule of Development and Production
Maximum Case

YEAR	EXPLORATION WELLS	DELINEATION WELLS		PLATFORMS		PRODUCTION AND SERVICE WELLS		TRUNK PIPELINE (kilometers)		PRODUCTION	
		Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas	Oil (MMbbls	Gas TCF)
1985											
1986	1										
1987	1										
1988	1	2									
1989	1	1									
1990	1	2		1		4					
1991	1	1	1			12					
1992	1	2	1	1		4					
1993	1	1	1			13					
1994				1		4		160			
1995					1	13	4	80			
1996					1		12		160	19	
1997							10		80	64	
1998										64	.200
1999										64	.252
2000										64	.252
2001										64	.252
2002										64	.252
2003										56	.252
2004										49	.252
2005										43	.252
2006										36	.252
2007										31	.252
2008										28	.252
2009										24	.252
2010										22	.252
2011										20	.252
2012										17	.252
2013										16	.252
2014										14	.252
2015											.252
2016											.252
2017											.205
2018											.152
2019											.100
2020											.057
2021											
2022											
2023											
2024											
2025											
2026											
TOTALS	8	9	3	3	2	50	26	240	240	759	5.250

Source: USDOI, MMS, Revision of Exploration and Development Report for Sale 92, 1984.

predict levels of drilling activity. That estimate also is used to predict levels of preliminary seismic activity: (1) a total of 20 exploratory and delineation wells, and (2) a total of 76 production and service wells would be drilled from five production platforms. Preliminary seismic activity for site-clearance work would occur at 25 sites. Since several production wells would be drilled from the same platform, each production well would not require separate seismic surveys. Therefore, the total number of surveys required would probably be fewer than 25 for a maximum-resource level.

The lessee has the option of running a site-specific survey, which involves 39 trackline miles of data, or a block-wide survey, which involves 188 trackline miles of data (see Alaska OCS Order NTL 83-5 for survey details). Most surveys probably would be site-specific due to cost considerations, but for the estimates made here, it is assumed that half of the surveys would be block-wide and half would be site-specific. Therefore, the estimate of total activity may be somewhat high. For the 25 sites, a total of 2,913 trackline miles are estimated to be surveyed. The actual level of activity may vary from this estimate for the following reasons: (1) the amount of recoverable petroleum may differ from the maximum-case resource estimate; (2) the proportion of site-specific surveys to the more extensive block-wide surveys may differ from the 50/50 assumption made here; (3) fewer than 25 site surveys may be required due to production platforms being sited on abandoned exploratory well sites that have already been surveyed; (4) and more than 25 site surveys may be performed if site-clearance work is done on lease blocks that are never drilled.

Exploration and production well-derived solids (muds and cuttings) resulting from the maximum-case scenario would be approximately 2.3 times greater than those derived in the mean case. Between about 113,000 and 138,000 tons of cuttings and about 3,091 tons of muds would be derived between 1986 and 1997.

C. Infrastructure Associated with Exploration, Development, and Production: Exploration, development, and production infrastructure would generally be the same as described for the mean case (proposal). Also, the size and scope of the support facilities could be greater than for the proposal because of the higher resource estimates.

D. Environmental Consequences:

1. Effects on Biological Resources:

a. Effects on Fisheries Resources: Overall effects on fisheries resources due to seismic activity, oil spills, natural gas releases, and discharges of drilling fluids, cuttings, and formation waters associated with the maximum-case scenario would be greater than those described for the mean case (proposal). Because the maximum case assumes resource levels of 759 MMbbls of oil and 5.250 TCF of gas, both of which are approximately double the resource levels estimated for the mean case, a substantial increase in spill-contact probabilities would be expected for areas used by concentrations of the more susceptible lifestages (i.e., nearshore egg, larvae, and juveniles) of fisheries resources. For example, the probability of a 1,000-barrel-or-greater spill occurring and contacting the Port Moller/Nelson Lagoon area would be expected to increase from 24 percent (mean case) to 44 percent. Drilling and production discharges would increase; consequently, localized lethal and sublethal concentrations, which could affect a portion of one or more regional fisheries populations, could increase. The overall effects of these increases in drilling and production discharges, seismic activities, natural gas releases, and oil spills are not expected to exceed moderate for salmonids, forage fish, groundfish, or other invertebrates, as compared to the minor overall effects that are expected for the mean case. Effects on red king crab are expected to be major.

b. Effects on Marine and Coastal Birds: Increasing projected oil resources from 364 to 759 MMbbls would approximately double the expected number of oil spills (1,000 bbls = 2 spills; 100,000 bbls = 0.08 spills) which potentially could be associated with this lease sale. The probability of 1 or more 1,000-barrel-or-greater spills occurring is 86 percent (mean case=61%), while for 100,000-barrel-or-greater spills, the probability is 6 percent (mean case=3%).

Such an increase would be reflected in greater risk to bird populations, especially where they are concentrated at certain seasons. For example, the probability of a 1,000-barrel-or-greater spill occurring and contacting the Port Moller/Nelson Lagoon Biological Resource Area (7) would be expected to increase from 19 percent (mean case) to 36 percent (maximum case). A corresponding increase in the number of spills expected (from 0.21 to 0.44) indicates that there is a substantial probability of a spill entering this area. The probability of oil entering Nelson Lagoon during the critical fall-migration period, when many oil-spill trajectories trend toward the peninsula, could be elevated considerably once a spill enters the nearshore zone. The probability of spill occurrence and contact with the land segment representing the entrance to Nelson Lagoon increases from 5 percent (mean case) to 12 percent (maximum case).

These values suggest that a substantial increase in oil resources could increase considerably the risk of major effects from oil spills in several areas where marine and coastal birds are concentrated. Most importantly, the potential exists for major adverse effects in lagoons along the northern coast of the Alaska Peninsula, where large numbers of waterfowl and shorebirds concentrate during spring- and fall-migration periods, and areas surrounding large seabird nesting colonies in the Shumagin Islands south of the Alaska Peninsula. The risk of moderate effects would increase most importantly in the general area of the Shumagin Islands and adjacent waters of the Alaska Peninsula (nesting seabirds), and in coastal waters including the 50-meter depth contour, especially north of the peninsula, where large numbers of shearwaters concentrate. Elsewhere, and in other seasons, effects are expected to be minor.

A substantial increase in disturbance during spring- and fall-migration periods could result from increased numbers of air-service flights (10 per day to 5 platforms; mean case=4 per day to 2 platforms) in the vicinity of Izembek and Nelson Lagoons. At Izembek, in particular, adjacent to the Cold Bay air-staging facilities, brant and perhaps other waterfowl species could experience major disturbance effects. Elsewhere, disturbance effects are expected to remain as described in Section IV.B.1.a.(2).

c. Effects on Pinnipeds and Sea Otters: The overall effects of the proposal on pinnipeds and sea otters are likely to be somewhat greater than those described for the proposal. A twofold increase in petroleum resources would increase the projected number of oil spills of 1,000 barrels or greater to about 2 spills, versus 1 spill under the mean case, and would substantially elevate spill-contact probabilities for sea otter, sea lion, harbor seal, and fur seal habitats within or adjacent to the lease sale area. The increased tanker traffic out of Balboa Bay would greatly increase the risk of oil effects on local sea otter populations in the Shumagin Islands and would increase spill risks to migrating fur seals near the southern shore of the Alaska Peninsula. Spill risks to marine mammal coastal habitats on the northern coast of the Alaska Peninsula also would increase. As a result, the level of oil-spill effects on fur seals may increase to moderate, while oil-spill effects on sea otters also would increase but are still not likely to exceed moderate. Oil- spill risks to sea otter habitats other than the Port Moller area are very low for the mean case. Oil-spill effects on sea lions and harbor seals probably would remain minor, as under the mean case. Increased localized changes in harbor seal and sea lion distributions at rookeries and/or haulout areas may occur as a result of increased disturbance associated with higher levels of industry activity. However, the level of noise and disturbance effects on the regional pinniped and sea otter populations of the North Aleutian Basin lease sale area is likely to remain minor, even in the maximum case. Potential oil-spill effects on fur seals may increase to moderate under the maximum oil-resource case, while the level of oil-spill effects on other pinnipeds and sea otters is likely to be the same as under the mean case. Noise and disturbance effects are likely to remain minor, as under the proposal.

d. Effects on Endangered and Threatened Species: Overall effects on endangered and threatened species, due to direct and indirect effects of oil spills and disturbances associated with development and transport of extracted oil, would be greater than those described for the mean case, although the logistic and product-transportation patterns would be the same as for the mean case. Since the maximum case assumes a level of petroleum resources about two times greater than that estimated for the mean case, an increase in oil-spill-contact probabilities would be expected. Increased noise and disturbances associated with higher levels of development would be expected in the maximum case and could result in localized changes in distribution and numbers of potentially sensitive endangered species. Effects on migrating whales (especially gray and humpback whales) are not expected to exceed moderate. Effects on species not as common (blue, sei, sperm, and bowhead) in the lease sale area are not expected to exceed moderate.

e. Effects on Nonendangered Cetaceans: Overall effects on nonendangered cetaceans because of direct and indirect effects of oil spills and disturbances associated with development and transport of extracted oil, would be greater than those described for the mean case, although the logistic and product-transportation patterns would be the same as for the mean case. Since the maximum case assumes a level of petroleum resources about three times greater than that estimated for the mean case, an increase in oil-spill-contact probabilities would be expected. Increased noise and disturbances associated with higher levels of development would be expected in the maximum case and could result in localized changes in distribution and numbers of potentially sensitive nonendangered cetaceans. Effects on all 10 species of migrating cetaceans possibly are not expected to exceed moderate. Effects on all those species that are not as common (see Sec. IV.B.1.a.(5)) in the lease sale area are not expected to exceed minor.

2. Effects on Social and Economic Systems:

a. Effects on Commercial Fishing Industry: Development of maximum-case resources could produce effects greater than those discussed in the proposal. Space-use conflicts would be greater for longer oil and gas pipelines (a total of 480 km instead of 420 km of parallel pipe), the increased number of development platforms, and the longer time period of development (five platforms in place between 1994 and 2020 instead of two between 1990 and 1993). This could cause a maximum projected catch loss of 3 percent of annual catch rather than 2 percent, which could increase economic loss to fishermen. However, effects of space/catch loss on commercial fisheries are still expected to be minor.

In the maximum case, the level of exploration and supply-vessel traffic could be twice as great as for the proposal (mean case) because there would be 20 exploration and delineation wells rather than 10, and more than double the number of platforms (five instead of two) during the development phase.

Also, the development phase would be longer--7 years instead of 3 years. Therefore, the potential for interaction with fixed fishing gear could be twice as great and could occur over a much longer period. During the development phase, interference with crab pots could cause major effects on crab fisheries in the maximum case.

Because more oil industry vessels would be in the area with the maximum case, longline-gear loss may increase to minor even though, in most cases, vessels should be able to successfully avoid contacting and thus damaging buoy poles. Damage or loss of trawl gear from the increase in bottom obstruction and debris would be greater than for the proposal, but would remain at less than one incident per year.

The production of over twice as much oil in the maximum case (759 MMbbls compared to 364 MMbbls in the proposal) would increase oil-spill risks and thus the risk of damaging gear and causing lost fishing time and income. Overall effects are still expected to be minor for all fisheries, except for the red king crab fishery, where effects are expected to be major.

b. Effects on Local Economy: Total employment effects would peak at nearly 1.5 times the peak employment of the mean case, and total employment during the production phase would be 73 percent greater than production-phase employment for the mean case. However, the larger number of jobs created by the maximum case would be irrelevant to future levels of joblessness in the region, because current unemployment and projected unemployment in the absence of the proposed sale are negligible in the communities that would be affected by the lease sale. The maximum case would be slightly more likely than the mean case to cause port congestion, housing shortages, or increased rates of price inflation in Unalaska. The overall economic effects of the maximum case would be minor.

c. Effects on Community Infrastructure: The effects on Cold Bay's community infrastructure from population increases resulting from support-facility activity would be very similar to that of the proposal. In the maximum case, OCS-generated demands could increase about 1.5 times over those of the proposal. The increased demands would pose no problems other than those identified for the proposal and, with the exception of the water-supply and sewage-treatment systems, the total demand would be within the capabilities of the existing systems. The sewage-treatment and water-supply systems, which are currently overutilized, would require upgrading in the near future to meet minimum standards. Although OCS-generated use would increase the demand on these systems, it is expected that new facilities would be on-line before the bulk of OCS-related demand occurred in the production phase. These OCS activities would have a negligible effect on Cold Bay's infrastructure.

The effects on Unalaska's infrastructure would be similar to those identified in the proposal, although OCS-generated demands on basic services would increase about 1.5 times over those of the proposal. The OCS demands could be accommodated by the additional facilities necessary to meet base-case needs and generally would have a negligible effect on Unalaska's basic services.

d. Effects on Subsistence-Use Patterns: The maximum case encompasses a considerably greater level of resource potential than the proposal and, therefore, would increase the size of the labor force, the magnitude of offshore activities, and the potential for oil-spill incidents. Using the same basic scenario as used for the proposal, the effects on subsistence-use patterns at Unalaska and Cold Bay could increase somewhat over the levels established for the proposal, but not to any great extent. This is based on the limited extent of subsistence practices carried on at Cold Bay and the marginality of OCS-related effects at Unalaska compared to the effects associated with development of the groundfish industry. On the lower Alaska Peninsula, direct effects on subsistence resources from oil-spill incidents could be increased due to increased resource and activity levels and to the use of the Balboa Bay transshipment terminal site. Here, as elsewhere in Bristol Bay, however, subsistence-use patterns are likely to be affected more by the indirect economic effects of changes in the commercial-salmon-fishing industry than by direct effects on local subsistence resources. As explored in the case of the proposal, such potential effects would be more likely to occur in the maximum case. The effects on subsistence-use patterns as a result of the maximum case would be expected to be negligible.

e. Effects on Sociocultural Systems: The relatively larger resource potential of the maximum case is the basis for a considerably greater labor force and level of potential activity within the lease sale area and at support-base locations. These support-base locations are the same as those designated in the analysis of the proposal, namely Unalaska and Cold Bay. Here, the potential effects on sociocultural systems could increase somewhat over the relatively inconsequential levels established for the proposal, but not to any appreciable extent.

This also should be the case for the Bristol Bay region as a whole, although an increased potential for risk to the commercial salmon fishery should result from the increased level of activity in the maximum case. The increased tankering activities and their proximity to the communities of the lower Alaska Peninsula subregion could increase potential effects on sociocultural systems of the subregion as a whole, and especially on Sand Point, where the population could increase as a result of terminal operations and increased tankering could increase the risk on marine resources, which are the basis of the local subsistence lifestyle. The effects of the maximum case on the sociocultural systems of Unalaska, Cold Bay, and the Bristol Bay region are anticipated to be negligible. The effects on the Alaska Peninsula and Sand Point are anticipated to be minor and moderate, respectively.

APPENDIX B

Exploration and Development Scenario

Minimum Case

North Aleutian Basin (Sale 92)

Prepared by

Minerals Management Service

Minimum Case
North Aleutian Basin (Sale 92)

A. Description and Resource Estimates: The hypothetical development strategy for the minimum case is based on a resource level of 83 MMbbls of oil (Table B-1). The resource estimates and the analysis of the minimum case are based on the following major assumptions.

- Decreasing the projected oil resources from the mean case of 364 to 83 MMbbls would reduce the expected number of oil spills (0.22 1,000-barrel-or-greater and 0.005 100,000-barrel-or-greater spills).

- The development of gas resources is not included in the analysis of the minimum case. Current market prices and the high cost of liquefaction and transportation make development of gas resources uneconomic (Dames and Moore, 1982; USDOI, MMS, 1983).

- Hydrocarbons from offshore production platforms would be transported directly to markets by tankers.

- Marine support for offshore operations would be based out of Unalaska. Cold Bay could serve as the primary air-support site.

B. Development Timetable: The exploration period is expected to begin in 1986 and to end in 1990 (Table B-1). Five exploration wells and three delineation wells are expected to be drilled from one rig. If commercial quantities of hydrocarbons are located during the exploration phase, planning and construction of the platform would start around 1987. One production platform may drill 6 production and service wells (Table B-1). Production is expected to begin in 1993, with a peak annual production of 7 MMbbls occurring between 1994 and 1999. Production is expected to cease by the year 2012.

The level of preliminary seismic activity would depend on the number of exploratory and delineation wells drilled and the number of production platforms installed from which production wells would be drilled. These surveys would use high-resolution instruments to evaluate shallow geologic hazards for drilling clearance. This appendix uses the minimum-case resource estimate to predict levels of drilling activity. That estimate also is used to predict levels of preliminary seismic activity: (1) a total of eight exploratory and delineation wells, and (2) a total of six production and service wells would be drilled from one production platform. Preliminary seismic activity for site-clearance work would occur at nine sites. Since several production wells would be drilled from the same platform, each production well would not require separate seismic surveys. Therefore, the total number of surveys required probably would be fewer than the nine projected for the minimum-resource-case level.

The lessee has the option of running a site-specific survey, which involves 39 trackline miles of data, or a block-wide survey, which involves 188 trackline miles of data (see Alaska OCS Order NTL 83-5 for survey details). Most surveys probably would be site-specific due to cost considerations; but for the estimates made here, it is assumed that half of the surveys would be block-wide and half would be site-specific. Therefore, the estimate of total activity may be somewhat high. For the nine sites, a total of 1,362 trackline

Table B-1

Estimated Schedule of Development and Production
Minimum Case

YEAR	EXPLORATION WELLS Oil	DELINEATION WELLS Oil	PLATFORMS	PRODUCTION AND SERVICE WELLS Oil	PRODUCTION OIL (MMbbls)
1985					
1986	1				
1987	1	1			
1988	1	1			
1989	1	1			
1990	1		1		
1991				6	
1992					
1993					2
1994					7
1995					7
1996					7
1997					7
1998					7
1999					7
2000					6
2001					5
2002					5
2003					4
2004					3
2005					3
2006					3
2007					2
2008					2
2009					2
2010					2
2011					2
TOTALS	5	3	1	6	83

Source: USDOI, MMS, Revised Exploration and Development Report for Sale 92, 1984.

miles are estimated to be surveyed. The actual level of activity may vary from this estimate for the following reasons: (1) the amount of recoverable petroleum may differ from the minimum-case resource estimate; (2) the proportion of site-specific surveys to the more extensive block-wide surveys may differ from the 50/50 assumption made here; (3) fewer than nine site surveys may be required due to production platforms being sited on abandoned exploratory well sites that have already been surveyed; (4) and more than nine site surveys may be performed if site-clearance work is done on lease blocks that are never drilled.

Exploration and production-well derived solids (muds and cuttings) resulting from the minimum-case scenario would be approximately .23 times less than those derived in the mean case. Between about 11,000 and 16,000 tons of cuttings and less than 1,344 tons of muds would be derived between 1986 and 1991.

C. Infrastructure Associated with Exploration, Development, and Production: Exploration, development, and production infrastructure would generally be the same as described for the mean case (proposal), with the exception of the trunk pipelines and the transshipment facility which would not be required. Also, the size and scope of support facilities could be smaller than for the proposal because of the lower resource estimates.

D. Environmental Consequences:

1. Effects on Biological Resources:

a. Effects on Fisheries Resources: The overall effects on fisheries resources due to oil spills and discharges of drilling fluids, cuttings, and formation waters associated with the minimum-case scenario would be less than those described for the mean case (proposal). A decrease in spill-contact probabilities for nearshore areas (particularly Port Moller) used by the more susceptible lifestages (i.e., eggs, larvae, and juveniles) of fisheries resources would be expected because (1) the minimum case assumes a resource level of 80 MMbbls of oil (compared to 364 MMbbls for the mean case), and (2) hydrocarbons are not transported through Port Moller to Balboa Bay by pipeline. The expected number of oil spills also would be reduced. In addition, drilling and production discharges would be diminished; consequently, localized lethal and sublethal concentrations that could affect a portion of one or more regional fisheries populations would decrease. There would be no oil-spill effects on the southern coast of the Alaska Peninsula because there would be no transshipment terminal or tankering activities out of Balboa Bay.

Discharges of drilling fluids, cuttings, and formation waters would still have some localized lethal or sublethal effects on fisheries resources. If an oil spill occurred, effects could be as described in Section IV.B.1.a.(1). As predicted for the development of the mean case, the overall level of effect of the minimum case on salmonids, forage fish, groundfish, and other invertebrates, is expected to be minor. Effects on red king crab would be expected to be major.

b. Effects on Marine and Coastal Birds: Decreasing projected oil resources from 364 to 80 MMbbls reduces the expected number of oil spills (1,000 bbls - 0.22 spill; 100,000 bbls - 0.005 spill) that could be associated with this lease sale. The probability of 1 or more 1,000-barrel-or-greater spills declines from 61 to 21 percent; the 100,000-barrel-or-greater spill probability is extremely low (0.5%). This level of development would result in a substantial reduction of risk to bird populations in potentially affected areas. In the vicinity of the Shumagin Islands (summer) and the lagoons of the Alaska Peninsula (spring, fall), effects are expected to be moderate. Elsewhere, and in other seasons, effects are likely to range from negligible to minor.

c. Effects on Pinnipeds and Sea Otters: The overall effects on sea otters and pinnipeds from oil spills and disturbances associated with development and transportation of extracted oil probably would be less than described for the proposed sale (mean case), since the spill rates and the volume of oil transported presumably would be reduced. However, short-term direct and indirect effects could occur in the event of an oil spill. Industrial activity still could disturb population segments of sea otters and pinnipeds, regardless of the absolute level of petroleum-resource estimates. Overall, effects on pinnipeds and sea otters probably would be minor under the minimum case, as compared to moderate in the mean case.

d. Effects on Endangered and Threatened Species: The overall effects on endangered species from direct and indirect effects of oil spills or disturbances associated with development and transport of extracted oil would be less than described for the mean case (proposal), since the spill rates and the volume of oil transported would be reduced. Short-term, localized effects could occur in the event of an oil spill, although about 2.5 times less oil would be available. Industrial activity during the migration and summer feeding periods in the lease sale area could still pose spill risks and/or potentially disturb at least local populations of endangered cetaceans, regardless of the absolute level of petroleum resource estimates. There would be no effect on species along the southern shore of the Alaska Peninsula, since no transshipment terminal would be built. Endangered species could be exposed to increases in tankering traffic, since no pipeline would be built and all oil would be loaded offshore and transported directly to markets. The level of effects on endangered species probably would be negligible in the minimum case.

e. Effects on Nonendangered Cetaceans: The overall effects on nonendangered cetaceans from direct and indirect effects of oil spills or disturbances associated with development and transport of extracted oil would be lower than described for the mean case (proposal), since spill rates and the volume of oil transported would be reduced. Short-term, localized effects could occur in the event of an oil spill, although about 2.5 times less oil would be available. Industrial activity during the migration and summer feeding periods in the lease sale area still could pose spill risks and/or potentially disturb at least local populations of nonendangered cetaceans, regardless of the absolute level of petroleum-resource estimates. There would be no effects on species along the southern shore of the Alaska Peninsula, since no transshipment terminal would be built. Nonendangered cetaceans could be exposed to increases in tankering traffic, since no pipeline would be built and all oil would be loaded offshore and transported directly to markets. The level of effects on nonendangered cetaceans probably would be negligible in the minimum case.

2. Effects on Social and Economic Systems:

a. Effects on Commercial Fishing Industry: Development of minimum-case resources would produce substantially lowered effects from those discussed in the proposal (see Sec. IV.B.2.a.). Space-use conflicts would be reduced to virtually nonexistent because there would be no oil or gas pipelines with the minimum case. Furthermore, the number of development platforms would be reduced from two to one, and the time period of development would decrease from 3 years to 1 year (1991-1992 instead of 1990-1993). The effects of space/catch loss on commercial fisheries are expected to decrease from minor in the proposal to neglibible in the minimum case.

In the minimum case, the level of exploration- and supply-vessel traffic would be reduced from the proposal (mean case) because there would be eight exploration and delineation wells rather than 10, and only one platform to serve (instead of two) during the development phase.

In addition, the development phase would be of shorter duration--only 1 year instead of 3 years. Therefore, the potential for interaction with fixed fishing gear would be lower, and this interaction would occur over a much shorter period than for the proposal. During the development phase, interference with crab pots could cause moderate effects on crab fisheries, but the likelihood of this happening is less than one-half what it is for the proposal because there would be only one platform (instead of two), and because the development phase is only for 1 (instead of 3) years. During the exploration and again during the production phases, potential effects on crab fisheries would be negligible.

Because fewer oil industry vessels would be in the area with the minimum case than with the proposal, longline- and trawl-gear loss would drop to negligible. The production of only 23 percent as much oil in the minimum case (80 MMbbls compared to 364 MMbbls in the proposal) would decrease oil-spill risks, and thus the risk of damaging gear and causing lost fishing time and income. Overall effects of oil spills are expected to decrease from minor to negligible with the minimum case.

b. Effects on Local Economy: Total employment effects would peak at about one-half the level of the peak employment of the mean case, and production-phase-employment effects would be about 60 percent as great as for the mean case. The overall economic effects of the minimum case would be minor.

c. Effects on Community Infrastructure: The demand for services and facilities in Cold Bay from OCS-generated-resident populations resulting from air-support operations in the minimum case would be about one-half of the projections for the proposal (mean case). Population levels projected for the minimum-resource level would indicate a negligible effect on the community's infrastructure. The small additional demand placed on existing services and facilities would be offset by a demand decrease resulting from population loss attributed to contraction of the labor force in the transportation, communication, and government sectors. With the exception of the water- and sewage-treatment systems, all basic services would be able to accommodate OCS and base-case population needs. The water- and sewage-treatment systems would require upgrading to meet minimum standards; however, these modifications would be required in the absence of OCS activities.

The demand for services and facilities in Unalaska resulting from OSC-marine-support operations would be about half that projected for the proposal. Generally, all basic services would require modifications to meet base-case and OCS-generated demands; however, OCS-generated service demands would account for less than 5 percent of the total demand over the life of the project. Population increases resulting from OCS operations in Unalaska would have a negligible effect on the city's infrastructure.

d. Effects on Subsistence-Use Patterns: The minimum case does not incorporate the Balboa Bay transshipment terminal scenario, because of the anticipated low level of resources. The resulting offshore-loading scenario, combined with much reduced levels of onshore and offshore activities, should all but eliminate effects on subsistence-use patterns in Bristol Bay and on the Alaska Peninsula and should greatly reduce potential effects at Unalaska and Cold Bay. Effects on subsistence-use patterns would be negligible.

e. Effects on Sociocultural Systems: The limited activity associated with the minimum case, and the use of offshore loading in place of the oil terminal on the Alaska Peninsula, suggest a more limited level of potential effects on sociocultural systems as a result of the lease sale. The effects should be all but eliminated in Bristol Bay and on the Alaska Peninsula and should be reduced at Unalaska and Cold Bay. The effects on Unalaska, Cold Bay, Bristol Bay, and the Alaska Peninsula would be negligible as compared to minor for Sand Point.

APPENDIX C

Population Projections for the Cities of Unalaska and Cold Bay

Prepared by

Minerals Management Service

Appendix C
Population Projections for the Cities of Unalaska and Cold Bay

The following tables in this appendix provide population projections for the base case (future without the proposal) and Proposal (Alternative I) for the cities of Unalaska and Cold Bay.

Table C-1
Base-Case Population Projections for the City of Unalaska

	Resident Population	Non-Project Enclave Population	Project Enclave Population	Military Enclave Population	Total Population Including Enclaves and Military
1981	687	609	0	0	1,296
1982	665	233	0	0	898
1983	652	166	0	0	818
1984	791	186	119	0	1,097
1985	756	262	60	0	1,079
1986	830	337	98	0	1,264
1987	903	412	170	0	1,485
1988	889	488	43	0	1,420
1989	911	593	9	0	1,513
1990	975	699	12	0	1,686
1991	1,089	854	10	0	1,953
1992	1,139	1,009	10	0	2,158
1993	1,223	1,165	8	0	2,396
1994	1,313	1,320	6	0	2,639
1995	1,427	1,476	79	0	2,982
1996	1,579	1,576	159	0	3,314
1997	1,808	1,676	253	0	3,737
1998	1,985	1,776	163	0	3,924
1999	2,275	1,776	66	0	4,117
2000	2,235	1,776	0	0	4,011
2001	2,233	1,776	0	0	4,009
2002	2,229	1,776	0	0	4,005
2003	2,227	1,776	0	0	4,003
2004	2,226	1,776	0	0	4,002
2005	2,224	1,776	0	0	4,000
2006	2,223	1,776	0	0	3,999
2007	2,222	1,776	0	0	3,998
2008	2,221	1,776	0	0	3,997
2009	2,221	1,776	0	0	3,997
2010	2,220	1,776	0	0	3,996

Source: University of Alaska, ISER, 1984.

Table C-2
Base-Case Population Projections for the City of Cold Bay

	Resident Population	Non-Project Enclave Population	Project Enclave Population	Military Enclave Population	Total Population Including Enclaves and Military
1981	225	0	0	0	225
1982	226	0	0	0	226
1983	197	0	0	0	197
1984	198	0	97	0	295
1985	186	0	76	0	262
1986	186	0	137	0	323
1987	179	0	124	0	303
1988	169	0	56	0	225
1989	161	0	16	0	177
1990	159	0	16	0	175
1991	159	0	10	0	169
1992	157	0	10	0	167
1993	157	0	10	0	167
1994	157	0	10	0	167
1995	156	0	10	0	166
1996	164	0	10	0	174
1997	184	0	40	0	224
1998	206	0	50	0	256
1999	214	0	40	0	254
2000	211	0	0	0	211
2001	211	0	0	0	211
2002	210	0	0	0	210
2003	210	0	0	0	210
2004	210	0	0	0	210
2005	210	0	0	0	210
2006	210	0	0	0	210
2007	210	0	0	0	210
2008	210	0	0	0	210
2009	209	0	0	0	209
2010	209	0	0	0	209

Source: University of Alaska, ISER, 1984.

Table C-3
Population Projections
(Including the Effects of the Proposal)
for the City of Unalaska

	Resident Population	Non-Project Enclave Population	Project Enclave Population	Military Enclave Population	Total Population Including Enclaves and Military
1981	687	609	0	0	1,296
1982	665	233	0	0	898
1983	652	166	0	0	818
1984	791	186	119	0	1,097
1985	756	262	60	0	1,079
1986	850	337	122	0	1,310
1987	906	412	174	0	1,492
1988	893	488	48	0	1,429
1989	915	593	15	0	1,523
1990	996	699	45	0	1,740
1991	1,101	854	31	0	1,987
1992	1,223	1,009	142	0	2,375
1993	1,309	1,165	13	0	2,487
1994	1,425	1,320	6	0	2,751
1995	1,536	1,476	79	0	3,091
1996	1,686	1,576	159	0	3,421
1997	1,914	1,676	254	0	3,844
1998	2,091	1,776	163	0	4,030
1999	2,381	1,776	66	0	4,223
2000	2,341	1,776	0	0	4,117
2001	2,338	1,776	0	0	4,114
2002	2,334	1,776	0	0	4,110
2003	2,332	1,776	0	0	4,108
2004	2,330	1,776	0	0	4,106
2005	2,326	1,776	0	0	4,102
2006	2,324	1,776	0	0	4,100
2007	2,323	1,776	0	0	4,099
2008	2,322	1,776	0	0	4,198
2009	2,321	1,776	0	0	4,097
2010	2,318	1,776	0	0	4,094

Source: University of Alaska, ISER, 1984.

Table C-4

Population Projections (Including the Effects of the Proposal) for the City of Cold Bay

	Resident Population	Non-Project Enclave Population	Project Enclave Population	Military Enclave Population	Total Population Including Enclaves and Military
1981	225	0	0	0	225
1982	226	0	0	0	226
1983	197	0	0	0	197
1984	198	0	97	0	295
1985	186	0	76	0	162
1986	189	0	168	0	357
1987	179	0	130	0	309
1988	169	0	64	0	233
1989	162	0	27	0	189
1990	162	0	43	0	205
1991	161	0	28	0	189
1992	169	0	143	0	312
1993	209	0	14	0	223
1994	228	0	10	0	238
1995	227	0	10	0	237
1996	235	0	10	0	245
1997	255	0	40	0	295
1998	277	0	50	0	327
1999	285	0	40	0	325
2000	282	0	0	0	282
2001	281	0	0	0	281
2002	281	0	0	0	281
2003	281	0	0	0	281
2004	281	0	0	0	281
2005	279	0	0	0	279
2006	279	0	0	0	279
2007	279	0	0	0	279
2008	278	0	0	0	278
2009	278	0	0	0	278
2010	276	0	0	0	276

Source: University of Alaska, ISER, 1984.

APPENDIX D

Economic Tables for the Base Case and Proposal

(Alternative I)

Prepared by

Minerals Management Service

Appendix D

Economic Tables for the Base Case and Proposal (Alternative I)

The following tables in this appendix provide historical information about employment, population, and income in the Aleutian Islands Census Division and in the communities of Unalaska/Dutch Harbor and Cold Bay. Also provided are projections of employment to the year 2010 in the communities of Unalaska/Dutch Harbor and Cold Bay, with and without the proposed North Aleutian Basin (Sale 92).

Table D-1

Average Monthly Wage and Salary Employment in the Aleutian Islands Census Division (1965 - 1980)

						(Dollars)									
Industry	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Construction	54	137	125	142	195	285	187	181	180	235	221	116	140	98	114
Manufacturing	411	422	471	349	476	657	610	675	851	783	991	1130	1621	1739	1720
Transportation, Communications, and Utilities	55	51	46	57	45	61	41	93	93	87	88	38	31	55	90
Wholesale-Retail Trade	138	152	138	134	136	125	124	142	137	148	149	110[e]	101[e]	114[e]	116[e]
Finance, Insurance, and Real Estate	4[e]	4[e]	1[e]	5[e]	7[e]	7[e]	8[e]	7[e]	12	27	32	37	38	40[e]	76[e]
Services	13[e]	108[e]	232[e]	268	143	240	82	47	33	20	93	150	171	180	152
Federal Government, Total	707	633	550	523	528	574	640	704	813	626	618	569	682	704	676
(Military-Related)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(n.a.)	(486)	(405)[e]	(424)[e]
State, Local Government	138	157	160	174	168	178	206	227	257	316	330	287	371	387	408
Miscellaneous and Unclassified 1/	6[e]	50[e]	112[e]	75[e]	23[e]	51[e]	84[e]	110[e]	97	107[e]	99[e]	37[e]	0	0	11
Civilian Job Total	1526	1714	1835	1727	1721	2178	1982	2186	2473	2349	2621	2474	3155	3317	3363
Military Personnel (active duty only)	n.a.	n.a.	n.a.	3927	3833	3994	3263	3314	3347	3410	3753	3026	2868	2392	2504
Total	n.a.	n.a.	n.a.	5654	5554	6172	5245	5500	5820	5759	6374	5500	6023	5709	5867

Sources: Statistical Quarterly (Alaska Dept. of Labor). The figure of 486 for the number of military-related civilian Federal government jobs in the year 1978 is from Numbers - Basic Economic Statistics of Alaska Census Divisions (Alaska Dept. of Commerce and Economic Development, November 1979). Comparable figures for 1979 and 1980 were estimated based on changes in numbers of active-duty military personnel. Numbers of military personnel were obtained from unpublished reports of the U.S. Bureau of Economic Analysis.

e = estimated

n.a. = information not available

1/ Includes sand and gravel operations related to construction.

Table D-2

Population and Estimated Per Capita Money Income by Place in the Aleutian Islands Census Division[1/]

Community	1970	1980	1970-80 Change	1970-80 Percent Change	Estimated Per Capita Money Income	
					1969	1977
Adak	$4,022	$3,313	-$709	- $18	--	--
Unalaska	342	1,322	980	+ 287	$2,636	$8,290
Sand Point	360	619	259	+ 72	3,274	9,483
Shemya Station	1,131	600	- 531	- 47	--	--
St. Paul	450	551	101	+ 22	2,290	6,410
King Cove	283	462	179	+ 63	2,368	6,830
Cold Bay	256	228	- 28	- 11	--	--
* Chignik	83	179	+ 96	+ 116	--	--
St. George	163	158	- 5	- 3	--	--
* Chignik Lake	117	138	+ 21	+ 18	--	--
Akutan	101	126	+ 25	+ 25	--	--
* Perryville	94	108	+ 14	+ 15	--	--
Atka	88	93	+ 5	+ 6	--	--
False Pass	62	65	+ 3	+ 5	--	--
Nelson Lagoon	43	59	+ 16	+ 7	--	--
Nikolski	57	50	- 7	- 12	--	--
* Chignik Lagoon	0	48	+ 48	--	--	--
* Ivanof Bay	48	41	- 7	- 15	--	--
Attu	0	29	+ 29	--	--	--
Belkofski	59	10	- 49	- 83	--	--
Squaw Harbor	65	6	- 59	- 91	--	--
Other	233	85	- 148	- 64	--	--
Census Division Totals	$8,057	$8,290	+$233	+$ 3	$3,317	$7,932

1/ The Aleutian Islands Census Division is the geographic area used by the U.S. Census Bureau for the collection and presentation of data in the 1970 census. The area used for the 1980 census is similar, except for the exclusion of the five communities indicated above by asterisks (*). The larger 1970 census division corresponds to the geographic area used by the Alaska Dept. of Labor and the U.S. Bureau of Economic Statistics for the reporting of employment, personal income, and other types of economic statistics.

Source: State of Alaska, Department of Labor, January 1981; U.S. Bureau of the Census, June 1980; U.S. Bureau of the Census, March 1981.

Table D-3
Cold Bay Labor Force By Sector - 1982

Industry	Total Employees			Percent of Total Labor Force		
Government	63			40.9		
Federal		43			27.9	
Federal Aviation Admin.			16			10.4
National Weather Service			5			3.2
Fish & Wildlife Service			4			2.6
U.S. Post Office			2			1.3
Federal Military (USAF)			16			10.4
State		19			12.3	
Dept. of Transportation			6			3.9
Dept. of Fish & Game			7			4.5
R.E.A.A. (School System)			5			3.2
Magistrate			1			0.7
Municipal		1			0.7	
Clerk			1			0.7
Private Employers	91			59.1		
Transportation		34			22.1	
Reeve Aleutian Airways			22			14.3
Peninsula Airlines			10			6.5
Cold Bay Truck Rental			2			1.3
Communications		31			20.1	
R.C.A.			28			18.2
Alascom			2			1.3
Interior Telephone Co.			1			0.7
Service		18			11.7	
Flying Tigers Lines			16			10.4
Northern Power Co.			2			1.3
Manufacturing/Processing		6			3.9	
Northern Peninsula Fisheries			5			3.2
Seawest			1			0.7
Construction		2			1.3	
Well Digger			1			0.7
Laborer			1			0.7
TOTAL		154			100.0	

Source: Impact Assessment, Inc., 1983.

Table D-4
Total Employment, Basic Employment, Secondary Employment[1/] and Resident Status of Workers, by Industry, for Unalaska (Dutch Harbor) - 1980

INDUSTRY CLASSIFICATION	(1) BASIC INDUSTRY JOBS: BASIC JOBS HELD BY PERMANENT RESIDENTS	(2) BASIC INDUSTRY JOBS: BASIC JOBS HELD BY TRANSIENT WORKERS	(3) BASIC INDUSTRY JOBS: TOTAL BASIC EMPLOYMENT	(4) SECONDARY[1/] JOBS (ALL HELD BY RESIDENTS)	(5) TOTAL EMPLOYMENT (BASIC & SECONDARY)
(1) Fish Harvesting.	35	115	150	0	150
(2) Fish Processing.	117	1,049	1,166	0	1,166
(3) Mining.	2	0	2	0	2
(4) Construction.	0	0	0	12	12
(5) Transportation, Communication, & Utilities...	14	0	14	43	57
(6) Trade.	0	0	0	60	60
(7) Finance, Insurance, & Real Estate.	20	0	20	7	27
(8) Services.	0	0	0	44	44
(9) Federal & State Gov't...	6	0	6	12	18
(10) Local Government.	0	0	0	64	64
(11) All-Industry Totals ...	194	1,164	1,358	242	1,600

Source: All information about the total number of jobs, by industry, and information about which jobs serve the local market (secondary jobs) and which jobs serve markets outside the local community (basic jobs) is taken from pages 14-18 of OCS Technical Report Number 59 (Alaska Consultants, Inc., May 1981). The information is based on a special survey of employers that was conducted by Alaska Consultants. Assumptions about the number of fishermen and fish-processing workers who are permanent residents and the number who are transient workers are based on information from pages 48-50 of OCS-Technical Report Number 57 (Institute of Social and Economic Research, April 1981), supplemented by information from miscellaneous sources.

[1/] All employment figures are stated in terms of annual average (12-month) fulltime equivalent jobs.

Table D-5
Annual Average Employment at Unalaska/Dutch Harbor (1981 - 2010) with and without the Proposal (Alternative I)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	PROJECTED EMPLOYMENT WITHOUT THE LEASE SALE			ESTIMATED EMPLOYMENT EFFECTS OF THE PROPOSED LEASE SALE			TOTAL PROJECTED EMPLOYMENT WITH THE LEASE SALE OCCURS			PERCENTAGE INCREASES DUE TO THE LEASE SALE		
YEAR	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT
1981	368	609	977	0	0	0	368	609	977	0	0	0
1982	352	233	585	0	0	0	352	233	585	0	0	0
1983	341	166	507	0	0	0	341	166	507	0	0	0
1984	426	305	731	0	0	0	426	305	731	0	0	0
1985	401	322	724	0	0	0	401	322	724	0	0	0
1986	445	435	879	13	25	38	457	459	917	3	6	4
1987	488	582	1,069	2	4	6	490	586	1,075	0	1	1
1988	476	531	1,007	2	5	7	479	536	1,014	0	1	1
1989	487	602	1,089	3	6	9	490	608	1,098	1	1	1
1990	524	711	1,235	13	33	46	537	744	1,281	3	5	4
1991	593	864	1,457	8	21	29	600	885	1,486	1	2	2
1992	621	1,019	1,640	53	132	185	674	1,151	1,825	8	13	11
1993	671	1,173	1,844	54	5	59	724	1,178	1,903	8	0	3
1994	724	1,326	2,050	70	0	70	794	1,326	2,120	10	1	3
1995	793	1,555	2,347	68	0	68	861	1,555	2,416	9	0	3
1996	885	1,735	2,619	67	0	67	951	1,735	2,686	8	0	3
1997	1,025	1,929	2,954	66	0	67	1,091	1,930	3,021	6	0	2
1998	1,133	1,939	3,071	66	0	66	1,199	1,939	3,137	6	0	2
1999	1,311	1,842	3,153	66	0	66	1,377	1,842	3,219	5	0	2
2000	1,284	1,776	3,060	66	0	66	1,350	1,776	3,126	5	0	2
2005	1,262	1,776	3,038	64	0	64	1,326	1,776	3,102	5	0	2
2010	1,245	1,776	3,021	61	0	61	1,305	1,776	3,081	5	0	2

Source: Technical Report 87: St. George Basin and North Aleutian Shelf Economic and Demographic Systems Analysis, prepared by the Institute of Social and Economic Research, University of Alaska.

Note: The projections of resident employment and total employment (Columns 1,3,4,6,7, and 9) represent jobs in all industry categories. The no-sale projections of enclave employment in Column 2 include fish-processing jobs filled by seasonal workers housed in dormitories, in addition to petroleum-industry jobs filled by commuters, also housed in dormitories, who would leave the region frequently for extended periods of rest and recreation. The petroleum-industry jobs included in Column 2 are jobs that would result from OCS Sale 70 (assuming exploration only), Sale 83 (assuming a commercial discovery), and Sale 89 (assuming exploration only). The enclave jobs resulting from proposed Sale 92, in Column 5, consist entirely of additional petroleum-industry jobs filled by commuters housed in dormitories during work periods, who would leave the region frequently for extended periods of rest and recreation.

Table D-6
Annual Average Employment at Cold Bay (1981 - 2010) with and without the Proposal (Alternative I)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	PROJECTED EMPLOYMENT WITHOUT THE LEASE SALE			ESTIMATED EMPLOYMENT EFFECTS OF THIS PROPOSED LEASE SALE			TOTAL PROJECTED EMPLOYMENT WITH THE LEASE SALE			PERCENTAGE INCREASES DUE TO THIS LEASE SALE		
YEAR	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT	RESIDENT EMPLOYMENT	ENCLAVE EMPLOYMENT	TOTAL EMPLOYMENT
1981	153	0	153	0	0	0	153	0	153	0	0	0
1982	154	0	154	0	0	0	154	0	154	0	0	0
1983	134	0	134	0	0	0	134	0	134	0	0	0
1984	134	97	231	0	0	0	134	97	231	0	0	0
1985	126	76	202	0	0	0	126	76	202	0	0	0
1986	126	137	263	2	31	33	128	168	296	1	23	13
1987	121	124	245	0	6	6	122	130	252	0	5	2
1988	115	56	171	8	8	16	115	64	179	0	14	5
1989	110	16	126	1	11	12	110	27	137	1	69	9
1990	108	16	124	2	27	29	110	43	153	1	169	23
1991	108	10	118	1	18	19	109	28	137	1	180	16
1992	107	10	117	8	133	141	115	143	258	7	1330	121
1993	106	10	116	36	4	40	142	14	156	33	40	34
1994	106	10	116	49	0	49	155	10	165	46	0	42
1995	106	10	116	48	0	48	154	10	164	46	0	42
1996	111	10	121	48	0	48	160	10	170	43	0	40
1997	125	40	165	48	0	48	173	40	213	39	0	29
1998	140	50	190	48	0	48	188	50	213	34	0	25
1999	145	40	185	48	0	48	194	40	234	33	0	26
2000	143	0	143	48	0	48	191	0	191	34	0	34
2005	143	0	143	47	0	47	189	0	189	33	0	33
2010	142	0	142	45	0	45	188	0	188	32	100	32

Source: Technical Report 87: St. George Basin and North Aleutian Shelf Economic and Demographic Systems Analysis, prepared by the Institute of Social and Economic Research, University of Alaska.

Note: The projections of resident employment and total employment (Columns 1,3,4,6,7, and 9) represent jobs in all industry categories. The no-sale projections of enclave employment in Column 2 represent petroleum-industry jobs filled by commuters, housed in dormitories, who would leave the region frequently for extended periods of rest and recreation. The petroleum-industry jobs included in Column 2 are jobs that would result from OCS Sale 70 (assuming exploration only), Sale 83 (assuming a commercial discovery), and Sale 89 (assuming exploration only). The enclave jobs resulting from proposed Sale 92, in Column 5, consist entirely of additional petroleum-industry jobs filled by commuters, housed in dormitories during work periods, who would leave the region frequently for extended periods of rest and recreation.

APPENDIX E

Community Infrastructure Projections for the Cities of Unalaska and Cold Bay

Prepared by

Minerals Management Service

Appendix E
Community Infrastructure Projections for the Cities of Unalaska and Cold Bay

The tables in this appendix provide community infrastructure projections for the base case (Future without the Proposal) and proposal (Alternative I) for the North Aleutian Basin lease sale. These projections are based on the following assumptions: (1) industry would provide facilities and services for all employees residing in an enclave, and only employees who become permanent residents of the community would use local infrastructure; and (2) industry would develop the electrical- and water-supply capacity to meet support-base functions. An overall listing of tables is organized as follows:

Table E-1
Effects on Schools, School Years 1982/1983 to 2009/2010
Enrollments and (Classrooms)[1/]

City	1982/1983	1985			1990			1995		
		Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale
					Enrollment and(Number of Classrooms)					
Cold Bay	50 (4)	26 (3/)	26 (3/)	0 (0)	23 (3/)	23 (3/)	0 (0)	22 (3/)	32 (3/)	10 (0)
Unalaska	165 (20)[2/]	177 (3/)	182 (3/)	5 (0)	230 (3/)	235 (3/)	5 (0)	338 (3/)	363 (3/)	23 (1)

	2000			2005			2010		
Cold Bay	30 (3/)	40 (3/)	10 (0)	30 (3/)	40 (3/)	10 (0)	30 (3/)	39 (3/)	9 (0)
Unalaska	527 (26.5)	551 (27.5)	24 (1)	528 (26.5)	551 (27.5)	24 (1)	530 (26.5)	552 (27.5)	22 (1)

Source: Calculated by the MMS from the Institute of Social and Economic Research, University of Alaska, Technical Report No. 87, "Impact Analysis of the St. George Lease Offering and the North Aleutian Shelf Lease Offering," Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region 1984.

1/ Facility projections represent the number of classrooms necessary to maintain a 20:1 student:classroom ratio. Number of classrooms is indicated in parenthesis.

2/ Figures are for the 1981/1982 school year.

3/ Enrollments are projected to be less than the capacity of the school. No additional classrooms would be necessary.

Table E-2
Effects on Electrical-Capacity Requirements, 1984-2010
(Kilowatts)

	1984	1985			1990			1995		
City	Capacity of Existing Electrical System	Base-Case Projections[1]	Needs with Lease Sale [2]	Increment Due to Lease Sale	Base-Case Projections[1]	Needs with Lease[2] Sale	Increment Due to Lease Sale	Base-Case Projections[1]	Needs with Lease[2] Sale	Increment Due to Lease Sale
Cold Bay	1,600	698	698	0	596	608	12	585	851	266
Unalaska	1,200	2,835	2,921	86	3,656	3,735	79	5,351	5,760	409

	2000			2005			2010		
Cold Bay	791	1,058	267	788	1,046	258	784	1,035	251
Unalaska	8,381	8,741	360	8,340	8,723	383	8,325	8,693	368

Source: Calculated by the MMS from the Institute of Social and Economic Research, University of Alaska, Technical Report No. 87, "Impact Analysis of the St. George Lease Offering and the North Aleutian Shelf Lease Offering," Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region (1984).

[1] Base-case estimates of electrical-capacity requirements are based on an installed capacity of 3.75 kilowatts per resident (Alaska Consultants, 1981).

[2] Projected electrical-capacity requirements for the Proposal (Alternative 1) are based on an installed capacity of 3.75 kilowatts per new resident (Alaska Consultants, 1981).

Table E-3
Effects on Water-Supply Requirements, 1984-2010
(Million Gallons Per Day [MGD])

	1984	1985			1990			1995		
City	Capacity of Existing Water System	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale
Cold Bay1/	.030	.023	.023	0	.020	.020	0	.020	.028	.008
Unalaska2/	17.3	5.97	6.41	.44	9.81	10.10	.29	17.02	17.66	.64

	2000			2005			2010		
Cold Bay1/	.026	.035	.009	.026	.035	.009	.026	.035	.009
Unalaska2/	23.51	24.13	.62	23.45	24.05	.60	23.42	24.00	.58

Source: Calculated by the MMS from the Institute of Social and Economic Research, University of Alaska, Technical Report No. 87, "Impact Analysis of the St. George Lease Offering and the North Aleutian Shelf Lease Offering, " Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region (1984).

1/ Baseline water projections for Cold Bay are based on total population. Domestic demand is assumed to be approximately 125 gallons per person per day (Alaska Consultants, 1981). All figures are rounded to the nearest .001 MGD.

2/ Baseline water-demand projections for Unalaska are based on a standard of 170 gallons per person per day, with domestic demands accounting for 2.9 percent of total projected water consumption throughout the forecast period (Centaur Associates, 1984). Calculations do not include OCS-enclave workers for previous sales. It is assumed that industry would provide for their needs. All figures are rounded to the nearest .01 MGD.

Table E-4
Effects on Sewage-Treatment Facilities, 1984-2010
(Million Gallons Per Day [MGD] of Effluent)

	1984	1985			1990			1995		
City	Capacity of Existing Treatment Facilities	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale
Cold Bay[1/]	.0225	.023	.023	0	.020	.020	a	.020	.028	.008
Unalaska[2/]	not available	.173	.177	.004	.285	.288	.003	.494	.512	.018

	2000			2005			2010		
Cold Bay[1/]	.026	.035	.009	.026	.035	.009	.026	.035	.009
Unalaska[2/]	.682	.700	.018	.680	.697	.017	.679	.696	.017

Source: Calculated by the MMS from Institute of Social and Economic Research, University of Alaska, Technical Report No. 87, "Impact Analysis of the St. George Lease Offering and the North Aleutian Shelf Offering," Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region (1984).

1/ All figures represent millions of gallons per day of effluent and are based on a standard of 125 gallons of effluent per person per day (Alaska Consultants, 1981). All figures are rounded to the nearest .001 MGD.

2/ All figures represent millions of gallons per day of effluent and are based on a standard of 170 gallons of effluent per person per day. All figures are rounded to the nearest .001 MGD.

a = Less than .001 MGD of effluent.

Table E-5
Effects on Health Care, 1984-2010
Beds and (Physicians)[1]

City	1984	1985			1990			1995		
	Existing Health Care Beds and (Physicians)	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale
Unalaska	3(1)	3(1)	3(1)	0(0)	3(1)	3(1)	0(0)	3(2)	3(2)	0(0)

		2000			2005			2010		
Unalaska		7(2)	6(3)	0(0)	6(3)	7(2)	0(0)	7(2)	7(2)	0(0)

Source: Calculated by the MMS from Institute of Social and Economic Research, University of Alaska, Technical Report No. 87, "Impact Analysis of the St. George Lease Offering and the North Aleutian Shelf Lease Offering." Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region (1984).

[1] The physician forecast is based on a ratio of one physician per increment of 1,500 additional residents over a base population of 3,000 (Alaska Consultants, 1981). The acute-care-bed forecast is based on a ratio of 3.5 beds per increment of 1,000 additional residents over a base population of 3,000 (Alaska Consultants, 1981). Projections for Cold Bay were not included because additional physicians and acute-care beds would not be necessary due to the small population increases.

Table E-6
Effects on Law Enforcement, 1984-2010
Officers and (Detention Cells)[1]

	1984	1985			1990			1995		
City	Existing No. of Law Enforcement Officers/ (Detention Cells)	Base Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base-Case Projections	Needs with Lease Sale	Increment Due to Lease Sale	Base Case Projections	Needs with Lease Sale	Increment Due to Lease Sale
Cold Bay	1(1)	1(3)	1(3)	0(0)	1(3)	1(3)	0(0)	1(3)	1(3)	0(0)
Unalaska	18(3)	18(3)	18(3)	0(0)	19(4)	19(4)	0(0)	24(9)	24(9)	0(0)

	2000			2005			2010		
Cold Bay	1(3)	1(3)	0(0)	1(3)	1(3)	0(0)	1(3)	1(3)	0(0)
Unalaska	27(12)	27(12)	0(0)	27(12)	27(12)	0(0)	27(12)	27(12)	0(0)

Source: Calculated by the MMS from Institute of Social and Economic Research, University of Alaska, Technical Report No. 87, "Impact Analysis of the St. George Lease Offering and the North Aleutian Shelf Lease Offering," Anchorage, AK: U.S. Dept. of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region (1984).

[1] Police officer and detention-cell projections are based on a standard of one additional officer and detention cell for each additional population increment of 300 (Alaska Consultants, 1981). Projections for Alternative II (No Sale) are based on total population.

APPENDIX F

History of Seismic Activity in the North Aleutian Basin

Prepared by

Minerals Management Service

History of Seismic Surveys in the North Aleutian Basin

Much marine seismic work has been done in the North Aleutian Basin area by government agencies, research institutes and universities, and private industry. All seismic work conducted on unleased lands, including work conducted by industry, requires a permit (except for scientific research [30 CFR 251.-4-2] and U.S. Government agencies). This work has been regulated by the U.S. Department of the Interior. The first geophysical permit in the North Aleutian Basin was issued in 1963. From 1963 through 1982, 46 surveys were completed under permits. Of these, four were high-resolution surveys and 42 were deep-seismic surveys. A total of 51,034 trackline miles were surveyed by industry from 1963 through 1982, of which 4,751 were high-resolution and 46,283 were deep-seismic.

The high-resolution surveys used either a sparker (from 800-Joule [J] through 24-kilojoule [kJ] energy level) or a 500-J boomer as a sound source. In addition, 3.5-kilohertz [kHz] and 12-kHz subbottom profilers and fathometer systems were used. Most of the deep-seismic surveys run by industry used an array of airguns for a sound source. Sleeve exploders and waterguns also were listed in some North Aleutian Basin permits.

Some high-resolution seismic data from the North Aleutian Basin also have been acquired by the U.S. Geological Survey (USGS). The Geological Division of USGS collected approximately 680 trackline miles of data in 1976 for the Outer Continental Shelf Environmental Assessment Program (OCSEAP). The instruments used in this survey included 3.5-kHz and 12-kHz subbottom profilers and an array of five airguns. USGS also collected approximately 1,800 trackline miles of high-resolution data in 1981. A detailed technical discussion of the USGS marine-seismic equipment is found in Brune et al. (1979). In 1981, the Conservation Division of USGS (now part of Minerals Management Service) acquired 2,491 trackline miles of high-resolution data by contract, in preparation for Sale 75. This survey used various sound sources which included an array of up to four 15-cubic-inch waterguns, an 800-J sparker, a 3.5-kHz subbottom profiler, a fathometer, and a sidescan sonar. A listing of other marine-seismic work performed by governmental agencies and universities in the southern Bering Sea is contained in Cooper et al. (1979). In addition, an industry survey was done for the deep stratigraphic test (DST) well in the North Aleutian Basin. This was a high-resolution survey to investigate shallow drilling hazards.

APPENDIX G

Oil-Spill-Risk Analysis

Prepared by

Minerals Management Service

APPENDIX G

Oil-Spill-Risk Analysis

The tables listed in this appendix represent two types of probabilities:

1) Conditional Probabilities (Tables G-1 through G-9): these probabilities express the likelihood that a spill originating from a given location (launch points shown on Graphic 5) will contact a certain boundary segment or biological resource area. Probabilities are based solely on meteorological and oceanographic conditions.

2) Combined (Final) Probabilities (Tables G-10 through G-26): these probabilities express the likelihood that a given boundary segment or biological resource area will be contacted by an oil spill over the life of the oil field. These probabilities are based on the estimated level of resource (volume of oil) and the estimated spill rates.

Figures G-1 and G-2 show the different targets analyzed in this oil-spill-risk analysis. Twenty-three open-water targets (shown in Fig. G-1), 14 biological resource areas (Fig. G-2), and 200 boundary segments (Graphic 5) were included and used by the analysts to arrive at the effects discussed in Section IV of this EIS.

Table G-1. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 3 days.

Target	Hypothetical Spill Location																								
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
Land	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	46	n	n	n	n	n	n
Resource Area 1	n	n	n	n	9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	**	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	**	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-1. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 3 days.

Target	Hypothetical Spill Location																								
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
Land	n	5	n	19	n	n	n	n	n	4	n	n	n	n	n	n	n	n	14	5	n	n	n	n	n
Resource Area 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	35	n	**	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-1. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 3 days.

Target	Hypothetical Spill Location																								
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15
Land	n	n	n	n	n	n	5	2	n	n	n	n	2	n	n	3	n	n	25	n	n	2	n	n	2
Resource Area 1	n	n	55	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-1. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 3 days.

Target	Hypothetical Spill Location								
	E16	E17	E18	E19	E20	E21	E22	E23	E24
Land	n	n	2	5	5	14	n	7	n
Resource Area 1	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	n	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	**
Resource Area 9	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	7
Resource Area 11	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-2. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 10 days.

Target	Hypothetical Spill Location																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
Land	5	n	n	n	2	n	n	n	n	5	n	n	n	2	n	2	n	n	46	n	n	n	n	n	6
Resource Area 1	n	n	n	n	27	n	n	n	3	18	n	n	n	n	n	9	n	n	2	n	n	n	n	n	n
Resource Area 2	n	n	n	n	2	n	n	n	5	21	n	n	n	n	3	23	n	n	**	n	2	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 11	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	8	**	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-2. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 10 days.

Target	Hypothetical Spill Location																								
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
Land	11	14	n	25	n	n	n	n	n	24	n	n	n	n	n	n	7	7	32	22	n	n	n	n	4
Resource Area 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	34	n	n
Resource Area 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	22	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	17	49	n	**	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	n
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	34	n
Resource Area 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-2. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 10 days.

Target	Hypothetical Spill Location																						
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Land	n	n	2	n	n	n	5	2	n	5	2	5	2	n	2	5	4	2	33	n	4	12	9	24
Resource Area 1	n	n	62	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	35	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	7	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 11	n	n	n	13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-2. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 10 days.

Target	Hypothetical Spill Location									
	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
Land	35	9	12	23	16	40	33	30	12	n
Resource Area 1	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	n	n	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	**
Resource Area 9	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	n	n	n	n	n	n	12
Resource Area 11	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-3. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 30 days.

Target	Hypothetical Spill Location																								
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
Land	36	7	6	8	5	15	6	6	18	21	5	6	8	5	5	14	n	n	46	2	12	n	n	n	36
Resource Area 1	n	8	17	18	30	24	14	24	23	20	9	5	3	n	n	14	n	2	6	n	n	n	n	n	2
Resource Area 2	n	n	2	3	6	20	17	24	24	30	15	11	9	5	11	35	n	n	**	n	23	19	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	2	n	2	n	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	25
Resource Area 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19	n	n	n	n	n	n	n	n
Resource Area 10	20	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5
Resource Area 11	2	5	14	20	9	11	5	2	n	n	n	n	n	n	n	n	2	48	n	n	n	n	n	n	n
Resource Area 12	n	n	2	6	35	2	n	3	5	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	5	3	26	**	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-3. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 30 days.

Target	Hypothetical Spill Location																								
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
Land	36	45	4	53	n	n	6	5	1	25	4	n	5	10	7	17	51	31	35	27	6	1	14	17	25
Resource Area 1	2	2	14	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	42	n	n
Resource Area 2	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	2	13	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	25	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	2	25	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	33	49	n	**	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	15	n
Resource Area 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	24	n
Resource Area 10	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	51	n
Resource Area 11	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19	15	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	19	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	10	2	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-3. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 30 days.

Target	Hypothetical Spill Location																							
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Land	22	6	23	4	n	2	6	11	2	11	57	60	37	58	60	22	48	36	69	36	61	41	64	75
Resource Area 1	n	4	62	20	n	n	2	9	9	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	19	41	5	n	n	2	5	2	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 3	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	2	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	5	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 9	n	n	n	n	n	16	5	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 10	n	n	n	9	n	44	33	12	12	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 11	n	n	9	40	n	9	7	2	21	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	12	13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-3. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Resource Area within 30 days.

Target	Hypothetical Spill Location									
	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
Land	84	80	77	77	78	89	72	41	26	7
Resource Area 1	n	n	n	n	n	n	n	n	n	n
Resource Area 2	n	n	n	n	n	n	n	n	n	n
Resource Area 3	n	n	n	n	n	n	n	n	n	n
Resource Area 4	n	n	n	n	n	n	n	n	n	n
Resource Area 5	n	n	n	n	n	n	n	n	n	n
Resource Area 6	n	n	n	n	n	n	n	n	n	n
Resource Area 7	n	n	n	n	n	n	n	n	n	n
Resource Area 8	n	n	n	n	n	n	n	n	n	**
Resource Area 9	n	n	n	n	n	n	n	n	n	56
Resource Area 10	n	n	n	n	n	n	n	n	n	12
Resource Area 11	n	n	n	n	n	n	n	n	n	n
Resource Area 12	n	n	n	n	n	n	n	n	n	n
Resource Area 13	n	n	n	n	n	n	n	n	n	n
Resource Area 14	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-4. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 3 days.

Target	Hypothetical Spill Location																								
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 4	12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3
Sea Target 6	n	2	16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	9	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	2	17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	20	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n	n	n	8	3	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-4. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 3 days.

Target	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
	Hypothetical Spill Location																								
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	13	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	**	n	28	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-4. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 3 days.

Target	Hypothetical Spill Location																							
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	23	2	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 4	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	n	n	n	13	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-4. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 3 days.

Target	Hypothetical Spill Location									
	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
Sea Target 1	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	n	n	n	n	n
Sea Target 4	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-5. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 10 days.

Target	Hypothetical Spill Location																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	12	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 3	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 4	33	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9
Sea Target 5	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3
Sea Target 6	2	12	20	2	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3
Sea Target 7	n	n	2	8	2	20	2	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	6	n	n	n	2	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	3	6	n	n	n	n
Sea Target 11	n	n	n	n	2	n	n	2	3	17	n	n	n	n	3	29	n	n	2	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	2	3	14	21	4	17	2	3	n	n	6	n	n	n	n	n	n	n	n	n
Sea Target 13	n	2	n	n	n	n	23	8	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	21	4	4	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	2	2	n	n	2	8	17	20	8	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	2	n	n	2	n	15	n	n	n	n	6	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	2	12	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-5. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 10 days.

Target	Hypothetical Spill Location																								
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n
Sea Target 3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n
Sea Target 4	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	8	6	6	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 6	2	n	26	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	2	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	32	2	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	10	**	n	32	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-5. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 10 days.

Target	Hypothetical Spill Location																							
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	23	23	9	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 4	n	n	n	n	n	n	2	3	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	n	2	n	18	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	n	n	n	n	n	2	2	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-5. (Continued) -- **Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 10 days.**

Target	Hypothetical Spill Location									
	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
Sea Target 1	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	n	n	n	n	n
Sea Target 4	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-6. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 30 days.

Target	Hypothetical Spill Location																								
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
Sea Target 1	n	n	2	9	n	5	n	n	n	n	n	n	n	n	n	n	n	21	n	n	n	n	n	n	n
Sea Target 2	3	5	9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5
Sea Target 3	17	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11
Sea Target 4	33	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9
Sea Target 5	4	19	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3
Sea Target 6	2	14	20	19	n	12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9
Sea Target 7	3	12	6	8	15	20	6	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	5	9	8	6	14	3	6	5	5	2	2	n	n	n	n	n	2	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	3	2	n	n	3	9	2	n	2	n	2	2	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	2	n	9	2	n	3	n	3	5	6	8	n	n	2	3	21	10	2	n	n
Sea Target 11	n	n	n	2	2	5	6	14	12	18	11	2	9	n	3	29	n	n	17	n	n	n	n	n	n
Sea Target 12	2	3	n	n	2	2	11	15	21	23	17	3	3	n	n	19	n	n	n	n	n	n	n	n	2
Sea Target 13	n	2	n	n	n	8	23	21	10	2	8	n	n	n	2	n	n	n	n	n	n	n	n	n	2
Sea Target 14	n	2	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	6	21	23	4	2	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	2	2	n	n	n	2	2	n	n	2	14	18	21	19	2	n	n	n	n	n	n	n	n	2
Sea Target 17	n	n	n	2	n	2	5	5	n	2	11	12	15	11	17	n	n	n	2	23	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	5	2	5	9	11	2	14	3	n	n	2	14	2	n	2	4	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	12	2	4	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	13

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-6. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 30 days.

Target	Hypothetical Spill Location																								
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
Sea Target 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	7	n
Sea Target 2	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	5	n
Sea Target 3	5	2	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	13	n
Sea Target 4	8	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	8	12	19	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 6	5	6	27	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	3	3	11	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n
Sea Target 8	n	2	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	5	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	4	5	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
Sea Target 12	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	3	3	2	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	2	2	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	4	1	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	35	5	2	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	12	**	n	32	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-6. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 30 days.

Target	Hypothetical Spill Location																							
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14
Sea Target 1	n	n	1	7	n	2	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	14	n	5	9	19	21	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	26	23	14	7	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 4	n	n	n	n	n	5	3	3	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	8	5	10	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	n	2	n	n	n	2	2	9	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	1	n	n	n	n	2	5	2	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	9	5	n	n	2	2	7	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	2	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	4	5	5	n	n	n	2	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	2	6	n	n	n	2	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	1	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	15	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-6. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain Sea Target within 30 days.

Target	Hypothetical Spill Location									
	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
Sea Target 1	n	n	n	n	n	n	n	n	n	n
Sea Target 2	n	n	n	n	n	n	n	n	n	n
Sea Target 3	n	n	n	n	n	n	n	n	n	5
Sea Target 4	n	n	n	n	n	n	n	n	n	n
Sea Target 5	n	n	n	n	n	n	n	n	n	n
Sea Target 6	n	n	n	n	n	n	n	n	n	n
Sea Target 7	n	n	n	n	n	n	n	n	n	n
Sea Target 8	n	n	n	n	n	n	n	n	n	n
Sea Target 9	n	n	n	n	n	n	n	n	n	n
Sea Target 10	n	n	n	n	n	n	n	n	n	n
Sea Target 11	n	n	n	n	n	n	n	n	n	n
Sea Target 12	n	n	n	n	n	n	n	n	n	n
Sea Target 13	n	n	n	n	n	n	n	n	n	n
Sea Target 14	n	n	n	n	n	n	n	n	n	n
Sea Target 15	n	n	n	n	n	n	n	n	n	n
Sea Target 16	n	n	n	n	n	n	n	n	n	n
Sea Target 17	n	n	n	n	n	n	n	n	n	n
Sea Target 18	n	n	n	n	n	n	n	n	n	n
Sea Target 19	n	n	n	n	n	n	n	n	n	n
Sea Target 20	n	n	n	n	n	n	n	n	n	n
Sea Target 21	n	n	n	n	n	n	n	n	n	n
Sea Target 22	n	n	n	n	n	n	n	n	n	n
Sea Target 23	n	n	n	n	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.

Table G-7. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment witnin 3 days.

Segment	Hypothetical Spill Location																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
146	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	46	n	n	n	n	n	n

Table G-7. -- Probabilities (expressed as percent chance) that an oil spill starting at a
(Continued) particular location will contact a certain land or boundary segment within 3 days.

Segment	Hypothetical Spill Location																							
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
11	n	3	n	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
12	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
33	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n
34	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n
145	n	n	n	n	n	n	n	n	n	4	n	n	n	n	n	n	n	n	14	n	n	n	n	n	n

Table G-7. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 3 days.

Segment	Hypothetical Spill Location									
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5
7	n	n	n	n	n	n	5	n	n	n
8	n	n	n	n	n	n	n	2	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-7. (Continued)

Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 3 days.

Land Segment	Hypothetical Spill Location																							
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
40	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
42	n	n	2	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
52	n	n	n	n	n	n	n	n	25	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
57	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n
59	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	2	n	14	n	n	n
61	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
62	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	2	n	n	n	n	n
107	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
113	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-8. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 10 days.

Segment	Hypothetical Spill Location																							
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
7	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
8	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4
11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
33	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
146	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	46	n	n	n	n	n	n
147	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n

Table G-8. -- (Continued) Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 10 days.

Segment	Hypothetical Spill Location																							
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
10	2	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
11	10	11	n	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
12	n	3	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
33	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	n	n	n	n	n
34	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	n	n	n	n	n
50	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4
52	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n
53	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n
55	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
106	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
107	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
109	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
144	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
145	n	n	n	n	n	n	n	n	n	20	n	n	n	n	n	n	n	n	32	n	n	n	n	n	n

Note: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-8. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 10 days.

Segment	Hypothetical Spill Location									
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5
7	n	n	n	n	n	n	5	n	n	n
8	n	n	n	n	n	n	n	2	n	5
147	n	n	2	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-8. (Continued)

Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 10 days.

Land Segment	Hypothetical Spill Location																						
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
40	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
42	n	2	2	n	n	5	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
43	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
48	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
52	n	n	n	n	2	n	2	n	33	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
53	n	n	n	n	n	n	n	n	n	n	2	n	n	15	n	n	n	n	n	n	n	n	n	n
55	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
56	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n
57	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	20	2	n
58	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	2	n	5	n	n	n
59	n	n	n	n	n	n	n	n	n	n	2	2	n	2	2	5	7	7	5	2	26	n	n	n
60	n	n	n	n	n	n	n	2	n	n	n	7	9	5	n	n	5	5	n	n	n	n	n	n
61	n	n	n	n	n	n	n	n	n	n	n	n	n	2	10	n	n	n	n	2	n	n	n	n
62	n	n	n	n	n	n	n	n	n	n	n	n	n	n	18	n	n	n	2	n	n	n	n	n
64	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	8	n	n	n	n
65	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
106	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
107	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	12	n	n	n	n
108	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	5	n	n	n	n
110	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	2	n	n	n	n
112	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	5	5	n	n	n	n
113	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	2	n	9	n
148	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-9. -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 30 days.

Segment	Hypothetical Spill Location																								
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	B1
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
7	8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3
8	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
9	12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
10	13	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6
11	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19
12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4
28	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
29	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n
33	n	n	n	n	n	n	n	n	n	n	n	2	n	2	n	n	n	n	n	n	n	n	n	n	n
144	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
145	n	n	n	2	n	2	n	n	2	n	n	n	n	n	2	2	n	n	n	2	n	n	n	n	n
146	n	n	n	2	2	9	3	2	9	15	3	2	6	2	3	8	n	n	46	n	12	n	n	n	n
147	n	3	6	5	3	5	3	3	8	6	2	2	2	n	n	5	n	n	n	n	n	n	n	n	n
173	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
174	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
175	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n
176	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n
177	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-9. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 30 days.

Segment	Hypothetical Spill Location																								
	B2	B3	B15	D1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n
7	2	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	n
8	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
9	n	2	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
10	2	3	4	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
11	19	11	n	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
12	6	3	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
13	4	19	n	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	n	8	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
33	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	n	n	n	n	n
34	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	n	n	n	n	n
41	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
42	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4
48	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
49	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
50	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	16
51	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	n	n	n	n	n	n	n
52	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	n	n	n	n	n	n	n
53	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n
54	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n
55	n	n	n	n	n	n	n	n	1	1	1	n	n	n	n	n	n	1	n	n	n	n	n	n	n
56	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	5	n	n	n	n	n	n	n
57	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n	n	n	n	n	n	n	n
58	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n
59	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n
61	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n
62	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n
63	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	n	n	n	n	n	n	n	n
64	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
65	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
106	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
107	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
109	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n
110	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n
111	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	n	n	n	n	n	n	n	n
112	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n
113	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	n	n	n	n	n	n	n	n
127	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n
131	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n
132	n	n	n	n	n	n	n	n	n	n	n	n	5	7	5	n	n	n	n	n	n	n	n	n	n
133	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
144	n	n	n	n	n	n	n	1	n	2	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
145	n	n	n	n	n	n	6	4	n	21	n	n	n	n	n	n	n	n	35	5	n	n	n	n	n
146	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	1	5	n	n
147	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	9	n	n
181	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-9. (Continued) -- Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land or boundary segment within 30 days.

Segment	Hypothetical Spill Location									
	P22	P23	P24	P25	P26	F1	F2	F3	F4	F5
7	n	n	n	n	n	n	5	2	n	n
8	n	n	n	n	n	n	n	2	n	5
9	n	n	n	n	n	2	n	n	n	n
10	n	n	n	n	n	n	2	2	2	n
11	n	n	n	n	n	n	n	5	n	3
12	n	n	n	n	n	n	n	n	n	3
34	1	n	n	n	n	n	n	n	n	n
39	4	n	n	n	n	n	n	n	n	n
40	6	n	n	n	n	n	n	n	n	n
41	4	n	n	n	n	n	n	n	n	n
56	2	n	n	n	n	n	n	n	n	n
59	5	n	n	n	n	n	n	n	n	n
146	n	6	11	2	n	n	n	n	n	n
147	n	n	12	2	n	n	n	n	n	n
162	n	n	n	n	2	n	n	n	n	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-9. (Continued)

Probabilities (expressed as percent chance) that an oil spill starting
at a particular location will contact a certain land segment
within 30 days.

Land Segment	Hypothetical Spill Location																							
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5
7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
38	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
40	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
42	n	16	5	n	n	5	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
43	n	16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
44	n	7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
45	n	15	5	n	n	3	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n
47	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
48	27	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
49	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
50	n	3	n	18	5	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
51	n	n	5	7	15	2	8	2	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
52	2	n	2	n	7	n	3	8	42	5	22	8	5	8	n	2	3	n	n	n	n	n	n	n
53	n	n	n	n	n	n	n	n	n	2	2	5	20	23	n	10	15	5	n	n	5	n	n	n
54	2	n	2	n	n	n	n	n	n	n	n	n	2	n	n	n	2	n	n	n	n	n	n	n
55	n	n	2	2	2	2	5	n	n	5	n	n	2	2	n	2	n	2	n	n	n	2	n	n
56	n	n	n	n	2	n	2	n	n	n	2	5	n	n	n	n	n	n	n	n	n	10	n	n
57	n	n	n	2	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	20	2	n
58	n	n	n	n	2	n	2	n	n	2	2	n	2	n	2	5	2	7	2	n	9	n	n	n
59	5	n	5	12	9	n	7	7	12	9	16	7	12	9	5	9	14	7	5	2	26	n	n	n
60	12	2	9	14	16	9	14	16	9	12	9	7	14	12	5	5	5	5	5	n	n	n	n	n
61	n	n	n	n	n	n	n	n	n	n	n	n	n	3	23	20	17	12	12	2	8	n	n	n
62	n	n	n	n	n	n	n	n	n	n	n	n	2	n	18	7	3	15	12	n	8	n	n	n
63	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	2	n	n	n	2	n
64	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	7	8	8	7	n	n	n
65	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	10	2	n	n	n
66	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n
68	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n
75	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n
76	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	8	n	n	n	n
105	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
106	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n
107	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	12	n	n	2	n
108	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	n	n	n	n	9	n	n	n	n
109	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
110	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	5	n	n	5	5	n	n	n	n
111	n	n	n	n	n	n	n	n	n	n	n	n	n	2	2	2	2	2	5	5	n	n	n	n
112	n	n	n	2	n	n	2	n	5	n	5	n	2	7	14	7	7	9	9	9	n	n	n	n
113	n	n	n	n	n	n	n	2	n	n	2	n	2	7	2	5	2	2	7	7	5	n	9	n
114	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	2	n	n	n

Table G-9. (Continued)

Probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 30 days.

Land Segment	Hypothetical Spill Location																							
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23	E24
116	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n
117	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n
128	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n
130	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	2	n
131	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	5	n
144	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
148	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	2	n

Notes: ** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table G-10. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land or biological resource areas over the expected production life of the lease area, for port and at-sea spills of 1,000 barrels and greater.

Target	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	3	0.0	86	2.0	4	0.0	8	0.1	96	3.2	9	0.1	23	0.3	**	5.5	27	0.3
Resource Area 1	n	0.0	49	0.7	n	0.0	n	0.0	71	1.2	n	0.0	4	0.0	81	1.7	4	0.0
Resource Area 2	n	0.0	31	0.4	n	0.0	n	0.0	45	0.6	n	0.0	1	0.0	63	1.0	1	0.0
Resource Area 3	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Resource Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Resource Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Resource Area 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	5	0.1	5	0.1	6	0.1
Resource Area 7	17	0.2	17	0.2	19	0.2	20	0.2	20	0.2	23	0.3	24	0.3	24	0.3	27	0.3
Resource Area 8	n	0.0	37	0.5	2	0.0	n	0.0	41	0.5	2	0.0	n	0.0	44	0.6	3	0.0
Resource Area 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	38	0.5	2	0.0
Resource Area 10	n	0.0	3	0.0	n	0.0	n	0.0	25	0.3	1	0.0	5	0.1	42	0.5	8	0.1
Resource Area 11	n	0.0	n	0.0	n	0.0	n	0.0	16	0.2	n	0.0	3	0.0	61	1.0	3	0.0
Resource Area 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	50	0.7	n	0.0
Resource Area 13	n	0.0	3	0.0	n	0.0	n	0.0	3	0.0	n	0.0	n	0.0	13	0.1	n	0.0
Resource Area 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-11. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land or biological resource areas over the expected production life of the lease area, for port and at-sea spills of 100,000 barrels and greater.

Target	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	n	0.0	27	0.3	n	0.0	n	0.0	31	0.4	1	0.0	1	0.0	42	0.5	2	0.0
Resource Area 1	n	0.0	8	0.1	n	0.0	n	0.0	13	0.1	n	0.0	n	0.0	16	0.2	n	0.0
Resource Area 2	n	0.0	3	0.0	n	0.0	n	0.0	5	0.0	n	0.0	n	0.0	8	0.1	n	0.0
Resource Area 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Resource Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Resource Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Resource Area 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Resource Area 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	1	0.0	1	0.0	2	0.0
Resource Area 8	n	0.0	9	0.1	n	0.0	n	0.0	10	0.1	n	0.0	n	0.0	11	0.1	n	0.0
Resource Area 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	8	0.1	n	0.0
Resource Area 10	n	0.0	1	0.0	n	0.0	n	0.0	5	0.0	n	0.0	n	0.0	8	0.1	1	0.0
Resource Area 11	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	9	0.1	n	0.0
Resource Area 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	6	0.1	n	0.0
Resource Area 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Resource Area 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-12. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting sea targets over the expected production life of the lease area, for spills of 1,000 barrels and greater.

Target	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Sea Target 1	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	25	0.3	n	0.0
Sea Target 2	n	0.0	n	0.0	n	0.0	n	0.0	6	0.1	n	0.0	5	0.1	21	0.2	5	0.0
Sea Target 3	1	0.0	1	0.0	1	0.0	3	0.0	6	0.1	4	0.0	6	0.1	17	0.2	6	0.1
Sea Target 4	1	0.0	1	0.0	1	0.0	3	0.0	3	0.0	4	0.0	4	0.0	4	0.0	5	0.1
Sea Target 5	1	0.0	1	0.0	1	0.0	4	0.0	4	0.0	4	0.0	8	0.1	8	0.1	9	0.1
Sea Target 6	1	0.0	1	0.0	1	0.0	4	0.0	5	0.1	4	0.0	7	0.1	21	0.2	7	0.1
Sea Target 7	n	0.0	1	0.0	n	0.0	n	0.0	12	0.1	n	0.0	4	0.0	26	0.3	4	0.0
Sea Target 8	n	0.0	n	0.0	n	0.0	n	0.0	18	0.2	n	0.0	2	0.0	34	0.4	2	0.0
Sea Target 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	12	0.1	n	0.0
Sea Target 10	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	17	0.2	n	0.0
Sea Target 11	n	0.0	5	0.1	n	0.0	n	0.0	15	0.2	n	0.0	n	0.0	23	0.3	n	0.0
Sea Target 12	n	0.0	2	0.0	n	0.0	n	0.0	5	0.1	n	0.0	1	0.0	16	0.2	1	0.0
Sea Target 13	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	n	0.0	2	0.0	7	0.1	2	0.0
Sea Target 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Sea Target 15	n	0.0	1	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	n	0.0
Sea Target 16	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	n	0.0	1	0.0	5	0.1	1	0.0
Sea Target 17	n	0.0	n	0.0	n	0.0	n	0.0	5	0.0	n	0.0	n	0.0	15	0.2	n	0.0
Sea Target 18	n	0.0	5	0.0	n	0.0	n	0.0	15	0.2	n	0.0	n	0.0	23	0.3	n	0.0
Sea Target 19	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Sea Target 20	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 21	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 22	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 23	20	0.2	20	0.2	23	0.3	22	0.2	22	0.2	24	0.3	23	0.3	23	0.3	25	0.3

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-13. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting sea targets over the expected production life of the lease area, for spills of 100,000 barrels and greater.

Target	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Sea Target 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	n	0.0
Sea Target 2	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	3	0.0	n	0.0
Sea Target 3	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	1	0.0
Sea Target 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Sea Target 7	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	n	0.0
Sea Target 8	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	4	0.0	n	0.0
Sea Target 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Sea Target 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
Sea Target 11	n	0.0	1	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	n	0.0
Sea Target 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Sea Target 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 15	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 16	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 17	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	n	0.0
Sea Target 18	n	0.0	1	0.0	n	0.0	n	0.0	3	0.0	n	0.0	n	0.0	4	0.0	n	0.0
Sea Target 19	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 20	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 21	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 22	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 23	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	1	0.0	1	0.0	2	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-14. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land/boundary segments over the expected production life of the lease area, for spills of 1,000 barrels and greater.

Land Segment	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	6	0.1	n	0.0
7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	7	0.1	1	0.0
8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0
9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0
10	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	3	0.0	3	0.0	4	0.0
11	2	0.0	2	0.0	3	0.0	5	0.1	5	0.1	6	0.1	9	0.1	9	0.1	10	0.1
12	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	3	0.0	3	0.0	3	0.0
13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	7	0.1	7	0.1	8	0.1
14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0	2	0.0
42	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	1	0.0	n	0.0
45	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
50	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	5	0.1	n	0.0
51	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	9	0.1	n	0.0
52	n	0.0	23	0.3	n	0.0	n	0.0	26	0.3	n	0.0	n	0.0	35	0.5	n	0.0
53	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	4	0.0	n	0.0
54	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
55	n	0.0	n	0.0	n	0.0	n	0.0	4	0.0	n	0.0	n	0.0	10	0.1	n	0.0
56	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	3	0.0	n	0.0
57	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	3	0.0	n	0.0
58	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
59	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	18	0.2	n	0.0
60	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	21	0.2	n	0.0
61	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
63	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
64	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	1	0.0	n	0.0
65	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
66	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
76	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
103	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
104	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
106	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
107	n	0.0	1	0.0	n	0.0	n	0.0	2	0.0	n	0.0	n	0.0	2	0.0	n	0.0
108	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
110	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
111	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
112	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	6	0.1	n	0.0

Table G-14. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean)
(continued) occurring and contacting land/boundary segments over the expected production life of the lease area, for spills of 1,000 barrels and greater.

Land Segment	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
113	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	n	0.0	4	0.0	n	0.0
130	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
131	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	n	0.0
132	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	15	0.2	n	0.0
133	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
144	n	0.0	n	0.0	n	0.0	n	0.0	7	0.1	n	0.0	n	0.0	11	0.1	n	0.0
145	n	0.0	53	0.7	n	0.0	n	0.0	82	1.7	n	0.0	n	0.0	84	1.8	n	0.0
146	n	0.0	8	0.1	n	0.0	n	0.0	9	0.1	n	0.0	n	0.0	28	0.3	n	0.0
147	n	0.0	16	0.2	n	0.0	n	0.0	19	0.2	n	0.0	1	0.0	35	0.4	1	0.0
181	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
190	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
191	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
192	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
193	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
196	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
197	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
198	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0
199	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than 0.5 percent probability of one or more contacts within 30 days are not shown.

Table G-15. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land/boundary segments over the expected production life of the lease area, for spills of 100,000 barrels and greater.

Land Segment	------- Within 3 days ---------						------- Within 10 days --------						------- Within 30 days --------					
	PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING		PROPOSAL PIPELINE TRANSP.		CUMUL-ATIVE CASE		PROPOSAL OFFSHORE LOADING	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0
13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0
52	n	0.0	4	0.0	n	0.0	n	0.0	4	0.0	n	0.0	n	0.0	4	0.0	n	0.0
59	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
60	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
132	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
144	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
145	n	0.0	8	0.1	n	0.0	n	0.0	13	0.1	n	0.0	n	0.0	13	0.1	n	0.0
146	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	n	0.0
147	n	0.0	3	0.0	n	0.0	n	0.0	3	0.0	n	0.0	n	0.0	6	0.1	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than 0.5 percent probability of one or more contacts within 30 days are not shown.

Table G-16. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, pipeline transportation scenario, for spills of 1,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	3	0.0	3	0.0	8	0.1	7	0.1	23	0.3	21	0.2
Biol. Res. Area 1	n	0.0	n	0.0	n	0.0	n	0.0	4	0.0	4	0.0
Biol. Res. Area 2	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Biol. Res. Area 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 6	n	0.0	n	0.0	n	0.0	n	0.0	5	0.1	5	0.1
Biol. Res. Area 7	17	0.2	14	0.2	20	0.2	17	0.2	24	0.3	20	0.2
Biol. Res. Area 8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 9	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Biol. Res. Area 10	n	0.0	n	0.0	n	0.0	n	0.0	5	0.1	5	0.0
Biol. Res. Area 11	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	3	0.0
Biol. Res. Area 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-17. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, pipeline transportation scenario, for spills of 1,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Sea Target 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 2	n	0.0	n	0.0	n	0.0	n	0.0	5	0.0	4	0.0
Sea Target 3	1	0.0	n	0.0	3	0.0	3	0.0	6	0.1	5	0.1
Sea Target 4	1	0.0	1	0.0	3	0.0	3	0.0	4	0.0	4	0.0
Sea Target 5	1	0.0	1	0.0	4	0.0	4	0.0	8	0.1	8	0.1
Sea Target 6	1	0.0	1	0.0	4	0.0	4	0.0	7	0.1	7	0.1
Sea Target 7	n	0.0	n	0.0	n	0.0	n	0.0	4	0.0	4	0.0
Sea Target 8	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0
Sea Target 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 12	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Sea Target 13	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	1	0.0
Sea Target 14	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Sea Target 15	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 16	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Sea Target 17	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 18	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 19	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 20	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 21	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 22	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 23	20	0.2	19	0.2	22	0.2	20	0.2	23	0.3	21	0.2

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-18. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, pipeline transportation scenario, for spills of 1,000 barrels and greater.

Land Segment	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
7	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
8	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
9	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
10	n	0.0	n	0.0	1	0.0	1	0.0	3	0.0	3	0.0
11	2	0.0	2	0.0	5	0.1	5	0.0	9	0.1	8	0.1
12	n	0.0	n	0.0	1	0.0	1	0.0	3	0.0	2	0.0
13	n	0.0	n	0.0	n	0.0	n	0.0	7	0.1	6	0.1
14	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0
147	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than 0.5 percent probability of one or more contacts within 30 days are not shown.

Table G-19. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, offshore loading transportation scenario, for spills of 1,000 barrels and greater.

	Within 3 days				Within 10 days				Within 30 days			
Target	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	4	0.0	3	0.0	9	0.1	8	0.1	27	0.3	24	0.3
Biol. Res. Area 1	n	0.0	n	0.0	n	0.0	n	0.0	4	0.0	4	0.0
Biol. Res. Area 2	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Biol. Res. Area 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 6	n	0.0	n	0.0	n	0.0	n	0.0	6	0.1	5	0.1
Biol. Res. Area 7	19	0.2	16	0.2	23	0.3	20	0.2	27	0.3	23	0.3
Biol. Res. Area 8	2	0.0	2	0.0	2	0.0	2	0.0	3	0.0	2	0.0
Biol. Res. Area 9	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0
Biol. Res. Area 10	n	0.0	n	0.0	1	0.0	1	0.0	8	0.1	7	0.1
Biol. Res. Area 11	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	3	0.0
Biol. Res. Area 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-20. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, offshore loading transportation scenario, for spills of 1,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Sea Target 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 2	n	0.0	n	0.0	n	0.0	n	0.0	5	0.0	5	0.0
Sea Target 3	1	0.0	1	0.0	4	0.0	3	0.0	7	0.1	6	0.1
Sea Target 4	1	0.0	1	0.0	4	0.0	4	0.0	5	0.1	5	0.1
Sea Target 5	1	0.0	1	0.0	4	0.0	4	0.0	9	0.1	9	0.1
Sea Target 6	1	0.0	1	0.0	4	0.0	4	0.0	8	0.1	7	0.1
Sea Target 7	n	0.0	n	0.0	n	0.0	n	0.0	4	0.0	4	0.0
Sea Target 8	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0
Sea Target 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 12	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Sea Target 13	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0
Sea Target 14	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0	1	0.0
Sea Target 15	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 16	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Sea Target 17	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 18	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 19	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 20	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 21	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 22	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 23	23	0.3	21	0.2	24	0.3	22	0.2	25	0.3	23	0.3

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-21. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, offshore loading transportation scenario, for spills of 1,000 barrels and greater.

Land Segment	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
7	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
8	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
9	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
10	n	0.0	n	0.0	1	0.0	1	0.0	4	0.0	4	0.0
11	3	0.0	2	0.0	6	0.1	5	0.1	10	0.1	9	0.1
12	n	0.0	n	0.0	1	0.0	1	0.0	3	0.0	3	0.0
13	n	0.0	n	0.0	n	0.0	n	0.0	8	0.1	7	0.1
14	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	2	0.0
147	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than 0.5 percent probability of one or more contacts within 30 days are not shown.

Table G-22. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, pipeline transportation scenario, for spills of 100,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Biol. Res. Area 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 2	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Biol. Res. Area 8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-23. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets and land segments over the expected production life of the lease area, pipeline transportation scenario, for spills of 100,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Sea Target 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 2	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 15	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 16	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 17	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 18	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 19	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 20	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 21	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 22	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 23	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Land Segments with less than 0.5 percent probability of one or more contacts within 30 days are not shown.

Table G-24. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, offshore loading transportation scenario, for spills of 100,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	n	0.0	n	0.0	1	0.0	1	0.0	2	0.0	2	0.0
Biol. Res. Area 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 2	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 7	1	0.0	1	0.0	2	0.0	1	0.0	2	0.0	2	0.0
Biol. Res. Area 8	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Biol. Res. Area 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 10	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Biol. Res. Area 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Biol. Res. Area 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-25. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting targets over the expected production life of the lease area, offshore loading transportation scenario, for spills of 100,000 barrels and greater.

Target	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Sea Target 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 2	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 3	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Sea Target 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 15	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 16	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 17	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 18	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 19	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 20	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 21	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 22	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Sea Target 23	1	0.0	1	0.0	2	0.0	1	0.0	2	0.0	2	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent.

Table G-26. -- Probabilities (expressed as percent chance) of one or more spills, and the estimated number of spills (mean) occurring and contacting land segments over the expected production life of the lease area, offshore loading transportation scenario, for spills of 100,000 barrels and greater.

Land Segment	------- Within 3 days ---------				------- Within 10 days --------				------- Within 30 days --------			
	PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV		PROPOSAL		DEFERRAL ALTERN. IV	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
11	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
13	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0

Note: n = less than 0.5 percent; ** = greater than 99.5 percent. Segments with less than 0.5 percent probability of one or more contacts within 30 days are not shown.

FIGURE G-1

SEA TARGETS FOR THE NORTH ALEUTIAN BASIN LEASE SALE

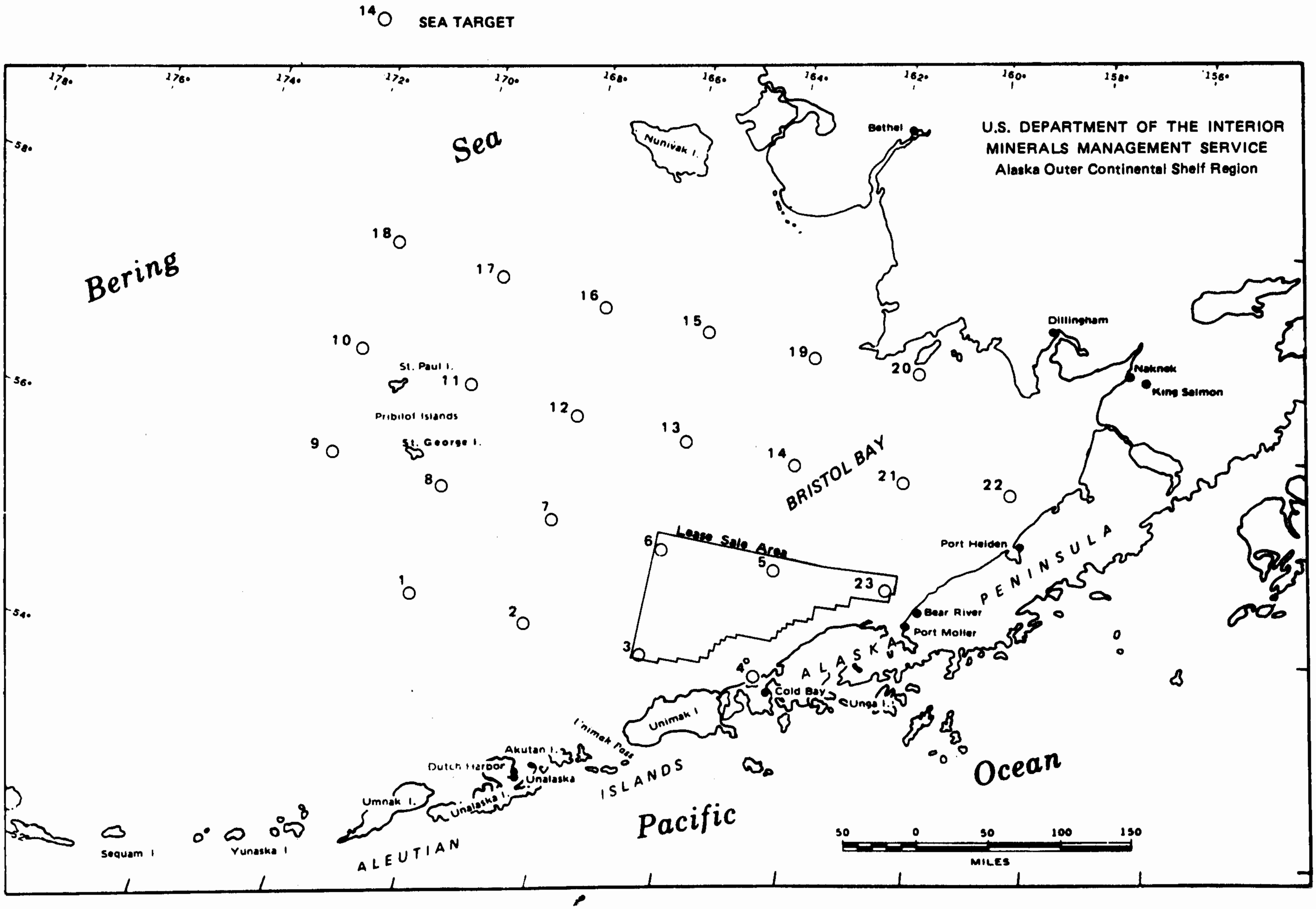
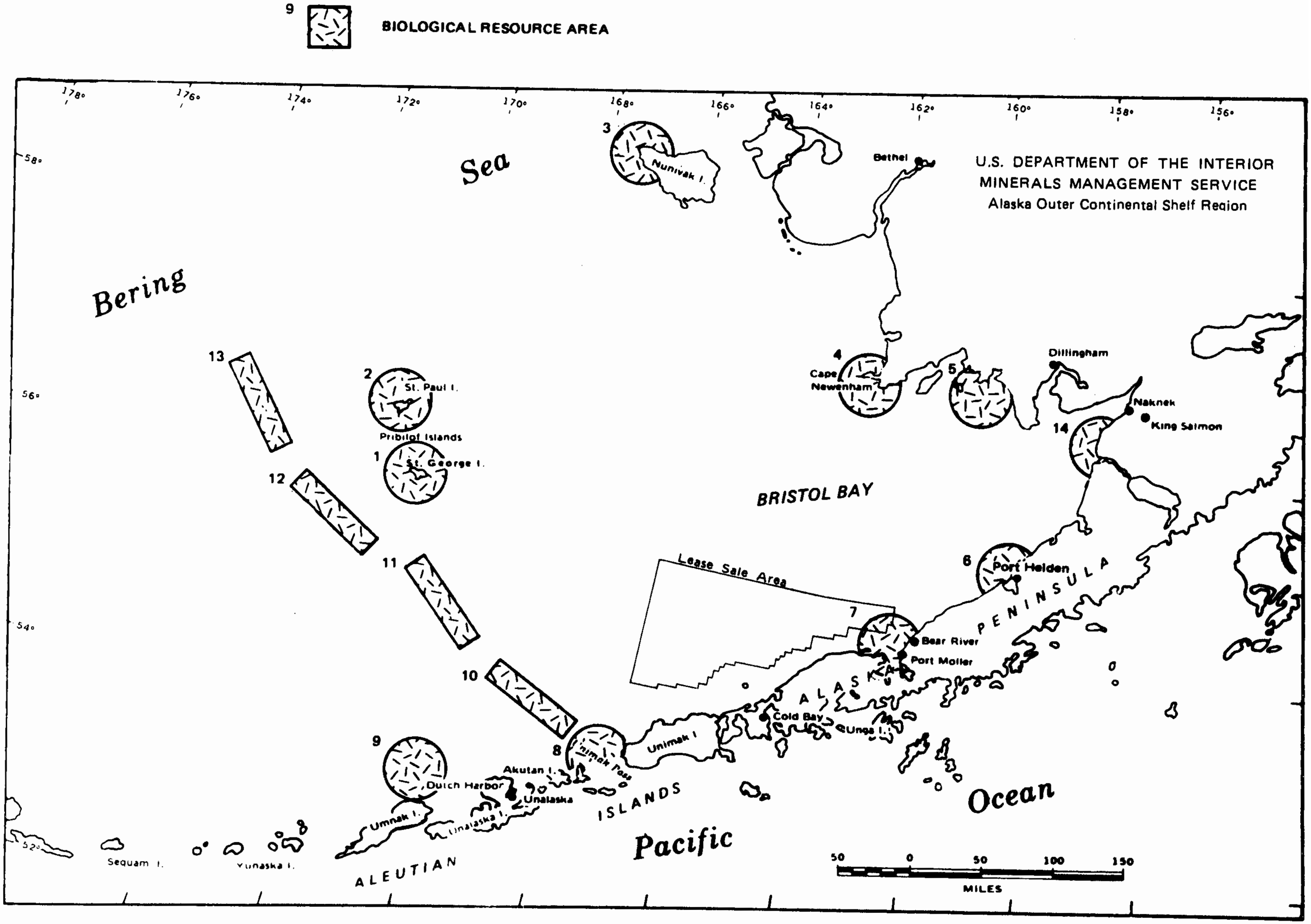


FIGURE G-2

BIOLOGICAL RESOURCE AREAS FOR THE NORTH ALEUTIAN BASIN LEASE SALE



APPENDIX H

Biological Opinion on Endangered Species

Requested by

Minerals Management Service

Prepared by

National Marine Fisheries Service

and

Fish and Wildlife Service

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Washington, D.C. 20235

F/M411:PM

MAR 2 1 1984

Mr. William D. Bettenberg
Director
Minerals Management Service
Department of the Interior
Washington, D.C. 20240

Dear Mr. Bettenberg:

Enclosed is the Biological Opinion prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), concerning the potential impacts to endangered whale species of Outer Continental Shelf (OCS) oil and gas leasing and exploration activities in the St. George and North Aleutian Basins.

Based on our review of the best available information on the proposed leasing and exploration activities in the St. George and North Aleutian Basins of the Bering Sea and on the biology and ecology of endangered whales in these areas, we have made the following determinations: (1) the general conclusions of the January 22, 1982, Bering Sea Regional and March 9, 1983, St. George Basin Biological Opinions remain valid; (2) the proposed activities are not likely to jeopardize the continued existence of the fin, humpback, bowhead, sei, blue, or sperm whales; (3) certain of the proposed activities are likely to jeopardize the continued existence of the gray and right whales; and (4) cumulative impacts to the right and gray whales may result from activities in the Bering Sea and other OCS areas. However, additional information is needed before a more reliable opinion can be rendered on such cumulative impacts.

The NMFS believes that the DOI can plan activities associated with OCS oil and gas leasing and exploration in such a way as to avoid the likelihood of jeopardizing the continued existence of the right and grey whales. The Biological Opinion contains reasonable and prudent alternatives that DOI can adopt to meet that goal.

Consultation must be reinitiated if there are subsequent modifications to the proposed action, if a species or critical habitat that occurs in the area covered by your program is subsequently listed, or if new information reveals impacts of the identified activities that may affect listed species. In addition, consultation must be reinitiated before development and production activities occur in the area.

I look forward to continued cooperation during future consultations.

Sincerely yours,

James E. Douglas, Jr.

for William G. Gordon
Assistant Administrator
for Fisheries

Enclosure

Endangered Species Act

Section 7 Consultation - Biological Opinion

Agency:

Minerals Management Service

Activities Considered During Consultation:

Oil and Gas Leasing and Exploration--St. George Basin and North Aleutian Basin

Consultation Conducted By:

National Marine Fisheries Service

Date of Issuance: MAR 2 1 1984

Background:

By letter of September 28, 1983, the Minerals Management Service (MMS) of the Department of the Interior (DOI) requested reinitiation of formal consultation with the National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act (ESA) for two proposed lease sales on the Outer Continental Shelf (OCS) of the Bering Sea: the St. George Basin (December 1984) and the North Aleutian Basin (April 1985) proposed lease offerings. Because these proposed lease offerings are scheduled within five months of each other, and will be addressed in a single environmental impact statement (EIS), and because the animals and ecosystems in these adjoining lease areas are similar, the MMS requested that formal consultation consider both areas simultaneously.

On October 4, 1983, a formal Section 7 consultation meeting was held between MMS and NMFS. At that meeting MMS provided NMFS with information available on the two proposed lease offerings. This information consisted of maps of lease area boundaries, draft exploration and development scenarios, proposed alternatives and stipulations, and oilspill risk analyses to be included in the EIS.

Previous consultations have been conducted between NMFS and MMS for this region of the Bering Sea OCS. On January 22, 1982, the NMFS issued a regional Biological Opinion for proposed OCS leasing and exploration in four planning areas in the Bering Sea. On March 9, 1983, the NMFS issued a Biological Opinion for St. George Basin Lease Sale 70, which was held on April 12, 1983. Information now available on the two newest proposed lease offerings warrants reexamination of these earlier Biological Opinions to determine if the conclusions they contain remain valid.

This is the NMFS Biological Opinion for the proposed lease offerings in the St. George Basin (December 1984) and North Aleutian Basin (April 1985) areas of the Bering Sea region. Except as modified herein, the information and conclusions of the aforementioned earlier Biological Opinions remain valid. We incorporate these Biological Opinions herein by reference.

New Information on Endangered Whales in the Southeastern Bering Sea:

Little new information is available on the species of endangered whales inhabiting these lease areas. Aerial surveys conducted in 1982 and 1983 (Leatherwood and Evans, 1982) have recorded additional sightings of several whale species within the proposed lease areas, but have not resulted in any increased understanding of whale abundance or distributions in the southeastern Bering Sea.

Our knowledge of gray whale abundance and migratory patterns remains as described in earlier opinions. Gray whales are most abundant along the perimeter of the North Aleutian Basin lease area in the spring (late March-June) where they follow the nearshore waters on their northbound migrations (Braham, in press). This coastal migration may be hindered by winter sea ice in the northern parts of Bristol Bay, and the whales may follow the ice edge on their path north. They return in the fall (October-January) and may traverse the lease areas in considerable numbers as they cross Bristol Bay in a broad front heading for the Alaska Peninsula and Unimak Pass (Rugh, in press).

Fin whales are the most common endangered whale species observed offshore on the shelf and shelf edge of the southeastern Bering Sea during the summer (Leatherwood and Evans, 1982). Some fin whales overwinter in the Bering Sea (Brueggeman, 1983).

Humpback whales are found in the southeastern Bering Sea from May through October (Braham et al., 1982). Most recent sightings have been in or adjacent to the St. George Basin lease area near Unimak Pass, the eastern Aleutian Islands, or widely distributed across the outer shelf east of the Pribilof Islands.

Bowhead whales are known to have occurred in both lease areas in the late winter and early spring (Braham et al., 1982). There have been four recorded

sightings since 1956. During unusual ice conditions, some bowheads are likely to be found in or near the northern sections of the lease areas (Brueggeman, 1982a).

Right whales have recently been observed near St. Matthew Island during the summer (Brueggeman, 1982b). The small population size of this species (less than 200) in the North Pacific has precluded many sightings in recent years. Earlier records suggest that right whales regularly occurred in the southeastern Bering Sea during the summer (Braham et al., 1982).

Other endangered whales, i.e., blue, sei, and sperm whales, may be occasional or rare entrants to these waters.

Description of Proposed Activities:

A general description of the activities associated with OCS leasing and exploration, as well as exploration scenarios for St. George Basin Sale 70 and North Aleutian Shelf Sale 75 were given in the Bering Sea Region Biological Opinion (pp. 6-10 of Attachment 1). Subsequent information on the exploration scenario for St. George Basin Sale 70 was given in the Draft and Final Environmental Impact Statements for that sale (DOI, 1981 and 1982). This information is incorporated herein by reference. This information suggests that any exploratory drilling probably would be conducted from either drillships or semisubmersibles. Because of water depth, gravel islands probably would not be used. Depending on the extent and distribution of seasonal sea ice, drilling might continue throughout the year or stop during the winter when sea ice is present (Hameedi, 1982).

Some additional information is available on the lease sales and the activities that may be associated with pre-lease and post-lease exploration in the newest proposed lease offering areas. Deferral alternatives have been identified by the MMS for the St. George Basin offering that would include a 50-mile deletion of tracts around the Pribilof Islands and/or a 50-mile deletion zone around Unimak Pass. Defferal alternatives identified for the North Aleutian Basin lease offering include deletion of the eastern tracts in inner Bristol Bay and/or a deletion of tracts within 25-miles of shore along the Alaska Peninsula.

Exploration scenarios for these sales identify Cold Bay as the location for air support facilities and Unalaska/Dutch Harbor as the marine support base. Estimates of the numbers of drilling rigs and exploratory wells to be drilled are the same in each of the lease offering areas: one exploratory rig will drill one well per year in each area, beginning in 1986 and ending in 1993.

Potential Impacts to Endangered Whales in the North Aleutian Basin:

The kinds of impacts to endangered whales that may be expected from OCS leasing and exploration were discussed in the Bering Sea Region and St. George Basin (Sale 70) Biological Opinions. No new information is available on specific impacts of concern in the St. George Basin area. The specific impacts of concern for the proposed North Aleutian Basin lease offering require additional discussion since further details of the proposed activities are now available.

Fin, gray, and humpback whales are the species most likely to inhabit the southeastern Bering Sea, residing there from approximately late March through

December (Braham et al., 1982). Gray whales probably are the first of these species to arrive. They begin entering the Bering Sea through Unimak Pass in April. Major concentrations of gray whales can be found in Unimak Pass immediately adjacent to Unimak Island and along the coast of the Alaska Peninsula in late March through May during the peak of their migration. If sea ice is present, gray whales may migrate along the ice edge and in leads that form as the ice recedes. During the spring, gray whales would be especially vulnerable to noise and vessel traffic disturbance in Unimak Pass and to any oilspills that may reach this area. Fin whales and humpback whales also may use Unimak Pass in the late spring but at lower densities.

In the summer, fin and humpback whales continue to enter the Bering Sea through Unimak Pass, and possibly other passes along the Aleutian chain, and occupy the shelf and upper slope of outer Bristol Bay. A small portion of the gray whale population inhabits the waters around the Pribilof Islands during the summer. Some right whales may also be present during the summer in portions of these lease areas.

By late fall, these whales begin leaving the Bering Sea. The southward migration routes of fin, humpback, and right whales are not known. Gray whales may cross the continental shelf of outer Bristol Bay in a broad front on their way south and are found in high numbers along the coast of the Alaska Peninsula and at Unimak Pass in November and December (Rugh, in press). The southbound migration of gray whales through Unimak Pass occurs over a somewhat shorter period of time than the northward migration in spring, again entailing virtually the entire population.

Some fin whales may overwinter in ice-free waters in the southeastern Bering Sea and bowhead whales may be present in ice-covered portions of the lease areas.

Impacts from Oilspills

Oilspills can impact whales directly by the oiling of individuals or indirectly by the effects of oil on their prey. Of the two, direct oiling is considered to be the more likely consequence of OCS activities in the North Aleutian and St. George Basins.

Oilspill trajectories calculated for the southeastern Bering Sea display significant seasonal variation due to shifts in wind and current patterns (Schumacher, 1982). Oilspill trajectories during the summer (June-August) show predominantly eastward transport of oil by the prevailing winds and currents, approaching the Alaska Peninsula and Bristol Bay (Schumacher, 1982). Trajectories from spill-sites in the southern portions of the lease areas (south of 53°30' N) could reach the shoreline of the Alaska Peninsula.

During the summer, oilspill trajectories indicate that oil also could cross shelf waters occupied by fin, humpback, and gray whales, but probably would not reach areas of known concentrations such as the Pribilof Islands or Unimak Pass.

During the fall, uncontained oilspills from the lease areas also would be transported eastward toward Bristol Bay and the Alaska Peninsula. Oilspills could transect southbound migratory paths of gray whales returning toward Unimak Pass, either across the Bristol Bay shelf or along the shoreline of the Alaska Peninsula. A spill reaching the Alaska Peninsula or Unimak Pass during November or December would likely affect the greatest number of gray whales.

Under winter conditions (December-May), oilspill trajectories from the St. George Basin area move to the northwest, and oil spilled in the northern lease tracts could reach the Pribilof Islands within 10 days (Schumacher, 1982). During winter, an uncontained oilspill most likely would move along the shelf edge or out off the shelf. If the oil encountered the ice edge it would become associated with the marginal sea ice which would slow its further spreading.

The only endangered whales likely to be present in the Bering Sea during the winter are the bowhead whales and some fin whales. Spills occurring in openwater may be carried northward toward the sea ice front, but probably would not penetrate the marginal sea ice to the broken pack ice which bowhead whales occupy. Some fin whales overwintering south of the ice front could be impacted.

Noise and Disturbance

Increased noise levels resulting from geophysical seismic activity, vessel and aircraft traffic, and from drilling are likely to be experienced by individuals or groups of endangered whales inhabiting or transiting the North Aleutian and St. George Basins lease areas. Quantification of the effects of these sources of disturbance has not been achieved. Studies have shown that whales exhibit apparent avoidance behaviors when they are in proximity of surface vessel and air traffic, and may result in the disruption of feeding activity, the interference with socialization and communication, a general stress increase, and the abandonment of traditional use areas (Malme et. al., 1983; Richardson, 1982; Richardson and Green, 1983).

Deep seismic geophysical exploration using airgun arrays produces loud underwater sounds which travel long distances. Source levels of 240-260 db re 1 uPa at 1 m and frequency ranges of 100 to 300 Hz characterize this type of seismic noise. If the sound source is sufficiently close, disturbance, displacement, and perhaps some physical impairment of cetacean hearing could occur (Braham et al., 1982). At greater distances, masking of communication and environmental perception is possible. Sensitivities of endangered whales to this source of disturbance is largely unknown for most species, although studies are ongoing on its effects on bowhead whales (Richardson, 1983; Reeves et al., 1983) and gray whales (Malme et al., 1983).

Cumulative Effects:

Cumulative impacts to endangered whales as a result of activities associated with these and other lease sales are possible. The DOI leasing program for the Alaska OCS calls for 13 lease sales in ten leasing areas off Alaska between 1984 and 1987. Most of the endangered whales that inhabit the southeastern Bering Sea for portions of the year also spend time in other proposed lease areas.

Gray whales in particular are subject to cumulative effects from OCS activities. Their migration path transects at least nine proposed or existing OCS lease areas between their southern range off Mexico and California and their northern range in the Bering and Chukchi Seas. Nearly their entire Alaska habitat is in proposed lease areas. Whether the cumulative effects of OCS activities will measurably affect the health of the gray whale population or result in a likelihood of jeopardy cannot now be foreseen.

Fin and humpback whales also may be subject to the cumulative effects of OCS activities. Movements of these whales are less certain and probably less defined than those of the gray whale. Fin whales are a more oceanic species that may only be exposed to OCS impacts when in the northern parts of their range (i.e., Gulf of Alaska and Bering Sea). Humpback whales, likewise, have winter ranges that are generally outside the areas of proposed OCS activities and would be subject to impacts only when they are in Alaska waters.

Right whales, because of their decimated numbers in the North Pacific, might suffer greatly from any individual lease sale containing traditional use areas, and also may be vulnerable to cumulative effects of OCS activities in Alaska. We know too little about the present distribution and migrations of right whales in the Bering Sea to determine the significance of potential cumulative impacts to this species. Should a major portion of its northern range undergo oil and gas exploration and development, this species may be the most susceptible of all endangered whales to adverse impacts from OCS oil and gas activities.

The bowhead whale also is susceptible to cumulative impacts from OCS activities in arctic and subarctic waters. However, the southeastern Bering Sea is not known to be a regular habitat of bowhead whales and presumably OCS activities in this area would not significantly contribute to the impacts to which this species may be exposed.

It is important that OCS activities are monitored for indications of cumulative effects to endangered whales. This is a long-term effort that will require careful planning and a dedicated commitment throughout the life of the OCS program. MMS should regularly review the status of OCS activities for potential cumulative effects in planning this research and in conducting the OCS program.

Conclusions:

Based on our review of the information on the proposed oil and gas exploration activities in the North Aleutian Basin and St. George Basin areas and the biology and distribution of endangered whales available to us, we believe that the information and general conclusions contained in the Bering Sea Region and the St. George Basin (Sale No. 70) Biological Opinions remain generally valid. Conclusions specific to the North Aleutian Basin (April 1985) and St. George Basin (December 1984) are provided below.

The endangered species for which NMFS has responsibility that may be affected by the proposed activities in these sale areas are the bowhead, gray, fin, right, humpback, sei, blue, and sperm whales.

Sei, blue, and sperm whales

We believe that the proposed activities are unlikely to jeopardize the continued existence of the sei, blue or sperm whales. We base this opinion on the occasional to rare occurrence of these species in the southeastern Bering Sea. It is not considered an area of abundance for these whales.

Fin and humpback whales

We believe that the proposed activities are unlikely to jeopardize the continued existence of the fin and humpback whales. We base this belief on the widespread distribution of these species in the North Pacific and Bering Sea and on the unlikelihood that individuals of either species would be found concentrated in any portion of these lease areas for any particular length of time. Thus, any impact resulting from these sales, at most, would be likely to affect only a few individuals and would not result in jeopardy to the continued existence of the population.

We qualify this determination, however, on the assumption that the North Pacific fin and humpback populations consist of single stocks of wide ranging and intermixing individuals. It is possible that those whales inhabiting the Bering Sea may represent distinct stocks or subpopulations from those in the Gulf of Alaska. Humpback whales, in particular, may segregate as summer stocks in the Bering Sea as they do in the Gulf of Alaska (Prince William Sound and Southeast Alaska). If this is true, a Bering Sea stock of these whales inhabiting the North Aleutian and St. George Basins lease areas may be of increased vulnerability to oil and gas impacts. Greater research on stock identity, particularly for humpback whales, is needed.

Bowhead whales

The NMFS concludes that the proposed activities are not likely to jeopardize the continued existence of the endangered bowhead whale. This conclusion is based upon the belief that few bowhead whales occur in the lease sale areas. We caution MMS that our no jeopardy conclusion is based on relatively little research concerning bowhead whale activity in this area. Bowhead whales are generally believed to overwinter in and migrate through ice-covered waters to the west and/or north of the proposed lease areas (Brueggeman, 1982a), but more site-specific information concerning the winter-spring habitat usages, such as migration, reproduction, and feeding, of bowhead whales is needed. Although the southeastern Bering Sea is not known to be a normal winter habitat, the complete winter-spring movements of this species are unclear. Consultation must be reinitiated if new information becomes available regarding bowhead whale occupation of either lease sale area.

Gray whales

The NMFS believes that certain of the proposed activities in the St. George and North Aleutian Basins lease areas are likely to jeopardize the continued existence of the endangered gray whale. Oilspills and disturbance from noise would be likely to result in adverse impacts to gray whales when they migrate through the southeastern Bering Sea in the spring and fall. Our concerns for potential impacts to the gray whale are discussed below.

A. Oilspills

The NMFS believes that an uncontrolled blowout or major oilspill in the waters of the southeastern Bering Sea during peak migration periods of gray whales is likely to jeopardize the continued existence of the species. Such an event in the spring (April to June) or late fall (November and December) has the potential to affect the greatest number of gray whales. We base this belief on the known abundance of these whales in or adjacent to the proposed lease areas at these times of the year, and on the projected movements that an uncontained oilspill would take towards areas likely to contain migrating whales.

Spring and late fall are transitional periods between summer and winter meteorological and hydrographic conditions (Schumacher, 1982), and there exists considerable uncertainty and variability in the projected oilspill trajectories for these seasons. Nevertheless, we are particularly concerned that an oilspill from either the St. George or North Aleutian Basins lease areas could reach Unimak Pass or the north shore of the Alaska Peninsula during either season and could affect a significant number of these whales. An oilspill during the fall may also intercept numerous gray whales migrating across the shelf from Nunivak Island to the Alaska Peninsula. Little is known concerning the size of the migratory population using this route, but there is recent information that this may be a significant migratory corridor for many gray whales (Rugh, in press).

The NMFS believes that the DOI can develop suitable measures for oilspill prevention and oilspill cleanup to ensure that any spilled oil does not reach these important habitats. The DOI can plan exploration activities to avoid the likelihood of jeopardizing the continued existence of this species, as required by Section 7(a)(2) of the ESA. Below we offer reasonable and prudent alternatives that the DOI can adopt to meet this goal.

B. Noise

1. The NMFS believes that the impacts of drilling noise from the proposed lease areas are unlikely to jeopardize the continued existence of the gray whale.

2. We believe that openwater geophysical seismic surveys ("deep seismic" using airgun arrays) would be likely to jeopardize the continued existence of gray whales if such activity forced them to alter their normal migration routes around or across Bristol Bay or prevented them from using the Unimak Pass migration corridor. The DOI can plan these surveys to avoid adverse impacts to gray whales and thereby avoid the likelihood of jeopardizing the continued existence of the species, as required by Section 7(a)(2) of the ESA. Below we offer reasonable and prudent alternatives that the DOI can adopt to meet this goal. We believe that high-resolution ("shallow seismic") surveys using weaker energy sources would be unlikely to jeopardize the species because of their reduced range of effects.

3. We believe that vessel and aircraft traffic resulting from these lease sales would be unlikely to significantly increase present levels of traffic in or near gray whale habitats, and would not be likely to jeopardize the continued existence of the species. However, we have recommended that a 1500 ft minimum altitude be observed by aircraft over areas occupied by endangered whales to lessen the likelihood of harassment.

C. Physical Impacts

Because no gravel islands will be constructed and low levels of exploratory drilling activity are anticipated, the NMFS believes that drilling platforms and other related structures, vessel traffic and other activities associated with exploration that may cause physical impacts to gray whales (i.e., collisions) or result in habitat alteration are unlikely to jeopardize the continued existence of this species.

D. Cumulative Impacts

The gray whale potentially is subjected to impacts from oil and gas activities throughout its range. Because of the relatively short history of OCS activities in Alaska, we are unable to identify the level of cumulative impacts beyond which there would be significant adverse impacts to the endangered gray whale. Therefore, we are unable to reach a conclusion as to the likelihood of jeopardizing the gray whale from the cumulative effects of oil and gas activities. The NMFS believes that considerably more attention should be given to potential cumulative impacts to gray whales in planning all OCS oil and gas activities.

Right whales

The NMFS believes that certain of the proposed activities are likely to jeopardize the continued existence of the endangered right whale. Historically, the southeastern Bering Sea was normal habitat for the North Pacific right whale (Berzin and Doroshenko, 1982). At present, this species is known to occur north of the St. George Basin during the openwater season, and may inhabit the St. George Basin area also. Although observations of right whales in the Bering Sea are rare, two individuals were sighted near St. Matthew Island in the summer of 1982 (Brueggeman, 1982b). Because of the possibility of site-fidelity for traditional use areas, right whales may reappear seasonally in some areas. Our concerns for potential impacts to the right whale are discussed below.

A. Oilspills

The NMFS believes that a major oilspill or uncontrolled blowout in areas where and when right whales would be affected would be likely to jeopardize the continued existence of the species. We base this belief on the critically small population size (less than 200 individuals) of the North Pacific right whale. Because this species is nearly extinct, we believe that adverse impacts to small numbers of right whales probably would have severe adverse effects on the entire population.

Therefore, we believe that satisfactory precautions must be taken to prevent impacts to right whales from spilled oil. The NMFS believes that it is possible for MMS to plan and conduct activities during the exploration phase in the North Aleutian Basin and St. George Basin areas to avoid the likelihood of jeopardizing the continued existence of the right whale. Below we offer reasonable and prudent alternatives that the DOI can adopt to meet this goal.

B. Noise

1. The NMFS believes that the impacts of drilling noise in the proposed lease areas are not likely to jeopardize the continued existence of the right whale.

2. We believe that "deep seismic" geophysical surveys using airgun arrays would be likely to jeopardize the continued existence of the right whale if such activities disturbed the feeding, mating or calf rearing activities of this species. We believe that it is possible for the DOI to plan these activities in such a manner as to avoid impacts to the right whale and therefore avoid the likelihood of jeopardizing the continued existence of this species. Below we offer reasonable and prudent alternatives that the DOI can adopt to meet this goal. We believe that high-resolution ("shallow seismic") surveys using energy sources considerably weaker than airguns would be unlikely to jeopardize right whales.

3. We believe that vessel and aircraft traffic could temporarily displace right whales from traditional use areas as well as disrupt feeding or social behavior. This could jeopardize the continued existence of this species. Below we offer reasonable and prudent alternatives that DOI can adopt to avoid the likelihood of jeopardy to this species.

C. Physical Impacts

The NMFS believes that drilling platforms and other structures, vessel traffic, and activities associated with exploration in the proposed lease areas that may cause physical impacts (i.e., collisions) to right whales or result in habitat alterations are unlikely, and therefore not likely to result in jeopardy to the continued existence of this species. We emphasize that this conclusion is based upon limited data on the extent of such activities or on the presence of endangered right whales in these lease areas.

D. Cumulative Impacts

The right whale potentially may be most susceptible to cumulative impacts resulting from OCS activities. We believe that adverse impacts to the right whale from such activities would be likely to jeopardize the continued existence of the species due to its critically small population size. Presently there is not sufficient information on the distribution, migration, and habitat use of right whales to determine the significance of potential cumulative impacts to the species. Therefore, we are unable to reach a conclusion as to the likelihood of jeopardy to right whales resulting from cumulative effects of oil and gas activities. The NMFS believes that considerably more attention should be given to these impacts to right whales in planning all OCS oil and gas activities.

Reasonable and Prudent Alternatives:

Section 7(b) of the ESA requires that the NMFS suggest reasonable and prudent alternatives that the DOI can adopt to avoid the likelihood of jeopardizing the continued existence of endangered species. Below we provide reasonable and prudent alternatives concerning the proposed North Aleutian and St. George Basins lease offerings. The DOI must develop appropriate measures to ensure that the proposed activities are not likely to jeopardize the continued existence of the endangered gray or right whales.

Oilspills

Major oilspills or well-blowouts can have severe adverse impacts on right whales that may be present in or near the proposed lease areas during the openwater season, and on gray whales during their spring and fall migrations through Unimak Pass and in the southeastern Bering Sea. The DOI must ensure that the waters in and adjacent to areas inhabited by right whales and migrating gray whales are free of spilled oil. In developing the necessary measures to provide this assurance, the DOI should carefully consider the time necessary for lessees to control a blowout and clean up spilled oil as well as the environmental conditions that may affect the time necessary for cleanup.

To avoid the likelihood of jeopardy to the gray whale, we believe that the identified alternatives given by MMS of leasing deferrals within a 50-mile radius of Unimak Pass and the Pribilof Islands, and within 25 miles of shore along the Alaska Peninsula, will substantially reduce the risk of oilspills to gray whales and should be adopted. To provide protection for right whales that may occur in or near the proposed lease areas, the DOI should develop a measure for temporary suspension of drilling, when it can be done in a safe manner, if right whales are encountered or believed to be present in the vicinity of a drilling operation.

Noise Disturbance

Deep seismic geophysical operations should only be conducted in waters near Unimak Pass or along the Alaska Peninsula at times of the year and in such a manner that do not disturb the spring and fall migrations of gray whales in the southeastern Bering Sea or through Unimak Pass. Deep seismic geophysical operations should not be conducted in the lease areas when right whales are present.

Vessel and aircraft traffic should maintain minimum approach distances from right whales (one mile horizontal, 1500 feet vertical) and should avoid areas known to be inhabited by right whales.

The NMFS should be consulted in developing the guidelines necessary to meet the above criteria, which should include monitoring for the presence of right and gray whales by those engaged in OCS activities. In this regard, we believe that the provisions contained in the Final Notice of Sale for

St. George Basin Lease Sale 70, if adopted for these lease sales, will avoid the likelihood of jeopardy to gray and right whales from noise disturbance impacts.

Research Needs:

The NMFS recognizes the valuable research efforts conducted to date by the Environmental Studies Program of the Alaska OCS Office of MMS, and we encourage their continuation. Below we provide our assessment of the kinds of additional information that need to be obtained before NMFS can formulate a more thorough Biological Opinion concerning the likelihood of jeopardy to endangered whales from future OCS activities in the North Aleutian Basin and St. George Basin. Although we need better information on all endangered whale species in this area, research efforts should emphasize the fin, gray, humpback, bowhead, and right whale.

A better understanding is needed on the effects of oil on large cetaceans, either from direct contact with spilled oil or as a result of indirect effects through changes in food supplies. The effects of oil on potentially sensitive tissues such as the skin, eye, or respiratory system are not certain. Ingestion of oil may affect feeding ability (i.e., baleen fouling), digestive and metabolic processes, and could be toxic to cetaceans in sufficient dosages. An ability of large cetaceans to detect and avoid oil would reduce the potential for these effects, but this ability is not known.

Noise may affect endangered whales. The types and levels of noise necessary to elicit behavioral responses are poorly known for most species. The relative sensitivity of different species and changes in sensitivities under different conditions are also unknown. In particular, the potential effects of geophysical seismic explofation on cetacean behavior needs to be studied. Short-term responses to noise are being studied and these studies should be continued. A better understanding of the behavior and social systems of these whales is needed to understand the relevance of these responses to long-term effects on the species.

The distribution and abundance of endangered whale populations in the southeastern Bering Sea are still largely unknown. Abundance, seasons of occurrence, and migration paths need better definition for all species. Continued systematic aerial and shipboard surveys covering all seasons are necessary to acquire more reliable population estimates and more quantitative habitat usage information.

For humpback whales specifically, a study of stock identity using photo-identification methods is important. Such studies elsewhere in the eastern North Pacific have provided a valuable data base from which to compare individuals and assess stock segregation and local habitat use patterns.

Unimak Pass is essential to the normal movements of most whales that enter and leave the Bering Sea. The use of Unimak Pass by these whales has been adequately documented only for gray whales. Better information on the movements of other whales through Unimak Pass, and the southbound movements of gray wheles across the southeastern Bering Sea is needed.

The cumulative effects of OCS activities are a major concern especially for the development and production phases, and deserve greater attention for the reasons mentioned earlier.

Recommendations:

Section 7(a)(1) requires that Federal agencies utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. To help the DOI meet this responsibility with respect to OCS activities in the Bering Sea, the NMFS offered additional recommendations in the Bering Sea Region Biological Opinion, and for the St. George Basin Sale 70 area. These recommendations are repeated below.

1. We recommend that MMS continue to fund research on the distribution, abundance, and habitat use of endangered whales in the Bering Sea. We recommend that MMS support those research needs for the North Aleutian Basin and St. George Basin areas that are identified earlier in this document.

2. We recommend that MMS conduct long-term monitoring of the locations and movements of endangered whales in the southeastern Bering Sea relative to the locations exploration activities, to assure that whales are not being affected by these activities.

3. We recommend that MMS continue efforts to understand the impacts of oilspills and noise on endangered whales. Specifically, we recommend the implementation of studies on the impacts of seismic geophysical noise on whales, especially gray whales, in the Bering Sea, and a continuation of these studies for other whales, such as the bowhead whale in more northern waters.

4. We recommend that MMS support efforts for the photo-identification of humpback whales in the Bering Sea to assess the questions of stock separation, seasonal movements, and habitat utilization.

5. Since the occurrence and distribution of cetaceans in the Bering Sea is not well known, the NMFS desires to expand the existing data base. Analysis of historical whaling records may provide important habitat use information and seasonal distribution of many of the commercially exploited whale species that occupy the Bering Sea, and we encourage these whaling records to be analyzed for this information. We further believe that the proposed exploratory activities furnish a valuable opportunity for obtaining additional new information on endangered whales, and therefore request that all large cetacean sightings during exploration activities be required to be reported to the Platforms of Opportunity Program of the National Marine Mammal Laboratory. The NMFS will furnish identification guides.

6. We recommend that the Bering Sea Biological Task Force, of which the NMFS will be a member, assist the DOI in OCS-related decisions for these lease sales that may affect endangered species and other biological resources of this region.

7. Lessees should be notified, through information contained in the Notice of Sale and the lease, of guidelines that vessel and aircraft operators should follow to avoid any potential harm to these cetaceans. Attachment 2 provides guidelines to vessel and aircraft operators to avoid harassing endangered whales. Since whales are sensitive to aircraft noise, aircraft operators should maintain a 1500 foot minimum altitude when flying over areas occupied by endangered whales.

Opportunities for Additional Consultation:

Informal consultation will be conducted on a continuing basis as necessary for post-sale activities in these lease areas. During the exploration phase, the DOI has agreed to provide the NMFS with all seismic permits and with exploratory drilling plans, including oilspill contingency plans and any subsequent revisions of such plans. Future actions that will affect endangered whales may require additional consultation pursuant to Section 7(a)(2) of the ESA. These actions will be evaluated as they become known, and we will continue to review, on a case-by-case basis, all new information that becomes available to us. The DOI should also continually review these plans to determine if and when further Section 7 consultation is necessary.

Formal consultation under Section 7 must be reinitiated upon initiation of the development phase in these and other Bering Sea lease areas. At such time, any additional information available on the potential impacts of endangered whales will be evaluated, details on the location and magnitude of OCS development will be gathered, and a new Biological Opinion will be issued.

Formal consultation must also be reinitiated if: new information reveals impacts of the proposed exploration activities that may affect listed species; the identified exploration activities are modified in a manner not considered herein; or a new species is listed or critical habitat is designated that may be affected.

This biological opinion in no way permits the taking of any endangered whales. Taking of such species, unless properly permitted, is prohibited under Section 9 of ESA and under Section 102 of the Marine Mammal Protection Act (MMPA). Section 17 of the ESA states that unless otherwise provided, no provision of the ESA shall take precedence over any more restrictive provision of the MMPA. Under Section 101(a)(3)(B) of the MMPA taking of depleted species of marine mammals can be permitted only fot scientific purposes. Accordingly, no statement concerning incidental takings pursuant to Section 7(b)(4) of the ESA is appended to this opinion.

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Attachment #1

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Mr. Robert Burford
Director
Bureau of Land Management
Department of the Interior
Washington, D.C. 20240

Dear Mr. Burford:

Enclosed is the Biological Opinion prepared by the National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act of 1973 (ESA) concerning the impact of the Outer Continental Shelf (OCS) oil and gas leasing program and associated exploration activities in the Bering Sea Region on endangered whales. Activities associated with production and development will be considered in future consultations.

Based upon our evaluation of the available information concerning the biology and distribution of endangered whales and the nature, extent and location of OCS activities the National Marine Fisheries Service (NMFS) concludes that there is insufficient information to make a reliable determination concerning the likelihood of jeopardizing the continued existence of endangered whales. Despite the inconclusive Biological Opinion the NMFS believes that it is possible for the Department of the Interior (DOI) to plan OCS explortory activities in the Bering Sea Region so that they are not likely to jeopardize the continued existence of endangered whales. This belief is based in part upon DOI's intention to reinitiate consultations pursuant to Section 7(a)(2) of the ESA for future lease sales in the Bering Sea Region. The DOI should also examine additional information on OCS activities in the Bering Sea Region and on the biology and distribution of endangered whales to determine if additional Section 7 consultations are required. Our Biological Opinion includes reasonable and prudent alternatives and recommendations to assist DOI in planning OCS activities in the Bering Sea Region and fulfilling its obligations under Section 7 of the ESA.

The Biological Opinion also provides DOI with an indication of the information that NMFS must have before a reliable determination on the likelihood of jeopardy to endangered whales from OCS activities in the Bering Sea Region can be made. The NMFS is aware of the considerable research efforts on endangered whales that the Bureau of Land Management has sponsored or conducted. We applaud this effort and encourage its continuation.

Consultation also must be reinitiated if there are subsequent modifications to the proposed action, if a species or critical habitat that occurs in the area covered by your program is subsequently listed, or if new information reveals impacts of the identified activity that may affect listed species. In addition, consultation must be reinitiated before development and production activities occur in the Bering Sea Region.

We look forward to continued cooperation during future consultations.

Sincerely yours,

/s/ Richard B. Roe
for William G. Gordon
Assistant Administrator
for Fisheries

Endangered Species Act

Section 7 Consultation - Biological Opinion

Agencies: Bureau of Land Management and U.S. Geological Survey

Activities Considered During Consultation: Outer continental shelf oil and gas leasing and exploration in the Bering Sea Region encompassed by proposed lease sales in Norton Basin (57, 88, 99), St. George Basin (70, 89, 101), Northern Aleutian Shelf (75, 92), and Navarin Basin (83, 107).

Consultation Conducted By: National Marine Fisheries Service (NMFS), Alaska Region

Background

On June 6, 1980, the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS) requested formal joint regional consultation pursuant to Section 7 of the Endangered Species Act of 1973 (ESA) on four proposed outer continental shelf (OCS) oil and gas lease sale areas in the Bering Sea Region (i.e., Norton Sound, St. George Basin, Northern Aleutian Shelf, and Navarin Basin) with regard to potential impacts of the Department of the Interior's (DOI) OCS oil and gas program on endangered and threatened species. As a result of that request, representatives of BLM, USGS, and NMFS met in Anchorage, Alaska on June 25, 1980, to discuss endangered species that might be affected by the proposed regional OCS oil and gas activities.

The NMFS agreed to conduct an "aggregate" consultation for OCS oil and gas leasing and exploration in the Bering Sea Region encompassed by the proposed lease sales in Norton Basin, St. George Basin, Northern Aleutian Shelf, and Navarin Basin. An "aggregate" consultation, as described in

50 CFR Section 402.04(a)(3), 43 FR 871, is an efficient approach to comply with consultation requirements of Section 7(a)(2) of the ESA, in that the BLM and USGS will be aware of additional information needs and potential problems at an early phase in the oil and gas leasing program in the Bering Sea. This is NMFS's Biological Opinion for OCS gas and oil leasing program in the Bering Sea Region.

Although NMFS considered the entire range of OCS activities in the consultation process, this Biological Opinion addresses only the leasing and exploration phases of OCS activities in the Bering Sea Region. Activities covered by this opinion include pre-lease exploration (geophysical surveys and Continental Offshore Stratigraphic Test Wells (COST Wells)), the lease sale, and post-lease exploration (geophysical surveys, construction, exploratory drilling, and associated support activities). BLM-sponsored research on the distribution and abundance of endangered whales, and on the effects of oil and other OCS activities has not been completed. When available, NMFS will review the results of the completed studies and plans for future exploration. DOI indicated that consultation will be reinitiated for each lease sale in the Bering Sea Region. In addition, DOI must review exploration plans and activities to determine whether consultations on those individual activities must be reinitiated. When the development and production phases are reached and as information on the specific impacts of the activities, including the cumulative impacts of the program becomes available, formal consultation must be reinitiated.

Consultation was conducted for the eight endangered species of whales listed below. No other listed species for which NMFS is responsible occur in the Bering Sea. There are no species proposed for listing or any designated or proposed critical habitat in the Bering Sea Region.

Common Name	Scientific Name
Right Whale	*Balaena glacialis*
Bowhead Whale	*Balaena mysticetus*
Gray Whale	*Eschrichtius robustus*
Fin Whale	*Balaenoptera physalus*
Sei Whale	*Balaenoptera borealis*
Blue Whale	*Balaenoptera musculus*
Humpback Whale	*Megaptera novaeangliae*
Sperm Whale	*Physeter macrocephalus* (= *P. catodon*)

Appendix I gives information about the population size, status, and occurrence of each of the endangered whales in the various lease areas.

This biological opinion discusses the distribution of endangered whales in the Bering Sea Region under consideration for OCS oil and gas leasing, the type and scope of the proposed exploratory activities, the possible impacts of pre- and post-sale exploration activities on endangered whales, and the research required to gather additional data and information. This opinion addresses the question of whether lease sales and exploration activities in the Bering Sea are likely to jeopardize the continued existence of endangered species of whales.

Proposed Lease Areas As Whale Habitats

The four proposed lease areas of the Bering Sea are important to the normal activities and movements of endangered whales. The lease areas encompass whale habitats that are vital to the survival of certain of these species. Individually, and collectively, OCS activities in these lease areas have the potential to harm populations of endangered whales.

Norton Basin:

Bowhead and gray whales frequent the area north of St. Lawrence Island and west of Sledge Island in the outer Norton Basin area (west of 166°W longitude). This area is vital to the spring and fall migrations of the bowhead and is a major feeding area for the gray whale. The lagoons and

nearshore coastal areas around St. Lawrence Island, especially near the western, southern, and eastern ends, are important feeding grounds for gray whales in the summer and fall. Chirikof Basin, north of St. Lawrence Island, is an extremely important feeding area for many gray whales during the summer and early autumn.

The Bering Strait is an important migratory corridor for bowhead, gray and some humpback and fin whales traveling to and from summer feeding grounds in the Chukchi and Beaufort Seas. Bowhead whales follow open leads in the pack ice to move north through the Bering Strait in April-May, and return south through the Bering Strait ahead of the pack ice in November-December. Gray and humpback whales travel through the Bering Strait from June to October when the pack ice is absent or sparse.

Fin, humpback, and perhaps sei whales seasonally occur in or adjacent to the outer Norton Basin area. Although right whales formerly fed in this area during summer, neither they nor blue nor sperm whales are known to occur there now. Inner Norton Sound is only occasionally occupied by any of these whales.

Navarin Basin:

The entire western Arctic population of bowhead whales may overwinter in the broken pack ice of the central Bering Sea, mainly south and west of St. Lawrence Island as far south as the ice front edge, and perhaps farther south into open water. Although the exact location of overwintering probably varies with the type and extent of the seasonal ice edge, the shelf portions of the Navarin Basin must be considered an important bowhead whale overwintering area.

The outer shelf edge of the Navarin Basin area also may be seasonally important as a summer feeding area for the fin whale, and possibly the humpback whale. Its importance to the Pacific right whale is unknown. The other whale species probably are only occasional visitors to this area.

St. George Basin:

The St. George Basin area is inhabited by gray whales from spring through fall. During the summer, a few dozen gray whales feed in shallow waters off the Pribilof Islands. A large segment of the gray whale population probably migrates southward directly through the northeast portion of the Basin from mid-October to late December.

Unimak Pass, southeast of the St. George Basin area, is an important migratory corridor for the entire eastern Pacific population of gray whales. Gray whale movements north through Unimak Pass peak in April and May, and the southward return through the Pass, peaks in November and December. The Pass is used by other species of whales as well.

Fin and humpback whales occur seasonally in the St. George Basin in the late spring and summer. Fin whales appear to concentrate over the continental slope and shelf edge. Humpback whales are found throughout the lease area; most sightings are near the Aleutian and Pribilof Islands.

A few individuals of the other whale species also may be found occasionally in this area, mostly in the summer and fall. A few bowhead whales have also been observed in the northwest portion of the lease area, all in early spring.

Northern Aleutian Shelf:

Almost the entire population of the gray whale passes near the North Aleutian Shelf area during migration northward in April-June and southward in late October through December. The east shore of Unimak Pass is the focal point of the migratory corridor. After entering the area through Unimak Pass, most gray whales migrate close to shore (within 3 km) and follow the perimeter of Bristol Bay to Nunivak Island. Gray whales feed in the shallow coastal areas along the north side of the Alaska Peninsula and Bristol Bay during their spring migration. In the fall, most gray whales pass within 1 km of the

west and south shores of Unimak Island as they leave the Bering Sea. Some fin whales summer along the shelf-edge, and small numbers of humpback, blue, sei, and right whales may occur in the spring-fall period in this area. Bowhead and sperm whales are not known to occur in this area.

Description Of Proposed Activities

A. Pre-lease Exploration And The Lease Sale

Prior to a lease sale, geophysical seismic information is gathered by geophysical companies. In the Bering Sea this typically is done by vessel surveys during the open water season. A considerable amount of high resolution, acoustic geophysical exploration already has been conducted in potential Bering Sea lease areas under USGS permits since April 15, 1975, and further surveys probably will be conducted in each area. These geophysical operations are carried out with ships up to 100 meters in length. Current geophysical technology entails the use of "air guns" or "sparkers." A limited amount of research (primarily observing responses of bowhead whales to these operations during the summer and fall) on the effects of these systems on cetaceans has recently begun in Arctic waters. Results to date have not been conclusive.

In most lease areas, one or more COST Wells are drilled prior to a lease sale to obtain geological samples of the rock and sedimentary structures of the area. COST Wells are drilled in the manner of any exploration well except that they typically are not drilled at a location where hydrocarbon reservoirs are believed to exist. Results of COST well drilling provides information on whether the sedimentary structures contain source rocks and reservoir rocks suitable for hydrocarbon generation and retention. Impacts associated with COST Wells include industrial noise, vessel and aircraft traffic, drilling muds and cuttings disposal, etc., but do not include an oil spill risk from

the well. On-structure drilling of COST Wells now is allowed but has not been requested by industry for the Alaska OCS. Such an activity would add the risk of an oil spill to the pre-lease activities and would require careful review and additional consultation pursuant to Section 7(a)(2) of the ESA.

Activities involved with OCS lease sales consist of offering the leases, submission of bids, and awarding of leases to the successful bidders.

B. Post-lease Exploration

After leases have been issued, the lessees are authorized, and in some instances required, to perform certain activities. Lessees may undertake certain environmental studies at this stage as part of their preparation of an exploration plan. These may include studies specifically required by lease stipulations and, if needed, studies to provide descriptions of the air quality, oceanographic conditions, and flora and fauna in the leased area that may be disturbed by exploration activities. Geological studies may involve bottom drag sampling or shallow coring. Other studies may employ certain high resolution geophysical instrumentation such as fathometers to determine topography and water depth, and sidescan sonar to map sea bottom irregularities. These studies use accepted sampling techniques that are passive in nature or localized in range.

Exploration plans identify where and how exploratory drilling will occur, and the Environmental Report that accompanies each exploration plan describes the potential impacts of the proposed exploration activities on the marine and coastal environments.

The type of offshore drilling unit used to drill exploratory wells in the Bering Sea will depend upon many factors including environmental conditions and water depth at the site, anticipated duration of the drilling program, type of unit available, time of year, and economic considerations. Depending upon conditions, jack-up rigs, semi-submersibles, or drillships will be employed as drilling platforms in the Bering Sea, and in some shallow areas in the Norton Sound area gravel islands may be used.

It is not known at this time how many or where exploratory and delineation wells will be drilled (the USGS has projected that 90 wells may be drilled in the four Bering Sea lease areas). Specific proposals on these matters will be stated for the first time in proposed exploration plans submitted by the individual lessees. The USGS issues drilling permits and will establish criteria under their operating orders to regulate the drilling activities. The U.S. Coast Guard (USCG) is responsible for permitting fixed and mobile drilling platforms and exploratory drilling vessels on the OCS. Construction of gravel islands in U.S. waters will require a permit from the Department of the Army, Corps of Engineers (COE) pursuant to Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. The National Pollution Discharge Elimination System (NPDES), created by the Clean Water Act and administered by the Environmental Protection Agency (EPA) is applicable to fixed platforms and rigs engaged in OCS oil and gas activities. Each of these agencies has consultation responsibilities under Section 7(a)(2) of the ESA for their involvement in these activities. NMFS will consult with these agencies as required by ESA. Additionally, lease stipulations covering these activities remain to be developed. Such stipulations should include protective measures for endangered whales. We provide recommendations and reasonable and prudent alternatives herein to help DOI meet its obligations under Section 7 of the ESA. The NMFS will review stipulations for their adequacy in protecting endangered whales.

C. Exploration Scenarios

Estimates on the proposed exploratory activities in the four Bering Sea lease areas have been presented for the proposed five-year schedule.[1] The

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[1] DOI. Draft Supplement to the Final Environmental Statement. Proposed Five-year OCS Oil and Gas Lease Sale Schedule. Jan. 1982-Dec. 1986. BLM, 66 pp + six appendices.

following discussion is based on these estimates. It should be recognized that these figures are likely to change as more detailed information is obtained. (The latest proposed schedule, (July 1981) has not yet been approved by Congress as required by law. Currently scheduled sale dates on sales 57 to 83 are taken from the June 1980 schedule.)

Norton Basin, Sales 57, 88, 99:

The first sale (57) is scheduled for November, 1982. Additional sales are planned for October, 1984 (88) and October, 1986 (99). USGS estimates the oil and gas potential of the Norton Basin area at 0.71 billion barrels (BBbl) of oil and 2.17 trillion cubic feet (TCF) of gas.

Up to five exploratory rigs may work in the area at any given time, and USGS estimates that a total of 20 exploratory and delineation wells would be drilled. Jack-up rigs will be preferred equipment for operations during the open water season in water depths greater than 20 meters. Drillships may be utilized in deeper waters, and gravel islands may be constructed in water less than 8 meters on 35 nearshore tracts just north of the Yukon Delta. Exploration could occur from 1983 to 1995.

Nome probably will be the primary support base. Existing facilities will be used to the extent possible, thereby eliminating or minimizing the need for new onshore construction. If gravel islands are constructed on shallow tracts, activities will be supported in the winter by anchored work barges holding heavy, bulky supplies. Alternatively, gravel islands could be supplied with icebreaker assistance. Air traffic would transit in and out of Nome, and possibly Unalakleet.

St. George Basin, Sales 70, 89, 101:

The first sale (70) is scheduled for December, 1982. Subsequent sales are proposed for December, 1984 (89) and December, 1986 (101). USGS estimates the oil and gas potential of the St. George Basin area at 1.48 BBbl of oil and 4.28 TCF of gas. A maximum of 3 exploratory rigs would work the area at any given time, drilling a total of 25 exploratory and delineation wells. Preferred rigs are larger semi-submersibles that can operate year-round unless severe ice-buildup occurs in abnormally cold winters. Drillships will be the equipment of second choice. Exploration wells will be drilled between 1984 and 1995.

Dutch Harbor will be the likely primary support base for exploration. Existing facilities would be used to the extent possible. Cold Bay may become a transit exchange base for personnel flying to and from the sale area.

Northern Aleutian Shelf, Sales 75, 92:

The first sale (75) is scheduled for October, 1983. A subsequent sale is proposed for April, 1985 (92). The Northern Aleutian Shelf area is estimated to contain 0.99 BBbl of oil and 2.37 TCF of gas. Hydrocarbon potential is believed to be highest in the southern portion of the area, near Cold Bay.

No estimates are available for the number of rigs that may operate in this area, but the number probably would be similar to that anticipated for the Norton and St. George Basin areas. It is estimated that 20 exploration and delineation wells may be drilled, between 1984 and 1996. Shore bases would be the same as used for the St. George lease area, i.e., Dutch Harbor and Cold Bay.

Navarin Basin, Sales 83, 107:

The first sale (83) is scheduled for December, 1984. A subsequent sale is proposed for March, 1985 (107). The Navarin Basin's oil and gas potential is estimated at 1.74 BBbl of oil and 7.14 TCF of gas. The northwest area near the U.S. - Russia 1867 Convention Line is believed to have the greatest potential for hydrocarbons. The number of exploratory rigs that may operate in this area is unstated. Based on the larger oil reserve potential of Navarin Basin compared to other Bering Sea lease areas, a greater number of exploratory rigs may be used. An estimated 30 exploration and delineation wells will be drilled between 1985 and 1998.

Until tracts are selected it is not possible to predict specific areas of impact. St. Paul and/or St. Matthew Island may serve as forward supply bases for operation in this area.

Potential Impacts To Endangered Whales From The Proposed Activities

Potential effects of oil and gas exploration and related human activities on endangered whales include the following:

1. Behavioral disturbances caused by noise from geophysical seismic surveys, aircraft and ship traffic, construction activities, and drilling activities. These disturbances could cause alterations of migration pathways with unknown effect, or displacement from feeding or breeding grounds;

2. Physical impacts from the placement of structures in areas inhabited by the whales;

3. Oil spills which, if they occurred when whales are present, could cause fouling of the feeding mechanism (baleen plates), disruption of respiratory function, ingestion of oil with uncertain effects on whale physiology, the irritation of skin and eyes, or a reduction of food supplies through contamination or alteration of the marine habitat.

Noise Disturbance:

Noise associated with petroleum exploration can affect whales adversely.[2] High frequency sounds cause permanent ear damage in laboratory animals and could affect marine mammals adversely. Low frequency sounds that are likely to result from petroleum exploration are less destructive than high frequency sounds; low frequency affects are difficult to determine. Although adverse physical effects from low frequency sounds on cetaceans are unknown, noise does have nonauditory stress affects on birds and mammals. These include physiological stress involving hormonal responses leading to lowered resistance and increased vulnerability to environmental disturbances, and endocrine imbalances that may affect reproduction adversely. The extent to which cetaceans may be susceptible to such stress-mediated effects is unknown.

Cetaceans rely on their well-developed auditory sense for communication and/or echo-location. Background noise from oil and gas activities in the marine environment could interfere with these functions and result in social disruption and echo-confusion.

Noise from boat and air traffic and from drilling activities could affect cetaceans moving through or feeding in OCS oil and gas exploration areas. Gray and humpback whales co-exist with human activities in certain areas, which suggests that some cetaceans can adjust to some levels of noise from boat and air traffic. Above some threshold, increases in ambient noise may have harmful effects. Barge traffic has been observed to disturb beluga whales in the Canadian Beaufort Sea, and Scammon Lagoon in Mexico has been closed to all but local fishing boats because of disturbance to gray whales there. Humpback whales, killer whales and Dall porpoises may have been affected adversely by boat traffic in Glacier Bay, Alaska. The National Park Service has published regulations governing the number of tour ships that may enter Glacier Bay and the speeds and distances that all vessels must observe in the presence of humpback whales. NMFS has published similar guidelines for the humpback whale grounds in Hawaiian waters.

Noise resulting from the construction of gravel islands in the Norton Basin probably would not affect whale behavior and migration since the islands probably would be placed in the shallow southeastern areas of inner Norton Sound where endangered whales usually do not occur. Studies being conducted in the Canadian Beaufort Sea on bowhead whales soon may provide additional information on the effects of noise produced by this activity. To avoid potential impacts construction of gravel islands should not occur when and where whales are present. The NMFS will make recommendations concerning the

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[2] Geraci, J.E. and D.J. St. Aubin, 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Mar. Fish. Rev., Nov. 1980, pp 1-12.

timing of gravel island construction as appropriate after reviewing USGS exploration plans.

More definitive studies are needed to predict more accurately the nature and extent of impacts to endangered whales from the noise produced by OCS activities on the migration, reproduction, or calving of whales, particularly the bowhead and gray whale. Regulation of aircraft and vessel traffic can ensure that this source of disturbance is minimized.

Physical Impacts:

Temporary gravel islands for exploration, once in place, are not likely to interfere with whale migration or other behavior. Observations in other geographic areas indicate that whale behavior is not disrupted by fixed platforms and islands.

The mooring chains used to position drill ships probably will not have an adverse impact on endangered whales; these chains will be taut, and it is unlikely that whales will become entangled. Reflectors can be mounted to mooring chaines to make them acoustically visible to whales.

Oil and gas exploration in the Bering Sea will result in an increase in ship and boat activities which will result in an increased risk of collisions between vessels and whales. The NMFS believes that the short-term increase in vessel traffic is unlikely to jeopardize the continued existence of any species of endangered whale. Fishing vessel traffic already is high and the additional increase by the petroleum industry operators probably will be minor. Nevertheless, certain areas contain significant numbers of whales, and encounters may be likely. Vessel operators should be advised of such areas and of boat operation procedures that can be used to avoid collisions.

Oil Spills:

Oil spills are not uncommon in OCS operations. The vast majority of these spills involve less than 50 barrels per incident and result in negligible measurable or long-term environmental damage. Large oil spills involving 1,000 or more barrels of oil are infrequent. Catastrophic spills such as an uncontrolled blow-out releasing thousands of barrels of oil into the environment over a period of days or weeks are too rare an event to calculate their probability of occurring with any reliability. Nevertheless, there is the potential for a blow-out to occur.

According to the National Research Council report on "Safety and Offshore Oil"[3] the rates of blow-outs in the past 10 years is 1 per 264 wells drilled in the U.S. waters. Most of these were gas blow-outs, but one well released 53,000 barrels of oil before being controlled. Four blow-outs required relief wells to be drilled to regain control. Exploratory drilling in new environments possesses unknown risks that may increase the potential of a well blow-out. Seasonal restrictions on drilling in certain areas can be used to preclude the possibility of a catastrophic oil spill during times of the year when endangered whale species are numerous and likely to encounter the spilled oil.

Oil spills have the potential to severly affect endangered whales. The magnitude of the impact would depend on the location, size of the spill, and on other environmental circumstances of the spill, conditions which are impossible to forecast. The risk of an oil spill in locations and times of year when whales are abundant should be avoided.

In the unlikely event of an encounter with a major oil spill, cetaceans could be severely affected. An oil spill could damage baleen whale feeding mechanisms, impair vision, and disrupt respiratory and digestive systems.

There is no (available) evidence that indicates whether cetaceans are able to detect and avoid hydrocarbon pollution. Accounts from past oil spills indicate that some marine mammals, for example seals and sea lions, sometimes do not avoid oil; however, no whales, dolphins, or porpoises have been found coated or fouled with oil.[4] Cetacean skin is usually smooth and unlikely to accumulate oil. Those species with major surface irregularities or eroded areas, such as the gray, humpback, and bowhead may retain oil on parts of their bodies. Unlike pinnipeds, whose fur is visibly affected by oil, an oil-fouled cetacean may go unnoticed. Although oil-fouled cetaceans have not been observed, the nature of their skin suggests that they may be particularly vulnerable to noxious effects of surface contact with hydrocarbons. Unlike other mammals, the epidermis of cetaceans is not keratinized, but is composed of living cells that are virtually unshielded from the environment and may be permeable to hydrocarbons. Cetacean epidermis may react to noxious substances, such as oil, in a manner similar to that of sensitive mucous membrances. Physical or chemical disruption by oiling might be expected to have immediate and far-reaching metabolic consequences, perhaps affecting vital ionic regulation and water balance.

Cetacean vulnerability to oil ingestion varies with species, type of oil and nature of the oil spill. Baleen whales such as blue, fin, humpback, and bowhead whales accidentally could engulf large quantities of oil while feeding on plankton concentrations that may be present in an oil spill area. Much of the oil thus engulfed probably would be forced out of the mouth during the feeding process; however, oil coating or fouling of the baleen plates could occur and some oil would be ingested. Studies in progress have demonstrated that oil causes matting of the baleen fringes, which reduces filtering efficiency. Other baleen whales, such as right and sei whales, which skim the water surface and cover relatively large areas while feeding, may be the most vulnerable to baleen fouling and oil ingestion from surface oil pollution. The affect of oil ingestion on whales is unknown.

The bottom-feeding gray whale is unlikely to ingest surface oil but could be prone to ingestion of hydrocarbons in the bottom sediments of nearshore areas that are contaminated by either acute or chronic oil pollution. Cetaceans, especially the benthic feeders, are reported to have a poorly developed sense of taste, as indicated by the presence of foreign material in their stomachs. This evidence implies that some whales may not be able to differentiate between hydrocarbon-contaminated and uncontaminated food.

Inhalation of oil and/or oil clogging of the cetacean blowhole are unlikely as the typical breathing cycle of cetaceans involves an "explosive" exhalation followed by an immediate inhalation and an abrupt closure of the blowhole. This process prevents inhalation of water and, presumably would keep oil from being inhaled. However, the more toxic volatile fractions of oil and hydrocarbon gas could be inhaled. Thus the inhalation of hydrocarbons probably would depend on the quantity and chemical properties of the oil.

The greatest potential indirect impact from oil and gas activities on cetaceans would be the destruction or contamination of critical food sources from acute or chronic oil pollution. Most of the migratory baleen whales (bowhead, fin, gray, and humpback) probably are seasonal feeders and rely on the abundant food sources of northern waters for the bulk of their annual nourishment. They live largely off their stored blubber reserves while migrating and while on their winter ranges.

Euphausiids and copepods are important foods of the bowhead, humpback, fin, blue, sei, and right whales, and benthic amphipods and other invertebrates are important foods of gray whales. The destruction or contamination of these food resources by oil pollution would adversely affect the associated whale species by causing them to migrate to their wintering areas in a lean and probably stressed condition. Inadequate nutrition probably would lead to reduced reproduction success, and increased mortality. Thus it is likely that an oil spill that affected food resources would cause

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[3] National Academy Press, 1981. Safety and Offshore Oil. Committee on Assessment of Safety of Outer Continental Shelf Activities. 332 pp.

[4] Geraci, J.E. and D.J. St. Aubin, 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Mar. Fish. Rev., No. 1980, pp. 1-12.

additional stress to an already endangered or depleted whale population. The right, humpback, blue, and bowhead whales are among the most endangered whale species and are also "restricted feeders," depending on an abundance of only a few species of plankton. These whales probably also have the lowest tolerance to increased stress and mortality.

The significant reduction of plankton populations in the Bering Sea as a whole from oil spills is improbable. However, oil spill in a localized feeding area with highly concentrated food resources could lead to localized and temporary loss or contamination of the food resources, and would contribute to adverse environmental stress on these already depleted whale populations. Of particular concern in the Bering Sea are the benthic food resources in localized gray whale feeding areas in Chirikov Basin, Bering Strait, and near St. Lawrence Island.

The bowhead whale and the gray whale would be the most vulnerable to the direct impacts of an oil spill. The bowhead would be most likely affected by an oil spill in the Bering Strait or Norton Basin near St. Lawrence Island during its spring and late fall migrations through these waters, and in the Navarin Basin during the winter. Gray whales are most vulnerable near Unimak Pass in the spring and fall, and in the Bering Strait, Chirikov Basin, and near St. Lawrence Island during the summer.

Cumulative Impacts:

Cumulative effects of the aforementioned impacts are unpredictable at this time. While cumulative impacts are possible, the degree of severity or time it would take to observe any measurable effects cannot be foreseen. NMFS will monitor OCS activities in the Bering Sea Region and review new information concerning endangered whales for indications of cumulative impacts. Studies funded by BLM also may provide information that will help identify such impacts. Should hydrocarbons be discovered in the Bering Sea, or should hydrocarbon exploration continue in combination with extensive development and production of hydrocarbons in any adjacent areas of the OCS, demonstrable cumulative impacts could be produced. Careful attention must be given to the overall population status of these species and the quality of their habitat during the development and production periods in any OCS lease areas.

Conclusions

The NMFS believes that there is insufficient information concerning oil and gas exploration activities in the Bering Sea to allow us to determine whether such activities are likely to jeopardize the continued existence of endangered whales found there. We lack important information regarding the specific details of activities that may occur in individual lease areas (such as acoustic geophysical surveys, locations of leases, and exploration plans, etc.). However, we believe that it should be possible for the BLM and USGS to plan activities during the exploration phase in such a way as to avoid the likelihood of jeopardizing the continued existence of any species of endangered whale. Below we offer some reasonable and prudent alternatives that DOI can now adopt to avoid the possibility of jeopardy to these endangered whales. We emphasize here that it is our belief that DOI plans to reinitiate consultation on all future lease sales in the Bering Sea Region. Such consultations can provide DOI with additional measures that can be taken to ensure that specific OCS exploration activities are not likely to jeopardize the continued existence of any species of endangered whale.

Future actions that may affect endangered whales will require additional consultation pursuant to Section 7(a)(2) of the ESA. These actions will be evaluated as they become known, and we will continue to review, on a case by case basis, results of studies and the necessary federal permit applications required for the OCS activities.

We have based our opinion on the following:

A. Pre-Lease Stage

There probably will be no adverse impacts to endangered whales from the environmental or biological studies conducted in potential lease areas. These activities include trawling, sediment sampling, and bottom-profiling.

Further geophysical seismic exploration is expected in each lease area. At this time, knowledge of future levels of activity is insufficient to predict the magnitude of potential effects on endangered whales of noise from seismic surveys. We are especially concerned that seismic noise may affect the behavior of endangered bowhead and grey whales on their feeding and breeding grounds and along with migratory corridors and could possibly lead to altered distribution patterns and reduced productivity. DOI should review geophysical permit applications to determine if consultation pursuant to Section 7(a)(2) is required. Permit applications should be sent to NMFS' Alaska Office for review and comment.

We assume that COST Wells will be drilled off-structure. Additional consultation under Section 7(a)(2) is required for drilling on-structure COST Wells.

B. Exploration Stage

The type, and number of exploration platforms in an area can only be estimated at this time. Information on the times and locations of these platforms, of the construction of gravel islands, and of drilling activities are needed to predict the effects of exploration activities on endangered whales. Because this information will not be provided until the exploration plans are submitted, all proposed exploration plans and accompanying environmental reports submitted to the DOI must be reviewed to determine if additional Section 7 consultations are required.

The effects of geophysical activities will be the same as discussed for the pre-lease stage.

Endangered Whales Research Needs

Additional biological data also are required before NMFS can render a reliable opinion concerning the likelihood of jeopardy to endangered whales from OCS activities in the Bering Sea. NMFS recognizes BLM's valuable research efforts on endangered whales, particularly the bowhead. We encourage the continuation of this effort. Below we provide DOI with our assessment of the kind and amount of information needed before NMFS can complete a comprehensive Biological Opinion on the question of the likelihood of jeopardy to endangered whales from OCS activities.

The BLM Alaska OCS Office[5] proposes that a key species/key effects approach be employed to obtain information and data sufficient to answer important effects questions. Under that approach, research efforts in the Bering Sea would be directed towards bowheads, gray, fin, and humpback whales. NMFS believes priority consideration should be assigned to research under such a program as given in Table 1. Emphasis should be placed on studying gray and bowhead whales in the Norton Basin, Chirikov Basin, and Bering Strait Regions, humpback, gray, and fin whales in the St. George Basin, gray and humpback whales in the Northern Aleutian Shelf and Unimak Pass, and bowhead whales in overwintering areas in the Navarin Basin. Seasonal distributions, numbers, and habitat uses are needed. Observations on other endangered whale species should be made whenever possible. The BLM should ascertain whether or not the right whale presently occurs in the Bering Sea.

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[5] Draft Technical Paper, "Endangered Species Research: A Rationale For The Selection Of A Research Strategy," by C.J. Cowles and J.L. Imm. BLM/OCS. Anchorage, Alaska.

Table 1. Endangered cetaceans, ranked by research need for four Bering Sea OCS lease areas, based on these criteria: total abundance, dependence on habitat, and susceptibility to location and of activity within or adjacent to lease areas.

	Norton Basin		St. George	No. Aleutian	Navarin
Rank	Outer	Inner	Basin	Shelf	Basin
1	Gray	Bowhead	Humpback/Gray	Gray	Bowhead
2	Bowhead	Gray	Fin	Humphack	Fin
3	Fin	-	Sei/Blue/Right	Fin	Humpback
4	Humpback	-	Sperm	Right	Sperm

Major data gaps exist on the effects of oil and associated OCS activities on cetaceans. Studies are needed to determine the effects of various sound frequencies and levels emitted from industry operations on the behavior of the whales. Research should continue to evaluate the impacts resulting from human activity and, to a lesser extent, offshore structures on whale populations. The effects of oil spills on cetaceans are still not understood. Studies currently conducted or funded by BLM have begun to address these problems, and meaningful results should become available within the next few years.

The NMFS believes that the question of cumulative impacts deserves considerably more attention than it has been given to date. We are especially concerned that the bowhead whale is potentially subject to any adverse effects that may be associated with OCS oil and gas activity throughout its entire Alaska range as well as in its summer habitats in Canadian waters. Risks to this whale from noise and other potential sources of behavioral disturbance, oil spills, and habitat displacement should be assessed from the perspective of its complete habitat range rather than on a lease area by lease area basis. To accomplish this will require substantially better knowledge of the biology and habits of this whale throughout its range and over its entire life cycle. Information on cumulative effects will become particularly critical as the development and production stages are approached in the Bering Sea and Arctic lease areas. In particular, knowledge of recruitment, habitat use patterns

adjacent to proposed lease areas, and knowledge of variations in habitat partitioning among areas by season are needed in order to help determine and predict impacts, if any, to the segment of the population affected.

Reasonable Prudent Alternatives

Despite our inconclusive Biological Opinion the NMFS believes that DOI can presently plan OCS activities to avoid the likelihood of jeopardizing the continued existence of endangered whales in the Bering Sea Region. Here we offer DOI reasonable and prudent alternatives to help DOI meet this goal.

We are unable, at this early stage in the OCS process, to provide detailed alternatives for each of the four Bering Sea lease areas. Additional consultations will be needed as more detailed information is made available on the locations, timing and nature of each proposed lease area activity and on endangered whales in these lease areas. Sale notices, and subsequent exploration plans and permit applications should be reviewed by DOI on a case-by-case basis as activities are proposed to determine if additional Section 7 consultation is needed.

At this time reasonable and prudent alternatives that should be incorporated into the OCS leasing process or included in leases to avoid impacts and to ensure protection of endangered whales during the lease sale exploratory phase of the oil and gas activities are as follows.

1. Leasing should not take place in the Bering Strait and Chirikov Basin. The Bering Strait is extremely important as a migratory corridor for the entire bowhead whale population (April through May, and November through December), for a substantial part of the gray whale population (May through October). Both the Bering Strait and Chirikov Basin are important feeding habitats which are extensively occupied by gray whales from May through October.

2. Seasonal drilling restrictions should be placed on leases in the following areas. Sufficient time must be included in the seasonal restrictions to allow for drilling of relief wells and oil spill clean-up before the endangered whales re-enter each area.

a. There should be no drilling in the moving pack ice zone of Norton Basin during the winter and spring seasons (November 1 through May 31). This restriction would protect the bowhead whale from the risk of an oil spill in leads and the moving pack ice where it would be impossible to clean-up. Oil from a spill in these areas could be transported with the pack ice to bowhead overwintering areas near St. Lawrence Island, or may be encountered in the lead systems by these whales on their northward spring migration.

b. Exploratory drilling in the Navarian Basin area should be prohibited during the winter and spring months (December 1 through May 31) when pack ice is formed and overwintering bowhead whales are present in the area. Drilling should be limited to the ice-free season (June 1 through November 30).

c. Drilling in the vicinity of Unimak Pass should be prohibited during the spring (April 1 to June 30) and fall months (November 1 to January 31) when the entire gray whale population migrates through these waters.

3. Aircraft and vessel traffic should be controlled to avoid disturbances to endangered whales.

Recommendations

Section 7(a)(1) requires Federal agencies to utilize their authorities in furtherance of the purposes of ESA by carrying out programs for the

conservation of endangered and threatened species. To help DOI meet this obligation with respect to OCS activities in the Bering Sea Region NMFS offers the following recommendations:

1. We recommend that the BLM continue their studies in the distribution, abundance and habitat use of endangered whales in the Bering Sea.

2. We recommend that the BLM continue studies to gather information on the impacts of oil spills on endangered whales as well as on the effects of noise on these species.

3. Since the occurrence and distribution of cetaceans in the Bering Sea is not well known, NMFS desires to expand the existing data base. We believe that exploratory activities furnish an excellent opportunity for obtaining data on endangered whales, and therefore request that all sightings during exploration activities be reported to NMFS Alaska Regional Office. NMFS will furnish identification guides.

4. We recommend that the BLM and USGS establish for the Bering Sea Region a Biological Task Force, of which NMFS will be a member, to assist the DOI in OCS-related decisions that may affect endangered species and other biological resources of this Region.

5. Lessees should be notified, through information contained in the Notice of Sale and the lease, of guidelines that operators should use to avoid any potential problems of harassment or physical harm to these cetaceans. Appendix II provides guidelines to vessel and aircraft operators to avoid harassing endangered whales.

Opportunities for Additional Consultation

DOI has indicated that consultation will be reinitiated for individual lease sales to be held in the Bering Sea Region. During the post-lease exploration phase, the DOI has agreed to provide NMFS with all exploration plans, and any subsequent revisions of such plans. DOI should review these plans to determine if further Section 7 consultation is necessary.

Consultation under Section 7 will be reinitiated upon commencement of the development and production phase in any of the Bering Sea lease areas. At such time, any additional information available on the potential impacts of endangered whales will be re-evaluated, details on the location and magnitude of OCS development will be gathered, and a new Biological Opinion will be issued.

Consultation also must be reinitieted if: new information reveals impacts of the proposed activities that may affect listed species; the identified activities are modified in a manner not considered herein; or a new species is listed or critical habitat is designated that may be affected by the proposed activities.

This biological opinion in no way permits the taking of any endangered or threatened species. Taking of such species is prohibited under Section 9 of ESA and is subject to prosecution unless permitted pursuant to Section 10(a) of ESA or by regulation.

TABLE A. Eastern North Pacific endangered whales occurring in or adjacent to OCS lease areas in the Bering Sea. Codes are: I - Important seasonally; O - Occasional, not normal habitat; R - Rare; N - Not present; Blank - no data. From Howard Braham, personal communication.

			LEASE AREAS				
						Norton	(57) 5/
Species	Popu-1/ lation Size	Status	St. George Basin (70)	No. Aleutian Shelf (75)	Navarin Basin (83)	Sound 4/ Outer	Inner
Bowhead	2,300	Stable or decreasing slightly	R	N	I	I	I
Gray	15,000+	Stable or increasing slightly	I	I	O	I	O
Fin	17,000	?	I	I	I?	O	O
Humpback	1,200	?	I	O	O	O	N
Blue	1,700	?	O	O?	R	N?	N?
Sei	9,000	?	O	O	O	R	N?
Right	200	?	I	O?	O?	N 2/	N
Sperm	200,000	?	O	N	O 3/	N	N

1/ Eastern North Pacific population sizes, Bering Sea components may be considered small for all but bowhead and gray whales.

2/ Formerly occurred in Norton Sound area.

3/ Edge of continental shelf, and in deeper water.

4/ West of 166°W longitude.

5/ East of 166°W longitude.

Appendix I

Endangered Whales Occurring in the Bering Sea

Eight species of endangered cetaceans may occur in the four proposed lease areas in the Bering Sea. These are the bowhead, gray, fin, humpback, blue, sei, right, and sperm whales. Information relating to population size, status, and occurrence of each species in the various lease areas is summarized in Table A.

Bowhead Whale:

The bowhead whale (Balaena mysticetus) is one of the rarest and one of the least known of the great whales. These ice-associated whales inhabit Arctic waters during the summer and Bering Sea waters in the winter. Bowhead whales pass through the Bering Strait and enter the Bering Sea in late fall, in advance of the winter extension of the arctic pack ice. From about November to April or May, the entire population of bowhead whales, estimated at about 2,300 individuals, may occupy the broken pack ice of the central Bering Sea. The exact location of the wintering area is poorly documented, but appears to extend from south and west of St. Lawrence Island to as far as the ice front edge, and perhaps occasionally farther south into open water. Their over-wintering range probably varies with the type and extent along the 100 to 200 m depth contour at the continental shelf edge. During 1979

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ice-breaker surveys, bowhead whales were seen in the vicinity of St. Matthew Island among broken ice up to 8/10 coverage as well as in polynyas south and west of St. Lawrence Island.

In spring the whales move through the broken ice and small open leads around St. Lawrence Island, travel northward through the outer Norton Sound area and pass through the Bering Strait on their migration to summering areas in the Arctic.

The nature of winter activities of bowhead whales in the Bering Sea is generally unknown. Mating and calving are believed to occur in the spring and may occur in the central and northern Bering Sea, as well as in the Chukchi and Beaufort Sea, during or prior to the commencement of the spring migration. The growth trend of the population is uncertain.

Gray Whale:

The gray whale, Eschrichtius robustus, has an eastern Pacific population that migrates from its wintering areas of Mexico to summer in the Bering and Chukchi and occasionally the Beaufort Seas. The spring migration of these whales through Alaska waters and into the Bering Sea follows the coastline close to shore. Whales first appear in the Gulf of Alaska from June to July. Inside the Bering Sea, the gray whales follow the Bristol Bay coast to the vicinity of Nunivak Island. From Nunivak Island they move offshore to their northern feeding areas.

Virtually the entire population of 15,000+ animals summer in the Bering and Chukchi Seas. Large concentrations of gray whales (5000+) occur from north of St. Lawrence Island to the Bering Strait from May to November where the waters of the major feeding areas are relatively shallow (20-50m). Some animals continue north through the Bering Strait into the Chukchi and shallow Arctic Seas. A small portion of the gray whale population summers in the southern Bering Sea, particularly near the Pribilof Islands.

The population of gray whales appears to be slightly increasing.

Fin Whale: The fin whale, *Balaenoptera physalus*, summers in the Bering Sea, occasionally as far north as the Chukchi Sea, and migrates to more southern latitudes in winter to mate and calve. The North Pacific population is currently numbered at 17,000 but it is unknown how many of these animals seasonally inhabit the Bering Sea. The growth trend of the population is unknown. Fin whales entering the Bering Sea are apparently composed of two groups; one of mainly mature whales and females without calves which follows the outer shelf edge to as far west as Cape Navarin; and a group of mainly nursing females and immatures which stays in the southern Bering Sea Region north of Unimak Pass. They are present during the summer in low numbers in outer Norton Basin and around St. Lawrence Island.

Humpback Whale:

The humpback whale, *Megaptara novaeangliae*, has a distribution similar to the fin whale. In the summer a portion of the population enters the Bering and Chukchi Seas, where these whales may spend up to 5-1/2 months on their feeding grounds. Their present North Pacific population is estimated at only 1,200 animals, and the condition of this population is uncertain. They often occur during summer and fall in the St. George lease area and adjacent waters, and may occasionally be encountered in other parts of the Bering Sea.

Blue Whale:

The blue whale, *Balaenoptera musculus*, probably rarely enters the Bering Sea; the few that do have been reported as far north as the Bering Strait. Most records for the Bering Sea are from off the continental shelf south of the Pribilof Islands.

Sei Whale:

The sei whale, *Balaenoptera borealis*, sometimes enters the southern Bering Sea, but are rarely encountered and little is known of their distribution in these waters. They have been reported from southwest of St. Lawrence Island and along the continental shelf edge. They are rare or absent from the northern Bering Sea Region.

Right Whale:

The right whale, *Baleana glacialis*, is nearly extinct in the North Pacific from over-exploitation by commercial whaling. The population may be below the critical number from which recovery can be expected. Only 200 animals are estimated to remain in the North Pacific. Sightings are exceedingly rare and little is known about the present distribution. St. Lawrence Island may be the northern limit of this species. Most Bering Sea sightings have been in July between the Pribilof Islands and the Aleutian Archipelago, mainly of single individuals.

Sperm Whale:

Sperm whales, *Physeter macrocephalus*, migrate to northern latitudes in the summer. Generally only males reach Alaska waters, the females and immatures are generally found farther south between 40° and 50°N latitude, but may enter

the Bering Sea during warm years. Male sperm whales are relatively abundant in the central Bering Sea to as far as 62°N latitude and are known to occur there from April to September. The main area of concentration appears to be along the continental slope between the Pribilof Islands and Cape Navarin, especially in the vicinity of 180°W longitude.

Appendix II

The Endangered Species Act prohibits harassment of endangered and threatened species whether the harassment occurs through an intentional or negligent act or omission. Harassment refers to conduct or activities that disrupt an animal's normal behavior or cause a significant change in the activity of the affected animal. In many cases the effect of harassment is readily detectible: a whale may rapidly dive or flee from an intruder to avoid the source of disturbance. Other instances of harassment may be less noticeable to an observer but will still have a significant effect on endangered whales.

Leaseholders must be prepared to take all reasonable and necessary measures to avoid harassing or unnecessarily disturbing endangered whales. In this regard, leaseholders should be particularly alert to the effects of boat and airplane or helicopter traffic on whales.

In order to insure that leaseholders may derive maximum benefits from their operations at a minimum cost to the health and well being of endangered whales, the following guidelines are offered to help avoid potential harassment of endangered whales.

(1)(a) Vessels and aircraft should avoid concentrations or groups of whales. Operators should, at all times, conduct their activities at a maximum distance from such concentrations of whales. Under no circumstances, other than an emergency, should aircraft be operated at an altitude lower than

1,000 feet when within 500 lateral yards of groups of whales. Helicopters may not hover or circle above such areas or within 500 lateral yards of such areas.

(b) When weather conditions do not allow a 1,000 foot flying altitude, such as during severe storms or when cloud cover is low, aircraft may be operated below the 1,000 foot altitude stipulated above. However, when aircraft are operated at altitudes below 1,000 feet because of weather conditions, the operator must avoid known whale concentration areas and should take precautions to avoid flying directly over or within 500 yards of groups of whales.

(2) When a vessel is operated near a concentration of whales the operator must take every precaution to avoid harassment of these animals. Therefore, vessels should reduce speed when within 300 yards of whales and those vessels capable of steering around such groups should do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group.

(3) Vessel operators should avoid multiple changes in direction and speed when within 300 yards of whales. In addition, operators should check the waters immediately adjacent to a vessel to ensure that no whales will be injured when the vessel's propellors [or screws] are engaged.

(4) Small boats should not be operated at such a speed as to make collisions with whales likely. When weather conditions require,

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(4) Small boats should not be operated at such a speed as to make collisions with whales likely. When weather conditions require, such as when visibility drops, vessels should adjust speed accordingly to avoid the likelihood of injury to whales.

When any leaseholder becomes aware of the potentially harassing effects of lease operations on endangered whales, or when any leaseholder is unsure of the best course of action to avoid harassment of endangered whales, every measure to avoid further harassment should be taken until the National Marine Fisheries Service is consulted for instruction or directions. However, human safety will take precedence at all times over the guidelines and distances recommended herein for avoidance of disturbance and harassment of endangered whales.

Leaseholders are advised that harassment of endangered whales may be reported to the National Marine Fisheries Service for further action, including prosecution, under the Endangered Species Act of 1973.

Attachment 2
Guidelines to Vessel and Aircraft Operators

The Endangered Species Act prohibits harassment of endangered and threatened species whether the harassment occurs through an intentional or negligent act or omission. Harassment refers to conduct or activities that disrupt an animal's normal behavior or cause a significant change in the activity of the affected animal. In many cases the effect of harassment is readily detectible: a whale may rapidly dive or flee from an intruder to avoid the source of disturbance. Other instances of harassment may be less noticeable to an observer but will still have a significant effect on endangered whales.

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(b) When weather conditions do not allow a 1,500 foot flying altitude, such as during severe storms or when cloud cover is low, aircraft may be operated below the 1,500 foot altitude stipulated above. However, when aircraft are operated at altitudes below 1,500 feet because of weather conditions, the operator must avoid known whale concentration areas and should take precautions to avoid flying directly over or within 500 yards of groups of whales.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503
(907) 276-3800

IN REPLY REFER TO:
SE

0 4 NOV 1983

Mr. David Russell
Director
Minerals Management Service
MMS-Mail Stop 644
12203 Sunrise Valley Drive
Reston, Virginia 22091

Dear Mr. Russell:

This responds to your September 28, 1983, request to reinitiate formal consultation pursuant to Section 7(a) of the Endangered Species Act (ESA), as amended, for Outer Continental Shelf (OCS) oil and gas leasing and exploration in the St. George Basin (Lease Sale No. 70) and the Northern Aleutian Shelf (Lease Sale No. 75).

BACKGROUND

A Biological Opinion and an amended Biological Opinion were issued on August 22, 1980, and September 16, 1980, respectively for the Bering Sea Region (copies attached). Your reason for reinitiating consultation is to ensure that conclusions contained in the earlier opinions are still valid in view of newly obtained information relative to these proposed sales.

BIOLOGICAL INFORMATION

The American and Arctic peregrine falcons (*Falco peregrinus anatum* and *F. p. tundrius*) short-tailed albatross (*Diomedea albatrus*) and Eskimo curlew (*Numenius borealis*) are endangered species considered in the 1980 opinions. There is no new information on the occurrence of these birds within the lease offering areas and we find the 1980 opinions to be current and entirely appropriate for these species.

During the summers of 1982 and 1983 new information on the endangered Aleutian Canada goose (*Branta canadensis leucopareia*) was obtained. A remnant nesting population of Aleutian Canada geese was discovered on Chagulak Island, an island in the southwest corner of the St. George Basin lease area, in the Islands of Four Mountains group.

The probability of an oil spill during exploration is minimal. Oilspill trajectory data indicate that the net transport of oil due to an oilspill within the St. George Basin lease area would probably be northward away from Chagulak Island. In addition, Aleutian Canada geese nest in terrestrial habitat at high elevations and seldom frequent estuarine habitat during the nesting season.

There have been unconfirmed sightings of fall migrating geese at Unimak Island. However, in a continuing migration study where leg banding and color marking has been used since 1974, there has never been a documented return or sighting of an Aleutian Canada goose, in Alaska, east of the Andreanof Islands. All data indicate that the geese migrate in the spring and fall directly over water between the outer Aleutian Islands (west of Unimak Pass) and the wintering areas in California. It appears, therefore, that migrating Aleutian Canada geese do not traverse the proposed lease areas.

BIOLOGICAL OPINION

Based on this information, it is my Biological Opinion that the proposed oil and gas leasing and exploration activities in the St. George Basin and in the Northern Aleutian Shelf are not likely to jeopardize the continued existence of the endangered Aleutian Canada goose, or the other endangered species previously considered.

This opinion does not address oil or gas development or production. Consultation will be required prior to start up of those phases. New information which could alter this Biological Opinion, the listing of new species which could be affected by the proposed action, or significant modification of the proposed action, will also require reinitiation of consultation.

Thank you for your cooperation and for your concern for endangered species.

Sincerely,

Acting
Regional Director

Attachments

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503
(907) 276-3800

IN REPLY REFER TO:
SE

1 0 NOV 1983

Mr. David Russell
Director
Minerals Management Service
EMS-Mail Stop 644
12203 Sunrise Valley Drive
Reston, Virginia 22091

Dear Mr. Russell:

Attached are copies of letters that we failed to attach to our November 4, 1983, Biological Opinion for the Outer Continental Shelf oil and gas leasing and exploration in the St. George Basin and the Northern Aleutian Shelf.

Please excuse this inconvenience.

Sincerely,

Keith M. Schreiner
Regional Director

Attachments

OFFICE COPY

AUG 2 2 1980

In Reply Refer To:
FWS/OES BLM/CS-80-2

Memorandum

To: Director, Bureau of Land Management
Director, U.S. Geological Survey

From: Associate Director

Subject: Biological Opinion Regarding Outer Continental Shelf (OCS) Oil and Gas Leasing and Exploration Activities in the Bering Sea Region

By memorandum received June 6, 1980, the Bureau of Land Management (BLM) and the U.S. Geological Survey (GS) requested a joint formal consultation on the proposed Outer Continental Shelf (OCS) oil and gas program in the Bering Sea region. Four proposed OCS lease Sales are scheduled to take place in this region between September 1982 and December 1984. This consultation considers oil and gas leasing and exploration activities in the area that encompasses proposed Sales 57 (Norton Basin), 70 (St. George Basin), 75 (Northern Aleutian Shelf), and 83 (Navarin Basin). By memorandum dated June 19, 1980, a list of four species which may be affected by the OCS programs was received from the BLM Alaska OCS Office, including the American and Arctic peregrine falcons (Falco peregrinus anatum, F. p. tundrius), short-tailed albatross (Diomedea albatrus), Aleutian Canada goose (Branta canadensis leucopareia), and Eskimo curlew (Numenius borealis).

Through informal consultation, agreement was made that the only "may affect" situation associated with the leasing and exploration activities would be for Sale #57 (Norton Basin). The affect would be possible disturbance of nesting peregrines along the coast near Nome by aircraft (primarily helicopters) supplying and servicing exploration activities. Similar work activities involving support and supply bases in Dutch Harbor, Cold Bay, and St. Paul will not adversely affect listed species or associated Critical Habitat. There is limited knowledge concerning current peregrine nesting areas in the Bering Sea region. However, BLM will be supplying such information by conducting a survey in the Sale #57 area this summer and the results of that survey should be available by September or October at the latest. If nesting birds are present this formal consultation must be reinitiated.

Neither the short-tailed albatross nor the Eskimo curlew have been recently reported in or near the Bering Sea Sale areas. Probably the most vulnerable habitat of the Aleutian Canada goose would be Buldir Island. However, net transport of oil spills in this region would likely be northward, away from Buldir Island. In addition, large distances between Buldir Island and the lease areas would allow substantial weathering of spilled oil. Thus, there appears to be little chance of spilled oil reaching Buldir Island, the only known nesting area for the species. Therefore, the only species included in this biological opinion are the American and Arctic peregrine falcons (Falco peregrinus anatum and F. p. tundrius), for which a summary of the biological data is provided below.

American and Arctic Peregrine Falcons (Falco peregrinus anatum and F. p. tundrius)

The peregrine is a medium-sized falcon. Both of these subspecies have been listed as Endangered since 1970 and Critical Habitat for the American falcon has been designated in California.

The principal cause of the peregrine's decline has been contamination by chlorinated pesticides. Other factors contributing to their decline include shooting, predation (by great horned owls in particular), egg collecting, disease, falconers, human disturbance at nesting sites, and loss of habitat to human encroachment.

The Arctic peregrine breeds in the North American tundra, and migrates mainly along the east coast where it is the most common of the two subspecies. While a few pair of American peregrines still breed in Labrador, the Eastern U.S. population of American peregrines is considered to have been extirpated. However, as a result of the captive breeding program at Cornell University, peregrine falcons have been reintroduced in the Northeastern U.S. There are indications that this reintroduction effort may be successful, and that someday breeding pairs may again occur in the Eastern U.S.

During migration, coastal habitats are used extensively by peregrine falcons. Peregrines can also be found as far as 300 miles offshore during the migration period. Since they are capable of feeding while in flight, it is possible that spills which remain offshore can result in the oiling of peregrines or their prey. In addition, peregrines which rest on beaches during migration may become oiled. The probability of a spill occurring during exploration activities, however, is very remote. The expansion of existing facilities, the establishment of new facilities, or the construction of gravel islands may impact this species and will require reinitiation of consultation before a Corps of Engineers Section 10 permit can be issued.

Since nesting and migration areas are relatively distant from the project area and the potential for an oil spill resulting from exploration activities is small, it is my biological opinion that the proposed oil and gas leasing and exploration activities associated with proposed OCS Sales 57, 70, 75, and 83 are not likely to jeopardize the continued existence of the listed species considered herein, and because there is no designated Critical Habitat within or near the project area, Critical Habitat will not be affected.

Should the use or expansion of other facilities be proposed or should the initiation of activities (such as the construction of gravel islands for exploration purposes) not specifically mentioned in this consultation.. proposed, reinitiation of Section 7 consultation will be required. Since development/production activities may affect listed species, Section 7 consultation will be required before this phase is entered. If a new species which may be affected should be listed, or additional pertinent information becomes available, or the project description change, Section 7 consultation must be reinitiated.

We would like to thank BLM and GS for their consideration in providing the necessary information needed to conduct this consultation.

/S/ Ronald E. Lambertson

cc: Directorate Reading File
DD Chron
AFA Reading File

FWS/OES:LWest:ad 7/18/80 235-2760 final 8/12/80

United States Department of the Interior
FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

In Reply Refer To:
FWS/OES BLM/GS-30-2

Memorandum SEP 16 1980

To: Director, Bureau of Land Management
Director, U.S. Geological Survey

Acting Associate
From: Director

Subject: Revision of August 22, 1980, Biological Opinion Regarding Outer Continental Shelf (OCS) Oil and Gas Leasing and Exploration Activities in the Bering Sea Region

Recent information from Dennis Money, Alaska Area Office, indicates that the peregrine nesting survey in the Sale #57 (Norton Basin) area of the Bering Sea cannot be accomplished for 1980. Therefore, the subject biological opinion should be amended to read as follows:

1. Page 1. Paragraph 2. Delete lines 7-12 "There is limited knowledge... formal consultation must be reinitiated."

2. Incorporate the following statements as the first paragraph on page 3.

   To assist you in exercising your authority for the conservation of listed species, the following actions are recommended:

   a. Aircraft supplying and servicing exploration activities must maintain at least 1500 feet altitude above nest level within 1 mile horizontal distance of peregrine falcon eyries identified in past surveys in the Sale #57 (Norton Basin) area. The U.S. Fish and Wildlife Service, Alaska Area Office, should be contacted to determine the location of these historical eyries.

   b. A complete updated survey delineating current peregrine nesting areas in the Sale #57 area should be completed no later than October 1981. If nesting birds are present this formal consultation must be reinitiated.

The revised biological opinion is attached.

Harold J. O'Connor

Attachment

cc: Directorate Reading File
DD Chron File - AFA File
[illegible]

APPENDIX I

Alternative-Energy Sources as an Alternative to the OCS Program

Prepared by

Minerals Management Service

Alternative-Engergy Sources as an Alternative to the OCS Program

To delay or eliminate the proposed sale in part or in whole, would reduce future OCS oil and gas production, necessitate escalated imports of oil and gas, and/or require the development of alternate-energy sources to replace the energy resources expected to be recovered if the proposed sale takes place.

The oil and gas that could become available from the proposal over the time period could add to national domestic production. If this proposed sale were cancelled, an additive impact of greater oil and gas deficits could be expected to result in increased imports. If the subject sale were cancelled, the following energy actions or sources might be used as substitutes. However, some of these actions are not feasible at this time and may not be during the estimated life of this production area.

It is anticipated that the oil and gas which would become available from this proposal in the assumed time period could provide a significant contribution to this region's energy supply; if the subject sale were cancelled, the following energy actions or sources might be used as substitutes:

-Energy conservation
-Conventional oil and gas supplies
-Coal
-Nuclear power - fission
-Nuclear power - fusion
-Oil shale
-Tar sands
-Hydroelectric power
-Solar energy
-Energy imports
    Oil imports
    Natural-gas pipeline imports
    Liquefied-natural-gas imports
-Geothermal energy
-Other energy sources
-Combination of alternatives

This section briefly discusses these alternatives. For more detailed information on each of these energy sources and environmental effects, refer to Energy Alternatives: A Comparative Analysis (University of Oklahoma, 1975), prepared for the Bureau of Land Management by the Science and Public Policy Program of the University of Oklahoma.

Energy Conservation: Vigorous energy conservation is an alternative that warrants serious consideration. Several studies have suggested that we could enjoy the same standard of living and yet use 30 to 50 percent less energy than we do now (Lansberg et al., 1979). Aside from these savings, it is now widely recognized that wasteful consumption habits impose social costs that can no longer be afforded, as do pollution and an inequitable distribution of fuel. Existing conservation programs include education, research and development, regulation, and subsidies.

The residential and commercial sectors of the economy are often characterized as inefficient energy consumers. Inadequate insulation, inefficient heating and cooling systems, poorly designed appliances, and excessive lighting are often noticed in these sectors. Reductions in consumption beyond those induced by fuel-price increases could be achieved by new standards on products and building and/or subsidies and incentives. Such incentives include standards for improved thermal efficiency in existing homes and offices and minimum thermal standards for new homes and offices.

Excessive consumption is also evident in the industrial sector, where energy-inefficient work schedules, poorly maintained equipment, equipment with extremely low-heat-transfer efficiencies, and unrecycled heat and waste materials are all commonplace.

Transportation of people and goods accounts for approximately 25 percent of nationwide energy use. Energy inefficiency in the transportation sector varies directly with automobile usage. Automobiles, which account for the bulk of all passenger movement in the nation, use over twice as much energy per passenger mile than buses do. Short- and midterm conservation measures, such as consumer education, lower speed limits, and rate and service improvements on public transit, and rail-freight transit may achieve considerable energy savings.

Other policies which could encourage fuel conservation in transportation include standards for more efficient new automobiles and incentives to reduce miles traveled. An important new development in the fuel economy area could be the modification of the standard internal-combustion engine. Although such an engine is now in the advanced stages of development, further study by automotive engineers, industry, and concerned federal agencies is necessary before an acceptable engine can be designed.

Significant energy savings are clearly possible through accelerated conservation efforts. In addition, several of the strategies mentioned above have been at least partially implemented by the Energy Policy and Conservation Act of 1975 (P.L. 94-163).

Environmental Effect: The environmental effects of a vigorous energy conservation program will be primarily beneficial. The exact nature and magnitude of these effects will depend on whether there is a net reduction in energy use or whether the reduction is accomplished through technological change and substitutions. For the former, the net effects will mean that fewer pollutants of all kinds will be unleashed. As an example, a 2.2-million-barrel/day savings would result in a diminishment nationwide of various pollutants by the following amounts (HUD Contract #H2026R: "Research Evaluation of a System of Natural Air Conditioning"):

Pollutant	Amount of Pollutant Per 1,000 gallons (lbs)	Tons of Pollutant per day
CO	4	189
Hydrocarbons	3	142
Particulates	23	1,088
NO_x	60	2,838
SO_x	157	7,426

However, if energy conservation is achieved by technological change or substitution, the net reductions also will be those above. Other effects could be related or attributed to an OCS lease sale in another unidentified area or as described below.

Conventional Oil and Gas Supplies: Large quantities of oil and gas still remain in the United States. Between 1955 and 1969, the U.S. had slightly increasing amounts of proved oil reserves of about 30 billion barrels. The discovery at Prudhoe Bay in 1970 raised the amount to 40 billion barrels, but reserves have been declining ever since. Since 1970, new oil discoveries have replaced less than half of production. Reserves are currently at the lowest level since 1951. U.S. production has been fairly constant since the mid-1960's at 8 to 9 million barrels daily. Similar patterns occur for natural gas. Proved reserves are currently estimated at 31.4 billion barrels of oil and 208.0 trillion cubic feet of natural gas.

Ultimately recoverable resources (all deposits known or believed to exist in such forms that economic extraction is currently or potentially feasible), in addition to proved reserves, are estimated to be about 82.6 billion barrels of oil (54.6 onshore/28.0 offshore), 13 years of consumption at current rates, and 593.9 trillion cubic feet of natural gas (426.9 onshore/167.0 offshore). This estimate is rising over time, mainly because of higher prices and new discoveries in unexplored areas. Unconventional hydrocarbons and recovery methods, especially enhanced recovery, could more than double these figures. The amount of ultimately recoverable reserves will depend on price, technology, geological information, and public policy such as price controls, access to federal lands, and environmental standards.

Petroleum production is severely constrained in the short run, and greatly affected by world prices in the long run. Although the long-run demand for fuel liquids is not forecast to decline significantly (feasible solid and gaseous substitutes do not appear to exist), consumption of conventional crude oil is expected to decline significantly, as synthetic liquids are produced from shale, tar sands, coal; biomass sources are utilized; and industry and utilities retire oil facilities and shift to coal and possibly nuclear power (Table I-5). Synthetic liquid from coal is expected to be the major source of liquid fuel by 2020, supplying 50 percent of all liquid fuel and 10 percent of all energy consumed.

The following table displays the dimensions of the projected decline in conventional crude oil demand (Table I-5):

	1980	2020
Quads of Conventional Crude Oil Consumed	34	8
As Percentage of Total Energy Consumption	45%	6%
Quads of Liquid Fuel Consumed	34	30
As Percentage of Total Energy Consumed	45%	21%

Conventional natural-gas consumption is expected to decline due to depletion, higher prices, and competition with synthetic gas from coal. Enhanced gas recovery from unconventional sources such as tight sands and Devonian shale is expected to make a significant contribution to gaseous fuel production, providing 50 percent of all gaseous fuel and 5 percent of all energy consumption by 2020. Ultimately recoverable reserves from such sources are estimated at 3,000 trillion cubic feet. The following table displays the dimensions of the projected decline in gaseous fuel demand (Table I-5):

	1980	2020
Quads of Conventional Natural Gas Consumed	20	6
As Percentage of Total Energy Consumption	26%	4%
Quads of Gaseous Fuel Consumed	20	15
As Percentage of Total Energy Consumption	26%	11%

A detailed description of the crude oil and natural gas systems is found in Chapters 3 and 4 of Energy Alternatives: A Comparative Analysis.

To substitute directly for the subject sale, a combination of onshore and OCS production from other areas and continued foreign imports would be required to make up for the estimated total production of this proposed sale.

Environmental Effect: This substitution would entail environmental effects such as land subsidence, soil sterilization, and disruption of existing land-use patterns. Equipment failure, human error, and blowouts also may impair environmental quality. Moreover, poor well construction, particularly in older wells, and oil spills can result in ground- and surface-water pollution.

The water pollutants from onshore oil production are oil and dissolved solids. The amounts of each vary over a wide range. A summary of onshore oil pollutants is available in Energy Alternative: A Comparative Analysis.

Air pollutants (particulates, NO_x, hydrocarbons, and CO) result from blowouts and subsequent evaporation and burning. These are generally insignificant, except locally. These effects will be basically the same, whether the production is onshore or offshore.

Given the fact that onshore supplies are dwindling, users of hydrocarbons from this proposal would have to continue their reliance on other regions and foreign imports for needed oil and gas. The decline in these supplies, even with energy conservation, could mean industrial shutdowns, increased unemployment, higher consumer prices, and changes in the standard of living. The lack of natural gas will mean additional use of "dirtier" alternative fuels (oil, coal) with consequent effects on air quality and human health.

Coal: Coal is the most abundant energy resource in the United States. Proven domestic reserves of coal are estimated at 438 billion short tons. This constitutes over one-quarter of the known world supply, 80 percent of proven U.S. fuel reserves, and 130 times the energy consumed in 1980. Ultimately recoverable reserves are estimated at 3.9 trillion short tons. A detailed discussion of the coal resource system can be found in Chapter 1 of Energy Alternatives: A Comparative Analysis.

Coal production (18.88 quads), consumption (15.67 quads), and inventories (203.6 million short tons) were at record levels in 1980, mostly as a result of increased demand from the electric utilities, including the conversion of existing power-generating units from oil to coal. The 7-percent increase in coal production over 1979 is the main reason for the U.S.'s record energy production in 1980.

Although domestic coal reserves could easily replace the energy expected to be realized from the proposed sale, serious limitations to coal development exist. In many uses, coal is an imperfect substitute for oil or natural gas. In many other cases, coal use and production is restricted by government constraints, limited availability of low-sulfur deposits, inadequate mining, conversion and pollution-abatement technology, and the hazardous environmental effects associated with coal extraction and from electricity generation. Coal production is also threatened by a unique set of labor problems associated with mining, and new, strict standards for coal-mine safety.

Due to its relative price advantage over other fuels, competitive market structure, and large resource base, coal consumption and production are expected to increase significantly and become the primary domestic-energy source in the future (Table I-5). Synfuels from coal also will be important (see below).

The Powerplant and Industrial Fuel Use Act of 1978 was designed to reduce petroleum and natural-gas consumption and to encourage greater use of coal and alternative fuels. The Act prohibits all new electric powerplants and large industrial boilers (and existing ones after 1990) from consuming oil or natural gas as a primary-fuel source unless an exemption is granted.

Although U.S. coal resources are very large, as with other extractable mineral fuels, there is some geographic dislocation. Most of our new low-sulfur coal is found west of the Mississippi River or in Alaska, far from industrial areas. Also, much of the western coal is in arid or semi-arid areas where scarcity of water could constrain development.

If an alternative to the proposed OCS sale is greater reliance on coal, it may be expected that mining would have to increase in western states to provide the necessary fuel resources.

Environmental Effect:

Coal Utilization: Combustion of coal results in various emissions, notably SO_2 and particulates. If the expected production from this sale is replaced by coal, there would be an increase in these pollutants, especially if coal is substituted for the natural gas presently used. Technology to control these emissions is available but has not yet been proven sufficient to be widely applied. The sulfur content of eastern coal varies considerably, but approximately 65 percent of the developed resources have a sulfur content exceeding 1 percent. Most of the U.S. low-sulfur coal is located in the western states. Any large-scale shift to coal would require relaxation of emission regulations or improvement of technologies to convert coal to gaseous or liquid fuels.

Surface Mining: The primary effect of surface mining is disruption of the land. This affects all local flora and fauna and water quality, and it increases landscape problems due to erosion and mine runoff. Reclamation is difficult in the western states due to the lack of water to assist in revegetation. Other problems include acid-mine-water drainage, leachings from spoil piles, processing waste, and disturbances caused by access and transportation. Noise and vibration resulting from operations also can be expected. Finally, surface mining causes conflicts with other resource uses such as agriculture, recreation, water, and wildlife habitat.

The land use of strip-mining ranges from 0.8 to 5.9 acres/10^{12} BTU extracted, depending on seam thickness and BTU content of the coal.

Underground Mining: Underground mining primarily affects land and water quality. The land effects are those that arise from subsidence, waste disposal, access, and transportation. Very little surface is disturbed. Subsidence can destroy structures, cause landslides and earthquakes, and disrupt groundwater-circulation patterns. The amount of subsidence can be controlled by the mining method used and the amount of coal removed. The utilization of certain mining methods and the restriction of the amount of coal extracts can have detrimental effects on the economics of the operation.

Water quality is affected by both processing waste and the drainage of acid-mine-water into surrounding areas. These can be minimized through the proper methods of control both during and after operations. Waste piles can be replaced in the mine and entrances sealed. This also would help to minimize subsidence. Other pollution problems are those associated with road and coal dust and the like, but these are minimal and easily controlled. Other disturbing aspects of mining have much less of an effect in an underground mine. Working conditions of underground mines have been improved under the Federal Coal Mining Health and Safety Act of 1969, although further efforts are needed to reduce health hazards. This program has resulted in increasing costs of underground mining when compared to surface mining, which has even more severe environmental consequences.

Coal Transportation: The five major transportation systems (road, rail, water, conveyor, and pipeline) all have some adverse environmental effects. These include air and noise pollution, safety hazards, land-use conflicts, trash-disposal problems, and aesthetic damage. However, since spill problems are not associated with coal, most of the effects can be controlled with greater care and consideration. A slurry pipeline also requires large supplies of water and must adequately dispose of this at the other end. Water availability is a problem in many areas of the U.S., especially in the west where energy resource requirements will have to compete with existing commercial and private users for a limited and fragile resource.

Coal Conversion: Technology for conversion of coal into gaseous and liquid hydrocarbons has been established for several decades, and a number of relatively low-capacity commercial plants exist in various parts of the world. However, few cost-effective advanced technologies have progressed beyond the pilot-plant stage.

Numerous problems remain before commercial development of synthetic fuels from coal can proceed. Specific technical problems must be solved. The cost effectiveness of synthetic fuels from coal will depend on prices of other fuels, primarily oil and natural gas.

The Energy Security Act of 1980 created the United States Synthetic Fuel Corporation. The corporation is empowered to provide financial assistance to the private sector for commercial synthetic fuel projects. The goal of the corporation is to increase synthetic fuel production to the equivalent of at least 500,000 barrels of oil per day by 1987 and 2,000,000 barrels per day by 1992.

Control of adverse environmental effects will increase the cost of producing synthetic fuels. Possible constraints on development include: technological constraints, availability of skilled workers, available raw materials (coal, water, steel), capital, institutional constraints, government policies (energy-resource leasing, coal-mining regulations, permit procedures, etc.) and the willingness of industry to invest in development of new technologies.

Synthetic oil and gas could contribute substantially to energy supplies by the year 2000. The most important contributions would be high-BTU gas from coal, synthetic crude oil from oil shales, and coal liquefaction. The success of these energy sources will depend on developing technology, the cost of the effects, and the cost of conventional oil and gas.

Coal Gasification: Gaseous fuels with low, intermediate, or high energy content can be produced. Low and intermediate gases are produced in a two-stage process involving preparation and gasification, and the output is utilized as feedstock for electric generators. A third process, "upgrading," is required to produce high-BTU gas, which produces an end product usable by the consumer.

Among low-BTU gasification processes under development are: Lurgi, Koppers-Totzek (both in commercial use), Bureau of Mines Stirred Fixed Bed, and Westinghouse Fluidized Bed. Among high-BTU gasification processes are: Lurgi High-BTU gasification process, HYGAS, BI-Gas, Synthane, and CO_2 Acceptor.

The environmental effects of coal gasification are those of mining plus those resulting from the production process. Gasification processes have lower primary efficiency than direct coal combustion; more coal will have to be gasified to reach an equivalent BTU output. However, it is likely that coal gasification will achieve primary efficiencies of 70 percent, which is about twice that of coal to electricity end use. Water effects of processing can be minimized by recycling and evaporation. However, large inputs of water are required for some of the technologies, thus creating the potential for conflicts in water-short areas. For example, a Koppers-Totzek gasifier producing 250×10^9 BTU per day will require water in the amount of 463,000 gallons per day and coal in the amount of 10,570 tons per day.

Air pollution could include sulfur dioxide, particulates, nitrous oxides, hydrocarbons, and carbon monoxides.

Land effects result from solid-waste disposal plus land use for the plant, coal storage, and cooling sands, etc. Solid wastes include ash, sulfur, and minute quantities of some radioactive isotopes.

Coal Liquefaction: Liquified coal is expected to replace conventional crude oil as the major source of liquid fuel and provide 10 percent of total domestic energy consumption by 2020 (Table I-5).

As with coal gasification, production of liquid fuels from coal requires either addition of hydrogen or removal of carbon from the compounds in the coal. Coal liquefaction can be accomplished by hydrogenation, pyrolysis, or catalytic conversion. Only catalytic conversion is in commercial operation. Among liquefaction processes under development are: synthoil, H-Coal, Solvent Refined Coal, Consol Synthetic Fuel, COED, TOSCOAL, and Fischer-Tropsch.

Again, the effects of liquefaction will be those of mining and those of the processing plants. The available technologies have a recovery rate of from 0.5 to 3 barrels of oil per ton of coal processed.

Water effluents from liquefaction plants could contain amounts of phenols, solids, oil, ammonia, phosphates, etc. The waste water could be treated to remove most of these products.

Air pollution could result from particulates, nitrogen, sulfur oxides, and other gases. Pollution-control facilities would be required but would lower the economic attractiveness of the plants.

Solid wastes would be mostly ash. If liquefaction plants were sited near mine openings, residue could be buried in the mines with little further environmental effects.

Nuclear Power - Fission: The predominant nuclear system used in the United States is the uranium-dioxide-fueled, light-water-moderated and cooled nuclear power plant. Research and development is being directed toward other types of reactors, notably the breeder reactor.

Between 1970 and 1980, nuclear-energy production increased from 21.8 billion kilowatt hours (1.4% of total U.S. electricity production and 0.4% of total energy production) to 251.1 billion kilowatt hours (11.0% of total U.S. electricity production and 4.2% of total energy production). Installed generating capacity increased from 6.5 million kilowatts (1.9% of U.S. total) to 56.5 million kilowatts (9.2% of U.S. total).

Due to environmental concerns, the growth of nuclear energy may be slowing. At the end of 1980 there were 75 reactors in the U.S., up from 19 in 1970. Although four reactors were licensed in 1980, fourteen other planned units were cancelled, and the Nuclear Regulatory Commission closed five for modification to comply with revised seismic requirements, and shut down eight reactors comparable to Three Mile Island's to determine the probability of a similar accident and to make required safety modifications. Nuclear-energy output was down 1.6 percent in 1980. There are currently 102 reactors under various stages of construction, construction-permit review, or on order.

Nuclear-power development has encountered delays in licensing, siting, and environmental constraints as well as manufacturing and technical problems. Future capacity will be influenced by the availability of plant sites, plant-licensing considerations, environmental factors, nuclear-fuel costs, rate of development of the breeder and fusion reactors, and capital costs.

Domestic uranium resources are probably plentiful. Ultimately recoverable reserves are estimated to be 6,876 million short tons, and large areas are unexplored. Twenty-one million short tons were consumed in 1980 domestic nuclear-energy production.

Although fuel-cycle costs of nuclear reactors have increased only slightly in recent years, present trends in reactor capital costs are significantly narrowing the economic advantage offered by fuel-cycle costs over coal- and oil-fired plants. Nuclear energy may provide up to 19 quads in 2020, 13 percent of total domestic consumption (Table I-5).

Environmental Effect: Although nuclear plants do not emit particulates or gaseous pollutants from combustion, the potential for serious environmental problems exists. Some airborne and liquid radioactive materials are released to the environment during normal operation. The amounts released are very small, and potential exposure has been shown to be less than the average level of natural radiation exposure. The plants are designed and operated in such a way that the probability of harmful radioactivity released from accidents is very low.

Nuclear plants use essentially the same cooling process as fossil-fuel plants and thus share the problem of heat dissipation from cooling water. However, light-water reactors require larger amounts of cooling water and discharge greater amounts of waste heat to the water than comparably sized fossil-fuel plants. The effects of thermal discharges may be beneficial in some, though not all, cases. Adverse effects can often be mitigated by use of cooling ponds or cooling towers.

Low-level radioactive wastes from normal operation of a nuclear plant must be collected, placed in protective containers, and shipped to a federally-licensed storage site for burial. High-level wastes created within the fuel elements remain there until the fuel elements are processed. Currently, spent fuel is stored at NRC-licensed facilities. Plans call for recovering unused fuels at reprocessing plants, solidifying the wastes, and placing them in storage at a federal repository.

Primary residuals from light-water reactors are waste-heat and radioactive emissions. For a 1,000 MW(e)-plant operating at a 75-percent load factor, a 33-percent-efficient nuclear plant would emit 47 x 10^{12} BTU's of waste heat annually. For comparison, a 40-percent-efficient fossil-fuel plant would emit 36 x 10^{12} BTU's of waste heat.

There are also effects on land, water, and air quality arising from the mining of these uranium ores. Dwindling amounts of high-grade reserves will increase the amount of land mined for lower-grade radioactive ores--primarily in western states. The mining operations will be similar to coal, but the nature and distribution of the deposits mean "lesser" effects while radioactive tailings cause unusual problems for disposal, the environment, and human health.

A more complete discussion of uranium mining and processing, the economics and environmental impacts, as well as nuclear fission and fusion can be found in Chapters 6 and 7 of Energy Alternatives: A Comparative Analysis.

Nuculear Power - Fusion: The controlled fusing of atoms in a reactor is a long- term alternative-energy source. Scientific feasibility has yet to be proven but looks promising. Technological and commercial feasibility will have to follow, however. The main obstacles are obtaining a high enough temperature, and containing the reaction. It is unlikely that fusion will be available to any significant degree before 2025.

Fusion is attractive for two reasons: abundant fuel sources and relative safety. The reaction is fueled by deuterium and tritium. Deuterium exists naturally in sea water and would be nearly cost-free. Tritium can be inexpensively produced in a reactor from lithium, which is plentiful.

Because of the small neutron activation involved in fusion reactions, there would be lower radioactive inventories, fewer radioactive wastes, and less serious fuel-handling problems and accident risks.

A proposed hybrid fusion-fission fuel cycle would fuel fission reactors with fusion-produced isotopes and multiply the energy release of fusion tenfold, while demanding less of the fusion core, thus enhancing the safety characteristics of both reactors.

A proposed pure deuterium process, while possessing a lower reaction rate, would have a neutronless fuel cycle. Thus all particles and products would be electrically charged and there would, in theory, be no radioactivity.

Environmental Effect: The environmental risks from fusion energy are probably less than fission, but the degree of reduction, and the social acceptability of that degree, cannot be determined presently.

Oil Shale: Oil shale is a fine-grained, sedimentary rock which, when heated, releases a heavy oil that can be upgraded to synthetic crude oil. The technology for exploitation currently exists. The resource base for shale is very large, perhaps as much as 360 billion barrels.

Large areas of the United States are known to contain oil-shale deposits, but those in the Green River Formation in Colorado, Wyoming, and Utah have the greatest commercial potential.

Classes I and II deposits are at least 30 feet thick, average 30 gallons of oil per ton of shale, and include only the most accessible and better-defined deposits. Class III deposits are as rich as Classes I and II, but more poorly defined and less favorably located. Class IV deposits are lower-grade, poorly defined deposits ranging down to 15 gallons of oil per ton of shale.

Environmental Effect: Oil-shale development poses serious environmental problems. With surface or conventional underground mining, it is very difficult to dispose of the huge quantities of spent shale, which occupy a larger volume than before the oil was extracted. Inducing revegetation growth in an area of oil shale development is difficult and may take more than 10 years. In-place processing avoids many of these environmental hazards. With underground mining, the spent-shale problem is much less severe.

Air pollutants from the mining will come from dust and vehicular traffic. These will be predominantly particulates, followed by NO_x and CO, with minimal amounts of hydrocarbons, SO_x and aldehydes.

The mining of oil shale requires little water, both for operations and for reclaiming solid wastes. Water pollutants are considered negligible but may arise if saline water was encountered during the operations and had to be disposed of.

However, the processing (retorting) operations of oil shale consume large quantities of water and generate large amounts of waste water. The waste water must be treated and can be reused in the process. Therefore, it has been assumed that water pollution will not be a problem outside the complex. However, the limited availability of input water in the development area could lead to resource-use conflicts.

Air pollutants vary with the technology used. Solid waste comprises the greatest problem of oil-shale processing. The volume of the waste is greater than the volume of the input. Therefore, backfilling and the like would not provide a sufficient disposal space. Finally, there are the effects of access and of transporting the products. These are analogous to those of coal mining in the case of access, and petroleum distribution in the case of transporting the product.

A fuller description of this energy source can be found in Chapter 2 of Energy Alternatives: A Comparative Analysis.

Tar Sands: Tar sands are deposits of porous rock or sediments that contain hydrocarbon oils (tar) too viscous to be extracted by conventional petroleum recovery methods. Large-scale production efforts have been developed in Canada, but U.S. ventures have been minor. U.S. resources are concentrated in Utah, with some potentially commercial quantities in California, Kentucky, New Mexico, and Texas.

About 1.5 tons of rich tar sands yield about one barrel of tar, or bitumen, the equivalent of about 6.3×10^6 BTU's. Tar can be recovered either from sands mined on the surface or underground, or by direct underground extraction of the oil without mining. Recovery is followed by processing, upgrading to synthetic crude, and refining.

Ultimately recoverable reserves may be 100 billion barrels, including other heavy oils.

Environmental Effect: Surface mining produces substantial residuals, including modification of surface topography, disposal of large amounts of overburden, dust and vehicle emmissions, and water pollution. Reclamation can minimize these effects. Residuals are similar to those of coal.

The effects of processing tar sands are similar to those of oil shale. These include solid tailings from extraction, cooling water and blowdown streams, thermal discharges, and off-gases. Under controlled conditions, these residuals can be minimized.

Underground extraction without mining can result in thermal additions, contamination of aquifers, surface spills, surface-earth movements, noise pollution, and emission of gases.

Hydroelectric Power: Hydropower is energy from falling water, which is used to drive turbines and thus produce electricity. Conventional hydroelectric developments convert the energy of natural regulated stream flows falling from a height to produce electric power. Pumped storage projects generate electric power by releasing water from an upper to a lower storage pool and then pumping the water back to the upper pool for repeated use. A pumped storage project consumes more energy than it generates but converts offpeak, low-value energy to high-value peak energy. A more detailed discussion of this energy source is found in Chapter 9 of the Energy Alternatives: A Comparative Analysis.

Many of the major hydroelectric sites operating today were developed in the early 1950's. Thirty to forty years ago, hydroelectric plants supplied as much as 30 percent of the electricity produced in the U.S. Although hydroplant production has steadily increased, thermal-electric-plant production has increased at a faster rate.

From 1970 to 1980, hydroelectric-power production has fluctuated slightly between 220 and 300 billion kilowatt hours, about 4 percent of total U.S. energy production. As a proportion of total U.S. electricity production and installed generating capacity, hydroelectricity has dropped from 16 to 12 percent, although the latter has increased from 55.1 to 76.4 million kilowatts. Much of the recent hydroelectric development has been pumped-storage capacity.

It is likely that hydroelectric power will continue to represent a declining percentage of the total U.S. energy mix due to the following: high capital costs, seasonal variations in waterflows, land-use conflicts, environmental effects, competitive water use, and flood-control constraints. Sites with the greatest production capacity and lowest development costs have already been exploited.

Environmental Effect: Construction of a hydroelectric dam represents an irreversible commitment of the land resource beneath the dam and lake. Flooding eliminates wildlife habitat and prevents other uses such as agriculture, mining, and free-flowing river recreation.

Hydroelectric projects do not consume fuel and do not cause air pollution. However, use of streams for power may displace recreational and other uses. Water released from reservoirs during summer months may change ambient water temperatures and lower the oxygen content of the river downstream, adversely affecting indigenous fish. Fluctuating reservoir releases during peak-load operation also may adversely affect fisheries and downstream recreation.

Screens placed over turbines prevent the entrance of fish, but small organisms may pass through and may be killed.

Fish may die from nitrogen supersaturation, which results at a dam when excess water escapes from the draining reservoir. High nitrogen levels in the Columbia and Snake Rivers pose a threat to the salmon and steelhead resources of these rivers. Other adverse effects to water quality include possible saline-water intrusion into waterways and decreased ability of the waters to accommodate modate waste discharges.

Air quality will be affected only by dust and emissions during the construction phase. Afterwards, if the impoundment is used for recreation, motor exhaust would occur.

Solar Energy: Applications of solar energy must take into account the following:

-- Solar energy is a diffuse, low-intensity source requiring large collection areas. Only a small portion of the potential energy is utilized.

-- Its intensity is continuously variable with time of day, weather, and season.

-- Its availability differs widely between geographic areas.

Potential applications of solar energy show a wide range. Among them are:

- Thermal energy for buildings-
    - Water heating, space heating, space cooling, combined systems
- Renewable clean fuel sources -
    - Combustion of organic matter
    - Bioconversion of organic materials to methane
    - Pyrolysis of organic materials to gas, liquid, and solid fuels
    - Chemical reduction of organic materials to oil

- Electric power generation -
    - Thermal conversion
    - Photovoltaic - residential/commercial, ground central station, space central station
    - Wind-energy conversion
    - Ocean-thermal difference

Solar-energy-collection systems are now commercially available nationwide. Sales of collectors have risen from 1.2 million square feet in 1974 to 14.3 million square feet in 1979.

Environmental Effect: Although fuel costs for backup systems and maintenance costs for solar units are small when compared with operating costs of conventional heating and cooling systems, the high initial or "fixed" costs of solar units make them unattractive to many homeowners and builders. However, the rising cost of gas and oil needed by conventional heaters means that, over time, the greater fixed costs of solar systems will be balanced by their lack of fuel costs.

Large-scale generation of electricity using solar energy is another promising application which is receiving increased funding. A number of technical and engineering problems now prevent commercialization of solar-steam-electric plants, though pilot projects are well underway.

Additional detail on this resource alternative is found in Chapter 11 of Energy Alternatives: A Comparative Analysis (U.S. Government Federal Policy Task Force Review Group, Solar Energy Analysis, 1978; Solar Energy Progress and Problems, 1978, EPA, USDOE, and Lawrence Berkeley Laboratories et al.).

Among the disadvantages of solar energy are high capital costs, expensive maintenance of solar collectors, thermal-waste disposal, and distortion of local thermal balances.

The effects so far identified with solar energy are relatively minimal. The primary effects of the use of this energy source on a wide scale will be land use. Due to the low density of the energy, large areas will be necessary for the collectors. However, the land use compares favorably with other forms of energy use, such as coal extraction.

To date, the only other known area of concern is thermal pollution. Direct use in space heating has no thermal effects. However, for solar-electric-power generation, heat will have to be collected and transferred to the generator.

Some localized thermal pollution may occur as a result, but the problem is not expected to be significant. Finally, solar plants can operate only intermittently. Thus, the energy will either have to be stored, or backup fossil-fuel plants will have to be built. These will have their own sets of environmental constraints.

Oil Imports: Spurred by new discoveries and competition, Middle East-oil production expanded in the 1950's and 1960's. New markets were opened and prices softened. The real price of oil fell from 1948 to 1972.

Simultaneously, U.S. consumption of oil increased while production stayed constant; imports were relied upon to make up the difference.

In 1973, the Arab-Israeli war was accompanied by an embargo imposed by OPEC against nations supporting Israel. The vulnerability of the importers to their own heavy demand became evident, and a huge price increase followed. This marked the end of the so-called era of "cheap energy," and efforts were made to curtail imports. Another large price increase occurred in 1979.

Three avenues were pursued for reducing imports: conservation, or reduced net-energy demand per unit of output; alternative energy; and increased domestic production. These are discussed elsewhere in this Appendix.

The results of these efforts for reducing imports seem to have been mostly successful. The underlying market structure for energy has been altered. World demand for oil peaked in 1977 and appears to be in an irreversible structural decline. Gross national products have been rising along with nonenergy output, alternative-energy sources, and non-OPEC production. Oil is wholly responsible for declines in energy use.

OPEC produced 32 million barrels per day (mbd) in 1977 and now produces 24 million barrels daily. Current projections of energy consumption until the year 2000 show rates of half of what was projected in 1972. The Department of Energy is currently projecting a .9-percent annual growth rate (actual growth was 1.9% annually from 1970-1979), and a 3-percent annual economic growth. The dimensions of the structural change for the U.S. in 1981 are as follows:

- Total energy consumption is down 5 percent.
- Petroleum consumption is down (8 percent) for the third straight year.
- Oil consumption as a percentage of total energy consumption is down 9 percent.
- Imports of petroleum are down for the fourth straight year. Imports in May 1981 were 5.2 mbd, the lowest in 10 years. This is 20 percent less than in 1980 and 38 percent less than in 1979.
- Imported petroleum as a percentage of total petroleum consumption is down 5 percent.
- Imported petroleum as a percentage of total energy consumption is down 27 percent.
- dollar of gross national product (GNP) has been steadily declining since 1970.

The OPEC probably will control the bulk of the world's oil production for the remainder of the century, due mainly to the short-term inelasticity of the supply of substitutes, and set prices based on factors besides price/cost relationships. Thus, the less dependent the U.S. is on OPEC, the less vulnerable the U.S. is to large, erratic price increases. Imports from the Middle East also bring problems of stability of supply, balance of payments, currencyexchange rates, and U.S. offloading capacity.

The U.S. will probably remain somewhat dependent on imported energy throughout this century and, as the 1970's showed, there are situations in the Middle East which could lead to major disruptions in supply or huge price increases. However, the propensity for such anomalies is less than in the past, due primarily to the following:

- As mentioned above, the underlying market structure for energy has been altered and demand for oil has declined drastically. Associated with this, OPEC will have considerable spare capacity, and price cohesiveness will be difficult to maintain.
- All OPEC nations need to produce oil to finance development. The goal of many OPEC nations is to maximize oil's long-term contribution to the national economy, rather than to maximize short-term profits. If revenue falls below a certain level where OPEC nations are not realizing an acceptable income, domestic tensions may ensue.
- The OPEC economies, especially Saudi Arabia's, are more interdependent with the West than previously. The OPEC has invested

interest and financial reserves in the West, imports a large amount of goods from the West, and has its oil prices tied to Western currency-exchange rates.

- -- The presence of strategic stockpiles provides both a deterrent to intentional disruptions in world markets and a cushion for smoothing price and supply shocks. Current stockpile inventories of most Western nations are at record levels.

The OPEC's output and pricing structure also will depend on its balancing of:

- -- Future vs. present proceeds.
- -- Benefits vs. costs of rapid modernization.
- -- Discipline in the market vs. the political unity of OPEC.

Environmental Effect: The primary hazard to the natural environment of increased oil imports is the possibility of oil spills, which can result from accidental discharge, intentional discharge, and tanker casualties. Intentional discharges would result largely from uncontrolled unballasting of tankers. The effects of chronic, low-level pollution are largely unknown. The worldwide tanker casualty analysis indicates that, overall, an insignificant amount of the total volume of transported oil is spilled due to tanker accidents. However, a single incident such as the breakup of the Torrey Canyon in 1967 or the Amoco Cadiz in 1978 can have disastrous results. Of more concern than tanker spills is the effect on the social and economic environment. The potential for a future embargo under this option is such that American productivity and policy could become subservient to foreign influence, having both economic and security implications for the nation. On a more subtle level, political alignments and policies of the U.S. could become tied to those of foreign oil powers. This option is the least acceptable for continued American energy independence.

Natural-Gas Imports: Imports of natural gas via pipeline have come largely from Canada; with small amounts also coming from Mexico. In 1980, net pipeline imports from Canada were 881 billion cubic feet, about 4.4 percent of the total natural gas used in the United States. These imports were about 33 percent of Canada's natural-gas production.

The natural-gas import situation continues to be highly uncertain. A major reason for this uncertainty is the disparity between prices for natural gas and alternative fuels in this country and the price of crude oil in world markets.

The United States and Canada concluded an agreement in March 1980 that established a formula for escalating the price of Canadian imports. The formula prices Canadian gas at the BTU-equivalent price of Canadian crude oil imports, minus an adjustment that reflects savings to Canada of certain transportation costs. In response to escalated Canadian prices, demand in the U.S. for Canadian gas dropped sharply. Consequently, Canada has foregone the opportunity to raise its export price. What modifications, if any, the Canadians will make to their pricing formula, and what minimum amounts of Canadian gas Americans must take under existing contracts, are matters currently being examined on both sides of the border.

Mexico could be a significant source of future imports because of its relatively large natural-gas-resource base. Imports from Mexico were of a local nature until 1957 and have declined since 1969. In September 1979, an agreement was concluded between the U.S. and Mexico regarding the importation and pricing of natural gas. A base price was specified to be escalated in proportion to the average price of five crude oils traded on the world market. However, the rapid increase in world oil prices between the time the agreement was concluded and the time the price escalation began brought the price of Mexican gas substantially below both oil parity and the Canadian gas price. Consequently, Mexico requested and received the same price as the Canadians.

Natural gas imports are expected to be eliminated in the long run, as domestic natural gas production will nearly satisfy decreasing demand, and synthetic gas from coal can provide the balance and replace imports.

Environmental Effect: The environmental effects of increasing gas imports derive mainly from the possible increased use of land for pipeline construction. A further effect is the risk of explosions and fires. Fluctuations of supply could influence quality of life, productivity, and employment. American policies also could become influenced by decisions of foreign gas producers; much as they could under the option of increasing oil imports.

Liquefied-Natural-Gas Imports: The growing shortage of domestic natural gas has encouraged projects to import liquefied natural gas (LNG) under long-term contract. Large-scale shipping of LNG is a relatively new industry. Several LNG projects are now under consideration on the Pacific, Atlantic, and Gulf Coasts. The security of foreign LNG is questionable. The complexity of the length of time involved in implementing these proposals has been increased by the need for negotiating preliminary contracts, securing the approval of the Federal Energy Regulation Commission and the exporting country, and making adequate provision for environmental and safety concerns in the proposed U.S. facilities. The authority to construct and operate facilities to implement imports and exports must be obtained separately from the Federal Energy Regulatory Commission. The costs of liquefying and transporting natural gas, other than overland by pipe, are high.

The U.S imported 85 billion cubic feet of LNG from Algeria in 1978. In March 1980, Algeria announced that it was demanding oil-price parity, free-on-board, for gas it exported to the U.S., and it subsequently discontinued deliveries. The free-on-board price does not include transportation, terminal, and regasification costs, which are substantial. Negotiations with the Algerians are in progress.

Environmental Effect: The environmental effects of LNG imports arise from tankers; terminal, transfer, and regasification facilities; and transportation of gas. The primary hazard of handling LNG is the possibility of a fire or explosion during transportation, transfer, or storage.

Receiving and regasification facilities will require prime shoreline locations and channel dredging. Regasification of LNG will release few pollutants to the air or water.

LNG imports will influence the U.S. balance of payments. This effect will depend on the origin and purchase price of the LNG, the source of the capital, and the country (U.S. or foreign) in which equipment is purchased and LNG tankers are built.

Geothermal Energy: Geothermal energy is primarily heat energy from the interior of the earth. It may be generated by radioactive decay of elements such as uranium or thorium, and friction due to tidal or crustal plate motions.

There are four major types of geothermal systems: hot-water, vapor-dominated, geopressured reservoirs, and hot-dry-rock systems.

In addition to electricity, geothermal energy can offer a potential for space heating, industrial processing, and other nonelectric uses in many areas which presently are highly dependent upon oil and gas for energy needs. However, geothermal-electric generating plants are smaller than conventional plants and require a greater amount of steam to generate an equal amount of energy. This is due to the fact that temperatures and pressures associated with geothermal areas are lower than those created at conventional power plants.

The greatest potential for geothermal energy in the U.S. is found in the Rocky Mountain and Pacific regions; some potential exists in the Gulf Coastal Plain of Texas and Louisiana. The geyser field in California is the most extensively developed source of geothermal energy in the U.S. It has been producing power since 1969. Exploration efforts are also underway in the Imperial Valley, Salton Sea, Mono Lake, and Modoc County, California.

Between 1970 and 1980, geothermal production increased from 525 to 5,073 million kilowatt hours, and installed generating capacity increased from 84 to 1,005 kilowatts. Geothermal energy presently accounts for less than 1 percent of total U.S. energy production.

Environmental Effect: A number of gases are associated with geothermal systems and may pose health and pollution problems. These gases include ammonia, boric acid, carbon dioxide, carbon monoxide, hydrogen sulfide, and others. However, adverse air-quality effects are generally less than those associated with fossil-fuel plants. Also associated with geothermal-energy systems are saline waters, which must be disposed of and isolated from contact with groundwater regimes.

Land-quality problems stem from disturbance due to construction of related facilities and possible ground subsidence which, in turn, can cause structural failures and loss of groundwater storage capacity.

Other Energy Sources: The high cost and rapidly shrinking reserves of traditional energy fuels have encouraged research into new and different sources for potential energy. Some of these alternate sources have been known for decades, but high costs and technical problems have prevented their widespread use. They include tidal power, wind power, organic fuels, and ocean thermal-gradients, among others. These sources are expected to account for up to 13 percent of total domestic energy consumption by 2020 (Table I-5).

Environmental effects of these alternatives are difficult to assess, especially since a great amount of research and development remain to be completed before operational-scale systems can be developed, tested, and evaluated for production and application.

The date of commercial availability of such alternatives will depend on the cost of the traditional energy fuels, the level of federally subsidized research through Energy Research and Development Administration assistance, and the solution of engineering and technical problems.

Combination of Alternatives: A combination of some of the most viable energy sources available to this area, discussed above, could be utilized to attain an energy equivalent comparable to the estimated production within the anticipated field life of this proposed action. However, this combination of alternatives, in order to attain the needed energy mix peculiar to the infrastructure of this area, would have to consist of energy sources attainable now or within the suggested timeframe that are transferable to the technology presently used. Viable substitutes would have to be available for the petroleum and natural gas required by the petrochemical industrial complex; the petroleum used for the transportation sector; and the electricity and fuels used in residential and commercial sectors.

Part II of the Energy Alternatives: A Comparative Analysis, particularly Chapter 16, "Comparing the Economic Costs of Energy Alternatives," discusses the factors that must be involved in developing technically and economically appropriate energy alternatives.

Tables I-1, I-2, and I-3 display U.S. production, consumption, and net imports of energy by type, 1970-1980. The most noteworthy change in energy to occur in the 1970's was the enormous increase in the prices of fossil fuels (see Table I-4).

These price increase were caused mainly by the large increases in crude oil prices set by OPEC in 1974 (357%) and in 1980 (95%). The OPEC controls the bulk of the world's oil production and can set market prices based on factors other than price/cost relationships. Increases in the prices of substitutes, gas and coal, followed.

Thus, while the amounts produced, consumed, and imported did not change drastically (although crude oil consumption and imports did rise and fall), their value did increase substantially.

Table I-5 displays the Department of Energy's (1980 Annual Report to Congress) projections of domestic energy production and consumption, by type, form 1985 to 2020. The DOE prepared three series of projections, each a function of a distinct time path (low, medium, or high) for the price of international (imported) oil. Even the low-price time series assumes (slight) real price increases (prices rising faster than the general inflation rate); Table I-5 displays the low-price projections, given the considerations regarding OPEC's waning price-setting strength.

Allowing favorable technologies and economies, the most viable domestically available energy alternatives would probably consist of: the use of coal, oil shale, tar sands, and biomass to produce synthetic liquids; nuclear energy, and coal to compete for the utility market; and renewables to supply a sizable portion of total energy requirements. The environmental effects of each of these alternatives have been discussed briefly in the previous sections. The result will be a long-term energy-supply transition from crude oil and less dependence on oil imports. Such patterns will require new, efficient technologies, major capital investments, and a high rate of growth in coal production.

The future U.S. energy-source mix will depend on a multiplicity of factors: the identification of resources; research and development efforts; development of technology; rate of economic growth; the economic climate; changes in lifestyle and priorities; capital investment decisions; energy prices; world oil prices; environmental quality priorities; government policies; and availability of imports.

It is unlikely that there will ever be a single definitive choice among energy sources, or that development of one source will preclude development of others. Different energy sources will differ in their rate of development and the extent of their contribution to total U.S. energy supplies. Understanding of the extent to which they may replace or complement offshore oil and gas requires reference to the total national energy picture. Relevant factors are:

-- Historical relationships indicate that energy requirements will grow in proportion to the gross national product.

-- Energy requirements can be constrained to some degree through the price mechanisms in a free market or by more direct constraints. One important type of direct constraint operating to reduce energy requirements is through the substitution of capital investment in lieu of energy, e.g., insulation to save fuel. Other potentials for lower energy use have more far-reaching effects and may be long range in their implementation--they include rationing, altered transportation modes, and major changes in living conditions and lifestyles. Even severe constraints on energy use can be expected to only slow, not halt, the growth in energy requirements within the timeframe of this statement.

-- Energy sources are not completely interchangeable. For example, solid fuels cannot be used directly in internal combustion engines. Fuel-conversion potentials are severely limited in the short term, although somewhat greater flexibility exists in the longer run and generally involves choices in energy-consuming capital goods.

-- The principal competitive interface between fuels is in electric power plants. Moreover, the full range of flexibility in energy use is limited by environmental considerations.

-- Regulation of oil and gas prices lowered the price below the product level that refiners (and consumers) paid for domestic oil, and prevented the incremental cost of all domestic producing fields from equating to the price of imports. This impaired the economy's ability to adjust to world energy prices: underproduction of domestic oil, overconsumption of imports, and impediments to alternative energy. Under deregulation, the real prices of oil and gas will be closer to the marginal costs of alternative energy.

-- A broad spectrum of research and development is being directed toward energy conversion--more efficient nuclear reactors, coal gasification and liquefaction, liquefied natural gas (LNG), and shale retorting, among others.

Several of these could assume important roles in supplying future energy requirements, although their future competitive relationship is not yet predictable.

Table I-1

U.S. Production of Energy by Type
1970-1980

	Coal			Crude Oil[1]			NGPL[2]			Natural Gas (Dry)		
Year	Quads	Percent of Total Production	Percentage Change from Previous Year	Quads	Percent of Total Production	Percentage Change from Previous Year	Quads	Percent of Total Production	Percentage Change from Previous Year	Quads	Percent of Total Production	Percentage Change from Previous Year
1970	15	24	---	20	32	---	3	5	---	22	35	---
1971	14	23	-7.1	20	32	0	3	5	0	22	35	0
1972	14	22	0	20	32	0	3	5	0	22	35	0
1973	14	23	0	19	31	-5.3	3	5	0	22	35	0
1974	14	23	0	19	31	0	2	3	-50	21	34	-4.8
1975	15	25	7.1	18	30	-5.6	2	3	0	20	33	-5.0
1976	16	27	6.7	17	28	-5.9	2	3	0	19	32	-5.3
1977	16	27	0	17	28	0	2	3	0	20	33	5.3
1978	15	25	-6.7	18	30	5.9	2	3	0	19	31	-5.3
1979	18	28	20.0	18	28	0	2	3	0	20	31	5.3
1980	19	29	5.6	18	28	0	2	3	0	20	31	0
Avg. Annual Growth			2.4%			1.1%			-4.1%			-1.0%

U.S. Production of Energy by Type
1970-1980
(cont.)

	Hydroelectric Power[3]			Nuclear Electric Power			Other[4]			Total Energy Produced	
Year	Quads	Percent of Total Production	Percentage Change from Previous Year	Quads	Percent of Total Production	Percentage Change from Previous Year	Quads	Percent of Total Production	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year
1970	3	5	---	0	0	---	0	0	---	63	---
1971	3	5	0	0	0	0	0	0	0	62	-1.6
1972	3	5	0	1	2	0	0	0	0	62	-1.6
1973	3	5	0	1	2	0	0	0	0	62	-1.6
1974	3	5	0	1	2	0	0	0	0	61	-1.6
1975	3	5	0	2	3	100	0	0	0	60	-1.7
1976	3	5	0	2	3	0	0	0	0	60	0
1977	2	3	0	3	5	50	0	0	0	60	0
1978	3	5	0	3	5	0	0	0	0	61	1.6
1979	3	5	0	3	5	0	0	0	0	64	4.9
1980	3	5	0	3	5	0	0	0	0	65	1.6
Avg. Annual Growth			0%			14.7%			0%		0.3%

Source: Energy Information Administration.

[1] Includes lease condensate.
[2] Natural gas plant liquids.
[3] Includes industrial and utility production of hydropower.
[4] Includes geothermal power and electricity produced from wood and waste.

Table I-2
U.S. Consumption of Energy by Type
1970-1980

	Coal			Natural Gas (Dry)			Petroleum			Hydroelectric Power[1/]		
Year	Quads	Percent of Total Consumption	Percentage Change from Previous Year	Quads	Percent of Total Consumption	Percentage Change from Previous Year	Quads	Percent of Total Consumption	Percentage Change from Previous Year	Quads	Percent of Total Consumption	Percentage Change from Previous Year
1970	13	19	---	22	33	---	30	45	---	3	4	---
1971	12	18	-8.3	22	32	0	31	46	3.3	3	4	0
1972	12	17	0	23	32	4.5	33	46	6.5	3	4	0
1973	13	17	8.3	23	31	0	35	47	6.1	3	4	0
1974	13	18	0	22	30	-4.5	33	45	-6.1	3	4	0
1975	13	18	0	20	28	-10.0	33	46	0	3	4	0
1976	14	19	7.7	20	27	0	35	47	6.1	3	4	0
1977	14	18	0	20	26	0	37	49	5.7	3	4	0
1978	14	18	0	20	26	0	38	49	2.7	3	4	0
1979	15	19	7.1	21	27	5.0	37	47	-5.7	3	4	0
1980	16	21	6.7	20	26	-5.0	34	45	-8.8	3	4	0
Avg. Annual Growth			2.1%			-1.0%			1.3%			0%

U..S. Consumption of Energy by Type
1970-1980
(cont.)

	Nuclear Electric Power			Other[2/]			Total Energy Consumed	
Year	Quads	Percent of Total Consumption	Percentage Change from Previous Year	Quads	Percent of Total Consumption	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year
1970	0	0	---	0	0	---	67	---
1971	0	0	0	0	0	0	68	1.5
1972	1	1	---	0	0	0	72	5.9
1973	1	1	0	0	0	0	75	4.2
1974	1	1	0	0	0	0	73	-2.7
1975	2	3	100	0	0	0	71	-2.8
1976	2	3	0	0	0	0	75	5.6
1977	3	4	50	0	0	0	76	1.3
1978	3	4	0	0	0	0	78	2.6
1979	3	4	0	0	0	0	79	1.3
1980	3	4	0	0	0	0	76	-3.9
Avg. Annual Growth			14.7%			0%		1.3%

Source: Energy Information Administration

[1/] Includes industrial and utility production, and net imports of electricity.
[2/] Includes geothermal power, electricity produced from wood and waste, and net imports of coal coke.

Table I-3
U.S. Net Imports of Energy by Type,
1970-1980

	Coal		Crude Oil and Refined Petroleum Products[1/]		Natural Gas (Dry)		Electricity		Coal Coke		Net Imports		Imports as Percentage of Total Energy Consumed	
Year	Quads	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year	Quads	Percentage Change from Previous Year	Percentage	Percentage Change from Previous Year
1970	-2	---	7	---	1	---	0	---	0	---	6	---	9.0	---
1971	-2	0	8	14.3	1	0	0	0	0	0	7	16.7	10.3	14.4
1972	-2	0	10	25.0	1	0	0	0	0	0	9	28.6	12.5	21.4
1973	-1	100	13	30.0	1	0	0	0	0	0	13	44.4	17.3	38.4
1974	-2	-100	12	-8.3	1	0	0	0	0	0	12	-8.3	16.4	-5.5
1975	-2	0	13	8.3	1	0	0	0	0	0	12	0	16.9	3.0
1976	-2	0	15	15.4	1	0	0	0	0	0	15	25.0	20.0	18.3
1977	-1	100	18	20.0	1	0	0	0	0	0	18	20.0	23.7	18.5
1978	-1	0	17	-5.9	1	0	0	0	0	0	17	-5.9	21.8	-8.7
1979	-2	-100	17	0	1	0	0	0	0	0	17	0	21.5	-1.4
1980	-2	0	13	-30.8	1	0	0	0	0	0	12	-41.7	15.8	-36.1
Avg. Annual Growth		0%	6.4%			0%		0%		0%		7.2%		5.8%

Source: Energy Information Administration.

[1/] Includes crude oil, lease condensate, imports of crude oil for the Strategic Petroleum Reserve, refined petroleum products, unfininshed oils, natural gasoline, and plant condensate.

Table I-4

Prices of Domestically Produced Fossil Fuels
(Cents[1] Per Million BTU's)

	1970	1980	Avg. Ann. Increase	1960-1970 Avg. Ann. Increase
Crude Oil	59.9	206.0	13.1%	-1.6%
Natural Gas	16.9	76.9	16.4%	-0.5%
Coal[2]	27.9	64.9	8.8%	-1.5%

Source: Energy Information Administration.

[1] Constant 1972 dollars.
[2] Bituminous coal and lignite.

Table I-5

Projected U.S. Energy Production and Consumption, by Type
1985-2020
Low Oil Price Scenario

	1985		1990		1995		2000	
	Quads	Percentage of Total Consumption	Quads	Percentage of Total Consumption	Quads	Percentage of Total Consumption	Quads	Percentage of Total Consumption
Domestic Energy Supply								
Liquid Fuels								
Conventional Crude Oil[1]	17.8	22.3	16.7	18.7	16.5	16.7	16.1	15.1
Enhanced Recovery	1.2	1.5	2.0	2.2	2.9	2.9	3.3	3.1
Shale Oil and Tar Sands	.0	.0	0.1	0.1	0.5	0.5	1.0	0.9
Synthetic (from coal)	.0	.0	.0	.0	.0	.0	1.4	1.3
Liquids from Biomass	.0	.0	.0	.0	.0	.0	0.3	0.3
Total	19.0	23.8	18.8	21.1	19.9	20.2	22.1	20.7
Gaseous Fuels								
Conventional Natural Gas	17.1	21.4	16.1	16.1	15.9	16.1	11.3	10.6
Enhanced Recovery	.0	.0	.0	.0	.0	.0	5.6	5.3
Synthetic (from coal)	.0	.0	.0	.0	.0	.0	0.2	0.2
Total	17.1	21.4	16.1	18.0	15.9	16.1	17.1	16.0
Coal[2]	22.8	28.5	30.3	33.9	37.9	38.4	38.0	35.6
Nuclear	5.6	7.0	8.0	9.0	9.1	9.2	11.1	10.4
Other[3]	3.4	4.3	3.6	4.0	4.1	4.2	10.2	10.0
Total Domestic Production	67.9	85.0	76.8	86.0	86.9	88.0	98.6	92.6
Imports								
Net Oil Imports	12.7	15.9	14.1	15.8	14.1	14.3	10.6	9.9
Net Gas Imports	1.5	1.9	1.1	1.2	1.3	1.3	1.0	0.9
Net Coal Imports	-2.2	---	-2.7	---	-3.6	---	-3.7	---
Total Net Imports	12.0	15.0	12.5	14.0	11.8	12.0	7.9	7.4
Total Consumption	79.9	100.0	89.3	100.0	98.7	100.0	106.6	100.0

[1] Includes NGPL.
[2] Does not include coal used for synthetic oil and gas.
[3] Includes hydroelectric, geothermal, solar, wind, and biomass. Does not include liquids from biomass.

Source: Energy Information Administration.

Table I-5 (cont.)
Projected U.S. Energy Production and Consumption, by Type
1985-2020
Low Oil Price Scenario (continued)

	2010		2020		Avg. Ann. Growth 1985-2000 (Percentage)	Avg. Ann. Growth 2000-2020 (Percentage)
	Quads	Percentage of Total Consumption	Quads	Percentage of Total Consumption		
Domestic Energy Supply						
Liquid Fuels						
Conventional Crude Oil[1]	12.5	10.1	7.9	5.6	-0.7	-3.6
Enhanced Recovery	3.7	3.0	3.0	2.1	7.0	-0.5
Shale Oil and Tar Sands	2.2	1.8	3.1	2.2	16.6	5.8
Synthetic (from coal)	6.8	5.5	14.8	10.4	---	12.5
Liquids from Biomass	0.5	0.4	0.8	0.6	---	5.0
Total	25.7	20.9	29.6	20.8	1.0	1.5
Gaseous Fuels						
Conventional Natural Gas	8.7	7.1	6.3	4.4	-2.8	-3.0
Enhanced Recovery	7.0	5.7	7.6	5.3	---	1.5
Synthetic (from coal)	0.7	0.6	1.3	0.9	---	9.8
Total	16.4	13.3	15.2	10.7	.0	-0.6
Coal[2]	47.7	38.7	59.5	41.8	3.5	2.3
Nuclear	16.3	13.2	19.1	13.4	4.7	2.8
Other[3]	13.5	11.0	18.4	12.9	7.6	3.0
Total Domestic Production	119.6	97.1	141.7	99.6	2.5	1.8
Imports						
Net Oil Imports	6.9	5.6	4.3	3.0	-1.2	-4.6
Net Gas Imports	0.4	0.3	0.1	0.1	-2.7	-12.2
Net Coal Imports	-3.8	---	-3.9	---	-3.5	-0.3
Total Net Imports	3.5	2.9	0.5	0.4	-2.8	-14.8
Total Consumption	123.2	100.0	142.3	100.0	1.9	1.5

---

[1] Includes NGPL.

[2] Does not include coal used for synthetic oil and gas.

[3] Includes hydroelectric, geothermal, solar, wind, and biomass. Does not include liquids from biomass.

Source: Energy Information Administration.

APPENDIX J

Archeological Analysis for the Proposed St. George/North Aleutian Basin Lease Offerings

Prepared by

Minerals Management Service

Appendix J
Archeological Analysis for the Proposed St. George/North Aleutian Basin Lease Offerings

This appendix includes "Archeological Analysis in the North Aleutian Basin" (Friedman, 1984/85), as well as a list of onshore historic and prehistoric sites in the lease sale area (Table J-1).

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
RESTON, VA. 22091

Official
FILE COPY
Surname

In Reply Refer To:
LMS-Mail Stop 644

JAN 11 1984

Memorandum

To: Regional Manager, Alaska Region

From: Deputy Associate Director for Offshore Leasing

Subject: Archeological Analysis for the St. George/North Aleutian Lease Offering

In accordance with our Interim Guidance on Outer Continental Shelf Cultural Resources (May 14, 1982), we are submitting an archeological analysis for the subject lease offering (attached). The report discusses the potential for and the survivability and detectability of prehistoric cultural resources in the offering area. The analysis concludes that, of the approximately 18,600 blocks in the offering area, none should require a cultural resource report from the lessee. There are 201 blocks which, if leased, will require additional study. The postlease analysis is necessary because these blocks are medium or high probability and there is insufficient data at this point to make a determination. This summary report was prepared by Ed Friedman, Archeologist, and Herb Schneider, Geophysicist.

Please review the analysis and use it with other information available to you in making your decisions concerning prehistoric cultural resource report requirements for the offering and later permitting actions. Please forward to us any comments you have regarding this analysis. If you have any questions or immediate concerns with this analysis, please contact Ed Friedman or Herb Schneider (FTS 928-6461).

Carolita Kallaur

Carolita Kallaur

Attachment

bcc: R. Smith/R. Tyagi/J. Gottlieb, Alaska Region
Official File (BEO)(EIS Lease Offering St. George/N. Aleutian) MS 644
Division File
Ahlfeld/Goll/Friedman/Schneider
AD/OMM
Offshore Chron
BEO Chron
LMS:BEO:EFriedman:dmb:01/04/84:860-6461

Disk Lear-Friedman

Archeological Analysis
Proposed Lease Offering
St. George/North Aleutian
(December 1984/April 1985)

prepared by
Edward Friedman and Herbert Schneider
Minerals Management Service
Reston, Virginia

Purpose

In accordance with the Minerals Management Service (MMS) Interim Guidance for Outer Continental Shelf Cultural Resources (May 14, 1982), this archeological analysis was prepared for the offshore lease offering for the St. George/North Aleutian areas. The analysis is intended to aid the Alaska Region in preparing environmental impact statement (EIS) discussions and the Offshore Leasing Management Division in making recommendations to the Secretary on cultural resource lease stipulations.

Project Area Description

The two adjacent planning areas that make up the proposed lease offering (Figure 1a and 1b) are the St. George Basin which lies in the eastern Bering Sea northwest of the Aleutian Islands chain and is bounded on the north by 59° N. latitude and on the south by the 3-geographical-mile line along the northern side of the Aleutian Islands. The area is bounded on the west by 174° W. longitude from 59° N. latitude to 56° N. latitude and by 171° W. longitude from 56° N. latitude to approximately 53°35' N. latitude. It is bounded on the east by 165° W. longitude from 59° N. latitude to the 3-geographical-mile line at approximately 54°14' W. latitude.

The North Aleutian Basin lies in the eastern Bering Sea northwest of the Alaska Peninsula and is bounded on the north by 59° N. latitude and on the north, south, and east by the 3-geographical-mile line. It is bounded on the west by 165° W. longitude from 59° N. latitude to the 3-geographical-mile line at approximately 54°40' N. latitude.

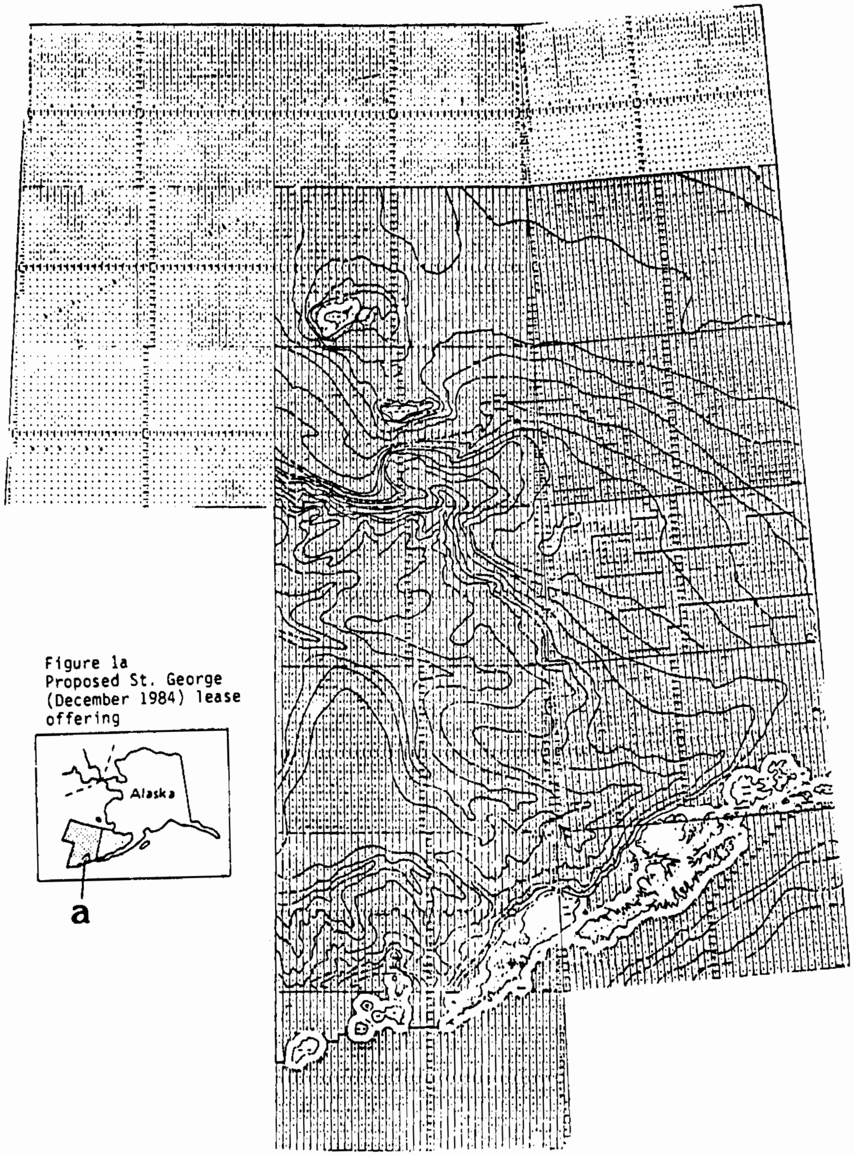


Figure 1a
Proposed St. George
(December 1984) lease
offering

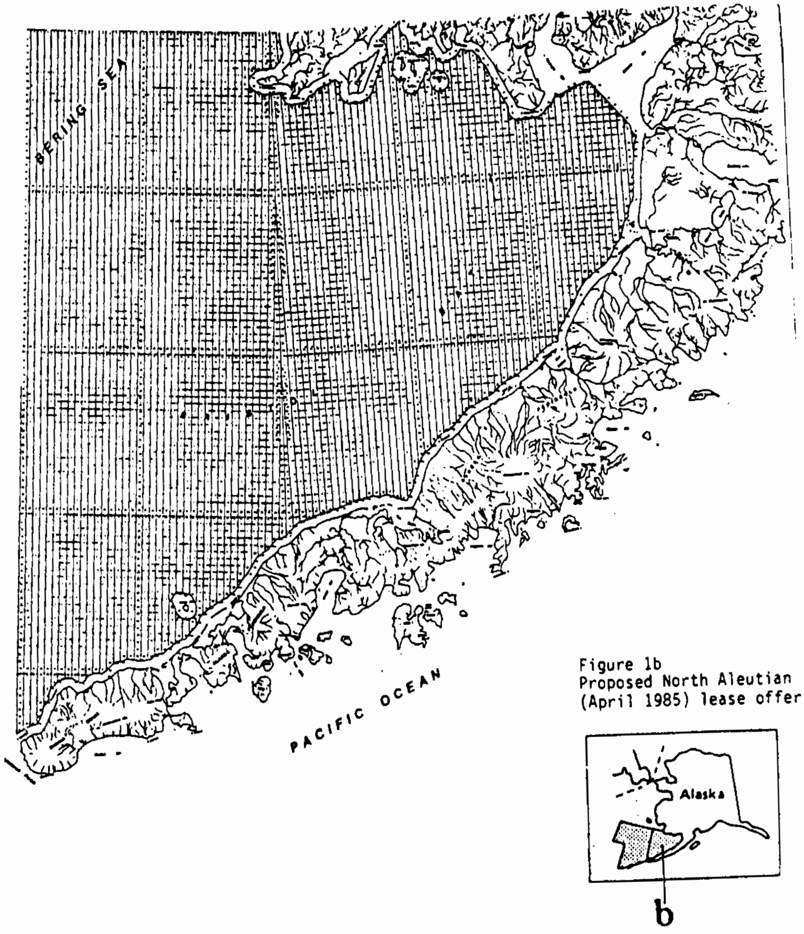


Figure 1b
Proposed North Aleutian
(April 1985) lease offering

The offering area contains approximately 18,600 blocks. About 95 have been leased in Lease Sale No. 70. Thus, 18,500 blocks were considered in this archeological analysis for the lease offering in the St. George/North Aleutian areas.

There are four proposed deferral areas: Inner Bristol Bay (1602 blocks), Alaska Peninsula (706 blocks), Unimak Pass (642 blocks), and Pribilof Islands (1699 blocks) (Figure 2a and 2b).

Method

The method used to develop the archeological analysis was established in the Interim Guidance.

The procedures outlined in the Interim Guidance are:

1. Examine the appropriate regional baseline study to determine if the blocks within the offering area have a high, medium, or low probability for prehistoric sites--those blocks falling in the low category will receive no further archeological consideration. If all the blocks are low probability, the cultural resource stipulation, if any, should not include a requirement for a report to identify prehistoric sites.

2. Examine the regional sea level curves when blocks of medium or high probability occur in the lease offering area. Blocks which lie in medium or high probability areas but were not above sea level during times of potential human habitation should be excluded from further consideration to incorporate a prehistoric site report requirement.

3. Examine the geological/geophysical literature for information regarding forces or processes that might have destroyed potential prehistoric sites or rendered them unrecoverable. Examples of such forces and processes are: glacial scouring, ice gouging, erosion, and excessive sedimentation.

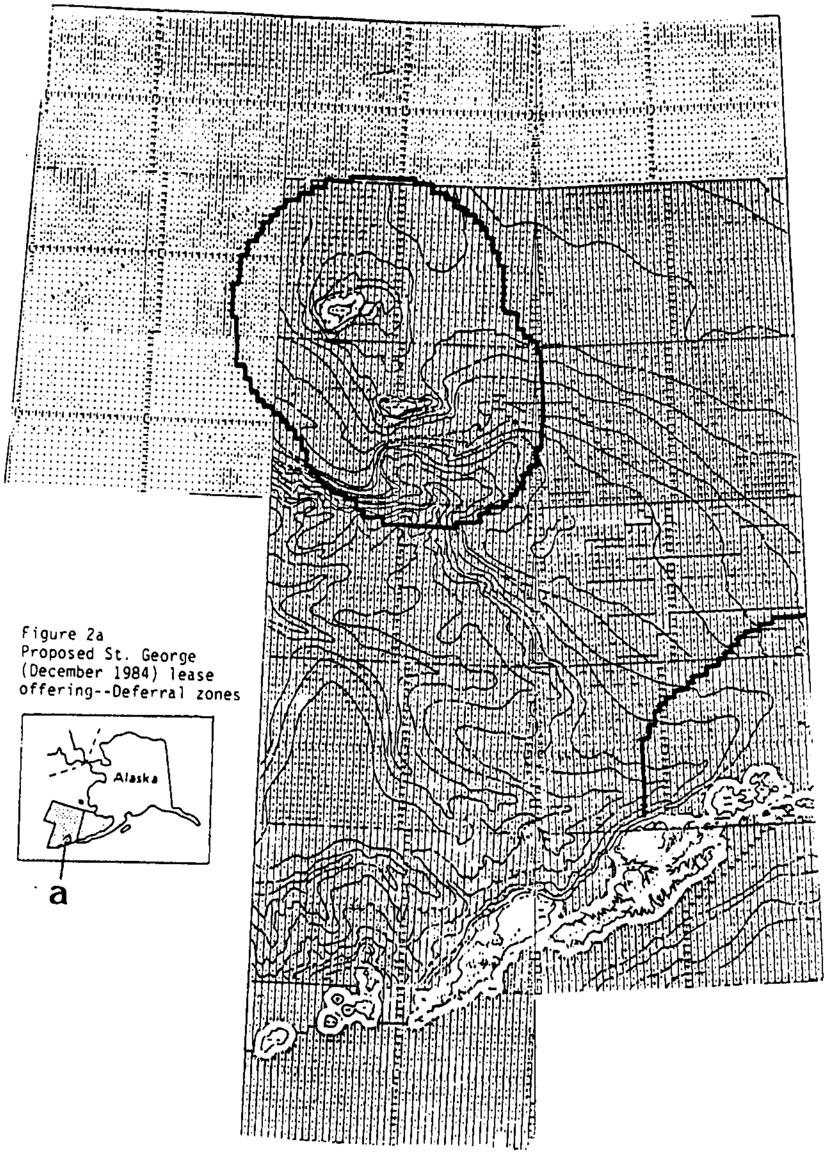


Figure 2a
Proposed St. George (December 1984) lease offering--Deferral zones

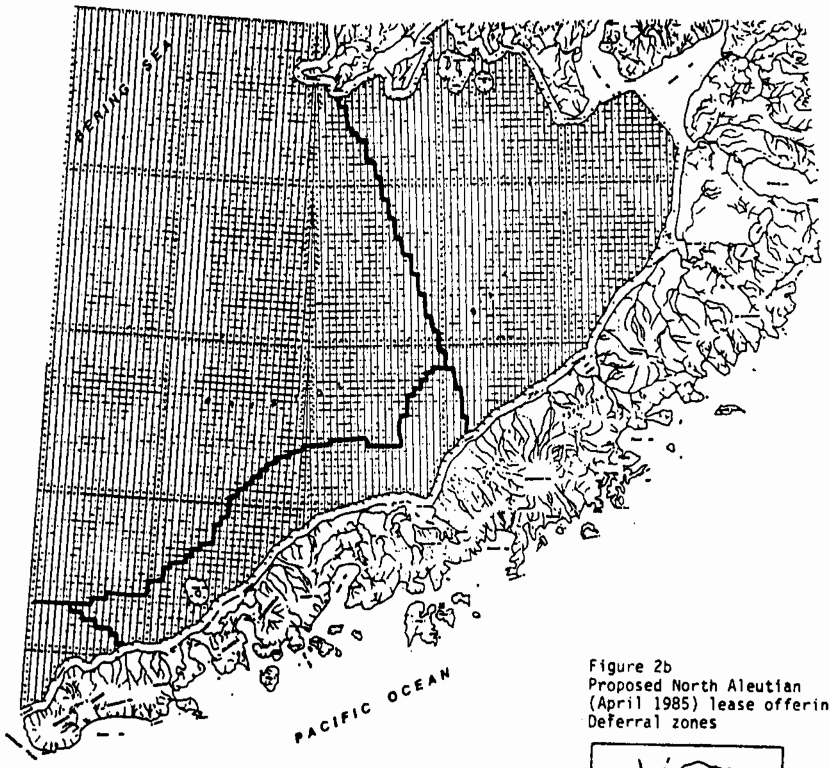
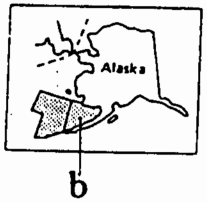


Figure 2b
Proposed North Aleutian
(April 1985) lease offering--
Deferral zones



Each block exhibiting exposure to such processes should be excluded from prehistoric site report consideration.

4. Examine the geology (resource) report, appropriate hazards survey, etc., for indications of significant landforms which were identified in the baseline study as being potentially habitable. Those blocks that do not contain significant landforms should be excluded from further consideration of a prehistoric report requirement under a lease stipulation. Specific landforms on blocks that have not been excluded in steps 1 through 3 above and have a medium or high probability for prehistoric sites should be examined in detail. Those blocks that are not excluded from further consideration should require a report under a lease stipulation.

In instances in which an archeological analysis has been conducted up to step 4 and it has been determined that no data exist relating to landforms, those blocks that are subsequently leased must have their postlease geohazards survey data examined for prehistoric site potential by an MMS archeologist and geophysicist.

5. If steps 1 through 4 above do not exclude all of the blocks with prehistoric site potential that are offered for lease in an area, and if the lessee proposes to conduct activities on a landform on one of those blocks, a prehistoric site report is required pursuant to the controlling lease stipulation.

Analysis

Step 1--Review of Baseline Study

Using the above method, we reviewed the approximately 18,500 blocks included in the offering area. A cultural resource baseline study has been prepared that covers the entire offering area (Dixon et al., 1976). As was noted in our comments on the draft environmental impact statement for Lease Sale No. 70, which coincides to a large extent with this lease offering, (March 31, 1982), ". . . the highly generalized nature of the cultural resource probability zones makes the report difficult to use for evaluating specific lease tracts." A recent study (Dixon et al., n.d.) refined the zones from the 9800 square miles to 9 square miles. Based on the revision there are five clusters of medium or high probability blocks. St. George Island, St. Paul Island (Figure 3a), Unimak Island, Inner Bristol Bay, and Cape Pierce (Figure 3b).

As no explicit criteria for establishing probability zones is presented in Dixon et al. (1976 or n.d.), those used for the adjacent Western Gulf of Alaska were employed (Dixon et al., 1977).

High Probability Areas

1. Nonglacial river mouths and constricted marine approaches to these river mouths, river margins, and lake outlets. Estuaries and rivers, particularly those issuing from lakes, would have concentrated anadramous fish and their predators.

2. Natural terrestrial constrictions, such as passes, which funnel large mammal movements.

3. Prominent spits, points, rocky capes, headlands, and islands that may have provided habitat for Phocid and Otarid seals and for marine birds. Such habitat is only considered high probability if it occurs in conjunction with one or more additional habitat types or if there is natural constriction which would tend to concentrate these species.

4. Areas of habitat diversity and general high marine intertidal productivity, particularly those which might have prompted extensive macrophyte development. An example of this type of environment would be deep sinous embayments.

Medium Probability Areas

1. Lake margins. Although the presence of fish and waterfowl resources enhance these areas as settlement locales, they are less likely to be as

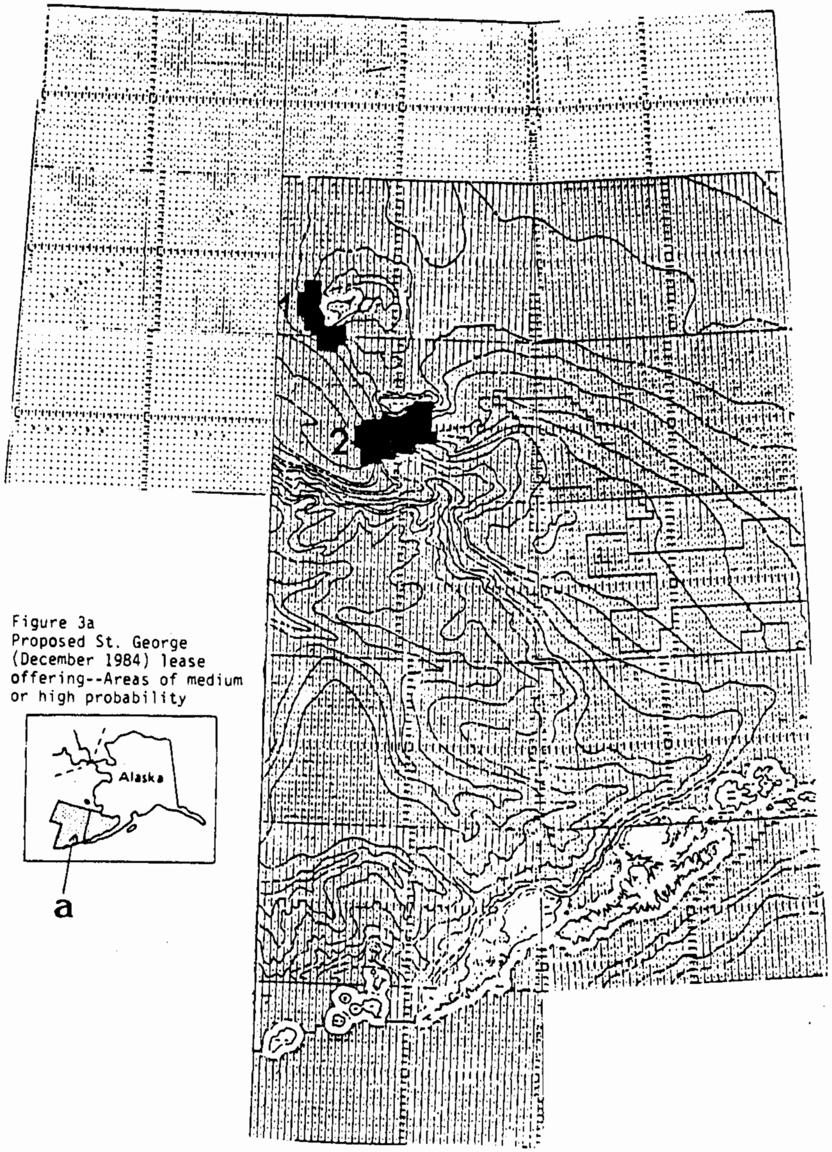


Figure 3a
Proposed St. George (December 1984) lease offering--Areas of medium or high probability

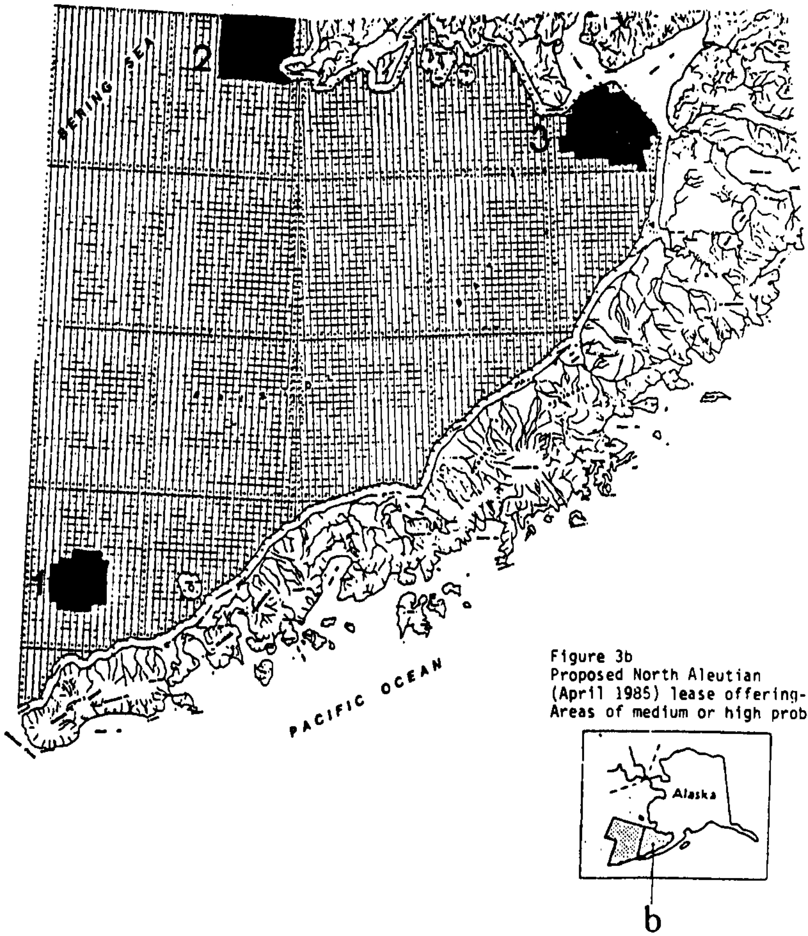


Figure 3b
Proposed North Aleutian
(April 1985) lease offering--
Areas of medium or high probability

productive (and consequently less likely to foster winter settlements) as those listed above.

2. North- and south-facing slopes. Guthrie (1976) indicated that south-facing slopes tend to concentrate grazing mammals during early spring plant maturation and that many times north-facing slopes provide wind-blown, snow-free winter ranges. However, neither of these habitat types concentrate grazers into specific locations where large aggregates of animals can be harvested. Although these areas are generally more productive, the mammals are scattered over a comparatively large area.

Step 2--Review of Sea Level Curves to Determine Habitability

The second step is to examine the regional sea level curves. Dixon et al. (1976) state that ", [D]uring the Quaternary period, Beringia was intermittently invaded by sea and ice. The sea level fell as much as 100-150 meters below its present level. . . ." A recently published volume (Hopkins et al., 1982) reexamines the body of literature dealing with sea level changes in Beringia. It establishes that the sea level fell to a minimum depth of -90 meters, between 25,000 and 17,000 years before present (B.P.). It is the latter figure, -90 meters which will be utilized in this analysis as one factor to determine habitability. Hopkins et al. (ibid) do not disagree with the earlier interpretations of global sea level having been -125 meters stating: " . . . the position of the ancient shoreline on any given segment of the continental margin differs as a result of local differences in tectonic history and local isostatic effects." They feel that Beringia deviated significantly from the worldwide norm. Using these data, numerous blocks in the lease offering area would not have been emergent (Table 1 and Figure 4a and b).

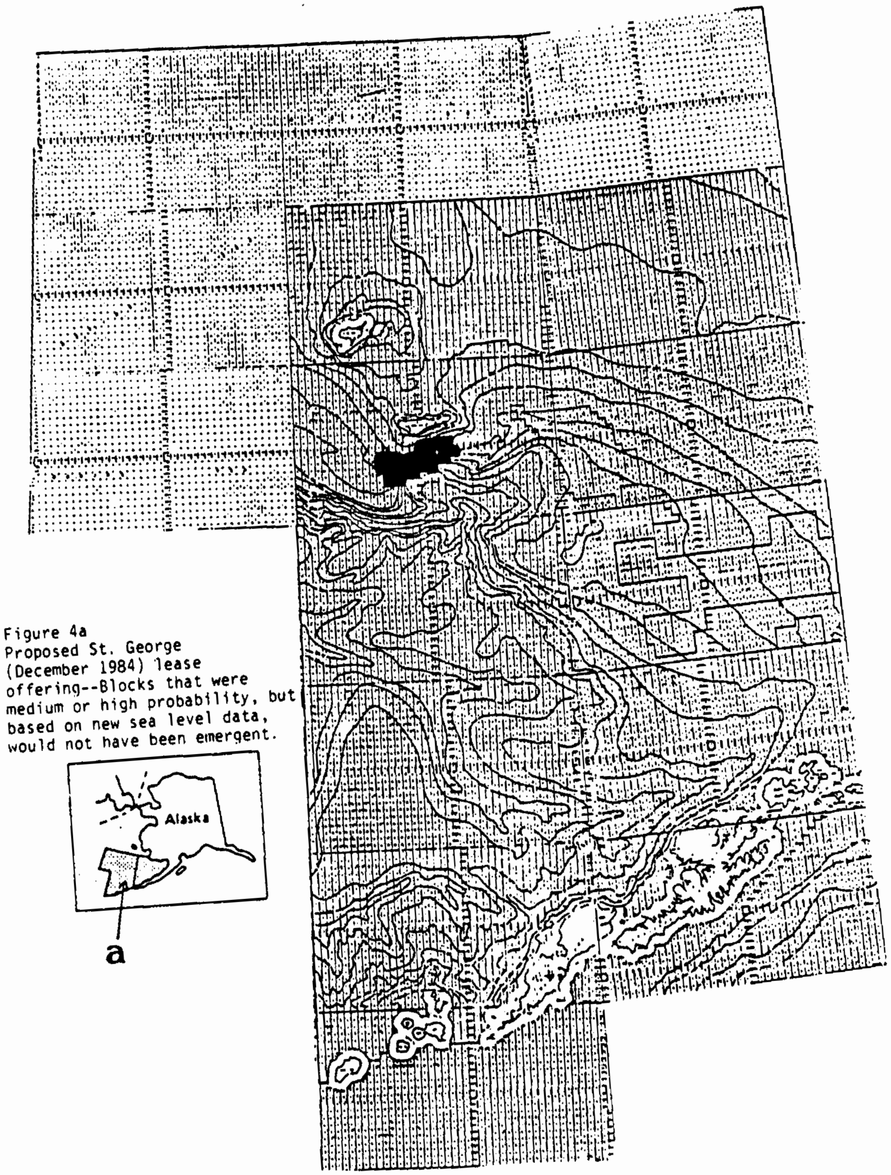


Figure 4a
Proposed St. George (December 1984) lease offering--Blocks that were medium or high probability, but based on new sea level data, would not have been emergent.

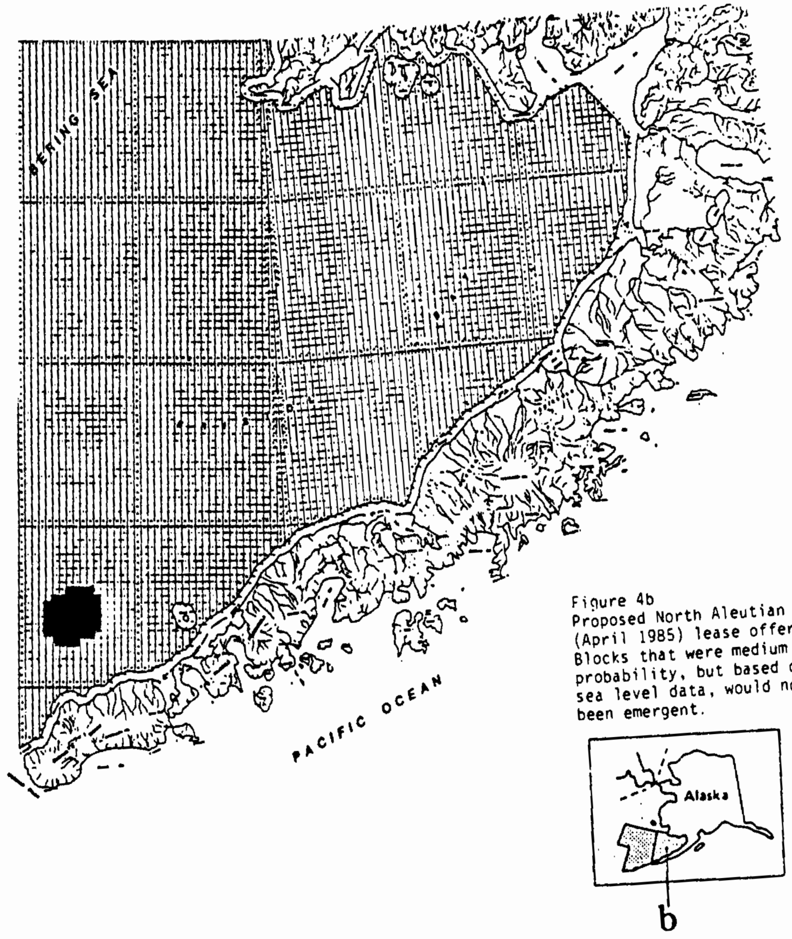


Figure 4b
Proposed North Aleutian (April 1985) lease offering--Blocks that were medium or hig probability, but based on new sea level data, would not have been emergent.

Table 1. Blocks that were medium or high probability, but based on new sea level data, would not have been emergent.

Protraction Diagram	Block Number
NO 2-8	379, 423, 466, 467, 498, 508-512, 541, 542, 548-555, 585-597, 630-638, 674-679, and 718-720
NN 3-2 (Cold Bay)	360-364-, 402-409, 445-453, 489-497, 33-541, 577-585, 621-628, 665-671, and 710-714

Step 3--Review of the Geological/Geophysical Data to Determine Survivability

Step 3 is to use ". . . information regarding forces or processes that might have destroyed potential prehistoric sites or rendered them unrecoverable." Dixon et al. (1976) focused on the probability of paleo-Indian populations inhabiting the offshore Bering Sea area prior to the postglacial marine transgression. This report also identified topographic features and areas based on paleogeography, paleoenvironment, and probable biomass productivity that these prehistoric groups would have sought to occupy and, in a general way, identified such areas and features within the Bering Sea area. Refinement of this study (Dixon et al., 1976) is necessary in order to further evaluate whether the medium/high probability areas have survived and can be detected using current geological/geophysical survey methods. We do not dispute the idea that this offshore area may have been inhabited by paleo-Indian groups or that they selected specific features for occupation. We point out that (a) many of the prehistoric sites did not survive the transgression, (b) some of the topographic features that were occupied are no longer recognizable, and (c) some of these features are not detectable.

According to numerous researchers such as Hopkins, 1959; Scholl et al., 1968; Sharma, 1972; Sharma et al., 1972; Knebel and Creager, 1973; Hickok, 1974; Sharma, 1974; Marlow et al., 1976; Gardner et al., 1979; Colinvaux, 1981; Hopkins, 1982; Marlow and Cooper, 1982, the probability of a prehistoric site surviving

intact is fairly low owing to the combined process of (a) long-term erosion due to extreme flatness and gentle slope of most of the shelf floor; (b) bottom turbulence due to shallow shelf depth; (c) scouring due to ice pile up along shoreline; and (d) erosion due to lack of protection because of insufficient sediment cover and bedrock exposure on the bottom.

We have briefly summarized some of the significant geological and geophysical research conducted in the southeastern Bering Sea. Based on the accumulated data, it is our position that few prehistoric sites would have survived the marine transgression. Those that did survive, would be subjected to subsequent destructive processes such as swift spring thaw outwash, rapid sedimentation, sediment slumping, and dynamic current and wave erosion.

Step 4--Review to Identify Significant Landforms

Step 4 calls for the examination of the ". . . geology report, appropriate hazard survey, etc., . . ." to determine the likelihood of significant landforms and the habitability and survivability of possible sites. Examination of numerous high resolution seismic profiles can indicate whether the remaining block areas could have been inhabited and, if so, if sites would have survived. Appendix 1 summarizes the information used in the habitability and survivability analyses.

1. Habitability Analysis

According to archeological information collected and analyzed over the last 50 years for the lease offering area, early man was most likely to have inhabited areas now identified as drowned stream canyons, ancient estuaries/lagoons, and channel-filled bays. Contrariwise, wide, gently sloping beach front areas were not often occupied due to lack of protective landforms, freshwater streams, or abundant food sources.

Topographic and bathymetric maps as well as high resolution profiles were studied to determine those blocks which do contain such significant landforms. Those which do not contain significant landforms are exempt from further cultural resource considerations (Table 3 and Figure 5a and b).

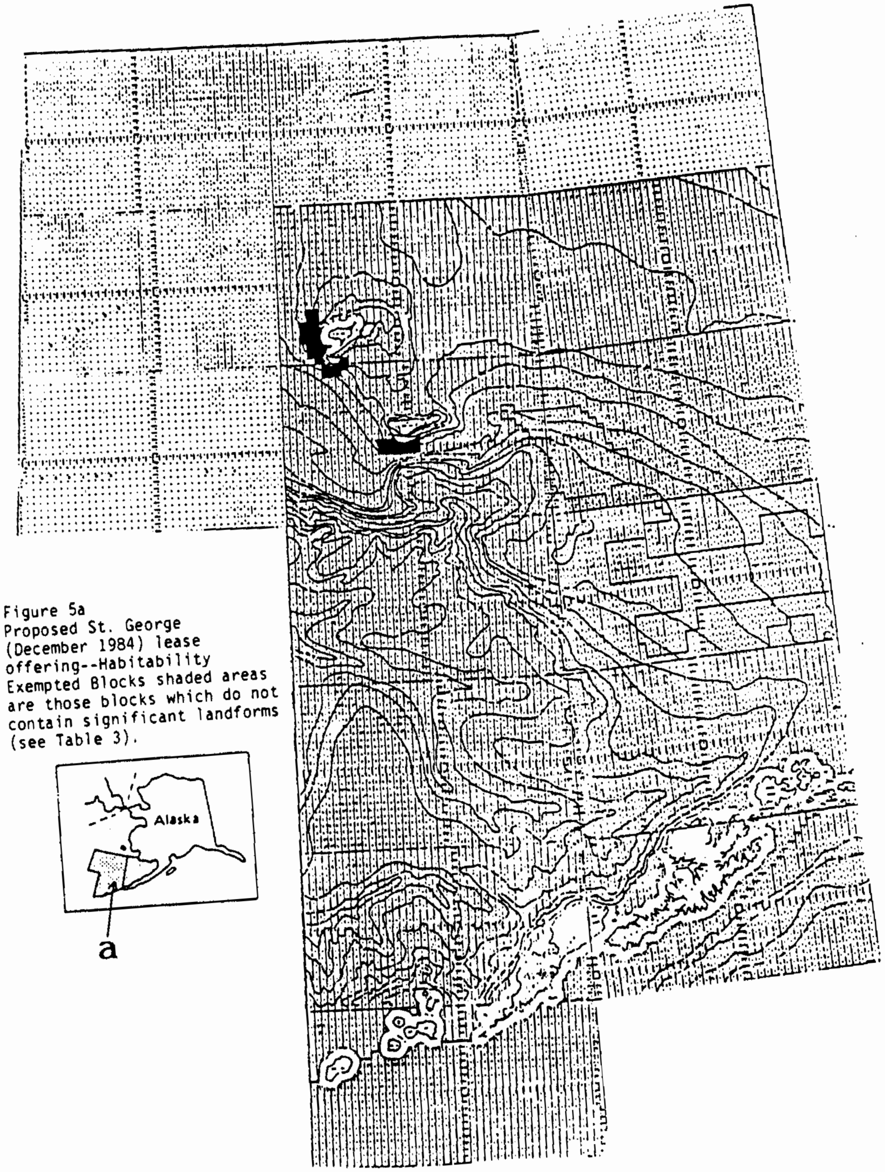


Figure 5a
Proposed St. George (December 1984) lease offering--Habitability Exempted Blocks shaded areas are those blocks which do not contain significant landforms (see Table 3).

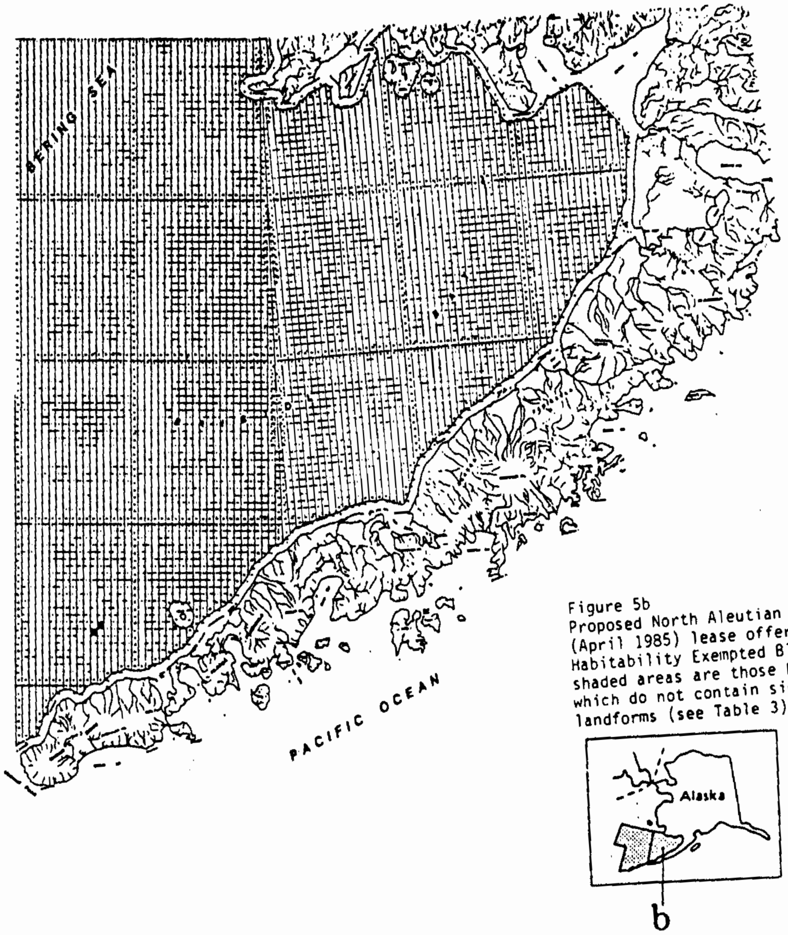


Figure 5b
Proposed North Aleutian (April 1985) lease offering--Habitability Exempted Blocks shaded areas are those blocks which do not contain significant landforms (see Table 3).

Table 3. Habitability--Blocks exempt from survey report due to lack of significant landforms.

Protraction Diagram	Block Number
St. Paul (NO 2-6)	665, 666, 709, 710, 752-754, 796-799, 840-843, 885-888, 929-931, 974-978
St. George (NO 2-8)	7-10, 51-53, 457, 499-504, 543-548
Cold Bay (NN 3-2)	629, 672

Survivability Analysis

The remaining blocks determined to be habitable are examined again using the survivability criteria (Step 3). Wide, gently sloping shelf areas are unlikely to have survived the marine transgression because of the high energy erosion of the seas reworking the ancient beaches.

Likewise, former high energy shores that lack a protective sediment cover also have a low probability for prehistoric site survivability. Thus, potential prehistoric site areas with little or no Holocene sediments or with bedrock exposed within the entire block would not have survived. The blocks that fall within this category are noted in Table 4 and Figure 6.

Table 4. Survivability--Blocks exempt from survey report due to lack of enough Holocene sediments for site protection and preservation.

Protraction Diagram	Block Number
St. George	375-378, 417-422, 460-465, 505-507

Due to the dynamic processes and the adverse forces in action in the lease offering area documented above, many landforms are no longer recognizable. Blocks containing landforms that are recognizable, having survived the dynamic

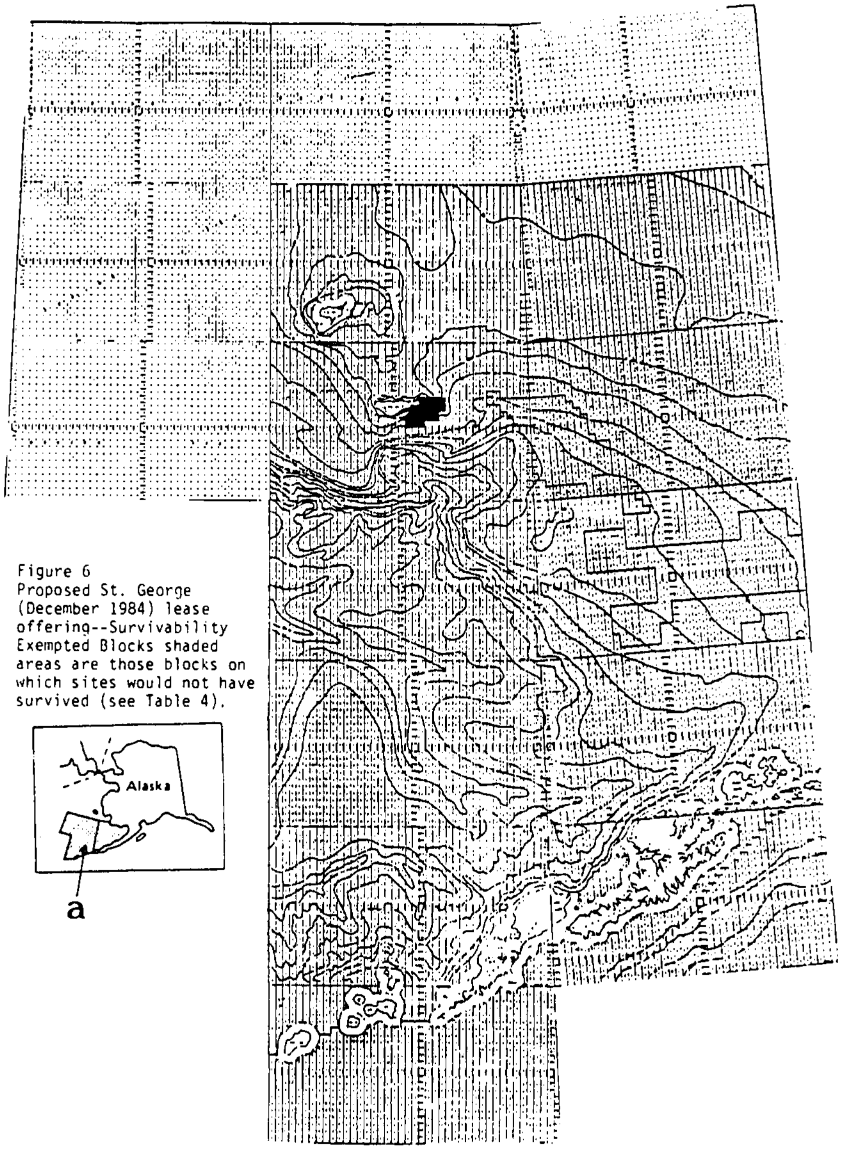


Figure 6
Proposed St. George (December 1984) lease offering--Survivability Exempted Blocks shaded areas are those blocks on which sites would not have survived (see Table 4).

processes or marine transgression, sedimentary burial, and erosion, have a high potential for a prehistoric site and may require a cultural resource report.

Because of the dearth of seismic data in the southeastern Bering Sea area (North Aleutian Basin) and the uncertainty of the sub-bottom interpretation, a determination cannot be made as to whether landforms have survived erosion and still exist (Appendix 1). Therefore, Table 5 and Figure 7 list those blocks that lack sufficient information to determine whether a prehistoric site exists and would require more survey information (e.g., hazards, data) if leased.

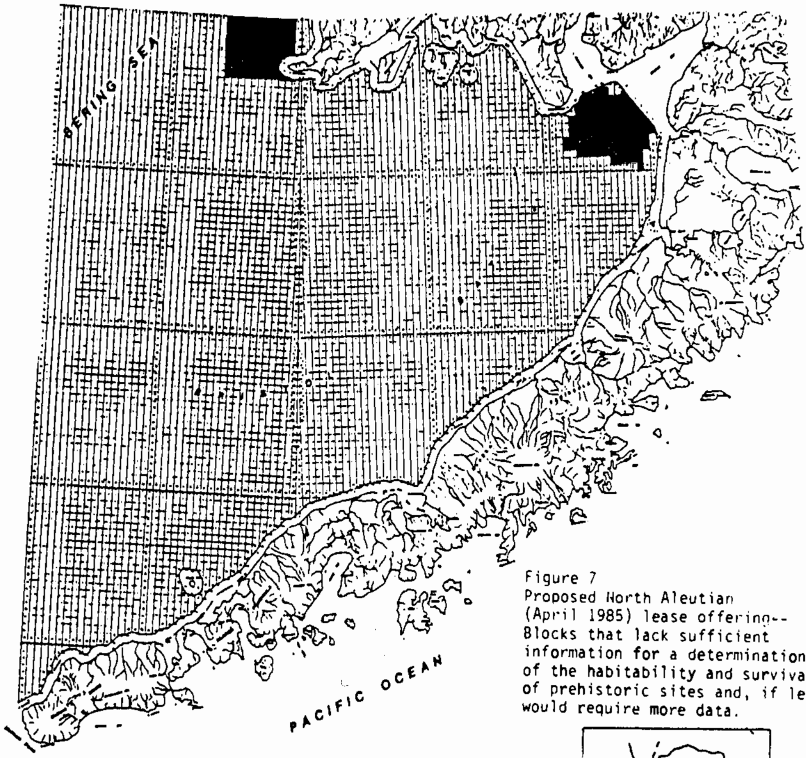
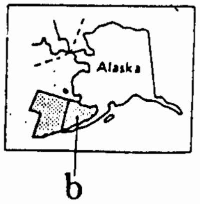


Figure 7
Proposed North Aleutian (April 1985) lease offering--Blocks that lack sufficient information for a determination of the habitability and survivability of prehistoric sites and, if leased, would require more data.



Step 5--Prehistoric Site Potential Recommendation

Step 5 calls for the integration of all available data and information in order to make a recommendation on which blocks should be designated as having a high probability for prehistoric sites.

As a result of the five-step assessment, we find that 68 medium or high probability blocks do not (a) have the potential for prehistoric sites, (b) contain landforms significant for human habitation, or (c) contain enough Holocene sediments for site protection and preservation. The prehistoric site report requirements should not apply to these blocks and are indicated as exempt in Tables 3 and 4 and Figures 5a and b, 6a and b. Those blocks that are not exempt owing to lack of sufficient information (201 blocks) are indicated in Table 5 and Figure 7. If leased, these blocks would require more data to allow for determination of habitability and survivability of prehistoric sites. The postlease data would be examined by an MMS archeologist and geophysicist and a report prepared.

Table 5. Blocks that lack sufficient information for a determination of the habitability and survivability of prehistoric sites and, if leased, would require more data (e.g., hazards survey).

Protraction Diagram	Block Number
NO 3-4	26-35, 70-79, 114-123, 158-167, 202-211, 246-255, 290-298, 334-342, 378-387
NO 4-4	492, 493, 533-540, 577-586, 621-631, 664-676, 708-720, 752-765, 795-807, 639-651, 885-894, 934-938, 982

If new data become available, this analysis could be refined to further assess which blocks would require a prehistoric site report.

Appendix I

Prehistoric Site Survival in the Southeastern Bering Sea

The survival of a prehistoric site on the continental shelf of the southeastern Bering Sea is determined by erosion processes that depend on one or more of the following bottom factors unique to this area: (1) the extreme flatness and gentle slope of the shelf floor, (2) the shallow depth of the shelf, (3) the pile up of shore ice due to winter storms, and (4) the lack of sufficient sediment cover and the exposure of bedrock on the bottom.

Bottom Factors Limiting Prehistoric Site Survival

The first factor (a gentle slope) allows a long period of time over which wave erosion can take place during a sea transgression. This erosion process would disturb and eventually destroy any surface prehistoric site. Additionally, onshore sediment deposition is extremely limited so the likelihood of any site surviving, because it was protected by sediments, is low.

The second factor (shallow depth-averaging 70 meters) limits the development of long-wave lengths which in turn limits the wave heights. The limitation of wave height (about 10 meters) causes many waves to break long before reaching the shore and consequently contributes to bottom turbulence. Frequent storms in this area generate waves about 200 meters long and 10 meters high, which significantly influence the bottom to a depth of about 94 meters (Sharma, 1972). Shallow water waves influence the bottom when the depth is less than one-half the wave length. The effect of deep wave motion on the bottom would tend to destroy, through churning, any prehistoric sites on the shelf floor.

The third factor (winter storms tend to pile up ice on the shorelines) results in shoreline scouring and gouging where ice accumulates. During the winter months (December to April) 10 to 70 percent of the southern Bering Shelf is ice covered depending on the severity of the weather (Sharma, 1979). The scouring occurs when ice is thickest and this reaches its maximum during March and April when unstressed floes reach 1 or 2 meters (Marlow et al., 1982). Many ice scour areas were observed to depths of 90 meters during several offshore surveys along the northern coast of the Alaska peninsula (Molnia et al., 1983). Ice scouring along shoreline beaches over a long period of time would be a significant factor in the destruction of prehistoric sites.

The fourth factor (the exposure of bedrock on the seabottom and the lack of sufficient sediment cover) would indicate that a potential prehistoric site was subjected to erosional processes that could destroy it. Holocene sediments are generally thin--only 3 to 4 meters over most of the southeastern Bering Sea shelf (Askren, 1972). The existence of bedrock and lack of landforms applies to the area around the Pribilof Islands.

Lease Offering Areas

Five subareas within the proposed offering area (two in St. George Basin and three in North Aleutian Basin, Figures 1a and 1b) were designated as having a medium or high probability for containing prehistoric sites (Dixon et al., n.d.). These areas were further analyzed to determine whether any sites could have survived and be detected.

St. George Basin

Seismic data (Moore, 1962; Askren, 1972; Gardner and Vallier, 1977; Gardner and Vallier, 1978; Cooper et al., 1982) indicates that the two subareas in the St. George Basin (St. Paul and St. George Islands) do not have enough sediments or significant landforms for prehistoric site preservation. The area west of St. Paul Island (Figure 1a-1) has a thin layer of sediments (Holocene) but no landforms. The area to the east of St. George Island (Figure 1a-2) has a bumpy, bathymetric configuration which is interpreted by this author to be bedrock (ancient volcanics) with little or no sediments. The area to the southwest of St. George Island has a smooth, thin layer of sediments but no significant landforms.

The assessment of this author regarding the probability of survival of prehistoric sites in the St. George planning area is that there is only a low probability that a prehistoric site could have survived the destructive effects of the transgressive Holocene seas; therefore, a survey report should not be required for any of the blocks in this area (see Archeological Analysis Tables 3 and 4).

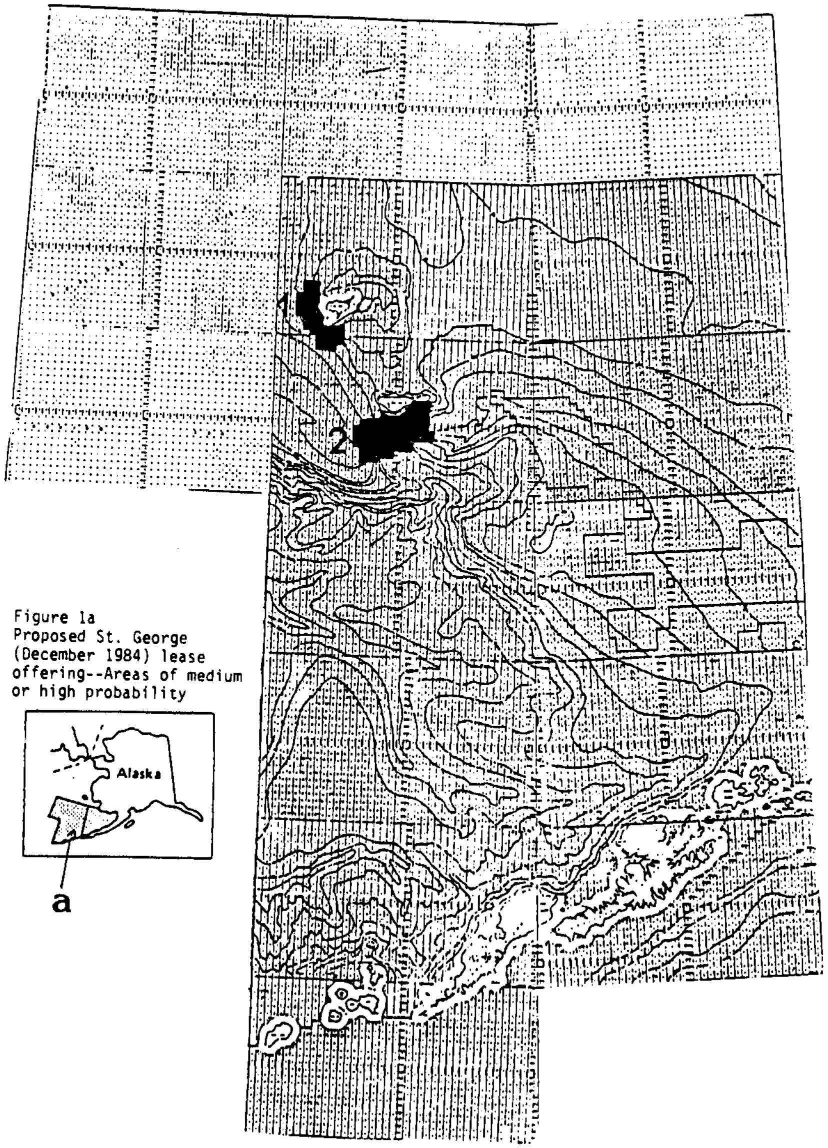


Figure 1a
Proposed St. George
(December 1984) lease
offering--Areas of medium
or high probability

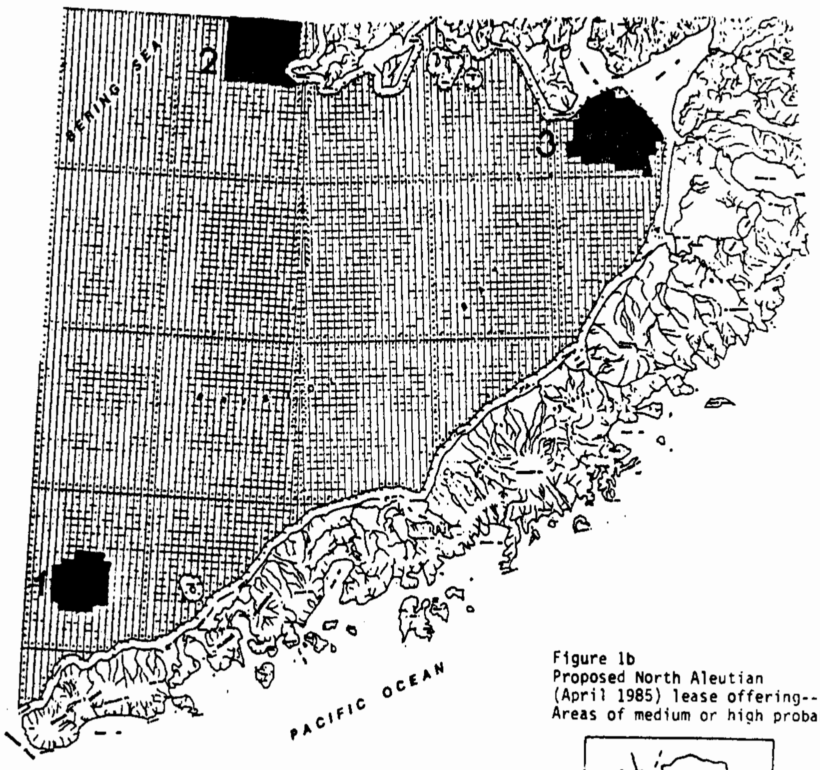
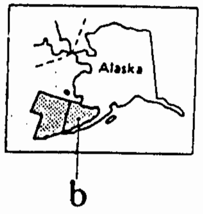


Figure 1b
Proposed North Aleutian
(April 1985) lease offering--
Areas of medium or high probabilit



North Aleutian Basin

An assessment of the probability of survival of prehistoric sites in the three subareas in the North Aleutian Basin is not as definitive as in the St. George Basin due to the dearth of data.

The area north of Unimak Island (Figure 1b-1) has only two blocks with depths less than 90 meters. Both blocks have flat bottom sediments with gradual slopes where wave action from long-term transgressive seas coupled with later bottom wave motion and ice scouring would surely have eroded or destroyed any prehistoric site. Also, no significant landforms are indicated on these blocks, therefore, a survey report should not be required for any of the blocks in this area (see Archeological Analysis Table 3).

Areas Lacking Sufficient Data

There are very little data in the two subareas in the North Aleutian Basin: (1) west of Cape Newenham (Kuskowim Bay Figure 1b-2) and (2) south of Kvichak Bay (Figure 1b-3). Askren (1972) and Sharma (1979) indicate that there may be ancient channeling in these areas as modern contoured channels are shown on bathymetric maps throughout the two areas (Creager and McManus, 1967, and USGS Topographic Maps: Kuskokwim Bay (Rev. 1969), Nushagak Bay (Rev. 1973), Naknek (Rev. 1981)). Bottom contours within the general North Aleutian Basin indicate that the modern Kuskokwim, Nushagak, and Kvichak Rivers flow along the south side of Bristol Bay bounded by the Alaska peninsula, through the Bering Canyon and into the abyssal Bering Sea. This follows the Pleistocene drainage pattern of these rivers during lowered sea level (Nelson et al., 1974).

Inconclusive Information

Both Kvickick and Kuskokwim bays contained braided streams during lower sea stands. Even though spring thaws cause swift swollen stream action, with massive erosional potential, there may be some Holocene sedimentation along channels that could protect a prehistoric site. The only seismic data in these two areas are from surveys conducted by Askren (1972), which gives inconclusive information on the detection of subsurface landforms. These two areas are part of what Askren calls the "disturbed zone" which is characterized by a lack of seismic sub-bottom continuity indicating a lack of sediment layering due to random mixing. He indicated that the reworking of the sediments by tidal, wind-wave, and permanent currents is responsible for the lack of sub-bottom continuity in the acoustic-profiling records shallower than 35 meters depth. He states that several bathymetric valleys and erosional features suggestive of river courses are seen in sub-bottom records, but that the shallow penetration of sound and the shallow core samples did not yield sufficient data to allow the correlation of these features with Holocene drainage systems.

An analysis of past lease hazards survey data should be sufficient to determine whether there are existing landforms that would indicate a prehistoric site.

Poor Sub-bottom Data

Askren (1972) mentions the uncertainty of determining the origin of a topographic high bordering the channel south of Kuskokwim Bay because of the blanketing by a strongly reflective sand layer which prevents effective shallow profiling below. He suggests that the topographic high may represent a constructional feature formed during the late Holocene.

A single frequency, 4,000 Hertz, sub-bottom profiler was used to survey the shelf. This system gives high resolution data but poor sub-bottom penetration. Strongly reflective compact sands might be better penetrated by a multi-frequency system such as a "boomer." The MMS Regional Manager should recommend that a "boomer" be utilized for better sub-bottom penetration if the blocks in this area are leased.

Postlease Data Examination

Because of the incomplete seismic data in the Kuskokwim and Kvichak Bay areas, a determination cannot be made as to whether landforms have survived the Holocene erosional processes and still exist. Therefore, if any of these blocks are leased, postlease hazards survey data must be examined by an MMS archeologist and geophysicist and a survey report prepared.

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Table J-1
Onshore Historic and Prehistoric
Sites of the North Aleutian Basin (Sale 92) Lease Area

Alaska Heritage Resources File (Quadrant No.) 1/	Name	Dating
XSI 001-010	Numbered Only	2/
XSB 001	Mitrofania	2/
XSB 002	St. Metrophan Cape	2/
XSB 003	St. John Theology	2/
XSB 004	Fishing Station	2/
XSB 005	Fox Farm	2/
XSB 006	NG-12	2/
XSB 007	BR-11	2/
XPM 001 3/	Port Moller V.S.	BC 3000
XPM 002	Unga Island	AD 1871
XPM 003	Apollo	AD 1899
XPM 004	Coal Harbor	AD 1902
XPM 005	Korovinsky	AD 1700
XPM 006	Delarof Harbor	AD 1700
XPM 007	St. Nicholas Cape	2/
XPM 008	Theo Kazan Church	2/
XPM 009	St. Vladimir Church	2/
XPM 010	Holy Ascension Church	2/
XPM 011	Cod-Fishing Station	AD 1909
XPM 012	Fishing Station	AD 1900
XPM 013	Fishing Station	AD 1916
XPM 014-17	Numbered Sites Only	2/
XPM 018	Fishing Station No. 2	2/
XPM 019-027	Numbered Sites Only	2/
XFP 001	Morzhovo	AD 1800
XFP 002	Sannak Post	2/
XFP 003	Bechevin Bay	AD 1920
XFP 004	Isanotski Strt.	2/
XFP 005	Isanotski	AD 1920
XFP 006	Isanotski East	2/
XFP 007	Whirl Point	AD 1920
XFP 008	Ikatan Bay	AD 1920
XFP 009	Ikatan Bay East	AD 1920
XFP 010	Ikatan Peninsula	AD 1920
XFP 011	Otter Cove	AD 1920
XFP 012	Cape Aksit	AD 1920
XFP 013	Lazaref Peak	AD 1920
XFP 014	Cape Lazaref	AD 1920
XFP 015	Ikatan Peninsula S.E.	2/
XFP 016	St. Nicholas Cape	2/
XFP 017	Holy Ascension Church	2/
XFP 018	Church of Theo	2/
XFP 019	Cannery	AD 1900
XFP 020	Samak Post Office	AD 1909

Table J-1
Onshore Historic and Prehistoric Sites of the North Aleutian Basin (Sale 92) Lease Area (cont.)

Alaska Heritage Resources File (Quadrant No.) 1/	Name	Dating
XFP 021	SI-4	
XFP 022	Samak Harbor	AD 1778
XFP 023	PN-44	2/
XFP 024	PN-45	2/
XFP 026	Bendixen Fur Farm	2/
XCB 001	IZM-1	AD 1050
XCB 002	IZM-2	AD 1190
XCB 003	IZM-3	AD 880
XCB 004	Stein's PN-43	2/
XCB 005	Izembek Lagoon	BC 3000
XCB 006	Outer Marker	2/
XCB 007	Belkofski Post	2/
XCB 008	Coal Oil Creek	AD 1920
XCB 009	Coal Oil Village	2/
XCB 010	Otter Pt. N.W.	2/
XCB 011	Otter Pt. Cabin	2/
XCB 012	Otter Pt. N.E.	AD 1920
XCB 013	Swanson Lagoon N.W.	AD 1920
XCB 014	Swanson Cabin	AD 1920
XCB 015	Swanson Lagoon N.E.	AD 1920
XCB 016	Swanson Village	2/
XCB 017	St. Catherine C.V.	AD 1920
XCB 018	Chunak Point	2/
XCB 019	Cabin	AD 1920
XCB 020	Holy Resurrection Church	2/
XCB 021	Kinzarf Lagoon W.	2/
XCB 022	Bricher Site	2/
XCB 023-031	Numbered Only	2/
CHK 001	St. Nicholas Chapel	2/
CHK 002	Port Heiden Church	2/
CHK 003	St. Nicholas Chapel	2/
CHK 004	Chignik Lagoon Village	AD 1800
CHK 005-015	Numbered Sites Only	approx. 1900
CHK 016	Chignik Spit	2/
CHK 017	Village	2/
CHK 018	Bear River	2/
CHK 020-027	Gary Stein 14H Selections (Onsaka)	2/
SUT 003	Sutawik Post	AD 1700
SUT 004	Kvichak	AD 1880
SUT 005	Aniakchak	2/
UNI 001	Lost Harbor	AD 1920
UNI 002	Artelnov	AD 1834

Table J-1
Onshore Historic and Prehistoric Sites of the North Aleutian Basin (Sale 92) Lease Area (cont.)

Alaska Heritage Resources File (Quadrant No.) 1/	Name	Dating
UNI 003	Akun Strait	BC 2000
UNI 004	Unimak Island	2/
UNI 005	Ugamak Island	AD 1820
UNI 006	Unimak Post	AD 1700
UNI 007	Cape Sarichef	2/
UNI 008	No Name	2/
UNI 009	Tigalda Site	2/
UNI 010	Avatanak	2/
UNI 011	Rootok	2/
UNI 012	Chulka	2/
UNI 013	Oslelo	2/
UNI 014	Akun Head	2/
UNI 015	Akutan	2/
UNI 016	Raven Point	2/
UNI 017	Pogrammi River	2/
UNI 018	Urilia Bay	2/
UNI 019	Big Dune	AD 1900
UNI 020	Urilia Cabin	AD 1900
UNI 021	Urilia Bay	AD 1900
UNI 022	Cataract Cove	AD 1900
UNI 023	Sea Lion Point	AD 1900
UNI 024	Promontory Hill	AD 1900
UNI 025	Unimak Bight N.W.	AD 1900
UNI 026	Unimak Bight	AD 1900
UNI 027	Unimak Island N.W.	AD 1900
UNI 028	St. Alex Nevsky	2/
UNI 029 3/	Cape Sarichef	AD 1904
UNI 030	Scotch Cape Lite	AD 1903
UNI 031	Broad Bight	2/
UNI 032-34	Bank's Sites	2/
UNI 035	Old Akun	2/
UNI 036-050	Bank's Sites	2/
UNI 051	Roadcut Site	2/
XNB DIL-035	Pilgrim 100B Aircraft (Still Flying)	AD 1929

Source: Alaska Heritage Resources File, 1985.

1/ XSI=Simeanoff Island, XSB=Stepovak Bay.
XPM=Port Moller, XFP=False Pass.
XCB=Cold Bay, CHK=Chignik, SUT=Sutvik.
UNI=Unimak Pass.
DIL=Dillingham.

2/ Date unknown.

3/ National Register Site.

APPENDIX K

Alaska OCS Regional Studies Program

Prepared by

Minerals Management Service

Appendix K

1. Environmental Studies Program: In each offshore area proposed for oil and/or gas development, extensive environmental studies are conducted before such development is allowed. Since 1974, studies of the Alaskan Outer Continental Shelf (OCS) have taken place under the auspices of the Outer Continental Shelf Environmental Assessment Program (OCSEAP). This program is conducted under interagency agreement between the Minerals Management Service (MMS) of the Department of the Interior and the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce. (Prior to the establishment of the Minerals Management Service in 1982, all functions of the OCS programs were under the Bureau of Land Management.) In addition, the Alaska OCS Region Environmental Studies Program of the MMS conducts studies of certain endangered and nonendangered species. Studies are also conducted by the MMS offices in other regions which may be applicable to this EIS.

The OCSEAP research in the North Aleutian region began in 1975 and has continued at a relatively high level. The studies have assembled historical information and collected new data. Research topics and objectives of the Alaska OCS Region's Environmental Assessment Program are described below.

Contaminant Distribution

These studies are intended to establish predevelopment hydrocarbon and trace metal concentrations in the water column, sediments, and biota of OCS regions.

Geologic Hazards

Geologic hazards to petroleum-related activities center around seismicity, surface and near-surface faulting, sediment instability, erosion and deposition, and stratigraphy.

Many hazards present in Alaska lease areas also occur in other U.S. shelf areas; however, in Alaska, these problems are unique in terms of severity and complexity. A knowledge of the nature, frequency, and intensity of severe environmental events is essential.

Seismic field studies began in fiscal years 1975 and 1976 to supplement existing studies being funded by other agencies. The Bureau of Land Management (BLM) directly supported part of the seismic program in a U.S. Geological Survey study, employing a land-based network of seismographic stations. All geohazard studies conducted by the University of Alaska were funded through BLM/OCSEAP. The major objectives of these seismic studies were to determine a probability scale for earthquake hazards and to improve the statistical reliability of the existing data base. This was accomplished through continuation of present observational programs and use of additional or improved instrumentation, such as ocean-bottom seismometers and strong-motion accelerometers.

Shelf-faulting and sedimentation studies were conducted to define potential hazards so that environmental risks could be reduced by outright avoidance or by appropriate regulation of facility siting, design, and construction. Certain geologic features, identified as potentially troublesome during regional reconnaissance of the proposed lease area, were studied in further detail. Shelf-faulting and sedimentation studies began in fiscal year 1975. The studies produced basic information on geologic hazards of the area, including location of probable active faults, potentially unstable sediments, and erosion and deposition areas on the shelf.

Pollutant Transport

Transport and transformation (weathering) of petroleum-related contaminants are significant considerations in an assessment of potential effects of offshore developments. Petroleum and other contaminants introduced into the environment can be transported in the atmosphere, in the water column, and by sea ice. During transport, contaminants undergo continual physiochemical changes, such as evaporation, flocculation, emulsification, weathering, biodegradation, and decomposition.

Transport studies are designed to provide information that will enable the Department of the Interior and other agencies to (1) plan stages and siting of offshore petroleum development to reduce potential risks to sensitive environments; (2) provide oil-spill trajectories, coastal landfall, and effects of oil-spill cleanup operations; and (3) assist in planning the location of long-term environmental-monitoring sites in the study area.

Long-term, direct measurements of coastal winds and currents in the North Aleutian Basin area have been performed by OCSEAP. Transport studies were designed to proceed from a regional description of oceanographic and meteorological features to analyses of processes. Oceanographic investigations included literature summaries, current measurements, hydrographic-station data, remote data sensing, and computer simulation of coastal-wind patterns.

The oceanographic studies lead in part to an oil-spill-trajectory model, which is the basis of the Oil-Spill-Risk-Analysis that is described in Section IV.A.3.

Biological Resources

A major reason for conducting biological population studies in the North Aleutian Basin was to determine which populations, communities, and ecosystems are at risk from either acute or chronic oil spills.

Studies of animal distribution and abundance, migration patterns, feeding sites, and population behavior are used to identify potential ecological sensitivity and vulnerability and to support descriptive/predictive analyses in this EIS. Site-specific "process" studies give further details on trophic and population interactions, disturbance sensitivity, habitat dependency, and physiological characteristics of unique or potentially sensitive biological communities.

Research on Effects

Studies of the effects of oil, drilling discharges, and disturbances on marine organisms and populations are continuing. The research is often applicable to several OCS areas. The results are used to predict possible long-term causal relationships between OCS-related activities and biological/chemical changes and to help develop stipulations and regulations which may mitigate effects. The studies program is also supporting research on effects to determine potential early-warning indicators that may be useful in detecting and quantifying environmental changes during monitoring of OCS development.

Studies List - North Aleutian

Table K-1 is a list of environmental studies conducted in the OCS areas under the MMS/OCSEAP environmental studies program. This appendix shows the subject or title, principal investigator(s), research unit number (RU), and year(s) of funding for studies identified as directly or indirectly contributing to the data base relevant to this proposed lease sale. Included in this list are studies contracted by OCSEAP and certain endangered-species investigations contracted by the MMS, Alaska OCS Region Leasing and Environment Office. Environmental assessments of effects made in this EIS are likely to use a broader data base than the studies listed in Table K-1; for example, additional studies conducted by other MMS offshore leasing offices and other federal, state, or international agencies may be pertinent data sources.

2. Social and Economic Studies Program: The Social and Economic Studies Program (SESP) of the MMS, Alaska OCS Region was created to determine and assess the potential onshore economic, social, and cultural effects from offshore oil and gas development. As a multiyear, multidiscipline program, SESP conducts studies on the economic, social, and cultural aspects of diverse groups. The SESP focuses on an ongoing investigation of the development process. This investigation begins with the assembly of baseline information and hypothetical development scenarios and continues through the monitoring of project development as it affects specific communities, regions, and the state as a whole. In addition, the program conducts special studies which provide region-specific information rather than lease-sale-specific information.

The analysis in this EIS draws upon numerous studies conducted specifically for the proposed North Aleutian Basin (Sale 92) other lease sales in the Bering Sea and other special studies. Table K-2 contains a list of these studies.

Studies conducted for the lease area ranged from an analysis of the petroleum development scenarios (outlining the technologies, industry costs, and supply prices of offshore hydrocarbon products) to an analysis of the local and statewide effects on employment, population, and infrastructure. Research was also undertaken to describe the effects of OCS development on transportation systems, the commercial fishing industry, and sociocultural systems--i.e. subsistence, family life, and social networks. Studies conducted for other lease areas were analyzed in some cases to provide information for the cumulative effects of the lease sales; in others, studies have provided documentation on cultural and economic effects analyzed in this EIS. These studies also have been incorporated in presale documentation for bidding systems, block evaluations, mitigating measures, secretarial issue documents, and postsale evaluations of exploration plans conducted by the Alaska OCS Region.

Table K-1

List of Environmental Studies Funded by MMS/OCSEAP for the North Aleutian Basin Area*

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
3	Arneson, Paul	Identification, Documentation and Delineation of Coastal Migratory Bird Habitat in Alaska Final Report September 1980		X	X		X					
5	Feder, Howard	Distribution, Abundance, Community Structure, and Trophic Relationships of the Nearshore Benthos Final Report December 1981	X		X							
16	Davies, John Jacob, Klaus Bilham, Roger	A Seismotectonic Analysis of the Seismic and Volcanic Hazards in the Pribilof Islands-Eastern Aleutian Islands Region of the Bering Sea Final Report September 1983	X		X	X	X	X	X			
19	Warner, Irving	Herring Spawning Surveys - Southern Bering Sea Final Report September 1978	X	X	X	X						
24	Kaiser, R.	Razor Clam Distribution and Population Assessment Study Final Report April 1977		X	X							
29	Atlas, Ronald	Assessment of Potential Interactions of Microorganisms and Pollutants Resulting from Petroleum Development on the OCS of Alaska Final Report December 1982						X	X	X		
34	Ray, Carleton Wartzok, Douglas	Analysis of Marine Mammal Remote Sensing Data Final Report April 1977		X								
38	Hickey, Joseph	A Census of Seabirds on the Pribilof Islands Final Report February 1977	X	X								
47	Lafleur, Philip Hertz, H. S. Chesler, S. N. Basnes, I. L. Becker, D. A.	Environmental Assessment of Alaskan Waters - Trace Element Methodology - Inorganic Elements Final Report May 1977		X								

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* The years marked denote when funding for this specific region took place. Study may have continued in other years without further funding or may have continued in other regions of the OCS during other years.

Table K-2

Social and Economic Studies Program Technical Reports

Technical Report			Date of Publication									
	PI	Title	75	76	77	78	79	80	81	82	83	84
MMS TR-60	Earl R. Combs, Inc.	St. George Basin & North Aleutian Shelf Commercial Fishing Analysis							X			
MMS TR-63	Dames and Moore	North Aleutian Shelf Petroleum Technology Assessment						X				
MMS TR-66	Peat, Marwick, Mitchell & Co.	Western Alaska Transportation Systems Analysis								X		
MMS TR-67	Payne and Associates	North Aleutian Shelf Socioeconomic Systems Baseline Analysis									X	
MMS TR-68	Institute of Social and Economic Research, University of Alaska	North Aleutian Shelf Statewide and Regional Demographic and Economic Systems Impact Analysis								X		
MMS TR-69	Alaska Consultants, Inc.	Western Alaska Local Socioeconomic Systems Analysis								X		
MMS TR-71	Earl R. Combs, Inc.	Alaska Peninsula Socioeconomic & Sociocultural Systems Analysis								X		
MMS TR-75	Impact Assessment, Inc.	North Aleutian Shelf Sociocultural Impacts, Non-OCS Analysis								X		
MMS TR-76	Louis Berger and Associates, Inc.	Forecasting Enclave Development Alternatives and Their Related Impact on Alaskan Coastal Communities as a Result of OCS Development								X		
MMS TR-77	Louis Berger and Associates, Inc.	Social Indicators for OCS Impact Monitoring									X	
MMS TR-80	Dames and Moore	Bering Sea Cumulative Economic OCS Petroleum Development								X		
MMS TR-86	Dames and Moore	Marketability of Bering Sea Natural Gas									X	
MMS TR-87	Institute of Social and Economic Research, University of Alaska	St. George Basin and North Aleutian Basin Economic & Demographic Systems Impacts Analysis										X
TR-92	Impact Assessment, Inc.	Unalaska: Socioeconomic Study & Impact Analysis									X	
TR-93	Impact Assessment, Inc.	Cold Bay: Socioeconomic Study & Impact Analysis									X	

Technical Report			Date of Publication									
	PI	Title	75	76	77	78	79	80	81	82	83	84
MS TR-95	Alaska Department of Fish & Game	Subsistence Based Economics									X	
MMS TR-97	Centaur Associates, Inc.	Bering Sea Commercial Fishing Industry Impact Analysis										X
MMS TR-102	ERE Systems, Inc.	North Aleutian Basin Transportation Systems Impact Analysis										X
MMS TR-109	Brown & Root Development, Inc.	Deep Water Sub-Arctic Petroleum Technology Assessment										X
MMS TR	Natural Resource Consultants	Applications of Damage Functions to Commercial Species in the Bering Sea				Ongoing Study						
MMS TR-110	Han-Padron Associates, Inc.	Offshore Loading and Pipeline Systems										X
MMS TR-108	Louis Berger & Associates	Unimak Pass Vessel Analysis										X

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
59	Hayes, Miles Boothroyd, Jon	Coastal Morphology, Sedimentation, and Oilspill Vulnerability of the Bristol Bay Coast Final Report April 1982							X			
62	Devries, Arttrus	The Physiological Effects of Acute and Chronic Exposure to Hydrocarbons and Petroleum on the Nearshore Fishes of the Bering Sea Final Report April 1976	X	X								
67	Fiscus, Clifford Roppel, Alton	Baseline Characterization Marine Mammals Final Report December 1981	X	X	X	X						
68	Fiscus, Clifford Harry, George	Seasonal Distribution and Relative Abundance of Marine Mammals in Gulf of Alaska Final Report March 1982		X	X	X						
72	Karinen, John Rice, Stanley	Lethal and Sublethal Effects on Selected Alaskan Marine Species After Acute and Long-Term Exposure to Oil and Oil Components Final Report April 1983	X	X	X	X	X	X				
73	Malins, Donald	Sublethal Effects of Petroleum Hydrocarbons Including Biotransformations, as Reflected by Morphological, Chemical, Physiological, Pathological, and Behavioral Indices Final Report June 1982	X	X	X	X	X	X	X	X		
75	Malins, Donald	Assessment of Available Literature on the Effects of Oil Pollutants on Biota in Arctic and Subarctic Waters Final Report November 1976		X								
77	Laevastu, Taivo Favorite, Felix	Ecosystems Dynamics, Eastern Bering Sea Final Report September 1979		X								
78/79	Merrell, Theodore O'Clair, Charles Zimmerman, Steve	Baseline Characterization of Littoral Biota in the Gulf of Alaska, Kodiak and Bering Sea Final Report October 1979	X	X	X							

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
83	Hunt, George	Reproductive Ecology of Pribilof Island Seabirds Final Report August 1981	X	X								
87	Martin, Seelye	The Interaction of Oil with Sea Ice Partial Final May 1982				X	X	X	X			
108	Wiens, John	Simulation Modeling of Marine Bird Population Energetics, Food Consumption, and Sensitivity to Perturbation Final Report February 1982	X	X								
111	Carlson, Robert	Seasonality and Variability of Streamflow Important to Alaskan Nearshore Coastal Areas Final Report March 1977	X	X								
138	Schumacher, J.	Gulf of Alaska Study of Mesoscale Oceanographic Processes			X	X	X	X				
140	Galt, Jerry	Numerical Studies of Alaskan Region Final Report 1980		X	X							
141	Coachman, L. K. Schumacher, Jim	Bristol Bay Oceanographic Processes			X	X	X					
153	Cline, Joel Feely, Richard	Sources, Composition and Dynamics of Natural and Petrogenic Light Hydrocarbons in Alaska Final Report December 1982	X	X					X	X		
162	Burrell, David	Natural Distribution of Trace Heavy Metals and Environmental Background in 3 Alaskan Shelf Areas	X	X	X							
174	Ronholt, L.	Baseline Studies of Demersal Resources of the Gulf of Alaska Shelf and Slope		X	X							
175	Pereyra, Walter	Baseline Studies of Fish and Shellfish Resources of the Eastern Bering Sea, Norton Sound, and Southeastern Chukchi Sea	X	X								
194	Fay, Francis	Morbidity and Mortality of Marine Mammal	X	X	X	X						

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
196/330	Divoky, G.	Distribution, Abundance and Feeding Ecology of Birds Associated with Pack Ice Final Report April 1982								X		
217	Hansen, Donald	Langrangian Surface Current Measurements Final Report October 1978		X	X	X						
232	Lowry, Lloyd Burns, John	Trophic Relationships, Habitat Use and Winter Ecology of Ice-Inhabiting Phocid Seals and Functionally Related Marine Mammals in the Bering Sea Final Report 1982			X	X	X					
239	Myres, Timothy	Ecology and Behavior of Southern Hemisphere Shearwaters (*Genus Puffinus*) and Other Seabirds, when over the Outer Continental Shelf of the Bering Sea and Gulf of Alaska Final Report November 1982	X	X	X							
241	Schneider, Karl	Distribution and Abundance of Sea Otters in Southwestern Bristol Bay Final Report October 1982		X								
243	Calkins, D.G. Pitcher, K.W.	Populaton Assessment, Ecology and Trophic Relationships of Steller Sea Lions in the Gulf of Alaska Final Report June 1982		X	X							
248	Burns, John Fay, Francis Shapiro, Lewis	The Relationships of Marine Mammal Distributions, Densities, and Activities to Sea Ice Conditions Final Report June 1980	X	X								
251	Kienle, Jurgen Pulpan, Hans	Seismic and Volcanic Risk Studies -- Western Gulf of Alaska Final Report August 1984							X	X		
257/ 258	Stringer, W. J.	Morphology of Beaufort, Chukchi and Bering Sea Nearshore Ice Condition by Means of Satellite and Aerial Remote Sensing Final Report September 1978			X	X	X					

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
267/663	Belon, Albert Stringer, W. J.	Operation of an Alaskan Facility for Application of Remote Sensing Data to OCS Studies (See 257/258)			X	X	X	X	X	X		
275	Shaw, D. G.	Hydrocarbons: Natural Distribution and Dynamics on the Alaskan Outer Continental Shelf Final Report February 1981	X	X	X							
282/301	Feder, Howard	Summarization of Existing Literature and Unpublished Data on the Distribution, Abundance and Productivity of Benthic Organisms of the Gulf of Alaska and Bering Sea	X									
284	Smith, Ronald	Food and Feeding Relationships in the Benthic and Demersal Fishes of the Gulf of Alaska and the Bering Sea Final Report March 1978		X	X		X					
285	Morrow, James	Preparation of Illustrated Keys to Skeletal Remains and Otoliths of Forage Fishes - Gulf of Alaska and Bering Sea		X								
289	Royer, Thomas	Circulation and Water Masses in the Gulf of Alaska Final Report March 1981			X	X	X					
290/291	Hoskin, Charles	Benthos-Sedimentary Substrate Interactions Final Report April 1978			X	X						
305	McRoy, P.	Sublethal Effects - on Seagrass Photosynthesis Final Report March 1977		X								
307	Muench, Robin	Historical and Statistical Oceanographic Data Analysis and Ship of Opportunity Program		X								
332	McCain, Bruce	Determine the Incidence and Pathology of Marine Fish Diseases in the Gulf of Alaska, Bering Sea and Beaufort Sea Final Report January 1980	X									
337	Lensink, Cal Bartonek, James	Seasonal Distribution and Abundance of Marine Birds Final Report November 1982	X	X	X	X						

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
338	Lensink, Cal Bartonek, James	Photographic Mapping of Seabird Colonies	X	X								
339	Lensink, Cal	Review and Analysis of Literature and Unpublished Data on Marine Birds Final Report December 1980		X								
340	Lensink, Cal Bartonek, James	Migration of Birds in Alaskan Marine Waters Subject to Influence by OCS Development Final Report May 1978		X								
341	Lensink, Cal Bartonek, James	Feeding Ecology and Trophic Relationships of Alaskan Marine Birds Final Report August 1983	X	X	X							
342	Lensink, Cal	Population Dynamics of Marine Birds Final Report January 1983	X	X								
343	Lensink, Cal Bartonek, James	Catalog of Seabird Colonies Final Report October 1978		X								
347	Searby, Harold Brower, William	Marine Climatology of the Gulf of Alaska and the Bering and Beaufort Seas Final Report 1977 (Vol. II)		X	X							
349	English, Tom	Alaska Marine Ichthyoplankton Key Final Report September 1976		X								
352	Meyers, Herb	Seismicity of the Beaufort Sea, Bering Sea and Gulf of Alaska		X								
353	Rogers, Donald Hartt, Allan	Description of the Present Status of Knowledge of the Distribution, Relative Abundance and Migratory Routes of Salmonids in the Gulf of Alaska North of 52N and West of 135W, and in the Bering Sea South of 60N and East of 175W Final Report November 1977		X								
367	Reynolds, Michael Walter, A. B.	Mesoscale Meteorology						X				

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84	85
380	Waldron, K. D. Favorite, F.	Ichthyoplankton of the Eastern Bering Sea Final Report April 1978			X								
426	Cooney, R.T.	Zooplankton and Micronekton Studies in the Bering/Chukchi Seas Final Report March 1978	X	X	X								
427	Alexander, Vera Cooney, R.T.	Ice-Edge Ecosystem Study: Primary Productivity, Nutrient Cycling, and Organic Matter Transport Final Report March 1979		X									
431	Sallenger, Asbury Ralph, John	Coastal processes of the Eastern Bering Sea Final Report May 1979		X									
435	Leendertse, Jan	Modeling of Tides and Circulation of the Bering Sea		X					X	X			
480	Kaplan, I. R. Venkatesen, M. I. Reed	Characterization of Organic Matter in Sediments from Gulf of Alaska, Bering and Beaufort Seas Final Report June 1981		X	X				X				
506	Robertson, D.	Major, Minor and Trace Element Analysis of Selected Bering Sea Sediment Samples by Instrumental Neutron Activation Analysis (INAA) Final Report November 1979		X		X							
549	Schumacher, James	Southeastern Bering Sea Oceanographic Processes Final Report June 1983						X	X	X			
556	Dean, Walter	Trace Metals in the Bottom Sediments of the Southern Bering Sea Final Report September 1978				X	X						
557	McLeod, W.	Quality Assurance Program for Trace Petroleum Component Analysis				X	X	X	X	X	X	X	X
579	Frohlich, C.	Offshore Alaska Seismic Measurement Program Final Report June 1982							X				
586	Biswas, N.	Compilation of a Homogeneous Earthquake Catalog for the Alaska-Aleutian Region Final Report September 1981						X	X				

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84	85
594	Baker, E.	Suspended Particulate Matter Distribution and Transport (NASTE) in the North Aleutian Shelf Area Final Report September 1982						X	X	X			
595	Griffiths, R.	Microbial Processes as Related to Transport in the North Aleutian Shelf and St. George Lease Areas (NASTE) Final Report September 1981							X				
596	Overland, J.	Regional Meteorology of the Southeast Bering Sea Final Report February 1984						X	X	X			
597	Payne, J.	Multivariate Experimental Analysis of Petroleum Weathering under Marine Conditions Final Report January 1984						X	X	X			
604	Martin, G.	Seafloor Geologic Hazards on the North Aleutian Shelf Final Report February 1983						X	X				
607	Van Baalen, C.	Biodegradation of Aromatic Compounds by High Latitude Phytoplankton Final Report April 1982							X				
609	Armstrong, D.	Distribution and Abundance of Decapod Larvae in the Southeastern Bering Sea with Emphasis on Commercial Species Final Report September 1982							X				
611	Fay, F.	Modern Populations, Migrations, Demography, Trophics, and Historical Status of the Pacific Walrus in Alaska Final Report September 1982							X	X			
612	Burns, J.	Biological Investigations of Beluga Whales in the Coastal Waters of Northern Alaska Final Report December 1983							X		X		
613	Burns, J.	Investigations of Marine Mammals in the Coastal Zone of Western Alaska During Summer and Autumn Final Report March 1983							X				

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84
614	Curl, H.	North Aleutian, St. George Transport Study - Central and Northern Bering Sea (NASTE)							X			
616	Anderson, B.	Bering Sea Marginal Ice Zone-T/S Analysis- Water Data 1980 Final Report January 1982							X			
619	Malins, D.	The Nature and Biological Effects of Weathered Petroleum Final Report December 1983								X	X	
620	Rice, S.	Lethal and Sublethal Effects of Petroleum Contamination on Postlarval Stages of King Crab Final Report December 1983								X	X	
621	Mofjeld, H.	Boundary Conditions and Verification for the Model of Circulation and Oil Spill Trajectories on the Eastern Bering Sea Shelf Final Report September 1983								X		
622	Leatherwood, S.	Aerial Surveys of Endangered Whales in Southern Bering and Gulf of Alaska Final Report June 1984								X		
623	Cimberg, R.	Ecological Characterization of Shallow Subtidal Habitats in the North Aleutian Shelf Final Report January 1984								X		
624	Pearson, W.	Feeding Ecology of Juvenile King and Tanner Crabs in the Southeastern Bering Sea Final Report March 1984								X	X	
628	Craighead, L.	Population Estimates and Temporal Trends of Pribilof Island Seabirds Final Report September 1982								X		
629	Evans, W.	Effects of Man-made Waterborne Noise on Behavior of Beluga Whales Final Report June 1983								X		
MMS	Mate, B.	Development of Satellite-Linked Methods of Large Cetacean Tagging and Tracking Capabilities in OCS Lease Areas							X	X	X	X

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84	85
MMS	Malme, C.I.	Investigations of the Potential Effects of Acoustic Stimuli Associated With Oil and Gas Exploration/Development on the Behavior of Migratory Gray Whales								X	X		
MMS	Mate, B.	Development of Large Cetacean Tagging and Tracking Capabilities in OCS Lease Areas - I Final Report May 1981					X	X					
MMS	Hobbs, L. Goebel, M.	Development of Large Cetacean Tagging and Tracking Capabilities in OCS Lease Areas - II Final Report March 1981						X	X				
MMS	Watkins, W.	Effects of Whale Monitoring System Attachment Device in Whale Tissues Final Report January 1981						X					
MMS	Braithwaite, L.	Effects of Oil on the Feeding Mechanism of the Bowhead Whale - Baleen Fouling Final Report June 1983						X					
MMS	Reed, M.	Simulation Modeling of Effects of Oilspills on Fur Seals										X	
638	Armstrong, D.	Pribilof Island Crab Investigations									X		
639	McMurray, G.	Distribution of Red King Crab Larvae and Juveniles along the North Aleutian Shelf Final Report May 1984									X		
643	Laevastu, T.	Simulation Modeling of the Effects of Acute Oil Spills on Commercially Important Fisheries Resources in the Bering Sea									X	X	
645	Wilson, D.	Environmental Characterization of the North Aleutian Shelf Nearshore Region. Review of Literature. Final Report March 1984									X		
650	Karinen, J.	Effects of Oiled Sediments on Crab Reproduction									X	X	

RU	PI	TITLE	75	76	77	78	79	80	81	82	83	84	85
658	Truett, J.	Environmental Characterization and Biological Utilization of the North Aleutian Shelf Nearshore Zone										X	X
659	Houghton, J.	Seasonal Habitat Use by Inshore Species of Fish North of the Alaska Peninsula										X	X
661	Rice, S.	Lethal and Sublethal Effects of Spilled Oil on Herring Reproduction										X	
662	Fishman, P.	Lethal and Sublethal Effects of Oil on Food Organisms of the Bowhead Whale										X	
4014	(Planned)	Effects of Petroleum-Contaminated Waterways on Spawning Migration of Adult Pacific Salmon											X
MMS	Kana, T.	Coastline and Surf Zone Smear Model										X	X
MMS	Payne, J.	The Integration of Suspended Particulate Matter and Oil Transportation Study										X	X
MMS	Johnson, S.	Monitoring of Nesting Seabird Colonies in Alaskan OCS										X	
MMS	(Planned)	Monitoring of Seabird Colonies in Alaskan OCS Lease Areas											X

APPENDIX L

Commercial Fishing Industry

Tables and Figures

Prepared by

Minerals Management Service

Appendix L

Commercial Fishing Industry Tables and Figures

The following tables and figures in this appendix provide information regarding the commercial fishing industry in the North Aleutian Basin.

Table L-1
North Aleutian Basin
Salmon Catch by Species, in Pounds

	1977	1978	1979	1980	1981	1982	6 Year Average
King							
Bristol Bay	2,989,045	4,577,782	4,534,195	1,881,902	4,542,235	5,186,532	3,951,949
Ak. Pen.	121,950	364,020	449,730	376,320	510,600	750,260	428,713
Total	3,110,995	4,941,782	4,983,325	2,258,222	5,052,835	5,936,792	4,380,662
Sockeye							
Bristol Bay	32,681,796	58,576,020	126,428,775	133,065,778	159,421,914	96,931,232	101,184,253
Ak. Pen.	5,056,320	8,617,010	17,721,470	25,830,930	23,678,150	21,605,870	17,084,950
Total	37,738,116	67,193,030	144,150,245	158,896,708	183,100,064	118,537,102	118,269,211
Coho							
Bristol Bay	836,277	707,033	2,296,312	2,249,388	2,004,269	4,841,543	2,187,470
Ak. Pen.	343,530	951,330	3,435,780	2,584,300	2,375,880	3,886,400	2,262,870
Total	1,179,807	1,658,363	5,732,092	5,023,688	4,380,149	8,727,943	4,450,340
Pink							
Bristol Bay	15,357	16,488,640	12,317	8,715,791	25,595	5,031,121	5,048,137
Ak. Pen.	5,797,820	20,703,020	23,655,950	26,472,410	18,169,560	22,268,220	19,511,163
Total	5,813,177	37,191,660	23,668,267	35,188,201	18,195,155	27,299,341	24,559,300
Chum							
Bristol Bay	10,388,066	8,222,439	5,984,860	8,196,464	10,032,088	6,971,954	8,299,312
Ak. Pen.	2,758,020	5,277,540	3,926,670	13,759,140	17,551,080	18,712,810	10,330,877
Total	13,146,086	13,499,979	9,911,530	21,955,604	27,583,168	25,684,764	18,630,189
All Salmon							
Bristol Bay	46,910,541	88,571,914	139,256,459	154,299,323	176,026,101	118,962,382	120,671,121
Ak. Pen.	14,077,640	35,912,920	49,189,000	69,023,100	62,285,270	67,223,560	49,618,581
Total	60,988,181	124,484,834	188,445,459	223,322,423	238,311,371	186,185,942	170,289,702

Sources: ADF&G Bristol Bay and Alaska Peninsula Annual Management Reports, 1982.

Table L-2
North Aleutian Basin
Ex-Vessel Value by Species in Millions of Dollars

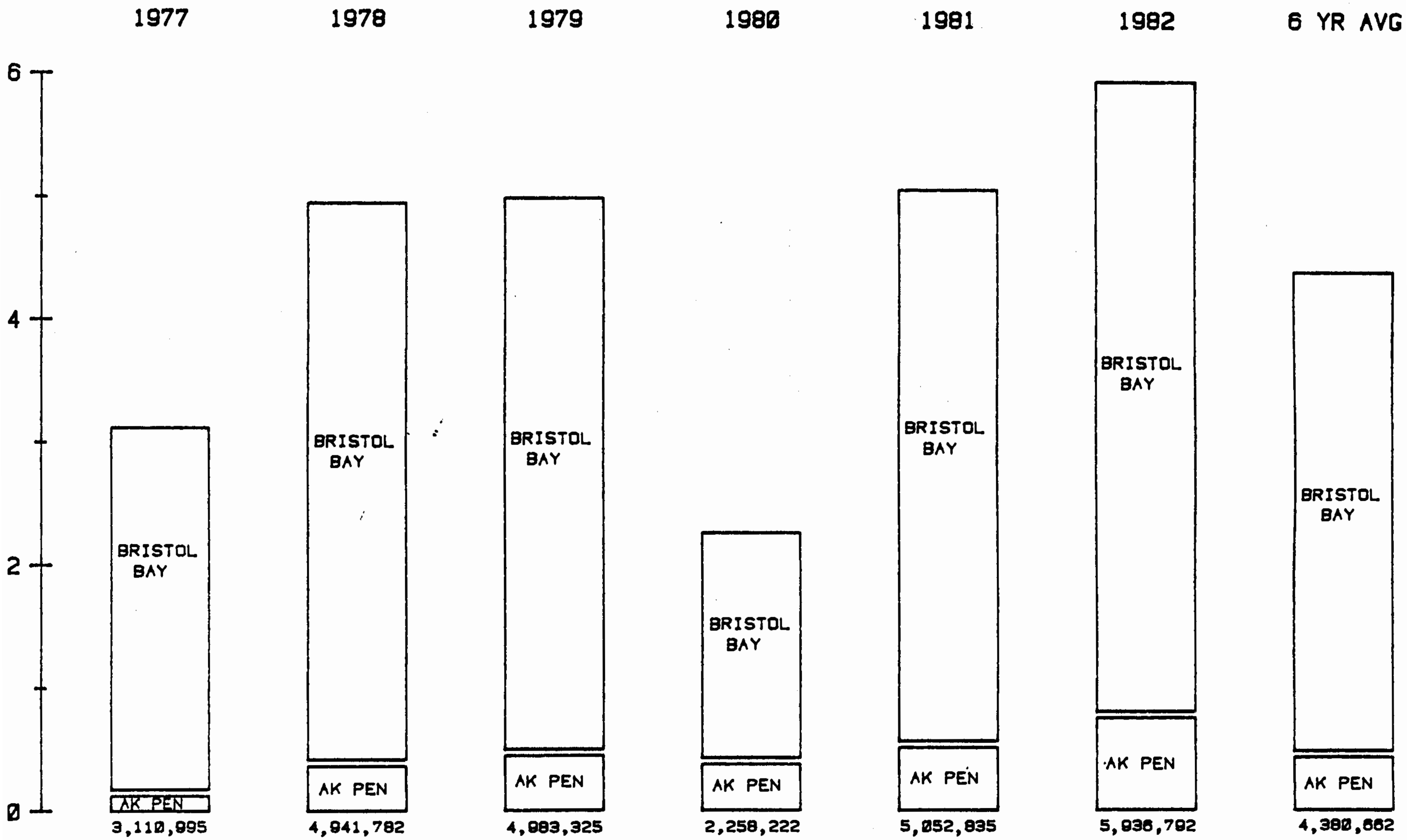
	1977	1978	1979	1980[a]	1981[a]	1982[a]	6 Year Average
King							
Bristol Bay	$1,940,000	$3,206,000	$4,541,000	$1,881,000	$5,599,000	$6,356,000	$3,920,000
Ak. Pen.	63,000	275,000	516,000	455,000	735,000	893,000	490,000
Total	$2,003,000	$3,481,000	$5,057,000	$2,336,000	$6,334,000	$7,249,000	$4,410,000
Sockeye							
Bristol Bay	$19,434,000	$40,034,000	$128,992,000	$76,118,000	$121,399,000	$68,308,000	$75,714,000
Ak. Pen.	3,339,000	6,595,000	20,660,000	10,074,000	21,074,000	18,797,000	13,423,000
Total	$22,773,000	$46,629,000	$149,652,000	$86,192,000	$142,473,000	$87,105,000	$89,137,000
Coho							
Bristol Bay	$445,000	$435,000	$2,387,000	$1,392,000	$1,458,000	$3,423,000	$1,590,000
Ak. Pen.	197,000	631,000	3,544,000	1,240,000	1,687,000	2,798,000	1,683,000
Total	$642,000	$1,066,000	$5,931,000	$2,632,000	$3,145,000	$6,221,000	$3,273,000
Pink							
Bristol Bay	$50,000	$5,424,000	$5,000	$2,173,000	$8,000	$1,071,000	$1,455,000
Ak. Pen.	1,140,000	6,400,000	9,020,000	7,942,000	8,358,000	3,340,000	6,033,000
Total	$1,190,000	$11,824,000	$9,025,000	$10,115,000	$8,366,000	$4,411,000	$7,488,000
Chum							
Bristol Bay	$4,275,000	$3,173,000	$2,480,000	$2,738,000	$4,027,000	$2,192,000	$3,147,000
Ak. Pen.	1,162,000	2,590,000	1,815,000	4,953,000	7,898,000	8,421,000	4,473,000
Total	$5,437,000	$5,763,000	$4,295,000	$7,691,000	$11,925,000	$10,613,000	$7,620,000
All Salmon							
Bristol Bay	$26,144,000	$52,272,000	$138,405,000	$84,302,000	$132,491,000	$81,350,000	$85,826,000
Ak. Pen.	5,901,000	16,491,000	35,555,000	24,664,000	39,752,000	34,249,000	26,102,000
Total	$32,045,000	$68,763,000	$173,960,000	$108,966,000	$172,243,000	$115,599,000	$111,928,000

Sources: Technical Report #71; ADF&G Bristol Bay and Alaska Peninsula Annual Management Reports, 1982; CFEC, 1983.

[a] Ex-vessel values estimated for 1980-82 for Alaska Peninsula based on average weights by species and weighted average prices for purse seine, drift and set net gear.

Figure L-1

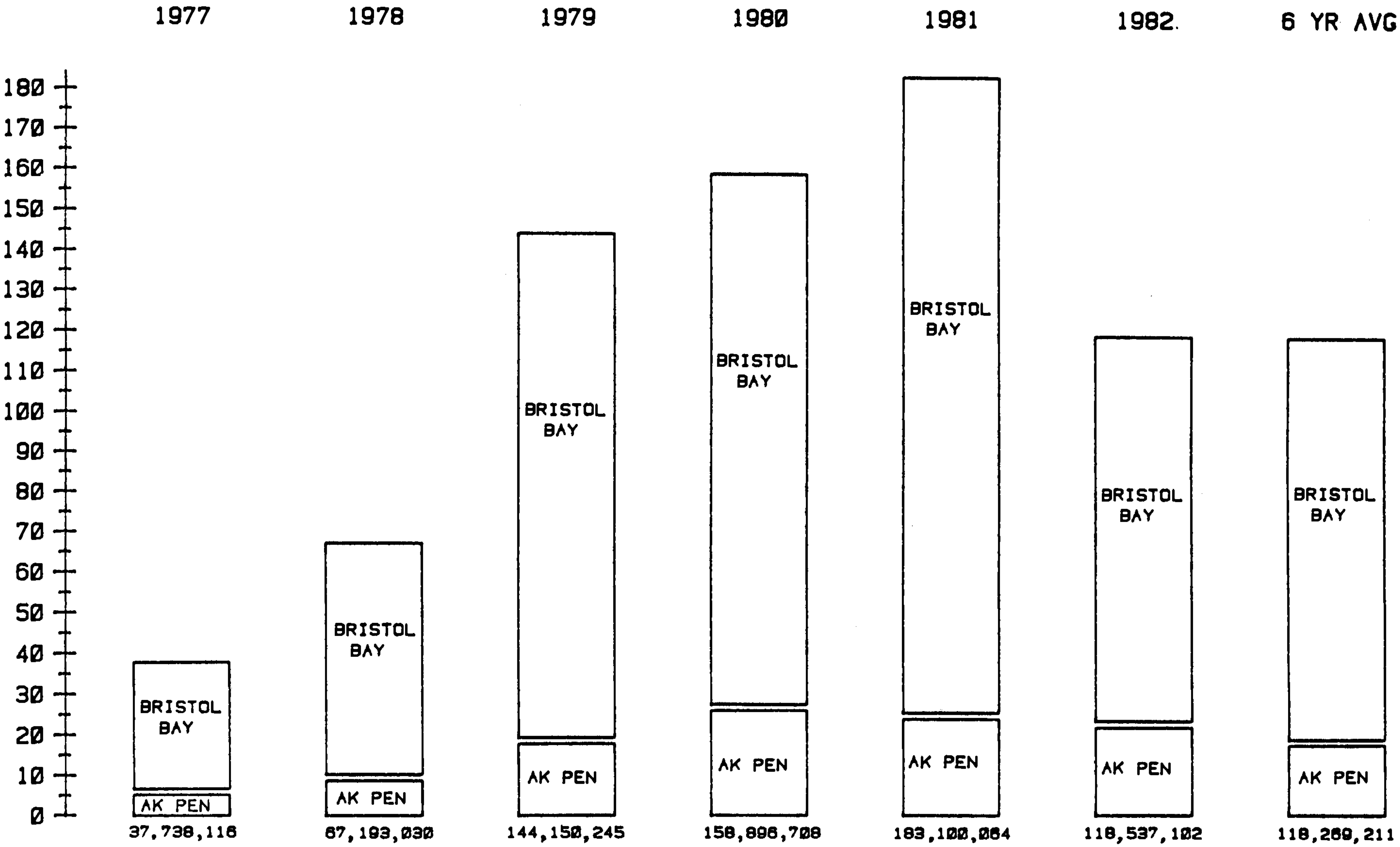
NORTH ALEUTIAN BASIN
KING SALMON
CATCH IN MILLIONS OF POUNDS



SOURCES: ADF&G BRISTOL BAY & ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982

Figure L-2

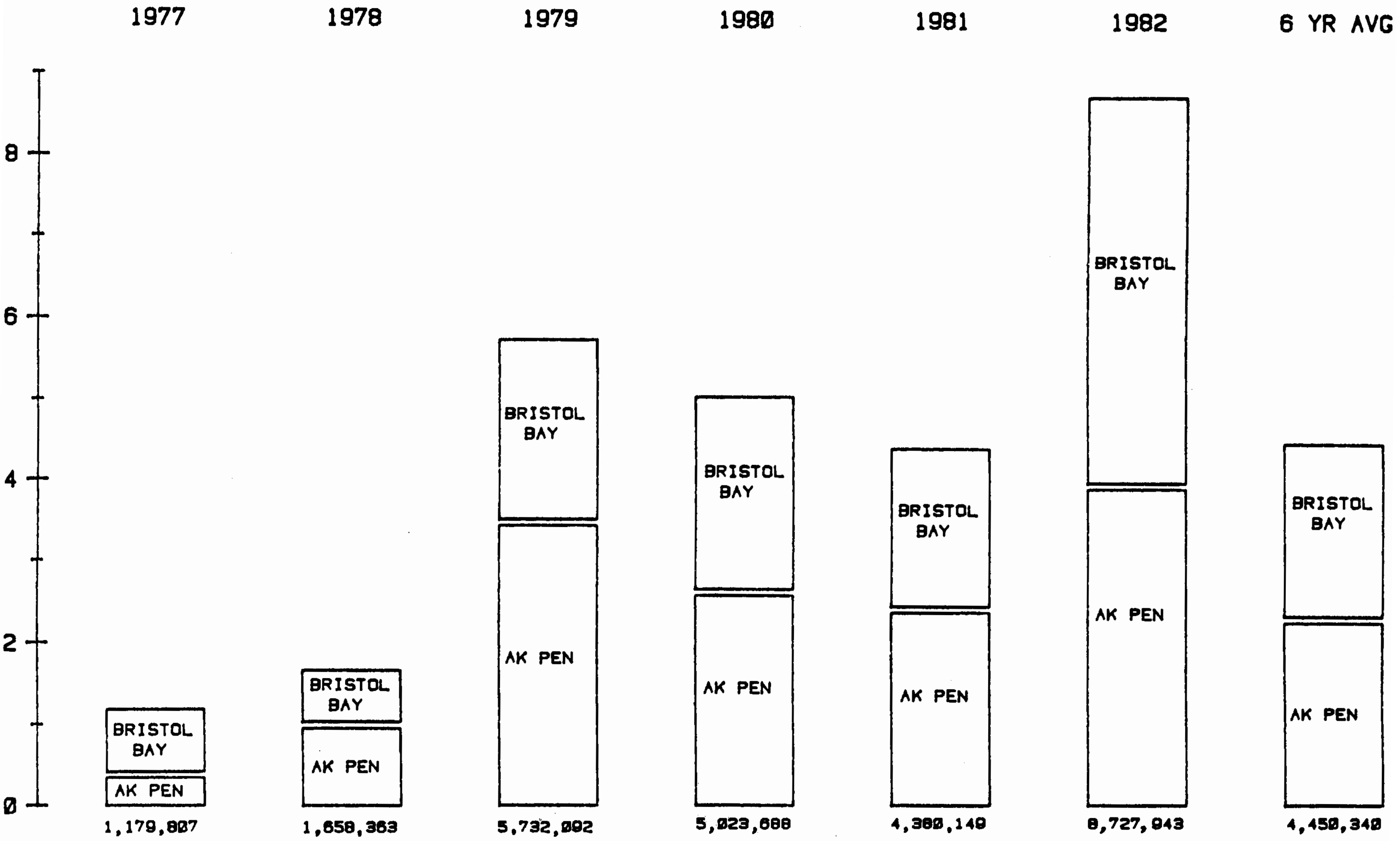
NORTH ALEUTIAN BASIN
SOCKEYE SALMON
CATCH IN MILLIONS OF POUNDS



SOURCES: ADF&G BRISTOL BAY & ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982

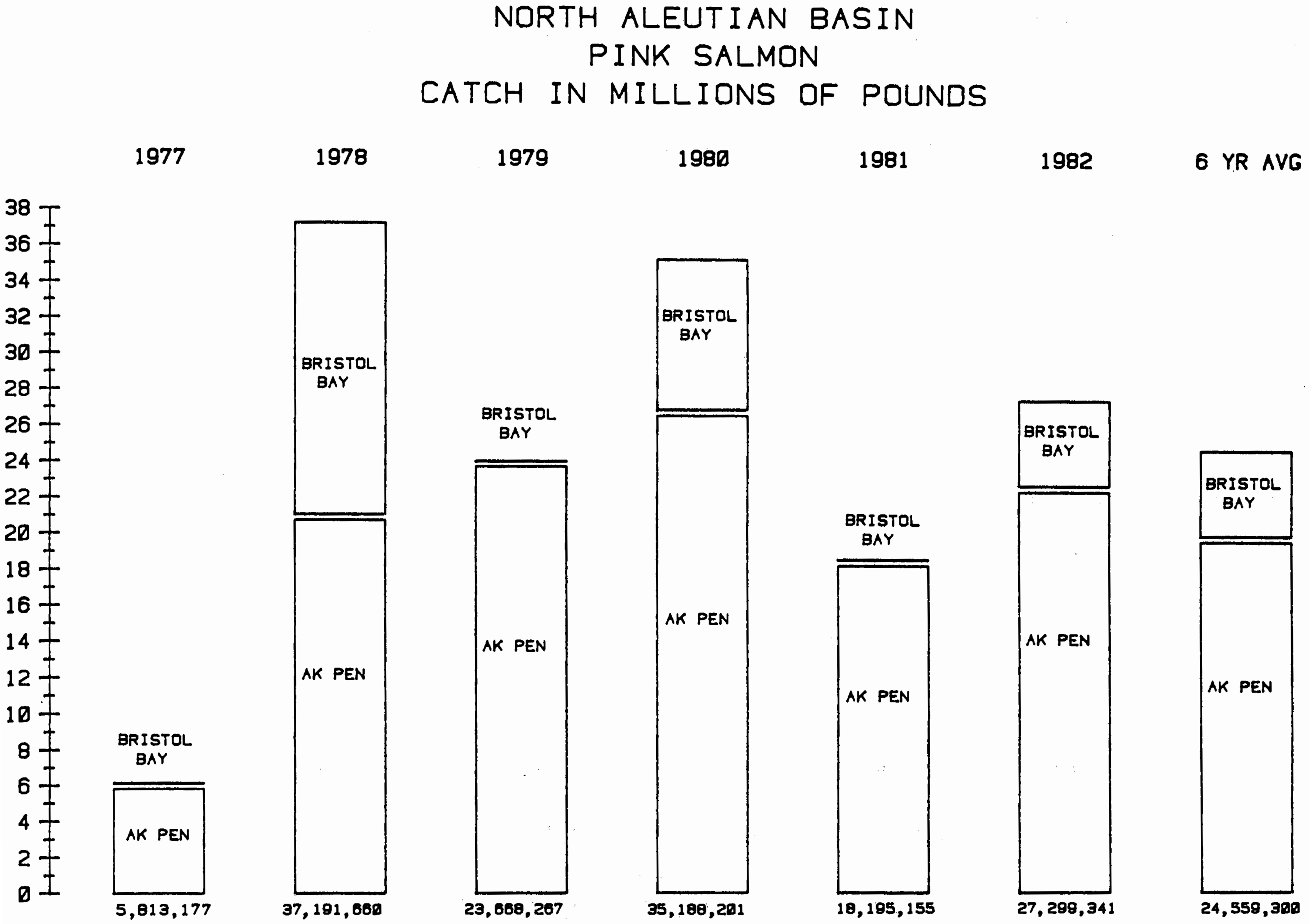
Figure L-3

NORTH ALEUTIAN BASIN
COHO SALMON
CATCH IN MILLIONS OF POUNDS



SOURCES: ADF&G BRISTOL BAY & ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982

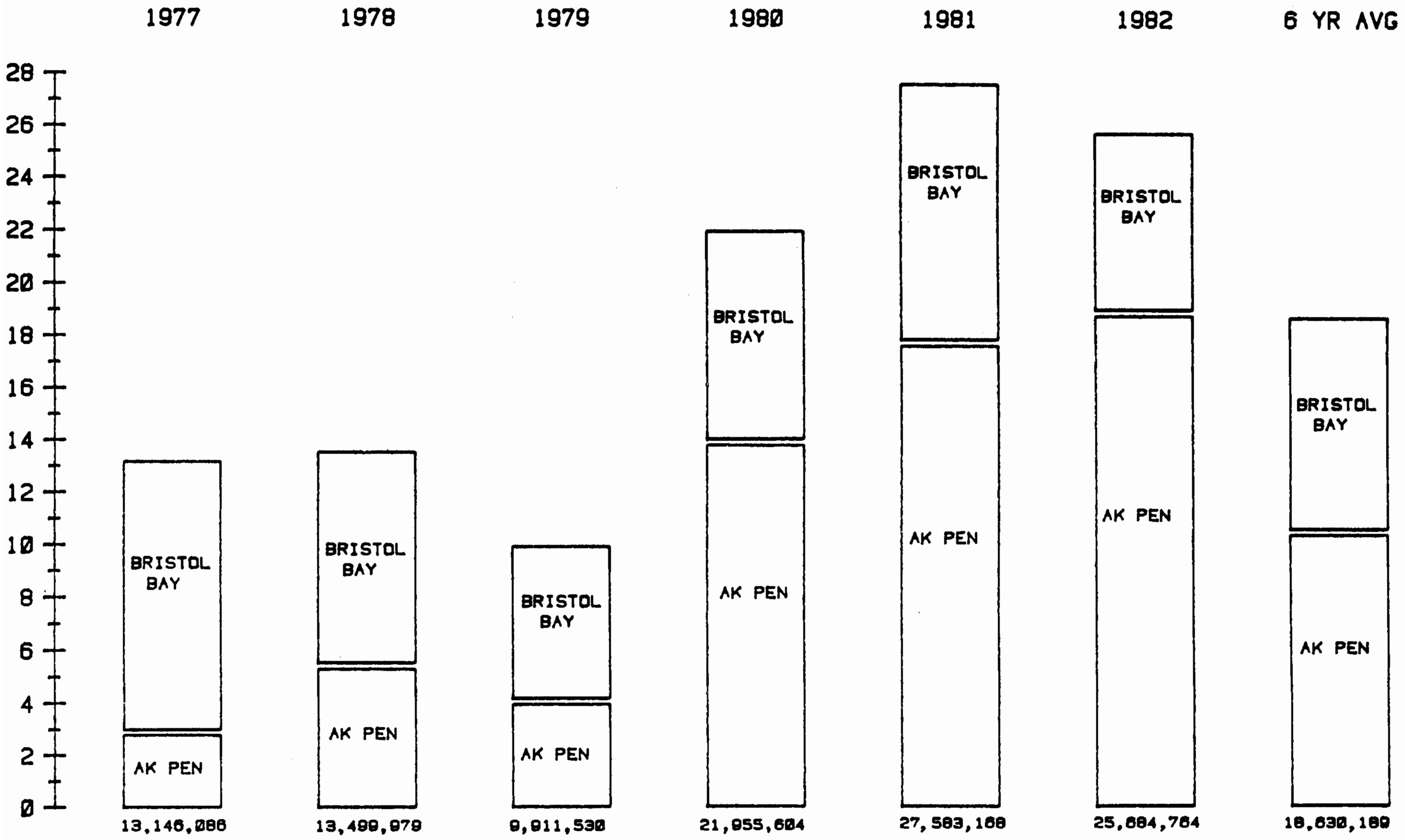
Figure L-4



SOURCES: ADF&G BRISTOL BAY & ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS,1982

Figure L-5

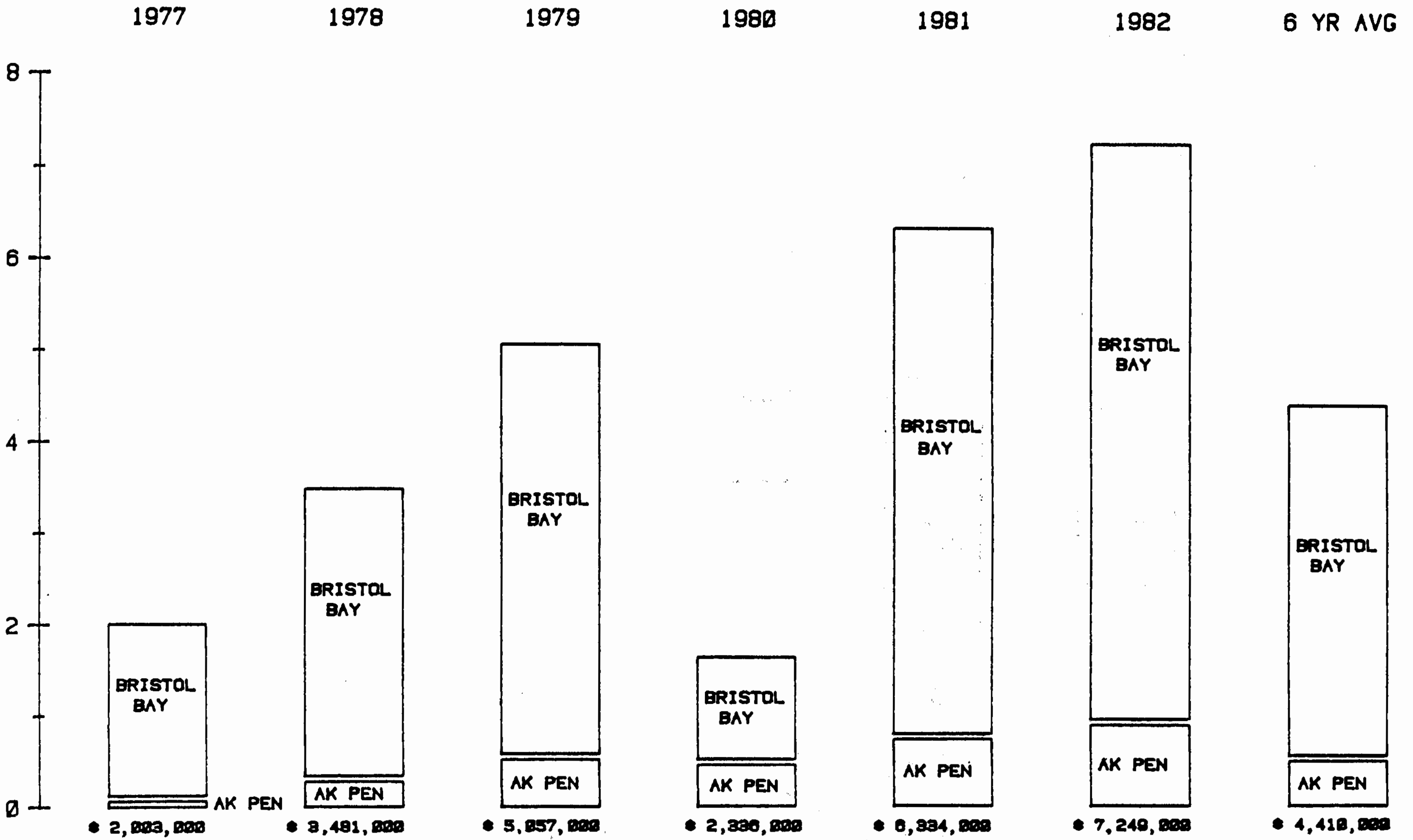
NORTH ALEUTIAN BASIN
CHUM SALMON
CATCH IN MILLIONS OF POUNDS



SOURCES: ADF&G BRISTOL BAY & ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS,1982

Figure L-6

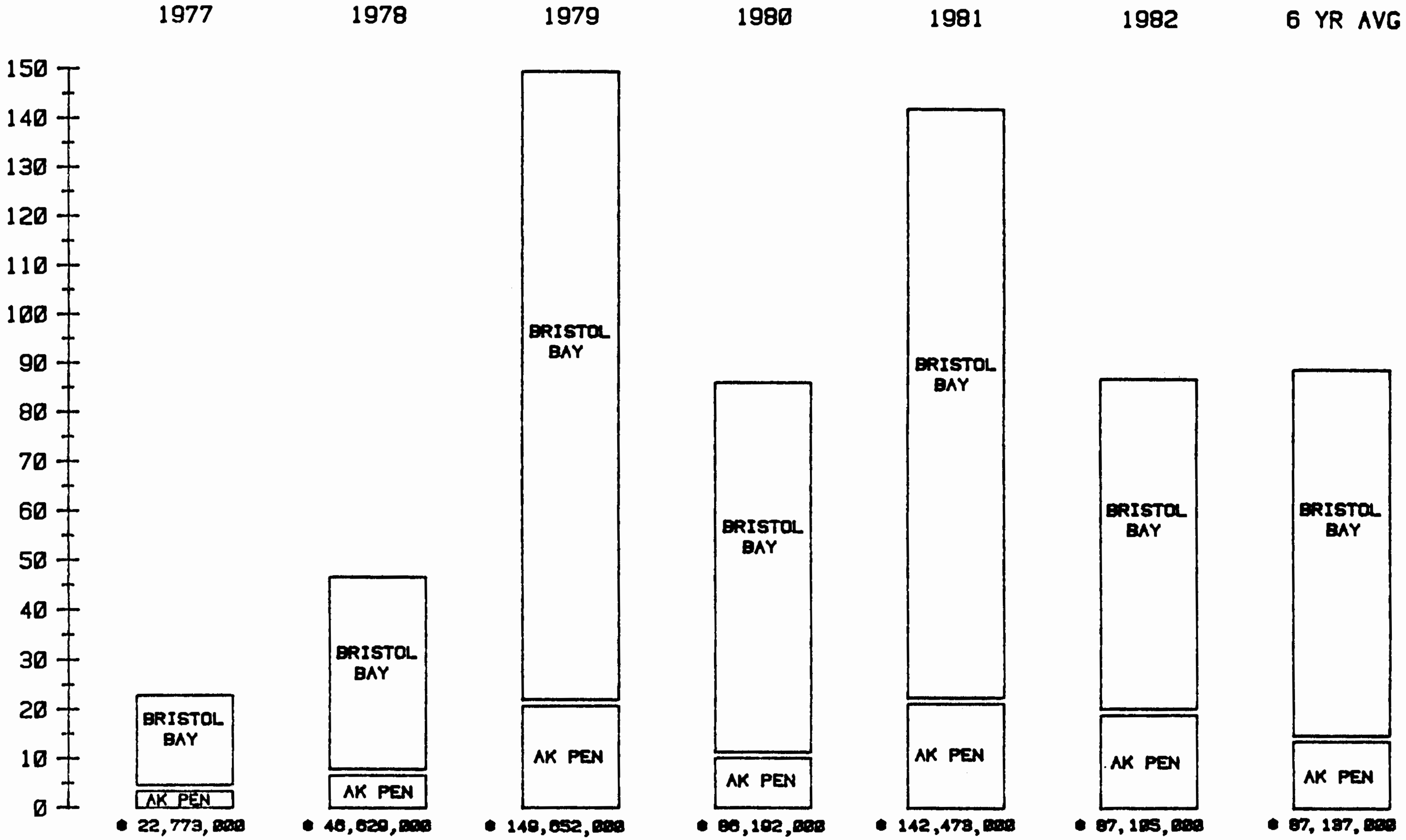
NORTH ALEUTIAN BASIN
KING SALMON
EX-VESSEL VALUE IN MILLIONS OF DOLLARS



EX-VESSEL VALUES ESTIMATED FOR 1980-82 FOR AK. PEN., BASED ON AVG WEIGHTS BY SPECIES & WEIGHTED AVG PRICES FOR PURSE SEINE, DRIFT AND SET NET GEAR.
SOURCES: COMBS, 1982; ADF&G BRISTOL BAY AND ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982; CFEC, 1983

Figure L-7

NORTH ALEUTIAN BASIN
SOCKEYE SALMON
EX-VESSEL VALUE IN MILLIONS OF DOLLARS

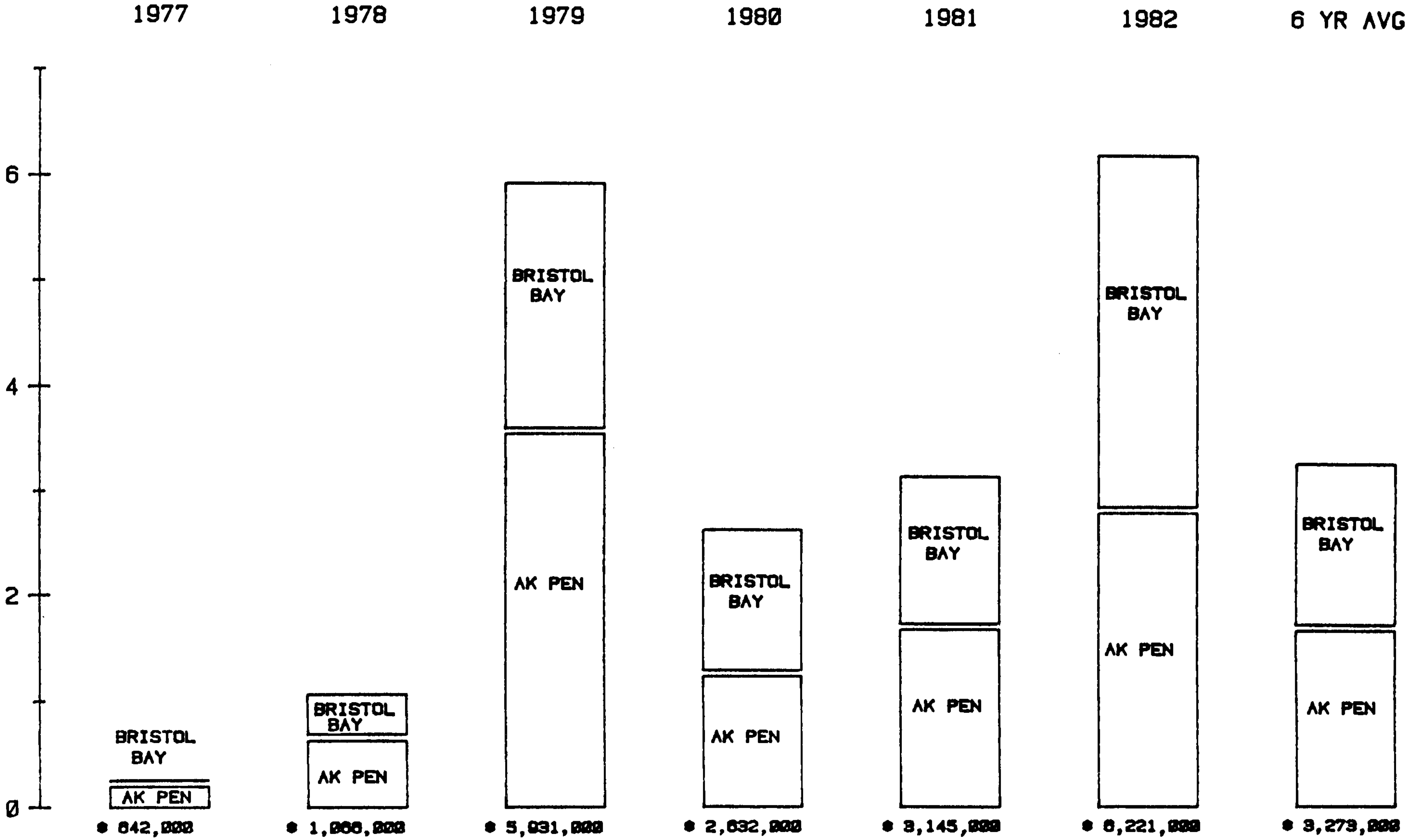


EX-VESSEL VALUES ESTIMATED FOR 1980-82 FOR AK. PEN., BASED ON AVG WEIGHTS BY SPECIES & WEIGHTED AVG PRICES FOR PURSE SEINE, DRIFT AND SET NET GEAR.

SOURCES: COMBS, 1982; ADF&G BRISTOL BAY AND ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982; CFEC, 1983

Figure L-8

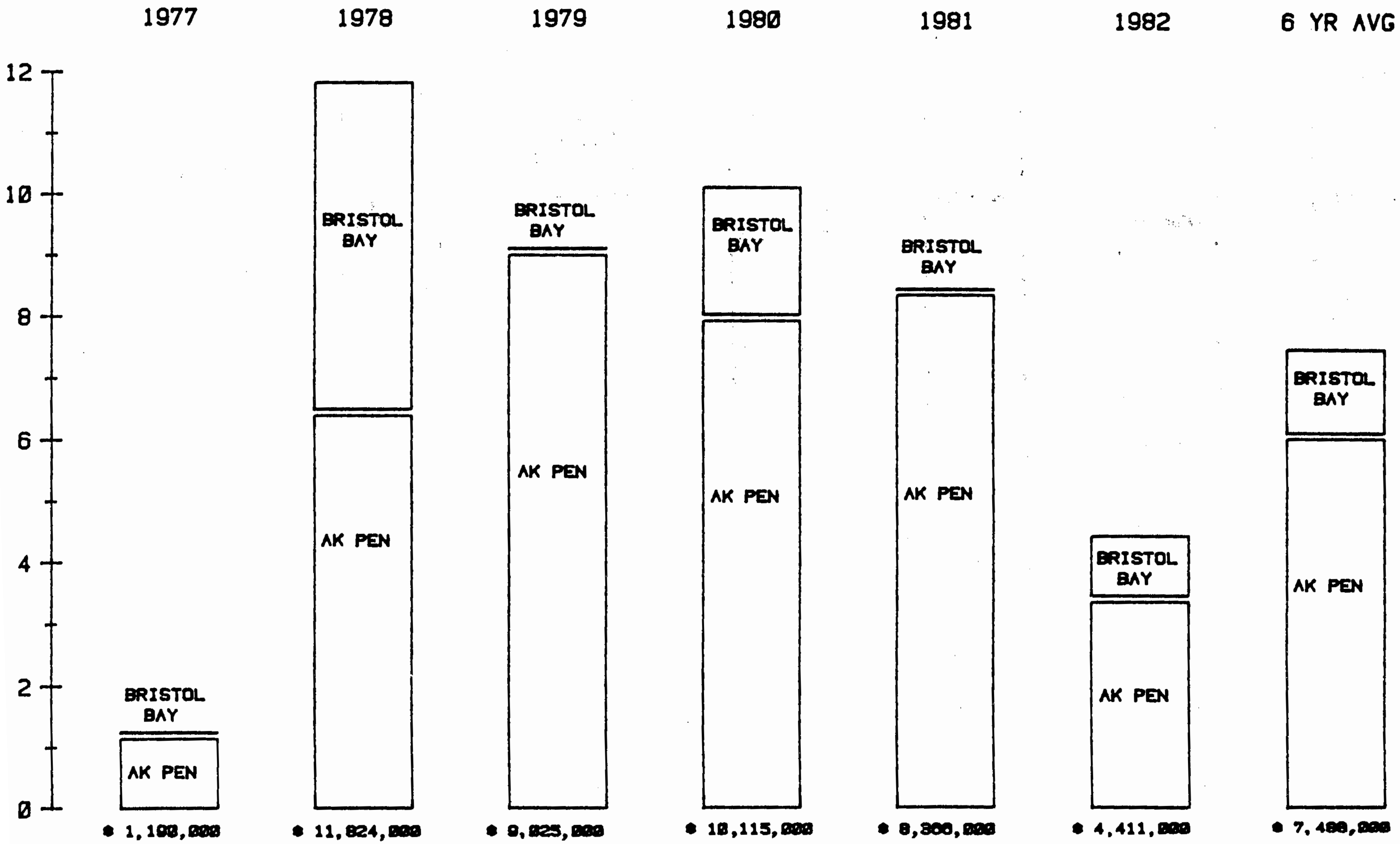
NORTH ALEUTIAN BASIN
COHO SALMON
EX-VESSEL VALUE IN MILLIONS OF DOLLARS



EX-VESSEL VALUES ESTIMATED FOR 1980-82 FOR AK. PEN., BASED ON AVG WEIGHTS BY SPECIES & WEIGHTED AVG PRICES FOR PURSE SEINE, DRIFT AND SET NET GEAR.
SOURCES: COMBS, 1982; ADF&G BRISTOL BAY AND ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982; CFEC, 1983

Figure L-9

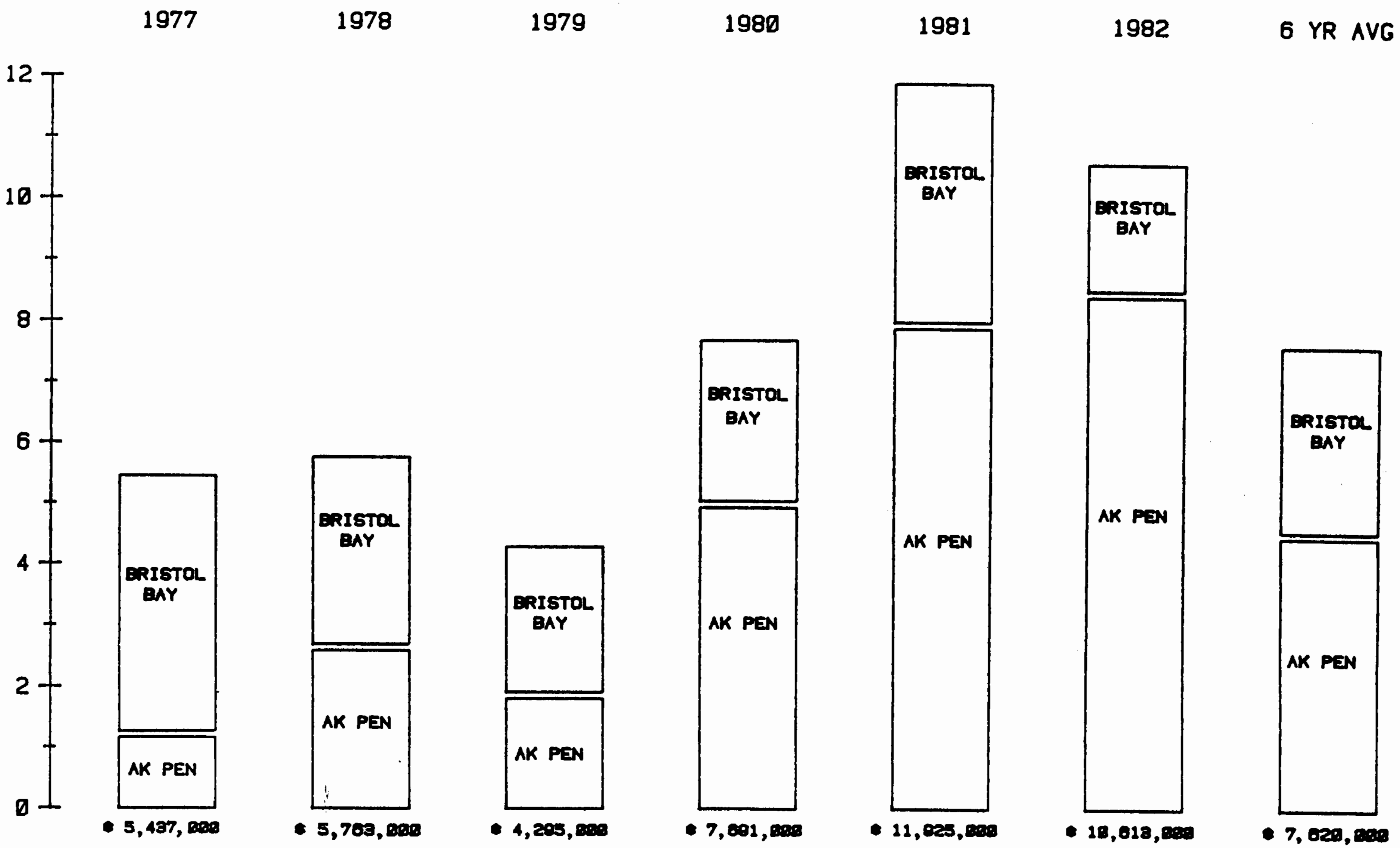
NORTH ALEUTIAN BASIN
PINK SALMON
EX-VESSEL VALUE IN MILLIONS OF DOLLARS



EX-VESSEL VALUES ESTIMATED FOR 1980-82 FOR AK. PEN., BASED ON AVG WEIGHTS BY SPECIES & WEIGHTED AVG PRICES FOR PURSE SEINE, DRIFT AND SET NET GEAR.
SOURCES: COMBS, 1982; ADF&G BRISTOL BAY AND ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982; CFEC, 1983

Figure L-10

NORTH ALEUTIAN BASIN
CHUM SALMON
EX-VESSEL VALUE IN MILLIONS OF DOLLARS



EX-VESSEL VALUES ESTIMATED FOR 1980-82 FOR AK. PEN., BASED ON AVG WEIGHTS BY SPECIES & WEIGHTED AVG PRICES FOR PURSE SEINE, DRIFT AND SET NET GEAR.
SOURCES: COMBS, 1982; ADF&G BRISTOL BAY AND ALASKA PENINSULA ANNUAL MANAGEMENT REPORTS, 1982; CFEC, 1983

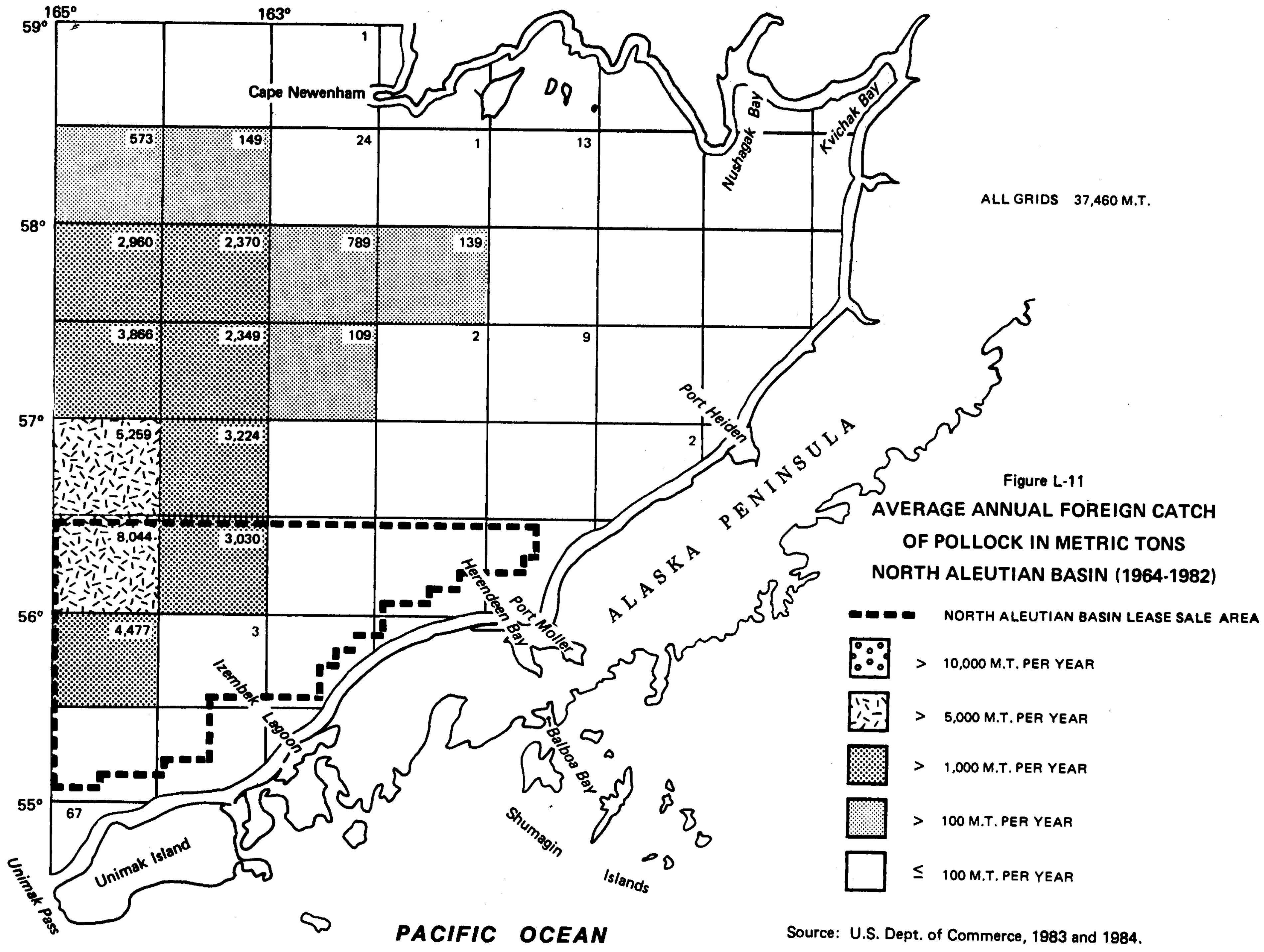
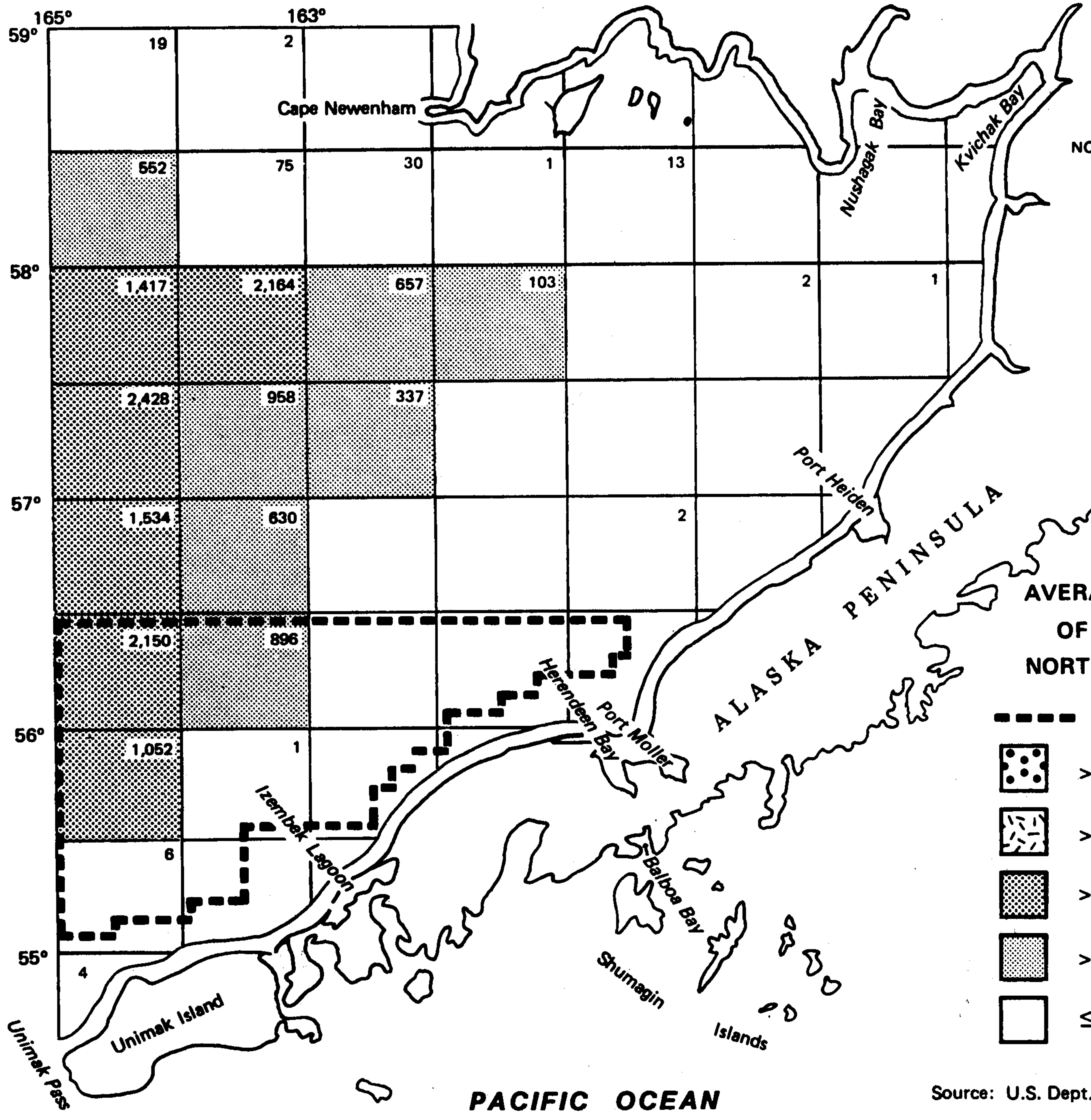


Figure L-11

AVERAGE ANNUAL FOREIGN CATCH OF POLLOCK IN METRIC TONS NORTH ALEUTIAN BASIN (1964-1982)

Source: U.S. Dept. of Commerce, 1983 and 1984.



NOTE: Since 1980, most of the flatfish have been landed by joint venture rather than foreign fisheries and have not been included with these averages. Joint venture average annual catch for 1980-1982 is 19,883 M.T., while the foreign catch average is only 14,395 M.T.

ALL GRIDS 15,034 M.T.

Figure L-12

AVERAGE ANNUAL FOREIGN CATCH OF FLATFISH IN METRIC TONS NORTH ALEUTIAN BASIN (1964-1982)

▬ ▬ ▬ NORTH ALEUTIAN BASIN LEASE SALE AREA

⁘ > 10,000 M.T. PER YEAR

▨ > 5,000 M.T. PER YEAR

▩ > 1,000 M.T. PER YEAR

▒ > 100 M.T. PER YEAR

☐ ≤ 100 M.T. PER YEAR

Source: U.S. Dept. of Commerce, 1983 and 1984.

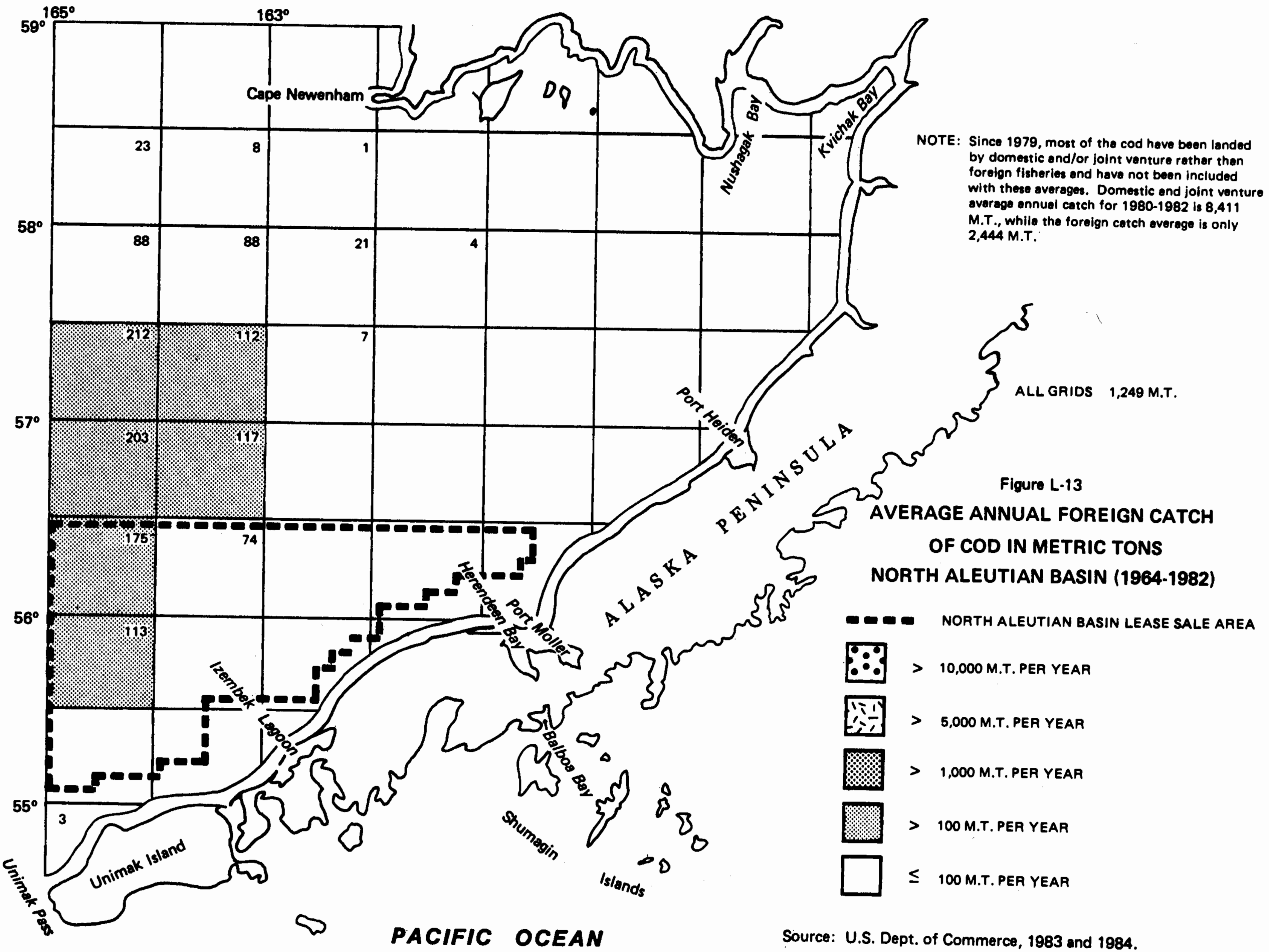


Figure L-13
AVERAGE ANNUAL FOREIGN CATCH OF COD IN METRIC TONS NORTH ALEUTIAN BASIN (1964-1982)

NOTE: Since 1979, most of the cod have been landed by domestic and/or joint venture rather than foreign fisheries and have not been included with these averages. Domestic and joint venture average annual catch for 1980-1982 is 8,411 M.T., while the foreign catch average is only 2,444 M.T.

Source: U.S. Dept. of Commerce, 1983 and 1984.

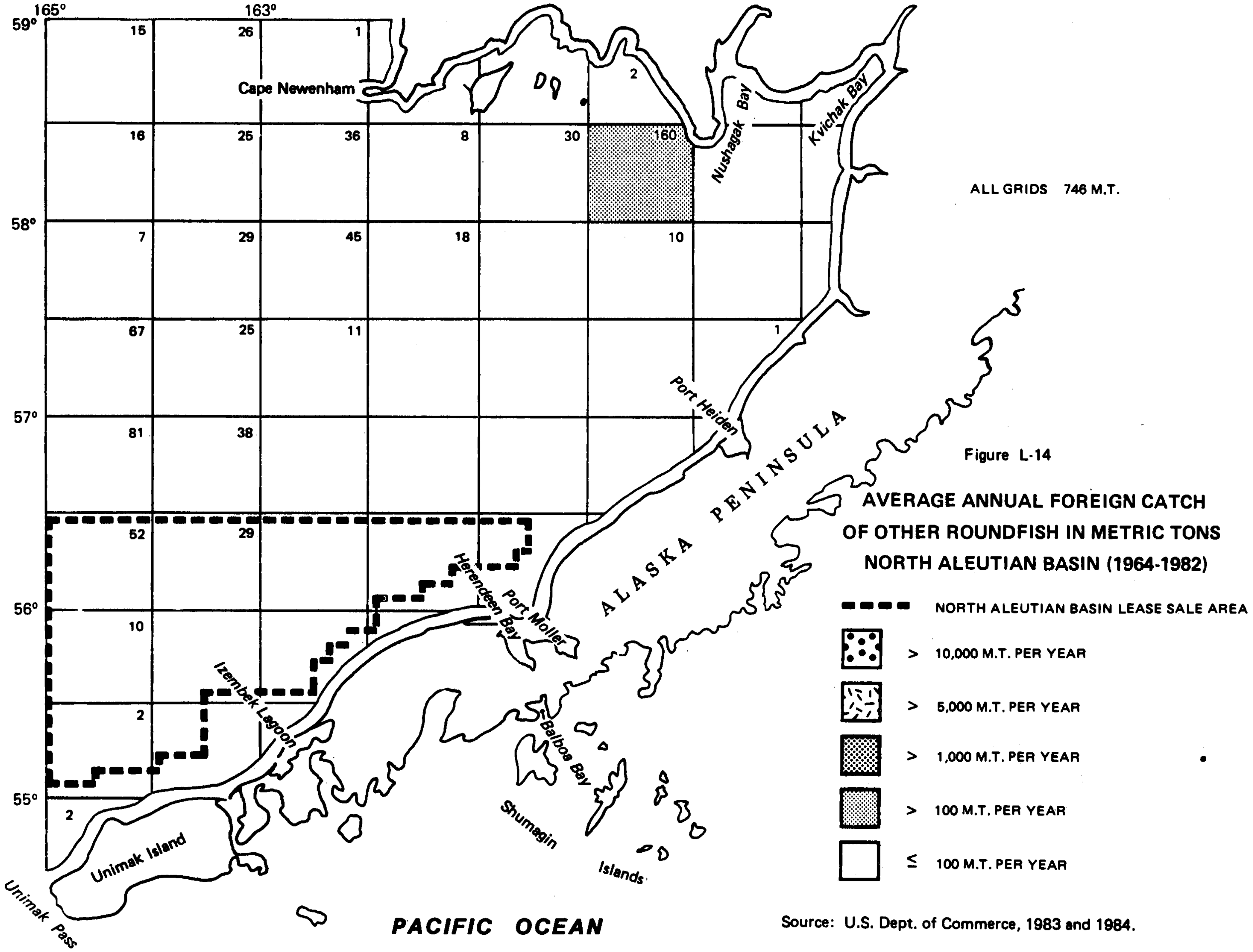


Figure L-14

AVERAGE ANNUAL FOREIGN CATCH OF OTHER ROUNDFISH IN METRIC TONS NORTH ALEUTIAN BASIN (1964-1982)

Source: U.S. Dept. of Commerce, 1983 and 1984.

APPENDIX M

Oil-Spill Response Equipment and Estimated Response Times for Mobilizing and Transporting Equipment to Dutch Harbor

Prepared by

Minerals Management Service

Appendix M

Oil-Spill Response Equipment and Estimated Response Times for Mobilizing and Transporting Equipment to Dutch Harbor

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor

CATEGORY: CONTAINMENT SYSTEMS

SUBCATEGORY: Open Ocean Boom

° Item: 1 each - 3,000-foot Whittaker Model 4300 Expandi Boom.

Description: N/A

Specifications:

Length:	50 feet/section
Weight:	177 pounds/section
Freeboard:	20 inches
Draft:	23 inches

Support Equipment:

1,000-foot pallet with all accessories required.
Vacuum cleaner, wet/dry type.
Vacuum valves.
Injection valves.

Limitations:

Minimum air temperature:	30°F
Maximum towing speed:	7 knots
Maximum swells:	5 feet
Maximum winds:	20 knots

SUBCATEGORY: Nearshore/Harbor Boom

° Item: 1 each - 3,000-foot Acme Corral Boom.

Description:

There are three packages (1,000 feet of boom in each package) stored on three trailers.

Specifications:

Length:	200 feet/section
Weight:	1.96 pounds/foot
Freeboard:	8 inches
Draft:	12 inches

Support Equipment:

Tow bridles.
Abrasion pad.
3/4-ton towing vehicles.

Limitations:

Maximum current:	3 knots
Maximum swells:	4 feet
Maximum towing:	12 knots (for locating deployed boom)
Minimum air temperature:	40°F

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor
(continued)

CATEGORY: RECOVERY SYSTEMS

SUBCATEGORY: Skimmers

- **Item:** 1 each - SOCK (Spilled Oil Containment Kit).

  Description:
  This open-ocean-oil skimmer will give good performance to 8-foot-wave heights, no performance degradation to 4-foot-wave height. Located on two 40-foot flatbed trailers. Operational performance has been demonstrated. Air transportable. Will recover oil up to 350 gallons per minute (gpm).

- **Item:** 1 each - Walosep W-1.

  Description:
  This is a baffle-weir skimmer with a diesel-hydraulically driven rotary-collection mechanism. Operational performance has been demonstrated over a wide range of viscosities in seas up to 9 feet. Recovery rates are up to 30 cubic meters per hour. Air transportable.

  Specifications:

Height:	27.5 inches
Width:	52.4 inches
Draft:	9.8 inches
Weight:	154 pounds

- **Item:** 2 each - Komara Miniskimmer.

  Description:
  This oleophilic disc skimmer is run by a diesel-powered-hydraulic motor; includes hose floats, clamps, hydraulic lines, and Petter diesel with built-in pump; high recovery efficiency (oil vs. water).

  Specifications:

Height:	18 inches
Width:	46 inches
Draft:	7.5 inches
Weight:	120 pounds
Maximum recovery rate:	10 tons crude per hour

  Support Equipment:
  Hydraulic power source, hoses, floats, connectors.
  Hipboots for deployment from shore.
  Vessel for offshore deployment.
  Spare discs and lines.
  Storage container for recovered oil.
  Diesel fuel for prime mover.

  Limitations:

Maximum wave height:	2 feet
Will handle some debris and emulsified oils.	

- **Item:** 2 each - Acme Skimmer Model FS400ASIC-39TG-4.

  Description:
  Weir-type floating skimmer head.
  1.8 horsepower, 3,450 rpm gasoline engine.
  Adjustable weir.

  Specifications:

Diameter:	46 inches
Weight:	138 pounds
Recovery rate:	25 to 275 gpm
Discharge hose:	4-inch diameter

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor
(continued)

Support Equipment:

Hipboots for deployment from shore.
Vessel for offshore deployment.
Hose - minimum 10 feet to allow unit to float freely.
Hose floats and clamps (1 float/15-foot discharge hose; handtools).
Additional pump required if more than 30-foot discharge head.
Storage container with connectors for recovered product.
Fuel for gasoline engine.

Limitations:

Maximum effective discharge head: 30 feet
Minimum air temperature: 32°F
Minimum hose temperatures: -5°F
Limited use in fast-flowing or rough water.
Will not handle debris or heavy oils.

SUBCATEGORY: Separators

° Item: 2 each - 200-barrel oil/water separator.

Description:

Mounted on 40-foot flatbed trailers.
For use with any collection system.
Tank-mounted on skids.
Drain valves.

Specifications:

Capacity: 200 pounds (8,400 gallons)
Fill openings: 2-inch, 4-inch, 6-inch

Support Equipment:

Trailer and crane for transporting and staging.
Hydraulic power pack.
Hose, kamlocks, valves, adapters, pump.
Extra gaskets, bolts, nipples.
Pipe wrenches.
Cable for lifting bridles.

CATEGORY: STORAGE SYSTEMS

° Item: 2 each - 100-pound holding and separator tank.

Description:

Tank-mounted on skids.
View port; hatch.
3 baffles.
Drain valves.
Shackle and sling bridle.

Specifications:

Capacity: 100 barrels (4,200 gallons)
Dimensions: 16 feet x 8 feet x 5 feet
Fill couplings: 2-inch, 4-inch, 6-inch
Weight: 12,000 pounds (empty)

Support Equipment:

Lowboy, tractor, and crane for transport and staging.
Hose, kamlocks, valves, adapters, pump.
Extra gaskets, bolts, nipples.
Pipe wrenches, kamlock tools.
Cable for lifting bridle.

Limitations:

For use on large vessels or land.

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor
(continued)

CATEGORY: TRANSFER SYSTEMS

- Item: 4 each - Gorman Rupp, 4-inch centrifugal pumps.

  Description:
  Lister diesel powered.
  Electric start.
  Kamlocked.
  Wash-down nozzles.

- Item: 1 each - hydraulic power pack for 200-pound oil/water separator pumps.

- Item: Hoses (all hoses kamlocked).
  10 each - 3-inch x 20-foot suction hose (200 feet).
  8 each - 3-inch x 50-foot discharge hose (400 feet).
  10 each - 4-inch x 20-foot suction hose (200 feet).
  8 each - 4-inch x 50-foot discharge hose (400 feet).

- Item: 3 each - Sludge Master 3 SMA3-A pump (air operated).

- Item: 2 each - Firestone Fabritank Model CFD-270.

  Description:
  Collapsible storage tank made of synthetic rubber-coated fabric.
  10 handles for positioning empty.

  Specifications:

Capacity:	25,000 gallons
Empty weight:	2,600 pounds
Flat dimensions:	34 feet, 4 inches x 27 feet
Fittings:	4-inch fill/discharge
	2-inch air vent
	2-inch bottom drain
Access ports:	2-fill/discharge cleanout ports

  Support Equipment:
  Forklift for moving crate.
  Support platform for filled tank.
  Dikes, impermeable liners, fire protection, as required.
  Adapters, kamlock fittings, dry-disconnect couplings.
  Hose and pumps.
  Torque wrench, extra bolts.

  Limitations:

Maximum capacity:	25,000 gallons
Maximum tank height:	63 inches (full)
Maximum fluid height in vent pipe:	½ inch (for product like diesel)
Minimum air temperature:	0°F
Onshore site:	Maximum 3 foot rise/100 feet

  Do not clean tank with steam.

- Item: 2 each - Dracone Dunlop Towable Bladder.

  Description:
  Towable, flexible storage container, nose-cone tow assembly and venting system. Three lengths 2-inch x 15-foot tow hose.

  Specifications:

Capacity:	2,500 gallons
Empty weight:	700 pounds
Dimensions packed:	6 feet x 5 feet x 4 feet
Dimensions filled:	3 feet x 45 feet

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor
(continued)

Support Equipment:

300-Foot tow rope rigging.
Lifting sling for filled container.
Tow vessel and pendant.
Connections and adapters for hoses to recovery devices and off-loading facilities.
Repair kit.
Cargo handling equipment to load/offload vessel.

Limitations:

Maximum towing speed: 12 knots
Maximum capacity: 2,500 gallons

CATEGORY: VESSELS

- **Item:** 2 each - Zodiac Mark V.

Specifications:

Length: 19 feet
Beam: 779 feet, 9 inches
Weight: 530 pounds in 2 packages
Motor: 1 each - 50 horsepower
1 each - 85 horsepower

Support Equipment:

½-ton vehicle to pull trailer.
Fuel for motor.
Lines, paddles, and lifejackets.
Air pump and patch kit for leaks.

Limitations:

Maximum passenger capacity: 15
Maximum payload: 3,300 pounds
Will withstand rough water.

- **Item:** 1 each - 2-man life raft.

CATEGORY: SORBENTS

- **Item:** 60 bales - 3M Type 270 boom
(5 - 8-inch x 8-inch boom/bales).
12 rolls 3M Type 100 rolls
(150 feet x 3 feet x 3/8 inch/roll).

CATEGORY: OIL-SPILL CHEMICALS

- **Item:** Dispersant, 10 drums - Exxon Corexit 9527 (55-gallon drums).

CATEGORY: CHEMICAL AGENTS DISPERSANT SYSTEMS

- **Item:** 3 each - hand-operated spray unit.

Description:

Application of chemicals in small areas.
4-gallon capacity.

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor
(continued)

CATEGORY: OIL-SPILL TRACKING SYSTEM

° Item: Orion Oil Spill Tracking System.

Description:
1 aircraft receiver.
1 vessel receiver.
10 tracking buoys.

CATEGORY: BIRD/MAMMAL PROTECTION

° Item: 20 each - "Scare-Away" Model M-Y Cannon.

Description:
Cannon fired by liquefied petroleum gas to keep birds and other mammals away from oil.

Specifications:
Steel construction.
Electronic ignition of liquefied petroleum gas.
Sound similar to 37-mm cannon.
Frequency of detonation variable.

Support Equipment:
Liquefied petroleum gas.
Floating support platform for water deployment.

Limitations:
Must be turned on once per day.

CATEGORY: COMMAND CENTERS

° Item: 1 each - 40-foot semi-trailer equipped to serve as a command center for oil-spill-cleanup operations. The van has a self-contained power plant, lighting, and heating system. The communication package used in the van is packaged so that it can be removed and used in a remote command center location. Listed below is a typical inventory for the van:

. Foul weather clothing/footwear for 12 people.
. Two MSA air packs (model #401, pressure demand).
. Two fire/flame protection suits.
. One resuscitator (MSA Portolator).
. Spare parts for small engines, pumps, and generators.
. Medical kit, and individual kits for 12 persons.
. 10 Imperial survival suits.
. Oxygen and masks for emergency medical use.
. Steam/hot water cleaning machine (Anchorage).
. Fire extinguishers.
. Cleaning materials and preservatives for equipment.
. Small refrigerator.
. Aluminum ladder.
. Warn electric winch.
. Rear-loading ramp.
. Four built-in bunks per van with blankets (8 total).
. Nylon line.
. Antenna for UHF frequency (454-459 MHz).
. Antenna for VHF marine band, and antenna for aviation band, citizen band.
. 40-foot van spare tires and rims.
. 12 tables, 24 chairs.
. 110-volt extension cords.
. Wind speed and direction indicator.
. Charts and display boards.
. Clock.

Table M-1
Alaska Clean Seas (ACS) Equipment at Dutch Harbor
(continued)

CATEGORY: COMMUNICATION SYSTEMS

° Item: 10 station telephone PBX system with 20 station intercom.

° Items: Mobile UHF-FM radio repeaters (100-watt); receives on 459 MHz; transmits on 454 MHz.
Marine Band, VHF transceivers.
Aviation Band, VHF transceivers.
Citizen Band transceivers.

° Item: 1 each - base stations UHF antenna, mounted on the 40-foot Command Center vans, for use with repeaters or handheld MX-300 radios.

° Item: 1 each - Aviation Band 720 channels (7-watt), King KY-92 transceivers (118 MHz/136 MHz).

° Item: 12 each - UHF/FM handheld radios, Motorola MX-300; transmits on 459 MHz or 454 MHz; receives only on 454 MHz; battery-operated; located in Anchorage.

CATEGORY: MISCELLANEOUS EQUIPMENT

° Item: 20 each - boom lights
Marker lights for Acme Corral Containment Boom.
1 each - Herman Nelson BT-400-10 gasoline heaters 400,000 BTU capacity.
1 each - air compressor, 150 psi, 200-volt single phase or gasoline engine with electric-start.
2 each - portable lighting (explosion-proof) 100-watt lights with adjustable stands.
2 each - Koehler 3-kilowatt generators - gasoline-powered.
5 each - 40-foot flatbed trailer, selectively loaded with tanks, booms, and skimmers for fast response.
1 each - MSA Gas/O² Alarm Mod 269.
2 each - 40-foot storage vans.

Source: Marathon Oil Company, 1985.

Table M-2
On-Site Equipment Available on the Drilling Vessel for Immediate Response to an Oil Spill at ARCO Drill Site in Norton Sound, 1984

Equipment	Operational Capabilities
1,000 feet of 43-inch Expandi oil boom stored on a steel pallet	Works in waves up to 5 to 6 feet and winds up to 20 knots
1 Walosep W-1 skimmer complete with diesel hydraulic power unit and hoses, in steel-fiberglass storage box (storage box also serves as a 29-barrel capacity storage tank and oil/water separator)	Works in waves up to 10 feet
1 HIAB C-60 hydraulic crane, 22-foot reach for deploying skimmer (uses skimmer's hydraulic power unit)	
15 bales of 3M Type 156 oil sorbent pads (100 18-inch squares per bale)	For contained spills only
2 Kepner sea containers (1-1200 gallon, 1-600 gallon, each in metal storage box)	For contained spills only
2 hand sprayers-4-gallon capacity	Within skimming capabilities
8 drums (440 gallons) chemical dispersant - ARCO-Chem D-609	Requires permission from federal on-scene coordinator for use
2 drums (55 gallons) chemical collectant - Exxon OC-5	Requires permission from federal on-scene coordinator for use
4 tanks (500 barrels) skid mounted (10 feet x 40 feet x 9 feet)[1/]	

Source: Hooks, McCloskey and Associates, Inc., 1984.

[1/] Located at Unalaska shorebase.

Table M-3
Estimated Response Times for Mobilizing and Transporting Equipment to Dutch Harbor by Air Cargo Transport

EQUIPMENT OWNER	STORAGE LOCATION	ESTIMATED MOBILIZATION TIME 1/ (hours)		TRANSPORTATION TIME TO DUTCH HARBOR 2/	TOTAL RESPONSE TIME TO DUTCH HARBOR 3/ (hours)	
		(min)	(max)	(hours)	(min)	(max)
Alaska Clean Seas	Prudhoe	2	5	3.6	5.6	8.6
	Nome	2	5	2.3	4.3	7.3
	Anchorage	2	5	2.3	4.3	7.3
	Kenai	2	5	2.1	4.1	7.1
	Yakutat	2	5	3.2	5.2	8.2
	Dutch Harbor	2	5	0.0	2.0	5.0
Cook Inlet Response Organization	Kenai	2	5	2.1	4.1	7.1
U.S. Coast Guard	Kodiak	2	5	1.9	3.9	6.9
	Anchorage	2	5	2.3	4.3	7.3
Crowley Environmental Services	Anchorage	2	5	2.3	4.3	7.3
Alaska Offshore	Anchorage	4	-	2.3	6.3	-
Clean Sound	Seattle	2	5	7.0	9.0	12.0
Clean Bay	Concord	2	5	9.0	11.0	14.0
Clean Seas	Santa Barbara	2	5	11.8	13.8	16.8
Clean Coastal Waters	Long Beach	2	5	11.8	13.8	16.8
U.S. Navy	Stockton	2	5	9.0	11.0	14.0

1/ Estimated mobilization times were supplied by equipment owners and are overall ranges which are nonspecific to the type or quantity of equipment required.

2/ Estimated based on C-130 flight characteristics (300-knot flight speed).

3/ Total response times are the sum of estimated mobilization time and travel times by C-130 transport. They do not include the amount of time required to load the equipment or variations in travel time arising from adverse climatic factors which might be encountered enroute.

Source: Alaska Clean Seas, 1984.

Table M-4
Estimated Response Times for Mobilizing and Transporting Equipment to Dutch Harbor by Surface Vessel

EQUIPMENT OWNER	STORAGE LOCATION	ESTIMATED MOBILIZATION TIME[1] (hours)		ESTIMATED TRAVEL TIME TO DUTCH HARBOR (10 knots)[2]		TOTAL RESPONSE TIME			
						(min)		(max)[3]	
		(min)	(max)	(days)	(hours)	(days)	(hours)	(days)	(hours)
Alaska Clean Seas	Prudhoe	2	5	6	-	6	2	6	5
	Nome	2	5	2	16	2	18	2	21
	Anchorage	2	5	3	4	3	6	3	9
	Kenai	2	5	2	21	2	23	3	2
	Yakutat	2	5	4	1	4	3	4	6
	Dutch Harbor	2	5	-	-	-	-	-	-
Cook Inlet Response Organization	Kenai	2	5	2	21	2	23	3	2
U.S. Coast Guard	Kodiak	2	5	2	10	2	12	2	15
	Anchorage	2	5	3	4	3	6	3	9
Crowley Environmental Services	Anchorage	2	5	3	4	3	6	3	9
Alaska Offshore	Anchorage	2	5	3	4	3	6	3	9

1/ Estimated mobilization times were supplied by the equipment owners and are overall ranges which are non-specific to the type or quantity of equipment required.

2/ Travel times to site are from ports near storage site to Dutch Harbor. These estimates do not include the amount of time required to unload the equipment at the site or variations in travel time arising from adverse climatic factors which might be encountered enroute. Times are based on an average vessel speed of 10 knots.

3/ Total response times indicated are the sum of estimated mobilization times and travel times to the spill site.

Source: Alaska Clean Seas, 1984.

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